Engineering News-Record

A Consolidation of Engineering News and Engineering Record

A JOURNAL OF CIVIL ENGINEERING
AND CONSTRUCTION

ISSUED WEEKLY

VOLUME LXXXII

January 1 to June 30, 1919

McGRAW-HILL COMPANY, INC.
10TH AVENUE AT 36TH STREET
NEW YORK

ENGINEERING NEWS-RECORD

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A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, JANUARY 2, 1919 — Number 1

"Engineering News-Record" is a consolidation of "Engineering News" and "Engineering Record."

"Engineering News" was founded in 1874 by George H. Frost, as the "Engineer and Surveyor," which title subsequently became the "Engineer, Architect and Surveyor," then "Engineering News and American Railway Journal" and, finally, "Engineering News," under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

"Engineering Record" was established in 1877 by Henry C. Meyer as the "Plumber and Sanitary Engineer. The name was subsequently changed to the "Sanitary Engineer," "Engineering and Building Record" and, finally, to "Engineering Record." During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The staff of "Engineering News-Record" is composed of

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In Honor of American Shipbuilders

IT IS an honor and a privilege to dedicate this first of the year number to the American shipbuilders, and particularly to those among them who are our own brethren—the civil engineers and contractors who threw themselves unreservedly into the work, and were no small factor in its marvelous success and development. Fittingly, the issue opens with a message to these professional brethren from Edward N. Hurley, chairman of the United States Shipping Board. With emphasis and repetition he pays tribute to what they did. What is more, he promises that the industry they helped to build under stress of war will be permanent. That his vision may not be belied, he pleads that America may become "ship-minded," that, thinking internationally, we may acquire a fostering pride that shall install shipping as a permanent American industry. If we may speak for American civil engineers and contractors in reply to Mr. Hurley, we would say that they will be no less loyal in trying to perpetuate the industry than they were in building it. The keynote for a permanent industry is efficiency, efficiency in ship building, efficiency in ship operation. Both are the work of the engineer, for ship operation involves not merely the navigation of the ship and the handling of the crew at sea but the creation and operation of terminals that will load and discharge cargo rapidly and economically. There must also be favorable external conditions—which include what Mr. Hurley terms "ship-mindedness." Here, too, the engineer and the contractor will back Mr. Hurley in his efforts to give us a permanent merchant marine.

Carrying Abroad America's Engineering Message

REALIZING the value of the international exchange of ideas on things engineering, the McGraw-Hill Company on March 1 will begin publication of a magazine dedicated to that purpose. While eventually it is expected to appear in editions in several languages, the original issue will be in Spanish, under the name, *"La Ingenieria Internacional."* It is aimed to serve Latin America and Spain. The purpose of the new magazine, which has been under consideration for some years, is to afford a medium for the presentation of those developments in American engineering which may be of value to engineers, contractors and manufacturers in other lands. At the same time, following the practice of the present McGraw-Hill publications, a far-flung editorial organization will be developed, so that there will be drawn into the paper the best of engineering practice in Latin America, Spain and other Spanish-speaking countries. Aside from this function, the new magazine will be an important developer of international good-will, and at the same time a medium by which American manufacturers engaging in export trades can carry their message to prospective buyers in foreign lands. It may be a cause of surprise that the McGraw-Hill Company, whose specialized papers circulate so widely overseas, should establish a magazine to serve the foreign field. The reason, however, is not hard to find. The present highly specialized papers appeal only to those who are situated where engineering enterprise has made such progress that there is room for the specialist and need for the last refinement in equipment and design. But everywhere, the world over, are territories newly developing, where the engineer, the contractor and the manufacturer must each turn his hand to many lines. It is to serve the general practitioner so situated that the new magazine, and its later companions in other languages, will be started.

Will Prices and Wages Drop?

ON THE theory that there will be a marked drop in prices and wages, owners are holding in abeyance their construction projects. Is their expectation correct? Prices and wages, in the last analysis, are determined by the laws of supply and demand. They were forced to high levels by the war, since the supply of materials and labor was very short and the demand very great. The volume of goods which can be consumed, in the present state of the world's warehouses, may easily exceed the war demand, but the urgency of the war demand being absent, the conclusion seems sound that price and wage levels will recede. The puzzling question is as to the extent of the recession. In all likelihood the drop will be small, for, as one shrewd observer put it, "the shelves of the world are bare." That applies as well to public works, railroad improvements and private buildings as it does to manufactured articles. Highways have been neglected, cities without number are short of housing (and therefore of water-supply, sewerage, paving, fire protection, etc.), office building space is at a premium everywhere. Price and wage levels will probably go off, but, with a still abnormal demand and a lessened man-power, not only will the pre-war levels not be reached, but the price recession within a year will not be large. Just what the recession may be no one is willing to predict. Some place 15 per cent. as a maximum, others 25 per cent. But there is quite general agreement that all of the substantial lowering will come between now and June. It would not be surprising if in some products prices would again rise after the full peace demand is felt. What is lacking in war's insistence will be made up by the optimism of a renascent world.

Are We Wanted in France and Belgium?

EVERY day the question is asked of *Engineering News-Record*, "Are American engineers and contractors wanted in France and Belgium?" This journal has been at pains to learn the answer, and the answer at the present minute is, "No." France and Belgium, so far as their agencies in this country are informed, feel confident that their own engineers and contractors can satisfactorily handle the situation. Moreover, the materials will be largely of European origin. Only for construction machinery do the Belgians and the French seem to be turning to this country. Such at least is the situation for the present. What change will be brought about when the question of credits for restoration is raised remains to be seen. If they are granted by the United States Government, there will be the usual string, for the credit will be available in this country. What seems more likely than the granting of extensive Government credits is that strong financial groups here will undertake the financing of projects abroad, and will inevitably pick out large contracting organizations to do the work. When that time comes the personnel will likely be recruited in part here and in part from our men released abroad from military service. For the present, however, we must await the decision of the French and Belgian authorities upon the method of financing the work of restoration.

Unparalleled Municipal Opportunities

NINETEEN-NINETEEN offers unparalleled opportunities to every city, town and village in the land. Hosts of soldiers, sailors and war workers will be eager for employment, contractors and supply men will be turning from military to civil contracts, engineers and other technically trained men will stand ready to plan and direct construction, all after years during which municipal improvements have been at a standstill. At such a juncture great service may be rendered, by the undertaking of extensive construction, to those who have devoted themselves to the cause of democracy at home and abroad, while at the same time industry will be stabilized, general prosperity promoted and our municipalities provided with long-delayed and much-needed improvements.

To fulfill these multiple opportunities for service requires extensive and careful planning, both physical and financial. Some cities have already done such planning, or have it well under way. Others have scarcely begun. There is no time to lose. The construction season will soon be upon us. Men needing work, and highly deserving it, will be seeking employment in ever-increasing numbers, unless every city and village does its part.

Municipal work for 1919 should be planned with a view to starting first on jobs which can be got under way early in the year, and which can be adjusted readily to the labor supply, and perhaps to the materials supply as well.

No city should look upon finding employment for the demobilized as mere stop-gap work. There will be more need than ever in this year and succeeding years to have every undertaking fit into a carefully devised municipal program. As proof of this, let any city engineer, mayor, commissioner or councilman take pencil and paper and set down needed improvements and their approximate costs. The list will soon reach such a length and total as will exceed the financial ability of the municipality for years to come. This means that work for 1919 and succeeding years must be selected with regard to its relative value and urgency.

Where city-planning commissions with vision exist, municipal programs will have been formed before this. Where they exist but lack vision, it behooves them to open their eyes and their minds and point the way. Cities without planning boards might well create them, if state legislation permits, or seek statutory authority with the opening of their legislatures, where it is now lacking. But no city or village should wait for the legislature to authorize a planning commission. Coöperation among existing officials and the mere saying the word "plan" to the city engineer may be immediately productive of results.

Where there's a will there's a way. The opportunities for municipal improvements, combined with unparalleled service, are many and great. The war has been won, but the world and this country will not have been made "safe for democracy" if suitable work at adequate pay is not provided, both now and in the future, for every soldier, sailor and toiler who helped win the war.

The world expects every American municipality to do its duty.

A Year of Apprenticeship in Shipbuilding

THERE is satisfaction of a high type in the marvelous achievement of the nation during the year—multiplying its shipbuilding power to the degree that ten times as much was constructed as in any previous year. But it is no less satisfying to find that while building we have been learning. The year has been one of apprenticeship in the shipbuilding art.

During the hard winter that ushered in the new year of 1918 a new system for producing ships was just being put to trial. The inadequacy of the old methods and equipment furnished the motive. Yet before the new fabrication system had been made a reality came a more amazing development in the sudden rise of the old shipbuilding art to a wholly new level of achievement. And it is through the power of the revivified old art, without essential aid from the fabricating yards, that the country was able to set new standards in ship construction.

Much has been said in derogation of the speed-ship work; the results have been called stagey, all prepared for. But this very point gave the clew, it soon appeared: If a good performance resulted from thorough preparation, why should not preparation precede every piece of work? The advance was made right there. Each case, "Tuckahoe" or "Crawl Keys," reinforced the preceding ones in bringing this point to the fore.

The spirit of better management was grasped quite broadly. Yard after yard, discovering that labor could be used more efficiently, and equipment more intensively, by management, set about providing for steady flow of work, preparing all tasks, guarding against mutual interference of men and of material. Yards were expanded and rebuilt, to permit of doing this. When, in the midst of this activity a shop-trained manufacturer stepped into the shipbuilding field to build patrol boats, it turned out that what he had learned in factory work and carried over into his yard was already being applied by shipbuilders.

While the old-line yards moved forward thus, it is regrettable that ship fabrication lacked time to exhibit its full power of production. It is just as regrettable that the authorities have maintained silence on what results are being achieved by this iconoclastic method. For our coming development we need to have the guiding marks set. It is gratifying, therefore, that the review which we have been able to compile of results obtained in the use of the fabrication system gives grounds for a certain amount of optimism concerning its utility.

Specialization problems lead in the shipbuilding field today. There is specialization in labor and in equipment, while there is coming yard specialization, still in its earliest stages, but clearly indicated by the yards that are planned for definite sizes of ships and the yards that are pure assembly plants, with shop processes transferred to outside enterprises as far as possible.

In the future, specialization may develop further. Mr. Hurley's strong words on the unpredictable possibilities of our renascent maritime business mean too much to pass quickly out of mind. He opens a prospect into years that may bring many new tasks. But whether the key to their solution be increased efficiency, or specialization, we are the better prepared for them by the apprenticeship of the months just past. And we are the more amply equipped by being able to center on those tasks the fresh energy of the new working forces that have been gathered into the yards.

Light Aggregate For Structural Concrete

CONCRETE is essentially an artificial stone, and it approximates to the natural material even in weight. Though largely used as a structural material in frameworks where weight is a detriment, the original nature of concrete has so thoroughly controlled its uses that little effort has been made, until the past year, to effect a desirable saving in weight with no loss in strength. In developing a light but strong aggregate, then, the concrete-ship pioneers have now opened new possibilities for structural concrete, whether or not the concrete ship is more than a war-time expedient.

The invention of a light aggregate was born of necessity. Early in their studies the engineers of the Concrete Ship Section of the Emergency Fleet Corporation found that to compete in carrying capacity, and therefore in operating cost, with the steel ship, the concrete ship could not possibly use the standard 150-lb. concrete which had come to be accepted as inevitable in structural work. Experiments were made with many substances, both artificial and natural, before approval was fixed on a burnt shale-clay resembling in appearance certain volcanic tufas of the Pacific Coast.

Full information regarding the manufacture and properties of this material will soon be made public. At present it is sufficient to say that it fully satisfies the requirements of the Concrete Ship Section, that one large ship has been built of it, and a contract has been let for 10,000 tons to a cement company which is producing the material in one of its rotary kilns. Roughly speaking, the aggregate, crushed to ¼- and ½-in. size, makes a 1 : 2 concrete weighing about 100 lb. per cubic foot and breaking in compression at 4000 lb. in 28 days.

Assuming that more exhaustive tests will confirm these figures, the aggregate is a most important development in concrete construction. Dead load is a serious factor in reinforced-concrete design. No small part of every concrete member goes to support the member itself, and the accumulation of these dead loads as the foundation is approached further increases the required size of every member. If this dead load can be reduced 40 or 50 per cent., not only with no loss but actually with a gain in strength, the field of concrete in structural work has been widely extended.

As in all engineering problems, this one hinges on relative cost. The probability of a wider use of a structurally effective light aggregate depends on how cheaply it can be put down at the job. On this score there are not yet sufficient data to base predictions. It can be said, however, that the basic clay from which it is made is widespread, and that the technique of production is not so complicated that it cannot readily be undertaken at any modern kiln. Already aggregates of practically identical properties have been produced in Alabama, New Jersey, Missouri and California. Assuming that production of the aggregate will be undertaken commercially, it becomes a matter of computation for each structure whether a possible increase in cost due to the

special aggregate is balanced by the saving not only in concrete and steel, due to reduced dead weight, but, in building work, in the value of the space gained by the more slender columns of the lower stories. As used in shipwork the light-aggregate concrete is rich and strong, and the aggregate itself is fine. Such concrete is, of course, expensive, but in static structures, except possibly in columns, a leaner concrete with coarser aggregates would be used.

In mass concrete, weight is often a desideratum. Specially heavy aggregates giving concrete weighing up to 190 lb. per cubic foot have been used in dams, with resulting greater efficiency against overturning or shoving action of the retained water. In articulated structures, on the contrary, strength with minimum weight is wanted. It has been the impression for years that the two properties, strength and weight, were more or less proportional in concrete, and that an aggregate which floats, as does this new burnt clay, could not possibly have a strength usable in structures. If these views are to be revised and the new aggregate has such strength as the Government studies so far show it to have, its application is readily obvious to all structural engineers. There will be placed in their hands practically a new material whose economic advantages will need consideration in all projected designs.

What War Has Done for Contracting

THE war has benefited contracting.

A year ago this statement could not have been substantiated. Even now we are too close to events to make a true estimate of their influence. Only mental myopia can, however, blind one to the main fact that the war has given contracting a spirit and a purpose not possessed a year ago. Contracting is a far more definite force in industrial affairs than it was. With the coöperation of organized engineering and organized labor, it can become the power which will recreate a new, stable, construction industry. Only the tenets of an ancient autocracy stand in the way of such coöperation. A democracy of the engineer, the contractor and the workman, dedicated to the common purpose of service to construction, is a goal which war has brought within our vision.

In canvassing the war's accomplishments for contracting, one's thought leaps first to the successful operation in war construction of the cost-plus-sliding-scale-fee contract. A work of greater creative influence has been the development among contractors of a strengthened spirit of coöperation, culminating in the organization of the Associated General Contractors of America. And still there have been other gains.

A year ago the wisdom of the new war-construction contract was being questioned. The lapse of twelve months has furnished the answer. It is this: The cost-plus-sliding-scale-fee contract has operated successfully, and should not be permitted to disappear from public-works practice. It may well be that the details of this contract can profitably be altered, but its principle of assured fair compensation should be maintained inviolate. Government officials who have directed war construction, contractors who have performed this construction, and engineers who have watched the war work are a unit in this opinion. They are supported by the record of a thousand million dollars' worth of work accomplished with remarkable speed and with astonishing harmony between engineers and contractors and workmen.

Organized contracting is, in a very definite way, the outcome of war construction. Do not misread this assertion. The elements for organization existed; war conditions merely vitalized the spirit to organize. Patriotism was one of the influences; business foresight was another; perhaps also shame at being in a position where a gratuity must be accepted instead of a right demanded. The paramount force, however, was the lesson of the power of organization which war wrote for a nation to read.

When the call came to mobilize for war construction organized labor responded, and so did an organized construction materials industry. Contractors responded, but not organized contracting. Contracting had no organization. It is true that its interests were guarded in planning the war work, but the guardians were the engineers of the Federal war-construction bureaus. It was these facts, coming home to the contractors who were called upon for war work, which crystallized the sentiment that has materialized in the Associated General Contractors of America.

Recognition of the doctrine of the partnership of labor in the construction industry is another accomplishment of war. Organized labor had a seat in the councils which determined the policies of war construction. All that followed in improved working conditions was merely an outcome of the original action. Labor has made it plain that these privileges gained will not willingly be abandoned. Nor does sound reasoning advise their abandonment. Construction, like other industries, has reached the stage in its relations with labor where the decision must be made between comradeship or battle. War construction has demonstrated that comradeship is practicable.

War, then, has educated contracting to the possibility of establishing fair-compensation contracts; to the recognition of labor's right to participate in the management of construction, and to the advantages of organization. These are great gains. Let us not overestimate them. The principle of the fair-compensation contract has not become a belief; national organization of the contracting business has barely been begun, and the right of labor to partnership in management has been recognized but not accepted. Obviously, the problems ahead are mighty ones. What of the method of their solution? War has provided the answer here, also.

Organized coöperation of engineer, contractor and workman is the primary essential. If ground gained is not to be given up, this coöperation must be immediate. What stands in the way? Distrust between engineer and contractor; intolerance by both of the claim of labor to the right of a voice in determining the conduct of work. Successful coöperation of all three, impelled by the common purpose of war service, demonstrated how superficial the reason was for distrust and intolerance. It needs only the disposition of organized engineering and organized contracting and organized labor to come together in consultation to expose the shallowness of the reason even in peace-time construction.

American Ships—A Field of Vast Technical Opportunities

A Message to the Engineers and Contractors Who Threw Themselves Unreservedly Into War Production of Ships and Now Ask As to the Future of the Shipbuilding Industry

By Edward N. Hurley
Chairman, United States Shipping Board

IN THE building and manning of our new shipyards in the past twenty months there has been a tendency to overlook the contribution of the technical man.

That contribution has been very great. Only by making generous drafts upon the accumulated technical skill of other American industries has it been possible to produce war transports and food ships in record time.

But our task of organizing and mobilizing a new shipbuilding industry in a matter of months, in the emergency of war, caused the technical factor to be lost sight of for a time. We had to achieve the superhuman. The first appeal was patriotic. Had it not been possible to stir deeply the manual workers of this country, bring them into the shipyards by tens of thousands, and stimulate them to national service, we should never have succeeded. It was necessary to create new viewpoints among craftsmen, inspire them with a willingness to learn new trades, and call upon them for unusual energy and production. Had we not begun our task at this end we should never have accomplished what was necessary under the circumstances.

Of course, neither patriotism nor human willingness could have built the ships without the quiet teamwork of the technical men.

Now that the ships are being launched and delivered and put into service, I am glad to have this opportunity of thanking the technical men, and of emphasizing what I consider to be their best achievements, and of calling upon them for even greater contributions in connection with our new merchant marine.

Contribution of the Bridge Shops

The most notable contribution has been that of the fabricated ship. It is not conceivable that we could ever have built tonnage in such record-breaking time, without fabrication. And fabrication would never have been possible without the technical skill of our bridge and skyscraper industries to draw upon. In principle, it is thoroughly simple. In practice, however, it is most complicated. For the fabricated steel ship, when she is launched and delivered, represents the assembled materials from hundreds of mills and shops. No amount of ingenuity in designing or planning would make those materials fit into their proper places without the technical skill and experience which we found in establishments hundreds of miles from tidewater. No amount of patriotism, or willingness to break riveting records, could have assembled those materials in ships had technical accuracy been lacking. But the materials have come down to the seaboard from hundreds of shops, each making parts without knowledge of other contributing organizations, or of shipbuilding, and they have fitted with a refinement which is utterly new in the shipbuilding industry.

It is high time to review our technical results, and thank the technical men for their contribution, and to point out the solid groundwork they have laid for an American merchant marine and a real shipbuilding industry.

The reviewing of technical achievements may best be left to others who have been more directly identified with those details of the work in the Emergency Fleet Corporation and the shipyards. As Chairman of the United States Shipping Board, I can express my thanks and appreciation for the results, and testify to the resourcefulness and spirit of the technical men who have faced, not merely new problems, but unprecedented difficulties, shortages and handicaps, and won out against all odds. When the history of the war is written their achievements will be found as epoch-making and as characteristically American as the achievements of our fighting forces in France.

Future of Shipbuilding

New let us look a little into the technical future of our shipbuilding industry and our merchant marine.

Ship fabrication outside of the shipyard is unquestionably a success. Moreover, it is an American success, for no other country in the world possesses the technical resources of our bridge or skyscraper industries.

Is fabrication to be a permanent factor in our shipbuilding? Will it place us on a fair footing with other nations in cost of ship construction? Will it lead to the standardization of ships, both in hulls and equipment, and to standard practice in manning ships, and operating them, and turning them around in port?

I believe that all we have accomplished to date in this new industry points toward the fabricated standard ship. I believe that with our American facility in producing more bushels or tons or pieces per worker than any other nation, backed by the great ship-manufacturing plants which we have built for the war emergency, we shall be able to build ships as cheaply as any other nation—perhaps a little more cheaply. I believe that we shall operate ships largely with American officers and seamen, at American wages, and under American standards of living.

But we shall be able to do these things only if we apply American ingenuity and energy to the merchant marine as a whole. This is a national task. It calls for well informed public opinion and nation-wide interest in ships, first of all. Until we think of ships as we think of railroads we cannot have them—and when we think of ships in that way we can have anything.

This public opinion must be wise enough and strong enough to make all factors work together. The technical man, the ship operator, the seaman, the banker, the business man, the factory operative, the farmer, the salesman and the legislator must all work together for the common end. Ships are useless without cargo, cargo implies world trade, world trade is based upon international banking and investment, and all rest on national interest.

I believe that within the next year we shall see this national interest develop to such a degree that the American people will never again consent to be without ocean transportation facilities.

Somebody has said that none of us owns the United States—that our country was handed over to us by our forefathers and that we simply hold it in trust to be handed over to our children. Our forefathers left us America and also an American merchant marine. We have allowed the merchant marine to fall into decadence. We owe it as a duty to posterity to reconstruct it and hand it down once more. The bare facts about our new ships are so inspiring, and our world opportunities and obligations are so great, that simply to make these facts known during the next year should be to create the necessary interest in ships.

Now, most of the technical questions as to fabrication and standardization and operation, and the future of our shipbuilding industry, seem to me to turn upon the uses to which we shall put ships when we really want them badly enough and find work for them to do.

Shipping Development to Be Our Teacher

Great economies reside in the fabricated ship. But orders for our fabricated ships have been placed by the Government for war-time bottoms. When a government needs ships by the hundred, to transport troops, munitions and food, through a great standardized service, to the war zone, that is one thing. But if the Government, following the provisions of the Shipping Board act, disposes of these ships to private operators for service in carrying cargo and passengers on many different routes, that seems to me something entirely different. One operator will require cargo carriers of moderate tonnage and speed for charters. Another will want to put ships into scheduled freight service on regular routes. Still others will plan passenger-and-cargo liners to South America or Oriental ports, and still another may wish to enter the transatlantic passenger trade with fast ships of 20,000 or 30,000 or more tons. Therefore, the kind and quantity of service determine the type of ship and the number that can be operated. That in turn determines the kind and volume of ship orders and also the extent to which fabrication and standardization can be utilized.

Was it Liebig, the chemist, who about a hundred years ago confounded the chemical experts of his day by introducing the experimental laboratory? Up to that time, they say, chemists taught entirely by theory, lecturing upon what would happen if the substance A were mixed with the substance B —but never taking the trouble of mixing them. Then Liebig came along, as I remember the story, and actually mixed A and B, and they gave reactions never prognosticated in chemical theory.

Something of the sort is likely to happen when we actually begin operating merchant ships. It is easy to see that, with ships of our own, and a revival of our world trade, we shall create new American ocean routes. With the necessary backing of branch houses and branch banks abroad, the character as well as the volume of our trade will change, both in imports and exports. This suggests not only growth of our seaports, but probably a rearrangement of traffic to seaports over our railroads and inland waterways. Quite a number of conscientious citizens—usually inspired by local pride—are already theorizing about the effect upon this or that port. Other interested citizens are theorizing about navigation laws, seamen's wages, shipboard living conditions, and like matters—and very often from the viewpoint of self-interest. But just as it would have been impossible in 1865, when the Union Army marched up Pennsylvania Ave., to foresee the railroad development of the West during the following 15 years, much less carefully to arrange it all in advance by well planned theories, so I believe we are today facing a world expansion just as difficult to foresee in detail.

One assurance may be safely given the technical men who have gone into shipbuilding and who would like to continue therein—the assurance that when the energy of America turns to world channels, as it is now doing, it will give ample scope for technical activity. The world today is 18,000,000 tons of merchant shipping short of normal needs. That is, 4,000,000 tons more have been destroyed by submarines than have been built during the war and taken over from the enemy, and 14,000,000 tons shortage exists over what would normally have been built since 1914, without war. There are good grounds for anticipating that our shipyards will be busy during the next five years building up to the world's shortage, and that for five years afterwards they will be building for the world's growth. We shall need not only ocean tonnage, but increased lake tonnage, with vessels for inland waterways, tugs and barges for harbor use, and tonnage for coastwise trade, and repair and dry-dock facilities in keeping.

Let the Nation Become Ship-Minded

Types of ships and character of shipyards and construction will depend upon the demand. Along with these factors, let the technical men remember that the merchant ship is about to undergo almost startling improvements. We have the electrically welded ship just appearing over the horizon, as well as the motor ship operated with Diesel-type engines. These two modifications in themselves should keep the technical men busy during the next decade, for they promise radically new ideas in ship operation. The motor ship, for example, will give an unheard-of range of voyages, without bunkering, increased cargo space, improvement in working conditions and morale, and probably higher wages and general emancipation for seamen.

To sum up, briefly—American shipbuilding and the American merchant marine seem to me today comparable with our automobile industry when it was in its infancy. The technical men then set out to meet a known demand for road transportation with several distinct types of propulsion, such as the gasoline and the steam engine and the electric motor. The demand for vehicles far outran all anticipations. It determined the type of car, led the technical men into unforeseen fields of development, and, by modifying our whole national scheme of living, created an industry which has never since shown any signs of lagging. I believe that in shipbuilding and the merchant marine we are entering one more great field of unconditioned possibility.

Let us all work now to the end that this nation may become ship-minded, and the future will be ample enough for everybody.

Berth Construction and Side-Launching Practice in Great Lakes Shipyards

Berth Structure Simple—Timber and Concrete Foundations for Support of Ships—Concrete Launching-Way Stringers at One Yard—Keel-Blocks and Cradles Variously Arranged—Trip Shores To Release Ships

HIGH-PRESSURE shipbuilding in the yards of the Great Lakes has emphasized the simplicity and cheapness of berth construction and the saving of time secured by side launching. Ships can be laid down almost anywhere along a dock front, with little preparation of the berth. No submerged ways or other underwater work are required. The ways can be cleared and a new keel laid in much less than an hour. Building the ship on an even keel eliminates extra labor and delay in lining up the parts of the hull. Much ingenuity has been applied to the details of the method. It appears in modifications of timber berth foundations, the use of concrete substructures, quick-release keel-blocks of different forms, and variations in launching-way and cradle arrangements. The extensive enlargement of old yards and construction of new ones during the past two years because of the urgent demand for maximum ship output has created special opportunities for applying new ideas.

FIG. 1. LITTLE PREPARATION OF GROUND NEEDED FOR LAYING DOWN A SHIP IN A SIDE-LAUNCHING YARD

In a review of Great Lakes shipyard practice in *Engineering News-Record* of Nov. 28 and Dec. 5, 1918, pp. 978 and 1037, the various yards are listed and their main operating characteristics summarized. It may be referred to in connection with the present article.

Timber Berth Construction—Berths on firm fill require but little preparation of the ground for laying down a ship, as the view (Fig. 1) in the newest yard of the Lakes, the McDougall-Duluth Co. yard at Duluth, Minn., indicates. The keel-blocks are set on stringers founded on piles, as the soil is backfilled behind the timber dock front, but for emergency use this preparation could be dispensed with. In general, the company's timber berth construction is like that shown in Fig. 6 for its concrete berths, with timbers in place of the concrete caps. It is a longitudinal system.

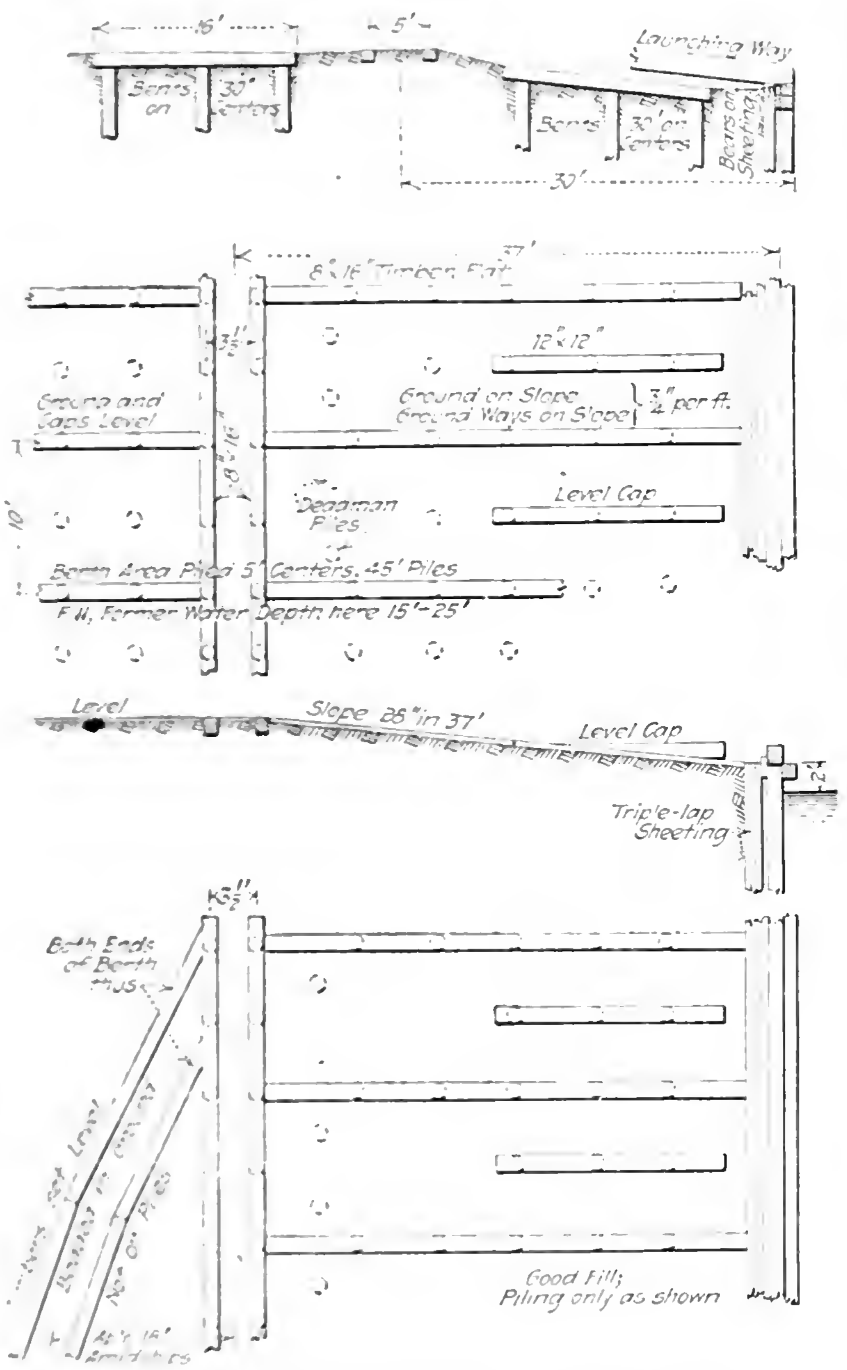
Several new berths of the Manitowoc Shipbuilding Co. at Manitowoc, Wis., are of the very simple type sketched in Fig. 2. A keel-block foundation consisting of two longitudinal stringers supported on piles runs down the center of the berth, and pile bents at right angles to the dock line give support for cribs or ways. The bents on the water side are set on a slope somewhat less than the launching slope of 1½ in. per foot, while those on the land side are level. The berth as a whole is not piled.

Somewhat more extensive foundation work, providing supports at 5-ft. intervals, was used in the four old berths, and was adopted again in building the new berths 5-9 of the American Shipbuilding Co.'s yard at Wyandotte, Mich., sketched in Fig. 3. Piles were driven 5 ft. on centers all over the berths; there was 20 ft. of water on the site of berths 7-9 only a year ago. The main bents are 10 ft. apart, and those on the water side have only half the launching slope, to give more room under the ship at the keel-block foundation level. Intermediate between the sloping caps are shorter level caps.

Stringer construction of a special kind is used on the land side of berth 10, the last one built at Wyandotte; its arrangement is sketched in Fig. 4. The water side of the berth is identical with that just described, except for the omission of intermediate piling, because of older and firmer fill. In the land half the ground is so firm that the stringers were laid without pile foundation. Direct bearing on the stringers of all main supports of the ship during construction is to be furnished by the arc-shaped pair of stringers. For supporting the launching ways, which carry load only an hour or two, blocking direct on the ground appears to be satisfactory.

McDougall and Toledo Have Concrete Berths—By substituting reinforced-concrete caps for timbers in some of the berths, the McDougall-Duluth Co. has produced a simple form of permanent foundation. It follows the stringer system on both land and water sides. Fig. 6 shows the layout and main dimensions. These concrete berths are the ones intended to be continued in service after the emergency shipbuilding is over.

More elaborate concrete berths are used by the Toledo Shipbuilding Co., Toledo, Ohio. They were built ten years ago, but are still practically in new condition, in spite of constant service. They consist of a complete gridiron of way bents and stringers or struts, arranged around a backbone formed by a heavy longitudinal girder under the keel-blocks. The waterside work is sloped to the inclination of the launching ways, and permanent 6 x 18-in. oak ways are bolted to the concrete caps of the transverse bents from this side. On the land side the concrete structure is level;



FIGS. 2 TO 4. VARIOUS FORMS OF TIMBER BERTH CONSTRUCTION USED IN GREAT LAKES YARDS

Fig. 2—Timber berth construction at Manitowoc. Fig. 3—Piled substructure of berths 7, 8 and 9, Wyandotte Yard. Fig. 4—Combined transverse and stringer type used at berth 10 at Wyandotte

hinged launching-way sections here can be raised up to the way slope. After a launch, they are dropped down to give free working room for setting keel-blocks and laying a new keel. Later they are taken out, at leisure, to leave the berth space clear, being easily replaced when preparations for the next launching are to be made.

Protection covers are provided for the fixed way timbers (on the water side), but they are rarely used. Lugs for launching-trip supports are formed in all the transverse concrete caps, so that the trip shores used in releasing a ship at the time of launch can be set anywhere.

Firm support is afforded by the concrete structure for the outboard rail of the gantry cranes with which the Toledo berths are equipped. This rail can be removed or replaced in a few minutes' time, and by reason of the firm foundation no time is lost in lining it up.

Wedge Keel-Blocks Save Time in Launching—While building, the ship is supported by keel-blocks (Fig. 1)

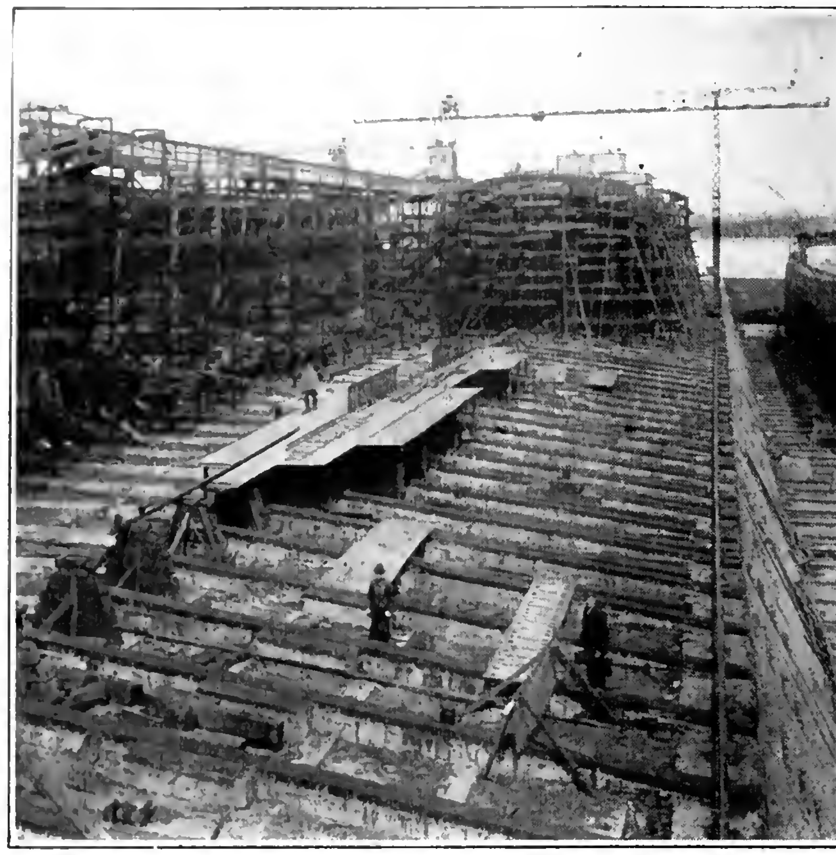


FIG. 5. TOLEDO YARD HAS FIXED LAUNCHING WAYS ON CONCRETE BERTH FOUNDATION

and props or shores just as in end-launching practice, except that it is level in both directions. Safety cribs are built up near the bilges as the ship grows, to give it stability independent of the shores. In the Cleveland yard of the American Shipbuilding Co. cribs are used on the water side only—three cribs, each 4 or 5 ft. square. Most other yards place cribs on both sides, and use eight to twelve in all.

As all the fixed supports must be taken out for launching, and their load transferred to the sliding blocks or cradles resting on the ways, special devices for releasing their load are used in many yards. The shores carry each only a small amount of load, and they are therefore easily knocked out after the ship has been wedged up on the cradles. The keel-blocks, however, which carry most of the load, are so held between foundation and ship that they cannot be knocked out. At Cleveland the top block, on which the flat keel rests, is a piece of 12 x 12 about 18 in. long, and in order to take the load off the keel-block at launching time this upper block is split out by steel wedges. For 30 keel-blocks the operation of splitting out—working at two simultaneously, so that there are 15 operations—takes the better part of an hour and keeps a large crew busy. Quick-release wedges have, therefore, been devised in several forms and are widely used.

Wedge blocks of the type shown by Fig. 10 are used in many of the yards either on the end blocks only or on all the keel-blocks. At Cleveland they are used only on the four end keel-blocks at stem and stern and (after the link is unbolted) they are knocked

out with a ram after the other blocks under the ship have been cut out—this being the final step in transferring the ship's weight to the cradles and putting strain on the trip-shore ropes so that the ship will start when the ropes are cut. The McDougall-Duluth yard uses these wedges on all keel-blocks, and so saves the work and delay of splitting out blocks; it also uses them on the safety cribs, as sketched in Fig. 11.

An ingenious double-wedge block, the Thompson keel-block, has been adopted at Manitowoc. This was originated by one of the company's carpenters and patented by him. It provides not only for quick release, but also for easy adjustment to proper height at the time of laying the keel, or later in replacing a keel-block after it is taken out for riveting the keel directly above. As sketched in Fig. 12, it consists of a bottom wedge whose upper sloping face is roof-shaped with longitudinal ridge, and two upper blocks bearing on the side slopes of the roof surface. The upper blocks are bolted together, but for releasing, after the bolts are taken out, they can be knocked away easily. When in place and bolted up they may be shifted lengthwise on the lower wedge for height adjustment. An important saving in launching time has been realized through the use of this block, as explained farther on.

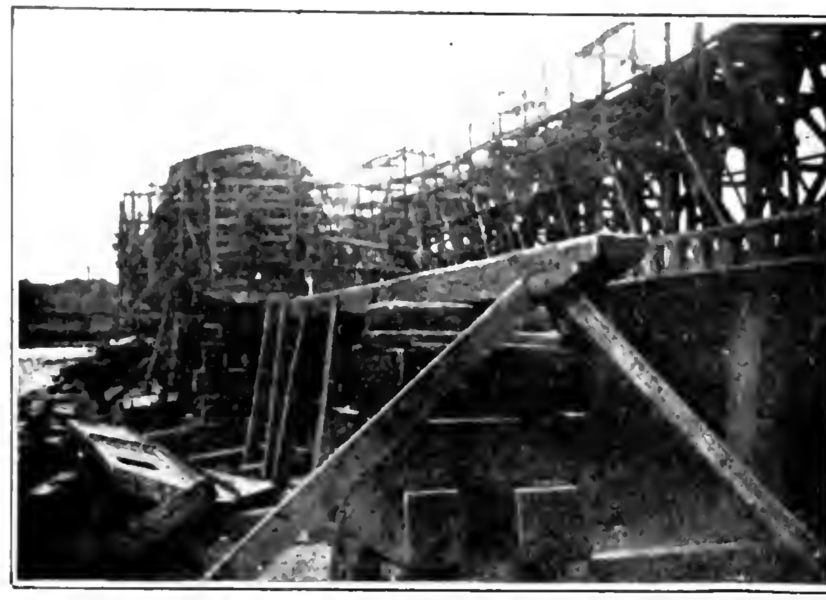
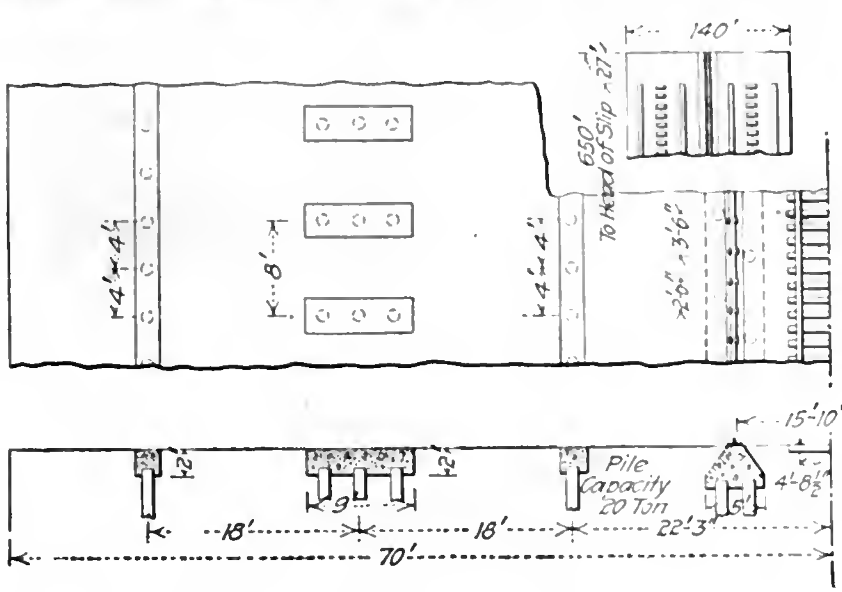


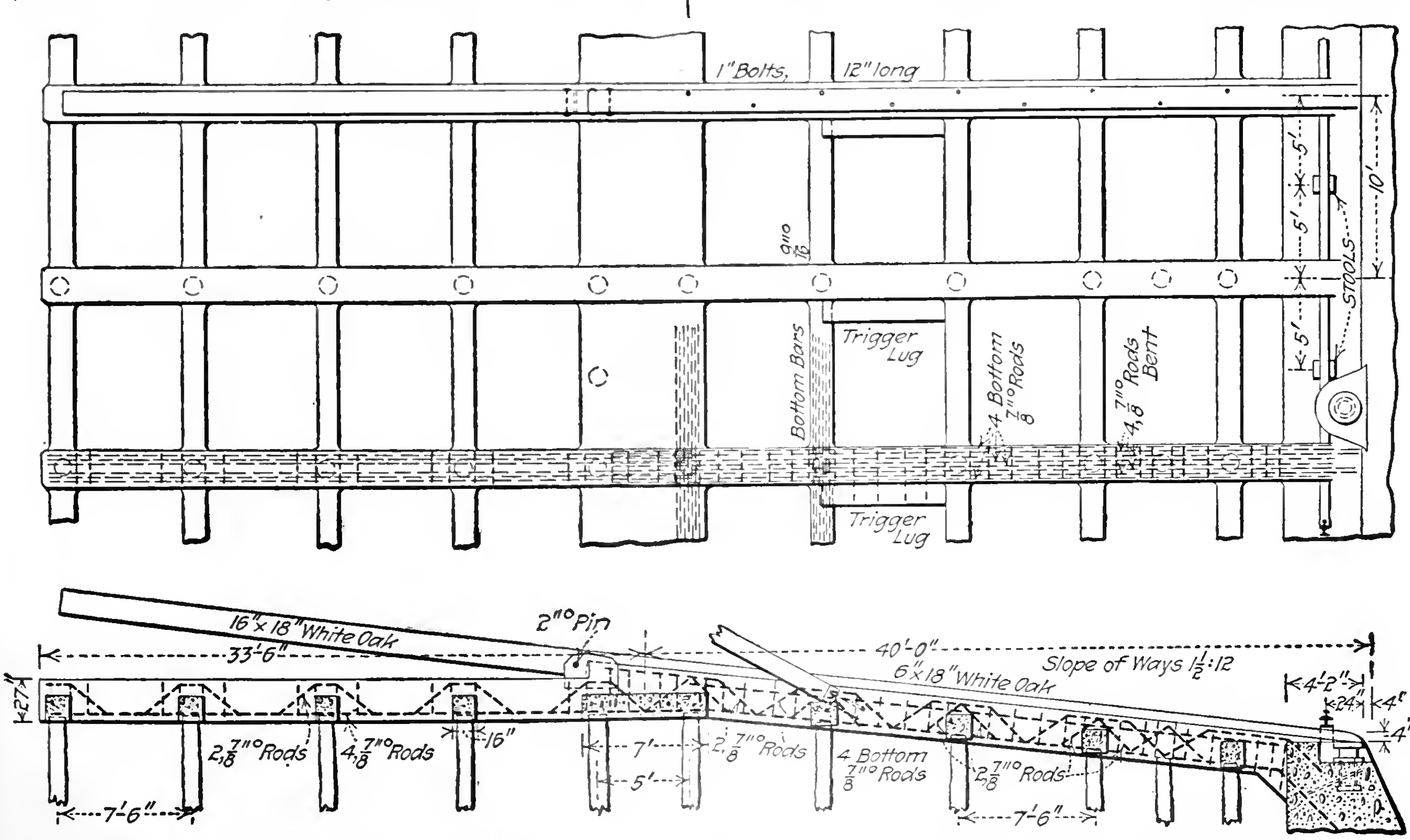
FIG. 8. TEMPORARY SILL LAID ON SAFETY CRIBS TO CARRY BOTTOM SHELL

Simple wedge blocks are used at the South Chicago yard of the Chicago Shipbuilding Co., as may be seen in Fig. 15. They are sketched in Fig. 13.

Toledo also uses blocks wedged on both sides, as can be seen also in the view, Fig. 5.

Launching Ways and Cradles—Twice as steep a launching slope is used in side launching as in end launching—$1\frac{1}{4}$ to $1\frac{1}{2}$ in. per foot, as compared with $\frac{5}{8}$ in. to $\frac{3}{4}$ in. The ship must acquire a considerable velocity to make its drop at the end of the ways properly, in view of the retardation produced by the ship's outer bilge entering the water just before the final drop (Fig. 16). Fig. 9 shows the general declivity of the launching ways as set for a 600-ft. ore steamer at Ecorse. A nearer view of the way surface as pre-





FIGS. 6 AND 7. WIDELY DIFFERENT TYPES OF CONCRETE BERTH CONSTRUCTION USED IN TWO YARDS
Fig. 6—McDougall-Duluth concrete berth foundation. Fig. 7—Concrete foundations for blocking and ways as built at Toledo

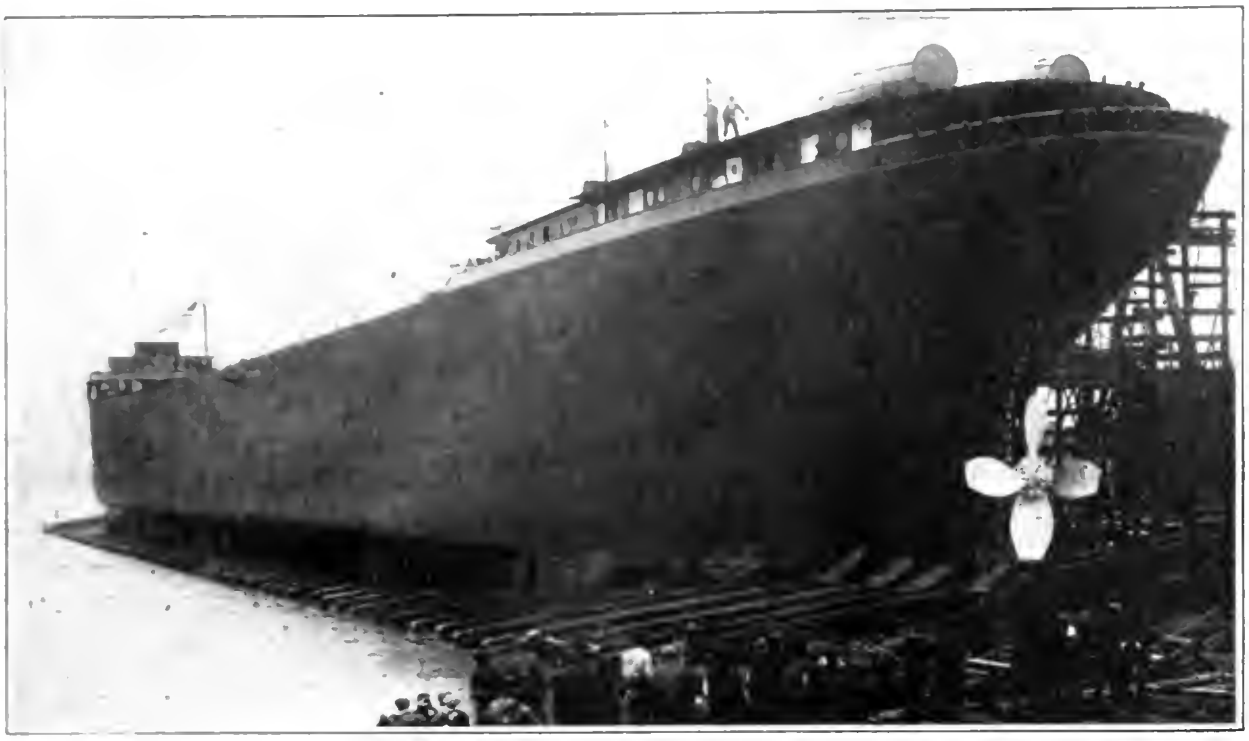
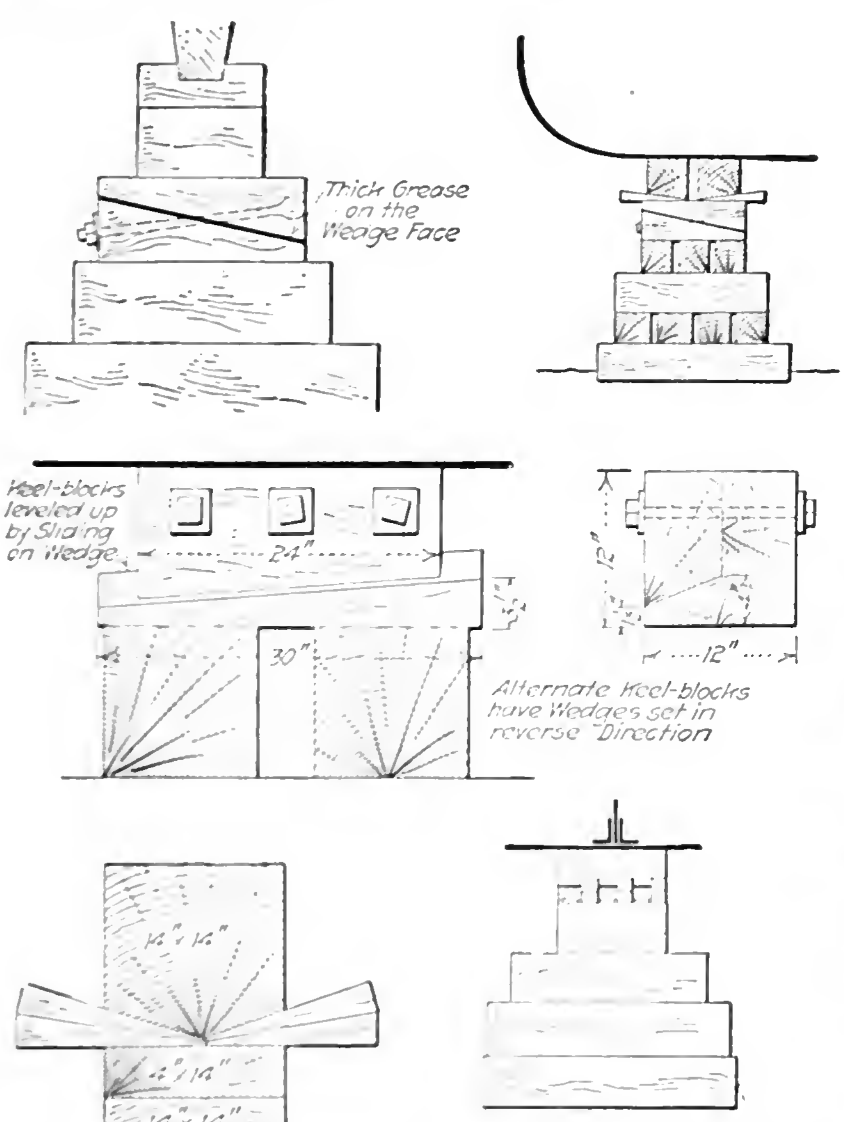


FIG. 9. TEN TRIP SHORES USED FOR 600-FOOT LAKE STEAMERS; EMERGENCY FLEET VESSELS REQUIRE ONLY FOUR

pared for one of the short Emergency Fleet ships appears in Fig. 17.

Timbers 18 x 24 to 20 x 20 or 24 x 24 are used for launching ways (Fig. 18). They are spaced 10 to 12 ft. apart (for example, 12 ft. at Cleveland, 10 ft. at Toledo and Wyandotte), in uniformly spaced arrangement, except at Duluth, where the interesting twin-way arrangement shown by Fig. 19 is used.



FIGS. 10 TO 13. WEDGE KEEL BLOCKS USED AT CLEVELAND, MANITOWOC, SOUTH CHICAGO AND TOLEDO

Fig. 10—Wedge block with locking link used on end keel-blocks (Cleveland). Fig. 11—Safety crib with quick-release wedge block (McDougall-Duluth). Fig. 12—Manitowoc duplex wedge keel-block. Fig. 13—Arrangement of wedges in keel-blocks at South Chicago.

Blocking under the way timbers, directly on the ground, forms their foundation. The forward end of the ways is usually supported on the bulkhead wall of the dock. The regular practice is to let the forward end of the timber bear on the main 12 x 12 pile cap of the dock front. At Manitowoc the timber is made to bear on the sheetpiling of the bulkhead and is kept clear of the pile caps (Fig. 2), as the former is considered better able to take the extra load as the ship passes over. At Ecorse, however, the ways are not allowed to bear on any part of the bulkhead, but are placed to clear the cap timber by about 3 in. (Fig. 20), the support being given wholly by blocking on the ground. Relatively light bearing pressures are developed between the sliding cradles and the ways. With the Emergency Fleet ships, weighing not over 1200 tons at launching, the total area of sliding surface is 250 to 400 square feet, giving three to four tons pressure on the sliding surface. With long Lake ships the pressure may be 9 to 10 tons per square foot. The American Shipbuilding Co.'s standard arrangement of ways and cradles, used with minor modifications at each of the company's six yards and representing fairly closely the general Lakes practice, is shown in Fig. 18, which exhibits the relation of ways and cradles to the ship and the edge of the dock. The ways do not extend down into the water so as to give support to the ship until it is floated off the cradle (as in end launching), but stop short at the edge of the dock. Launching involves a tipping of the ship just before the vessel finally leaves the ways, as the view Fig. 16 clearly portrays. The action is as sketched in Fig. 21, representing a

FIG. 15. WEDGE BLOCKS AT CHICAGO USED AT EVERY KEEL SUPPORT

FIG. 14. TRIP SHORE THRUST TRANSFERRED FROM LAUNCHING WAY TO ANCHOR RODS AT WYANDOTTE

FIG. 16. LAUNCHING WITH LOW DROP AT LORAIN; THE "LAKE DEVAL" WAS BUILT IN 24 WORKING DAYS

diagrammatic transverse section through the ship at the time of launch. Supported on its five lines of cradles, the ship when released moves down the ways from position A to positions B and C. By the time position C is reached the two lines of cradle

FIG. 17. SHIP TRANSFERRED TO CRADLES READY FOR LAUNCH (CLEVELAND)

on the water side, 1 and 2, have already passed over the ends of the ways and dropped out. At position C, the center line cradle K also drops out; the vessel then is unbalanced and pivots on cradle 3. While tipping to position D and beyond, it continues to move forward and strikes the water in position E. Forward movement continues, and the resistance of the water applied at the bilge increases the tipping moment and tends to relieve the load on the rear cradles. When cradle 4 drops out, the vessel soon settles to an even keel.

Ordinarily, the end of the ways is only a foot or two above the water surface, so that conditions are fairly represented by the sketch, Fig. 21. Much higher drops, however, occur at South Chicago (4 to 5 ft.) and at Buffalo. A new berth at Buffalo has a dock front about 7 ft. high, so that the keel of the ship is 10 to 12 ft. above water at the moment when the drop begins. At low water in the extreme case the drop is about 12½ ft., and this was the condition at the time the "Lake Delancey" was launched, on July 4. Fig. 23 shows how the ship took the water.

The cradles on which the ship moves down the ways are relatively simple arrangements of blocking in the flat-bottomed ship now being built. A row of center-line cradles the full length of the ship and two shorter rows of cradles on either side of the center line constitute the common arrangement. Six cradles are used at Duluth (Fig. 19). Wedges in the upper tiers of each cradle (see cross-section in Fig. 18) are the means for lifting the ship to transfer the weight from the shores and keel-blocks to the cradles. At Cleveland the cradle on the land side, which comes just inboard of the turn of the bilge, is blocked solid from way-timber to ship, and the wedges are set under the way-timber.

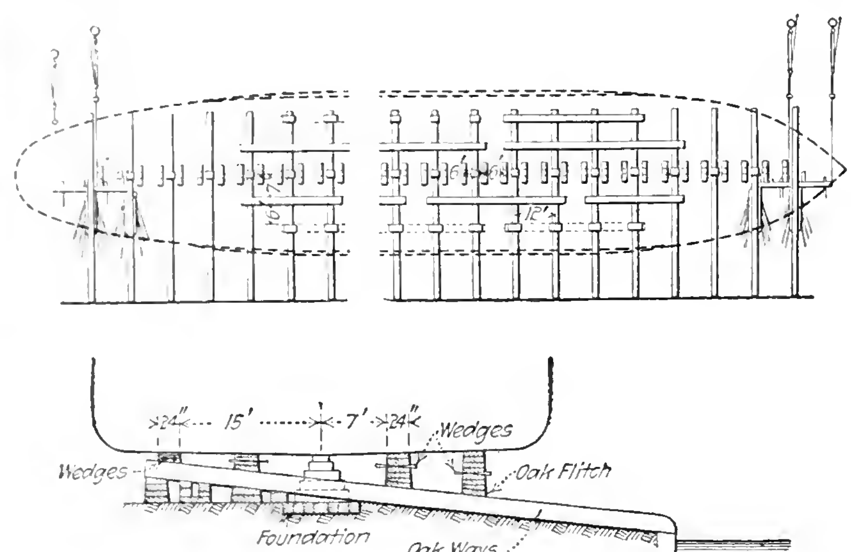


FIG. 18. TYPICAL ARRANGEMENT OF KEEL-BLOCKS AND CRADLES, AMERICAN SHIPBUILDING COMPANY

This is done partly because when put under the way, the wedges tend to lift its upper end.

More common practice has all the wedges above the ways, (sketched in Fig. 24) as at the Wyandotte yard. Single wedges are used in the cradles, except in the center-line cradle. The two cradles on the water side are tied together transversely by tie planks about mid-height, for greater stability.

Oak or maple sliding blocks are used on the ways, of a length not greatly exceeding the width of the ways

(usually 24 in.). In the twin-way arrangement used at Duluth, the sliding blocks or "butter boards" extend across the two ways of the twin pair. Their length of 8 ft. gives 6 in. of projection over the sides of the ways. Using the long butter boards and having two ways in a pair is believed to offer greater security

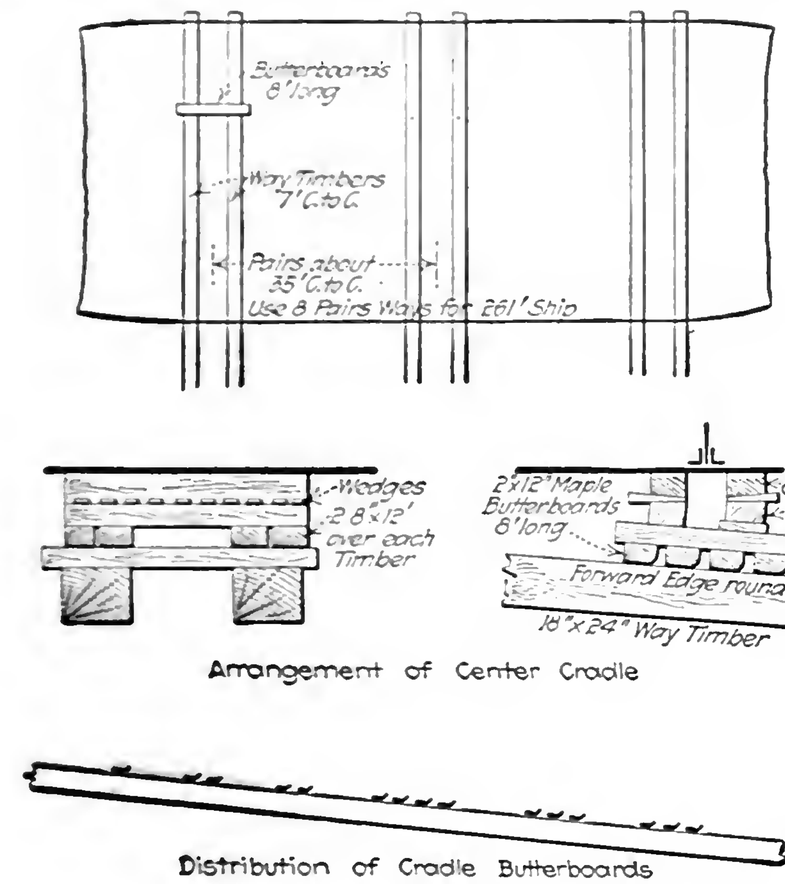


FIG. 19. TWIN WAYS AT DULUTH

against the cradles leaving the ways in case one end of the ship is released before the other and the ship skews during the launch.

Releasing the ship is accomplished by cutting the ropes holding trip shores constructed according to the drawing, Fig. 25. Each trigger consists of a lever parallel to the center line of the ship, one end resting against an abutment arranged on the side of a way timber and the other held by a bight of 1½-in. rope securely anchored inshore. This lever is about 10 ft. long. About a foot from its abutment or fulcrum end

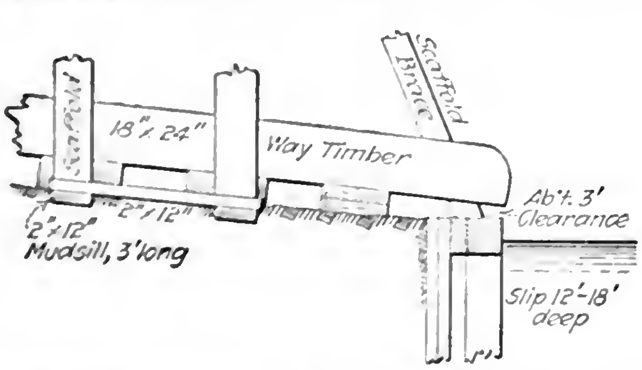


FIG. 20. ECORSE WAYS ARE KEPT CLEAR OF BULKHEAD

a short post footing against the lever bears against the keel of the ship or a ledger-block fastened to the side of the ship. In launching the 600-ft. ore steamers which constitute the main carriers of the Great Lakes, often four trip shores were placed at each end of the vessel and two near the center, making a total of 10 that had to be released simultaneously. The short 261-ft. vessels being built for the Emergency Fleet Corporation are launched with two trip shores at each end, four in all, arranged as sketched. The vessel shown in Fig. 9 is held by ten ropes, the four stern trip

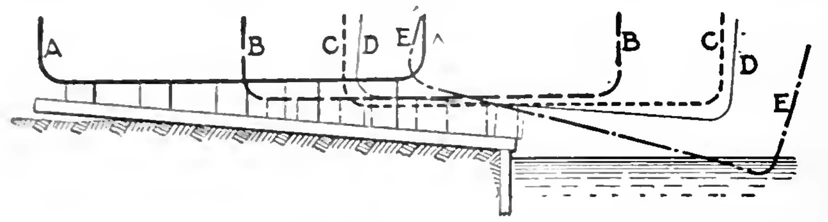
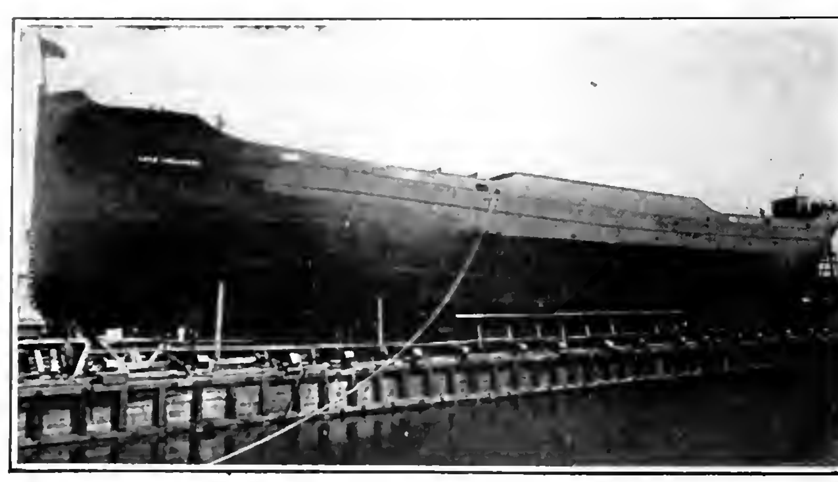


FIG. 21. SIDE-LAUNCHED SHIP TIPS AS THE CENTER-LINE CRADLES GO OFF WAYS

shores being visible in the picture. The two trip shores used for the Emergency Fleet vessels show clearly in Fig. 17, a view of the "Lake Alvada," launched Aug. 18 at the Cleveland yard.

As shown in Fig. 25 (see also Fig. 18), the thrust of the trip shores against the launching ways is absorbed by raking struts bracing the way timber which serves as abutment. An anchorage arrangement used at Wyandotte, shown in Fig. 14, transfers this thrust from the insecure ground at the berth to secure anchorage timbers some distance back. The same timbers serve for holding the ropes by which the long end of the trigger lever is held.

Hydraulic or screw jacks are placed against the side of the ship, one near each end, to start the ship from its static conditions before the ropes are cut. Most yards pump up these jacks in every case, to make sure



FIGS. 22 AND 23. LAUNCHING FROM HIGH DOCK—BUFFALO YARD CONDITIONS INVOLVE DROP OF 10 TO 12 FEET

that no obstruction is present and that the ship will start promptly.

Typical Launching Procedure—Transferring a ship from its fixed blocking to the cradles and launching it is an operation of an hour or an hour and a half. The following description of the procedure is from notes taken during a launching at the Cleveland yard, but the steps are substantially the same in all the

Lakes yards. At the start of the work described, the vessel rests on its keel-blocks, on one or two rows of posts or shores near each bilge, and on three to twelve safety cribs, also located near the bilges. The launching ways are in place, all the cradles are on the ways, with launching tallow between the contact surfaces, and are lightly wedged up against the ship.

Putting the entire launching gang on the water side of the berths, the launching boss clears this side of its fixed supports, as the first step. The men working in pairs, drive in the wedges of both lines of cradles on the water side of the ship; after a first "rally" of two or three minutes, followed by a breathing spell of the same length, a second rally transfers enough load to allow the shores to be knocked out. Simultaneously with removal of the shores, the cribs on this side of the ship are taken out by knocking out the wedges in the blocking. The water side of the ship is then free and on its cradles. Repeating these operations on the

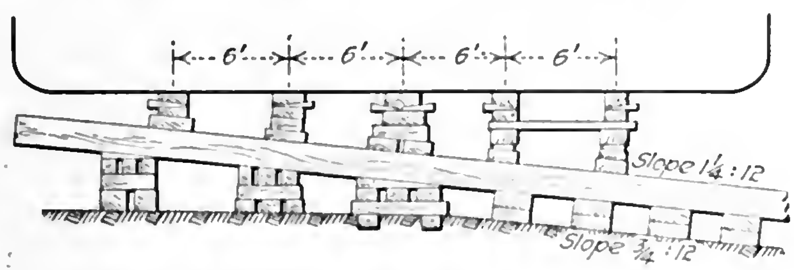


FIG. 24. CRADLE ARRANGEMENT AT WYANDOTTE

land side clears the ship of all fixed supports except the keel-blocks.

Trip shores and releasing ropes were placed on the previous day, and the ropes drawn up by tackle to a good strain. Everything is therefore ready for the removal of the keel-blocks. Beginning at the center, the blocks are split out, in pairs, first the two blocks amidships, then the one forward and the one aft of these, working on successively to the ends of the ships. When all are split out, the four end keel-blocks supported on wedge blocks tied by linke (Fig. 10) still hold the ship. The links are taken out and eight squads of men with heavy planks as battering rams get in position to knock out the eight sets of wedge blocks.

For even launching, the four ropes holding the ship must be cut simultaneously, and the ship must be ready to move. The latter requirement is assured by giving the ship a slight shift by means of the jacks before cutting the ropes. To make sure that the cutting goes on as a single blow, four axemen, one at each rope where the rope passes over a chopping block, work in conjunction with the launching boss and his two assistants in such a way that one signal is carried to all four. Close to each end of the ship is stationed one of the assistants, where he is in plain view of the two axemen at that end. Halfway between them, and in a little, back from the ship, the superintendent stands on a platform or box, in clear view of the assistants. Each of the latter has tacked to a rail in front of him and facing the boss four sticks or semaphore markers.

At a signal, the first ram gang at each end knocks out the wedge keel-block farthest from the end of the ship; the moment it is clear the assistant in charge turns down the first of his four markers. The other wedge blocks are then knocked out in order. As the last supports go out, the cutting ropes should show the strain of the ship's pull, and the last of the four markers is not turned down until the assistant in charge has made sure that this is so—in other words, that the ship is "alive"—otherwise, the jacks are applied to start the ship.

When the turning down of the last marker informs the superintendent that both ends are clear and alive, he slowly raises his outstretched arms, a signal to the axemen to raise their axes. The assistants at the ends follow him in this movement, and the axemen in their turn. After a moment's pause, the launching boss brings down his arms, and the signal goes through the chain to the axemen and results in a simultaneous cut on all the ropes.

Preparation for the launch may be started as soon as the ship's bottom is riveted; after this time there is no more occasion for working under the ship, so that ways and cradles do not interfere with anything. Ordinarily, however, no ways are set until about two weeks before the intended launching date, and if further delay is desirable the work may be started as late as a week before launching.

Launch Ship in Ten Minutes by Help of Wedge Keel-Blocks—Remarkably fast work in launching is accomplished at Manitowoc by a change in procedure which was developed after the adoption of wedge keel-blocks of the type described. The last half dozen launchings

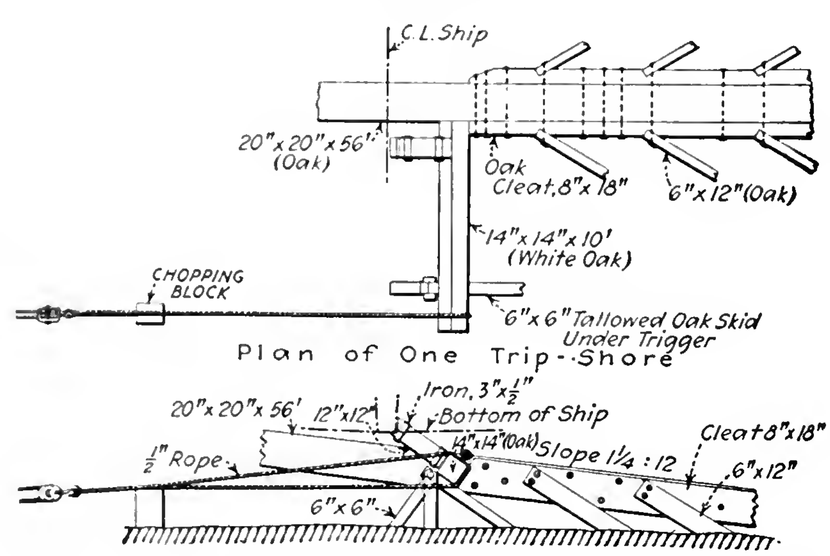


FIG. 25. TWO TRIP SHORES AT EACH END RELEASE THE SHIP; FOUR ROPES CUT SIMULTANEOUSLY ON SIGNAL

at this yard were made in about 10 min. each, from starting time to the moment the ship struck the water. A description of the method is contained in the following memorandum of Elias Gunnell, president of the Manitowoc Shipbuilding Company.

"The launching gang hardens up the upper side of the vessel and removes all shores and cribs on that side, in advance, so that on launching day all that is necessary is to harden up the lower side and remove the lower or river-side cribs and shores. There is no attempt to raise the vessel off the keel-blocks. After taking out the bolts a wedge is driven between the two pieces of the upper block, and the block comes free. Our last six launchings averaged just 10 min. from starting time to water. This time could be cut, but counting on the regular run of launching gangs that we use in these days, bolters and helpers, it is good time."

What the Year Has Taught About the Concrete Ship

Much Learned Regarding Design and Construction—Future Depends on Ability To Build in Cost Competition with Steel—Structurally, Ship Is Success

(Editorial Review)

WHEN the United States entered the war the concrete ship was unknown in this country. When the armistice was signed the Government itself had over a hundred ships and barges under contract, one American vessel had finished a 12,000-mile voyage ending at New York, and millions of dollars had been put into yards where vessels from 7500-ton oceangoing tankers down to 500-ton canal barges were being built. This new industry was developed practically in its entirety by engineers and contractors who had before no experience in ship design or construction. Whatever future it may have will undoubtedly remain in the hands of the concrete constructor who brought to the problem native ability and experience in the general art of concrete construction. Now that the war is over and the immediate critical need which developed the concrete-ship idea has passed, many are asking what has been learned in the past year and what are the chances for the concrete ship as a permanent competitor of the vessel of wood or steel. Even now it is too soon to do more than review certain obvious conditions and developments and to set down briefly some of the things that have been learned.

The history of the concrete ship has been told in these pages during the past year. It suffices now to repeat that the development was, early in the war, taken over by the Concrete Ship Section of the Emergency Fleet Corporation, and that the Shipping Board soon refused to allow any ships to be built for private account. In consequence, though hundreds of engineers interested themselves in the study of the problem, the only ships contracted for were those built under the auspices of the Fleet Corporation, except some small power boats and lighters for the War Department, towboats for the Railroad Administration and the Navy, and a few barges for private owners. The Concrete Ship Section conducted many studies in design and construction and, though handicapped by what at best may be termed a lack of sympathy in some quarters in the Fleet Corporation, is, together with its associated contractors, entitled to the major part of the credit for what has been done.

Design Based on Theory, Not Rules

Many pages might be written on the design of the concrete ship. In fact, many pages have been written recently. They all reduce to the fact that the usual ship-design methods have been used to determine bending moments, although strain studies now under way on actual ships may modify these methods in the future. The difficulty in design comes in proportioning members to meet the assumed moments according to theory rather than according to standardized rules based on past practice and performance, as has been the practice with steel ships. Distribution of shear in the shell has been particularly bothersome, and has been met in some cases by assuming larger unit stresses than have been common, though apparently justified by incomplete tests, and in some ships not yet beyond the design stage by radical rearrangement of the frame so that the shell takes no shear.

Construction Problems Many

Ship lines in the early ships, particularly in the "Faith," were very crude. The opposite extreme was reached in the first Government ship, the "Atlantus" launched last month at Brunswick, Ga., which takes on the appearance of a yacht and which, due to the very extreme fairing, was difficult to build. Between the two extremes lie the latest Government ships which have sufficient curving of the lines to present a good appearance, but which are not particularly complicated in form.

It is in construction of the concrete ship that most has been learned. It can be definitely said, for instance, that the claim of the violent advocates of a year ago, that no skilled workmen would be required on a concrete ship and therefore it could readily be built anywhere with little difficulty, is not true. No one who has gone through the first few months of building one of the large concrete ships will deny that the work requires the highest type of skill, and that even the training gained on reinforced-concrete buildings is inadequate—because, primarily, of the greater accuracy required in placing the steel and forms and of the greater congestion of the steel in the forms. A concrete ship does not require as many kinds of skilled labor as does the steel ship, but the labor that it does require must be of the highest type.

Placing Steel Difficult and Expensive

Difficulties which arose in the construction were mainly those connected with the placing of the steel in the narrow, congested forms. Contrary to many expectations, the construction and erection of the forms themselves have not proved overly difficult. It was, of course, a problem different from that met in building construction in that the whole form structure, inside and out, had to be erected complete before any concrete pouring started. In addition, all of the forms so erected had to be arranged in such manner as to allow free access inside the boat during the pouring, and a ready method of stripping, so as not only not to injure the concrete itself, but to preserve the forms for subsequent use. This has been met quite successfully and, so far as shown by figures given out, quite economically.

Placing the steel has been the critical element in the construction of both barges and ships. Bending itself has been very difficult. The curves are complicated and diverse, so that templets have to be changed frequently. Much of the steel is large in diameter. In none of the boats so far built has the cost of this work been reduced to what it may be ultimately. Placing the curved steel has still further complications, not only on account of the difficulty of fitting it to the curves in the forms, but

also because of the accuracy in its spacing which is required. Undoubtedly, with practice, the bending and placing of steel will be made cheaper. Indeed, it must be made so if the cost of the ships is to be brought down to a competitive basis.

Mechanical Hammering an Innovation

The element of mixing and placing the concrete has not given the trouble that was possibly anticipated. In fact, it has been shown that getting the concrete to the forms themselves is a minor detail, and no great elaboration of plant is required to insure it. The narrowness and the general congestion of the formwork make it difficult to place the concrete in the forms, so that delivery to a nearby point from which shoveling to the forms may be done requires only a moderate speed and quantity of concrete.

The placing of the concrete, however, could hardly be done at all successfully without the use of the air or electric hammer, which has been introduced by the Concrete Ship Section in the making of all of the Government ships. As stated above, all the forms in the ship must be up before the concreting starts. This leaves many bends and turns inside the forms around which the concrete must be led. The ideal consistency attempted by Mr. Edison in his concrete-house project of a decade ago is what the concrete shipbuilder would like. Lacking this so far impossible mixture, the hammer is the next best thing. Several of these hammers battering the inside forms during the pouring of the concrete permit the use of considerably drier mixture than used to be employed in thin, heavily reinforced wall work, and performs almost incredible feats in leading the concrete into the corners of the forms.

Behavior Tested in But One Ship

So far as performance of the concrete ship is concerned, our whole dependence is on the freighter "Faith," which was dry-docked in New York in November after a voyage down the Pacific to South America, up to New Orleans, thence to Havana, and up to New York. Barring the rather serious cracks in the deck where a winch was seated in a place not intended for it, the ship, to all outward appearances, is intact. All rumors to the contrary notwithstanding, her hull is free from anything but minor hair cracks, and the outside surface, which has been subjected to sea-water action for nine months, is in as smooth and unpitted a condition as any concrete in the dry air of the interior of a building.

The "Faith" is as "ugly as original sin." Her structural design, according to those who have investigated it, is susceptible of considerable improvement. She is heavy and therefore undoubtedly uneconomical, but she is an oceangoing concrete vessel which has successfully passed a long sea test.

What is the future of the concrete ship? It is still too early to draw definite conclusions, but the experience of the year seems clearly to indicate that structurally the problem is solved; improvements are bound to come, but the fears of a year ago as to difficulties in erection and dangers in service need not deter progress. The future today is bound up in costs. Competition with steel ships rests on cost per ton of freight carried, which is tied up to original cost plus carrying capacity per ton displacement. The concrete ship will have to be built sufficiently cheaper than the steel ship to counterbalance the extra cost of the dead weight, which is still higher than for the steel ship, despite the advantages of the new light aggregate.

This light aggregate, an artificially burnt clay developed by the Concrete Ship Section, gives promise of being a most important step forward in concrete-ship work. Weighing less than water, it produces in a 1:2 mixture a concrete having a weight of 100 lb. or slightly more, and a strength at 28 days of 4000 lb. By its use it is possible to produce a concrete ship with a carrying capacity to dead-weight ratio only slightly below that of the steel ship—so close, in fact, as to bring the two types in competition.

So far figures for the oceangoing ships have not been produced showing the closeness of this competition, but in towboats they have been made. Barges of identical dimensions, for instance—one of steel carrying 600 tons and one of 150-lb. concrete carrying 500 tons—have operating profits practically equal, using actual contract costs and identical freight charges. A barge built with the 100-lb. concrete would naturally show greater profit.

The costs of the seagoing ships have been confused by a number of things. The "Faith" is a private venture for which costs are not available. The first Government ship, the "Atlantus" will prove to be inordinately expensive. Until official explanations are given out, exact causes cannot be stated, but it seems evident that the slow construction and high cost were due to a combination of inexperience in concrete design and construction, a lack of proper plant equipment due to the fact that only one ship was to be built in the yard, a possibly praiseworthy experimentation with methods and devices, and—so many reports go—shiftless labor.

It is unfortunate that this first Government ship should have taken so long to build and have been so expensive, because it will undoubtedly be used as an argument against future development. Meanwhile, the other Government yards have been built at large expense for eight ships apiece. The big ships being turned out from these yards apparently are being built cheaply enough to permit them to compete fairly with steel vessels, *if the proper proportion of plant charge is assessed against each.* The responsibility for giving out full and authentic cost data on the concrete ship rests squarely on the Emergency Fleet Corporation. Only by knowing these figures can shipowners or prospective builders form their judgment of the practicability of this new kind of vessel.

Concrete shipbuilders are learning their trade in the hardest of schools. They cannot produce as efficiently or as cheaply now as they will after their first few units are turned out. It is going to take the backing of the Government or of courageous spirits such as those who financed the "Faith" to continue the big concrete ship as a commercial proposition, but the future is bright for any such venture. For the small barge, car-float or lighter, on the other hand, the field seems more immediately open. A number of contractors have learned to build such boats, and their experience should be worth much in reducing costs to a competitive basis.

Fabricated-Ship Construction in One Year's Experience

New System Now Thoroughly Tested by Large-Scale Working Has Proved Adaptable And Free from Inherent Difficulties or Elements of Excess Cost

(Editorial Review)

SINCE the "fabricated-ship" enterprise was launched by the Emergency Fleet Corporation as a war-time experiment, 15 months ago, actual hull construction has been in progress for a full year. The system has undergone a thorough, practical trial during this time. Its feasibility has been shown by the launching of a large number of fabricated ships, and the completion and acceptance of half a dozen.

No report on the outcome of this gigantic experiment has been made by the Shipping Board. Since, under the now changed conditions, the value of the ship-fabricating system depends on how it can maintain itself in commercial shipbuilding service, some notes on the practical working of fabricated-ship construction collected by representatives of *Engineering News-Record* are summarized here.

The "fabricating" system is characterized by the fact that the yard sublets to bridge-building shops the punching, shearing, planing, countersinking, scarfing, assembly riveting (so far as practicable within shipping limits), and in some cases the bending or curving of the plates and frames and other parts of the ships' hulls. This means that the work is done at a distance from the yard. It requires sending the necessary construction data from yard to shop by drawings or templets, or both, and obviously demands that the advance information be so precise that the parts will fit together when erected. Extensive changes in ship design, plant layout and construction methods have developed to suit.

Shipping Board Report on Method

So far as the Shipping Board's report (issued Dec. 1, 1918) indicates, the success of this new shipbuilding method is just as problematical as it was a year ago, for the subject is dismissed with the following remarks: "Summarizing the facts in connection with the fabricated ship, we find that the development of the structural steel ship and the enlistment, for the task of shipbuilding, of the engineering experience, the organizing ability, and the mechanical skill of the trades which built our bridges, our great office buildings and other commercial structures, may be counted upon to add from 3,500,000 to 4,000,000 tons of ships each year to our total.

"Three very significant facts should be noted with reference to this plan: First, if the yards had depended on their own fabricating shops and facilities it would have been impossible to develop an equal amount of new shipyard capacity for the manufacture of machinery and equipment, in two or three times the number of months required under the plan adopted. Second, without the ship-fabrication work and the ship equipment orders, hundreds of shops throughout the country might have been closed down, with immense losses to owners and employees. Third, the expense of new shop installations at the yards, if they had been built under the old system, would have run into hundreds of millions, and further concentration of the additional workers in the already overcrowded shipyard districts would have required many additional millions for housing."

Over $200,000,000 of public funds has been invested in the bridge-shop-fabrication system of shipbuilding, besides a large amount of private money. Exclusive of the latter item, the cost to date comprises $100,000,000 expended for shipyard plant and $100,000,000 or more for material and labor used in shipbuilding. The report of the Shipping Board from which these figures are deduced states that the ultimate expenditure for fabricated ships on present contracts will be nearly $500,000,000, so that with the plant cost a total investment of $600,000,000 will be chargeable to the fabrication system.

Quality of Work Excellent

All evidence obtainable testifies to the success of the fabricating method in point of quality of work. "The quality of the work is excellent; the possibility of delay constitutes the only danger of the fabricating system," says one yard manager. The results obtained at another yard are described by the statements of fitters and bolters of many years' service in old-line shipyards, that they have never handled steel that fits as well as the bridge-shop steel. An especially critical judge of shipbuilding matters, who spent many months in intimate daily touch with the work in a fabricating yard, states without reserve that "the work is superior to anything ever done in ordinary shipbuilding."

Curved Work Accurate—In some of the cases only the straight part of the ship is fabricated in the bridge shop, while in others molded and curved work also is done away from the yard. The quality of work appears to be independent of the large differences in system between the various yards, whose bridge-shop allotments range from 70 per cent. of the entire hull to 100 per cent.

The amount of altering or scrapping of bridge-shop-fabricated material has been negligible. As described by an experienced steel man now in shipyard work, the material does not contain many more field errors than ordinary viaduct work. One yard reports that during the construction of several ships not a piece was scrapped except for mistakes made in the yard itself.

Effect of Distance—Under present shipbuilding conditions fabrication is done at distances ranging from 5 to 1500 miles from the shipyard, yet there appears to be no effect of distance. Remote fabrication has been fully as successful as that done nearby. One yard had some of its best results, both in quality and deliveries, from the most distant shop of the several which fabricate its material. A concise summary of the effect of distance is found in the remark, "Fabrication at a distance is exactly the same thing as fabrication at the yard, except that the shop is 300 miles from the ways instead of 300 feet."

Distant Fabrication Does Not Complicate Erection—While many difficulties have developed in ship erection in the large fabricating yards during the year, it does not appear that these are chargeable to the system itself. It is, in fact, stated specifically that outside fabrication involves no greater erection difficulties or necessary costs than ordinary shipyard methods. Actual operations during 1918 have been affected by troubles of sequence of material and shortage of skilled labor to an extent that makes the erection performances no criterion of reasonable possibilities.

Conclusions on Cost Not Yet Possible

No present basis exists for comparing the cost of ships built under the outside-fabrication system with those built under ordinary methods. Main factors for comparison are the shop, transportation, handling and erection costs. Under the wholly abnormal cost, labor and urgency conditions of the past year, available figures are valueless for the necessary comparisons.

Concerning transportation costs: Some fabricated-ship contracts, let to shops located near steel mills, were based on fabrication in transit, so that the fabricated material arriving at the shipyard has no higher railway charge than raw steel shipped to the yard direct. In other cases the cost of shipment of steel to the bridge shop and thence to the shipyard has been several dollars per ton above that of direct shipment from mill to yard. It seems likely that under normal conditions the excess transportation charge, if any, would be negligible. Handling charges also should not differ materially.

Shop Costs Probably Favor Bridge Shop—So many factors bear on any comparison made between fabrication in a bridge shop and in a yard shop, that present contract prices throw little light on the matter. The fundamental element is the relative efficiency of the two kinds of plant. The past year's work has afforded opportunity for comparative judgments. Experienced shop managers state as a result of such comparisons that bridge shops are unquestionably able to work more economically than shipyard shops. For their normal production, bridge shops have been developed to a high degree of efficiency under keen competition, while no similar direct influence toward efficiency has been active in the case of shipyard shops. Men who have had occasion to study yard punch shops since the Emergency Fleet Corporation took over control of shipbuilding report that most of the shops could be greatly improved in efficiency by revising their layout, equipment, arrangement and operating systems.

Under present conditions, therefore, it appears probable that bridge-shop fabrication is about on even terms with yard-shop fabrication, taking into account the differences in shop efficiency and in amount of handling. It is assumed that the bridge shop is at the time in a position to do the shipwork without unbalancing its shop program or seriously lowering the load factor on part of its equipment, in view of the fact that shipwork makes use of only part of the equipment of a bridge shop.

The advantage of bridge shops having multiple and other automatic or semi-automatic punches, capable of doing most economical fabrication if the ship design permits their use, has been a factor in the past year's work. Its influence may be modified in future by the introduction in shipyards of multiple punches and semi-automatic punch tables, on an extensive scale.

Difficulties of Sequence in Getting Hull Material Due to Size of Operations

Serious difficulties have beset all the fabricating yards during 1918 with regard to the speed of building ships. These difficulties appear to have resulted partly from labor shortage and partly from irregularity in the receipt of fabricated material—in other words, the impossibility of getting hull material in sequence.

Though in the large yards steel has been piling up in storage since midsummer, yet in general the shipways have always been ahead of the steel supply. This meant not merely delay, but all the lack of system that hand-to-mouth living implies—and this under the worst kind of pressure for speed, the yard men explain. "The impossibility of getting material in sequence has brought a series of misfortunes in its train that no one who speaks plainly will deny," it is said. In part, perhaps, the sequence difficulties arose from the steel shortage, and in part from shop difficulties chargeable to the new character of the work. The abnormal scale on which the operations were conducted was the chief source of trouble, however. No reason has appeared for attributing the lack of sequence to the fabricating system itself. Under normal conditions and with the system worked on a normal scale, the difficulties should vanish.

Modifications of Ship Design

Practically all the fabricating yards have worked with simplified designs of ships. Simplification was thought necessary because of doubt as to whether bridge shops could do shipwork successfully. Allowance for the limitations, actual and fancied, of the existing shop equipment was therefore made by more or less radical simplification of lines and of structural details.

As a result of the past year's experience, many fabricated-ship men are coming to the belief that such simplification is not an indispensable thing with regard to feasibility or quality of work or its cost. Similarly, some of the large yards have virtually concluded that a large part of the templet making should be left to the bridge shop, and that detail drawings carefully developed in the drafting room are a satisfactory basis for fabrication.

Difficulties have arisen in the case of two yards through necessity for distributing their work among a very large number of individual fabricating shops. Uncoördinated deliveries have resulted from the distribution adopted, in a measure. It is now acknowledged that allotment to many fabricating shops offers a difficult problem.

Concentration of fabrication in a few big shops, to each of which large sections of a ship or entire ships could be allotted, has been decided upon in one case. Four inland ship-fabricating shops are being erected by the Emergency Fleet Corporation, of capacity 10,000 tons per month each, for this purpose. These shops will constitute an important basis for future ship-fabrication work.

Fourteen Points Essential to Establishing a Sound Railway Policy

By L. C. Fritch
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1. *Incorporation of Interstate Common Carriers under a Federal Act*
2. *Private Ownership and Operation*
3. *Federal Regulations and Control*
4. *Pooling of Traffic*
5. *Unification and Common Use of Facilities and Equipment*
6. *Regulation of Transportation Rates, Wages and Working Conditions of Employment by Interstate Commerce Commission*
7. *Uniform Accounting and Statistical Methods to be Prescribed by Interstate Commerce Commission*
8. *Federal Guarantee of a "Standard Return" to Meet Fixed Charges, Dividends and Surplus for Improvements*
9. *Representation on Board of Directors of the Federal Government*
10. *Elimination of State Regulation and Control in Interstate Commerce*
11. *Federal Control and Regulation of Capital Issues and Financing*
12. *Valuation of Property by Boards of Arbitration*
13. *Regional Directors to Supervise Operations*
14. *Standardization of Method and Practice in Railway Operation and Management*

Transportation is the most important item of all the various economic problems confronting the nation. In direct proportion to the wise solution of this problem will be our future progress.

The "fourteen points" enumerated above, if intelligently and rationally applied to this question, will solve the problem in the interest of the public, the owners and the employees, the three most vitally interested parties. Any settlement which does not protect these interests equitably and fully will retard national progress and adversely affect the welfare of the people.

1. *Federal Incorporation*—The first essential to enable common carriers to perform their public functions is an allegiance to one master, the Federal Government, which makes necessary incorporation under Federal statutes. Experience has conclusively shown that the 49 regulating bodies existing at the present time have neither the inclination nor the ability to adopt a uniform and rational set of regulations. It is not possible for a corporation or an individual to serve two masters, particularly when each master prescribes conflicting rules, a compliance in one case being an offense in the other. Under such chaotic conditions no satisfactory results can be obtained, and the proper solution can only be found in Federal incorporation.

2. *Private Ownership and Operation*—This is to be preferred to Government assumption of these functions, for the reason that a government has in the majority of instances completely failed to operate any enterprise efficiently, unless it may be a political machine. The nation at this time is not prepared to assume the financial burden which acquisition of ownership of some twenty billions of property would impose upon the people, in addition to the war debt, and if the operation of the railways is placed in the hands of the owners, and proper and sound public regulation is enforced, the results will be more satisfactory than could possibly be secured under Government ownership and operation. Proof of this fact is abundantly available. To be convinced of this truth it is only necessary to investigate the mistakes Canada has made in its railway policy.

3. *Federal Regulation and Control*—These are most essential elements in the proper solution of the future railway policy. The assumption of the control of railways during war time has demonstrated the necessity and wisdom of such action. While many things are done under war emergency measures which, in peace times, would not be necessary, yet the peculiar interests of the owners must be directed and controlled, and this can only be done by the supreme authority of the Government, which should rule for the benefit of the public as a whole and control the selfish purposes of the individual, be it a person or a community. Federal regulation and control will act as a governor to private ownership and operation, but it must be absolutely divorced from all political affiliations.

4. *Traffic Pooling*—The pooling of the traffic of the country among the railways will produce the most economical results and efficient service. It will move the traffic over the shortest and most economical routes, will prevent congestion and insure each carrier a fair proportion of traffic, resulting in a scientific use of the railways in the interests of the best service at the lowest cost. The most pernicious and destructive competition will be thereby eliminated, through cutting out unnecessary and duplicate service, resulting in reduction in cost and improved service otherwise unattainable. The repeal of laws now prohibiting the pooling of traffic is, of course, necessary. In effect, this law has been suspended during Federal control of the railways, with most excellent results. Under future Federal regulations the law should be repealed, if the public is to de-

rive the benefits of the economies already secured in this respect during Federal control. Service will still be the controlling competitive feature, which will be an incentive for efficiency in operation, and the best service at the lowest cost will inevitably result. The weaker lines must be compensated fairly in the division of traffic to enable them to give adequate service to the territories which they traverse. This is not a difficult matter and can be equitably adjusted.

5. *Unification and Common Use*—Federal control of the railroads has accomplished excellent results in the unification of terminals and common use of tracks, equipment and other facilities. Such results were impossible under private control, due to the selfishness of the individual roads, regardless of the benefits such use might be to the public. The duplication of expensive terminals, trackage, equipment, etc., has resulted in capital expenditures of millions which might have been avoided under a sane policy of regulation and common use. There is no field in the operation of railways more fertile of results—economical and beneficial alike to owners of the railways and the public—than the unification of terminal facilities, trackage and equipment and their common use under fair regulation, but it will require the supreme authority of the Government to make it effective and overcome the prejudice of the individual owners, which has been the means of preventing such consummation under private control.

6. *Regulation by Interstate Commerce Commission*—It is eminently unfair to hold that the Interstate Commerce Commission has entirely failed to perform its functions. As a regulating body it has performed eminent service to the public in the prevention of discriminations and favors to certain classes of shippers, and by these very means has performed the valuable service to the carriers in "protecting them against themselves." The carrier retained the revenues which before the days of the Interstate Commerce Commission were largely dissipated in refunds and rebates to favored shippers. The commission, by its regulation of rates, has given the public the lowest cost of transportation of any country in the world, and has thus fully justified itself as a public body. On the other hand, it may be claimed that the result of this extreme policy has reached its limit, and must be reflected in decreased transportation facilities and impaired service, due to the inadequacy of these rates to produce sufficient revenue to enable the carriers to perform their public function properly.

The duties and responsibilities of the commission should be enlarged to cover, not only the income, but the outgo of the carriers as well, to the end that sufficient revenue will be derived to meet the necessary expenditures of fixed charges, reasonable return on investment, operating expenses, and a surplus to provide necessary improvements and extensions. Granted these enlarged duties and powers, the commission will be alike responsible to the public, the owners, and the employees, and it will be in a position to demonstrate its usefulness and, if properly constituted, will amply justify its existence. The commission cannot be held responsible for its inability to secure results which it was powerless to secure under the laws regulating its duties. The proper solution lies in granting it the necessary legal powers to perform its various functions and then in holding it accountable for the results. If thus constituted, it will not be found wanting. The fixing of wages and working conditions of employees engaged in transportation should be controlled by the same body that prescribes the revenues of the carriers. The highly specialized departments of the commission should have charge of these important matters and alike protect the interests of the employees, the public and the owner of and investor in railway securities. Under present conditions, the operating heads of railways devote a large part of their time to negotiations with labor organizations over wage schedules, working conditions and grievances, leaving little time to be devoted to the legitimate duty of running their business. This should be corrected and the matter handled by a competent technical body, skilled in such matters, with time to devote to them and reach equitable conclusions which will be stable and satisfactory to the interests involved.

7. *Uniform Accounting*—The Interstate Commerce Commission has performed a valuable duty in prescribing a uniform system of accounting for common carriers, and while modifications of the existing system are desirable, it has produced greater reliability in operation and more confidence in the carriers, and has in this respect performed a service of inestimable value to both the public and the carriers. In addition to the system of uniform accounting, there should be prescribed by the commission a uniform method of reporting statistics covering the various operations. This is a necessary adjunct to the accounting system to enable the true results of operation to be reflected.

8. *Federal Guarantees*—The Government operation of railways under war-time conditions has been the means of saving from bankruptcy the majority of the companies taken over. It would have been impossible for many of these companies to pay the high costs of wages and material entering into operations during the war, and meet their financial obligations. The Government has performed a great public service in thus protecting the roads against the calamity which confronted them, and its duty will be fully met if the roads are retained under Government control until the proper adjustments in economic conditions have been made to enable them to carry their own burdens. A return of the roads to private control before that time would be a public calamity.

Under Federal control, the law provides that the carrier shall receive as compensation a "standard return" equal to the average annual operating income during the three years which ended June 30, 1917. In the case of the strong roads, this amount is generally sufficient to meet fixed charges, a reasonable dividend, and a surplus to finance necessary improvements and extensions. In the case of the weaker roads, however, this standard return is not sufficient to meet financial obligations. Some of the so-called "weaker" lines have made requests for additional compensation which have good and reasonable grounds for consideration, and in the interests of the public should be allowed, to enable these roads to discharge their financial obligations. It would be disastrous to have a number of these roads default in their payments at this time, and the Government owes it as a public duty to the communities served by these lines that they shall remain solvent corporations.

The proper policy to protect the transportation industry must make provision for the so-called "weaker" roads; they serve various communities which depend upon them for their existence. It is a Governmental duty to preserve these properties and aid them in such a manner as will enable them to exist and perform their functions properly. This can be done by guaranteeing a standard return to such companies sufficient to enable them to meet their financial obligations, paying the operating expenses, fixed charges, a reasonable return on the investment, and expenditures for improvements and extensions, all to be done under full Government regulation and control. The stronger lines might by an equitable plan assist the Government in meeting such obligations.

9. Government Directors—Government regulation and control makes necessary a voice in the management of the properties, and to this end adequate representations on the boards of directors is essential. The policy of selecting able representative business men to act for the Government in such capacity would result in business management of the railways in the interests of the public and would have a wholesome effect in railway administration.

10. No State Regulation of Interstate Matters—The regulation of common carriers by the various state commissions has resulted in confusion and increased cost of transportation, without any direct benefit to the public. There are certain functions which must be regulated by the communities, such as police powers, health regulation and questions of purely local character. These should be delegated to municipal and state authorities, but the broader powers, which affect interstate commerce, should be regulated by the Federal Government alone. At present there are 49 regulating bodies having jurisdiction over railway operation, and in no two states are the regulations the same. Indeed, the rules in some states conflict with those of an adjoining state, and in many instances what may be required in one state may be strictly prohibited in another. This could be regulated in a uniform manner by one authority—the Federal Government—with equal justice to all. There is scarcely a state-made rate which does not affect interstate rates—therefore it is the function of the Government to regulate interstate commerce without discrimination or favor to any community or person. This cannot be accomplished under state regulation. The first essential, therefore, to a uniform policy of Government regulation and control is to abolish state regulation and concentrate this power in the Federal Government, for the benefit of the whole people.

11. Federal Control of Financing—There may have been cases of flagrant violation of the rules of propriety in the issuance of railway securities in the past. There is no defense for such action and no apology can be made for it, but, because isolated cases have existed in the past, and because a limited amount may have been irregularly issued, is it fair to condemn the entire railway security issues? The proper solution of this problem is so to regulate railway financing and capital issues in the future that it will be impossible to continue the abuses of the past. This would restore public confidence in such investments and enable the roads to secure capital for improvements and extensions.

12. Valuation by Arbitration—The proper Government regulation and control of common carriers makes necessary a consideration of the value of the respective properties. It may be desirable to consolidate certain properties or operate them in common, which calls for data as to the value of the properties involved. The physical valuation of the railways being made by the Interstate Commerce Commission is promised in 1920 or 1921. This may, in many cases, be too late for the purpose of carrying out a general railway policy. Much doubt is expressed by railway owners as to the valuation which the commission will finally place on their property. This will result in lengthy litigation, to which the roads will resort, unless an agreement is reached. It would seem more desirable to submit the question of valuation to impartial boards of arbitration, which would reach results more quickly and with justice to all concerned.

13. Regional Operating Directors—Numerous suggestions have been made to apply the experience gained in the organization of the Federal reserve banking system to the regional control of railways. Seven regions have been created, each in charge of a regional director. The objection to this system is that it results in a centralized control, from which authority must be obtained governing the details of operation. Such a system will not produce the most efficient results, as it takes away from the direct operating heads of the various properties the initiative resultant from complete authority over the details of operation.

A system of regional boards of governors similar to those in the Federal reserve banking system would produce better results than the present scheme of centralized control over operations. The boards should act in an advisory and supervisory capacity only, leaving the details of operation and responsibility in the hands of the active managers of the respective properties.

The transportation business requires prompt action and will not brook the delay incident to appealing for authority to a central source, except in matters of policy. The man on the ground should have the authority to act on his own responsibility. With it he will secure results.

14. Standardization—Transportation is of a similar nature all over the country, and while the conditions under which the operations are conducted vary in different sections there are numerous and various practices and methods followed to obtain the same results within the same territory.

There is one method of obtaining a certain result which is better than every other plan, and on almost any railway system there are certain methods and practices used to obtain certain results, which methods and practices are better than those used on other roads. Experiments are costly, and much time, money and energy are needlessly expended. This could be avoided by utilizing the experience of others.

A committee or committees on the standardization of methods and practices in railway operation and management could save millions of dollars annually in the operation of our railroads, if the standards formulated were put into practical effect. These results can be secured through the means of regional boards having broad powers over the railways, all working to a common purpose, "The best service at minimum cost."

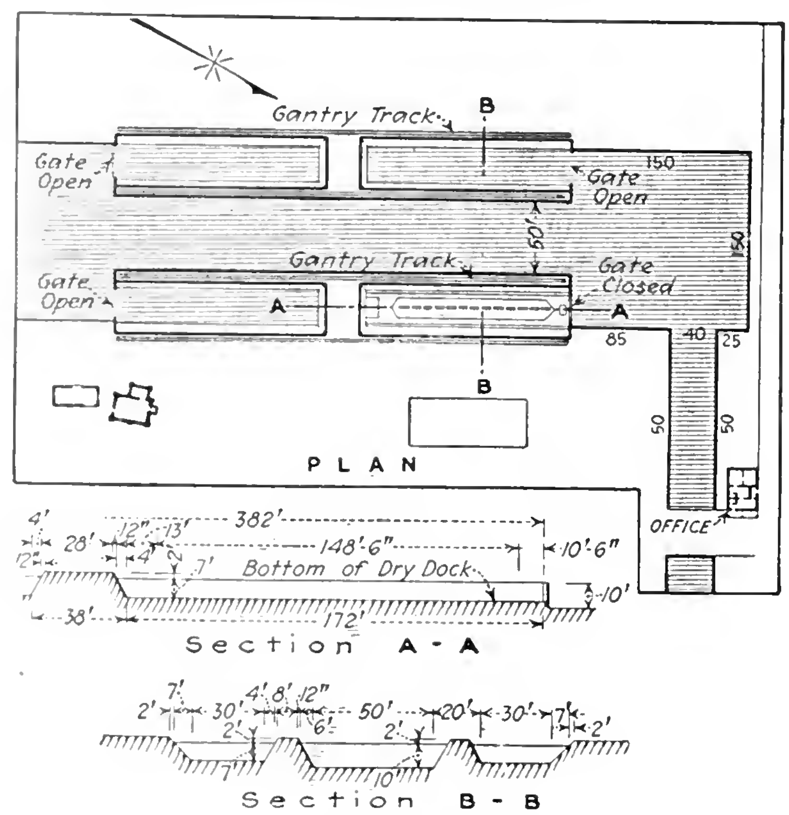
Build Boats in Dry Docks at New Yard in Detroit

Concrete Barges Under Construction on Concrete Floors Inside Dikes Which Will Be Flooded for Launching—Lighters Carry Construction Machinery Alongside Dry Docks

CONCRETE barges for the New York State Barge Canal are being built at the new yard of the Grayhaven Shipbuilding Co., on the Detroit River, Detroit, Mich., in a yard which contains many original features, the most important of which is the use of dry docks in which to build the barges. There are at least two building docks in this country for large ships, but the design of an entire shipyard around a series of dry docks is entirely new, so far as the records show. The yard is intended to be a permanent undertaking, though at present it is being devoted entirely to the construction of five concrete barges for the United States Railroad Administration.

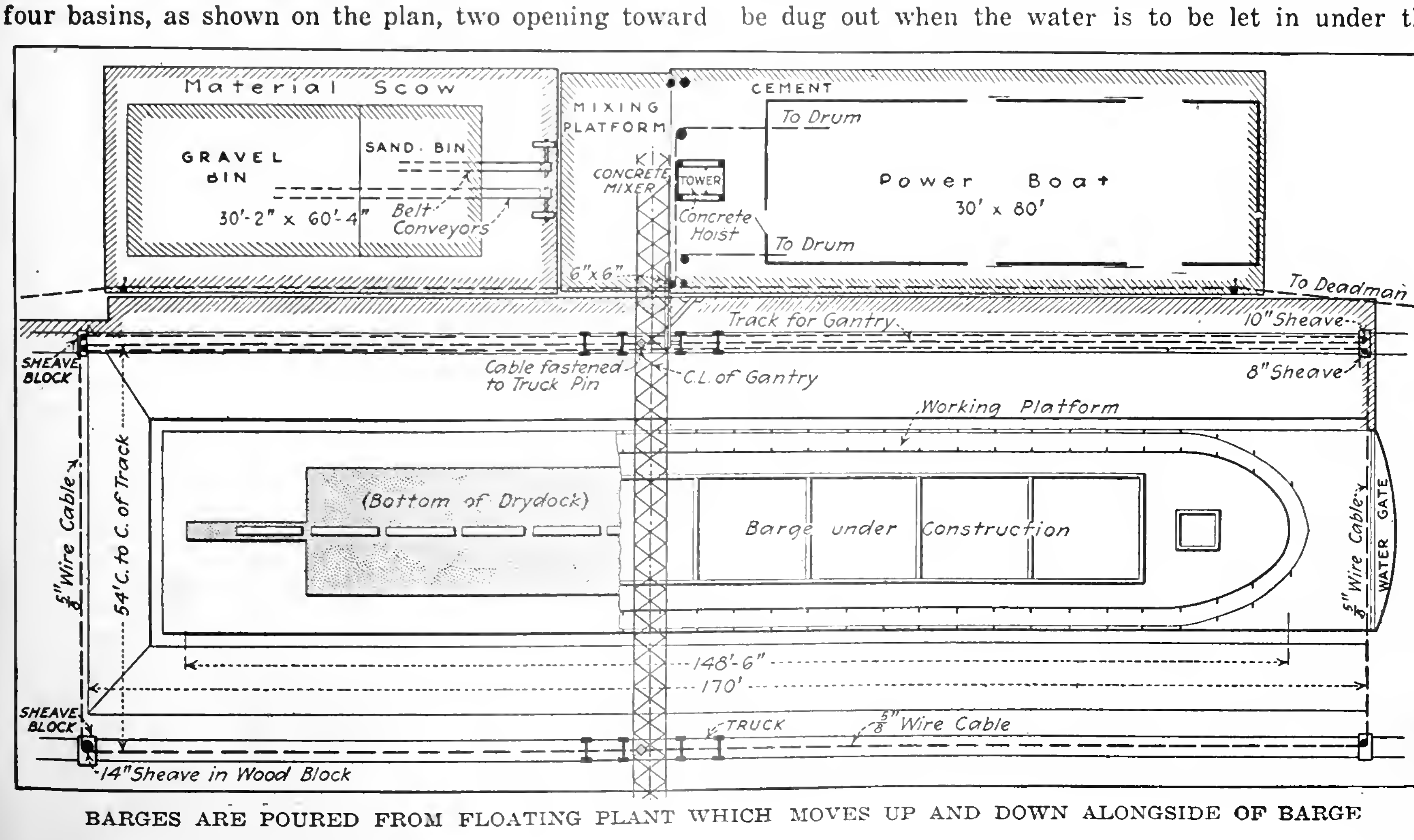
The site of the yard was a real-estate development, the main feature of which was a lagoon 150 ft. wide extending up from the Detroit River, which is about 2000 ft. away. This lagoon was connected by a cross canal to a similar lagoon also extending to the river, it being the intention to sell building lots with water frontage on the whole site. No houses had been built at the time it was taken over last July. The dry docks of the new yard have been built out into the lagoon, and the waters of the lagoon will be used not only to float the completed barges out to the river, but also to carry lighters and barges bearing the construction material and plant. Connection is also established over a bridge across the connecting canal between the lagoons, so that the yard may be reached by trucks and wagons.

The first step toward constructing the dry docks was to throw up a continuous dike about 382 ft. long at a distance of some 50 ft. from the shore of each lagoon, and then to cut in two the basin so formed on each side, with a cross dike extending to the shore. This formed four basins, as shown on the plan, two opening toward the shore and two toward the river. The bottom of each basin was then paved with a 5-in. thickness of concrete; the side slopes of the dikes were smoothed off but left unpaved, and gates were placed across the opening of each of the basins. Four dry docks were thus formed,

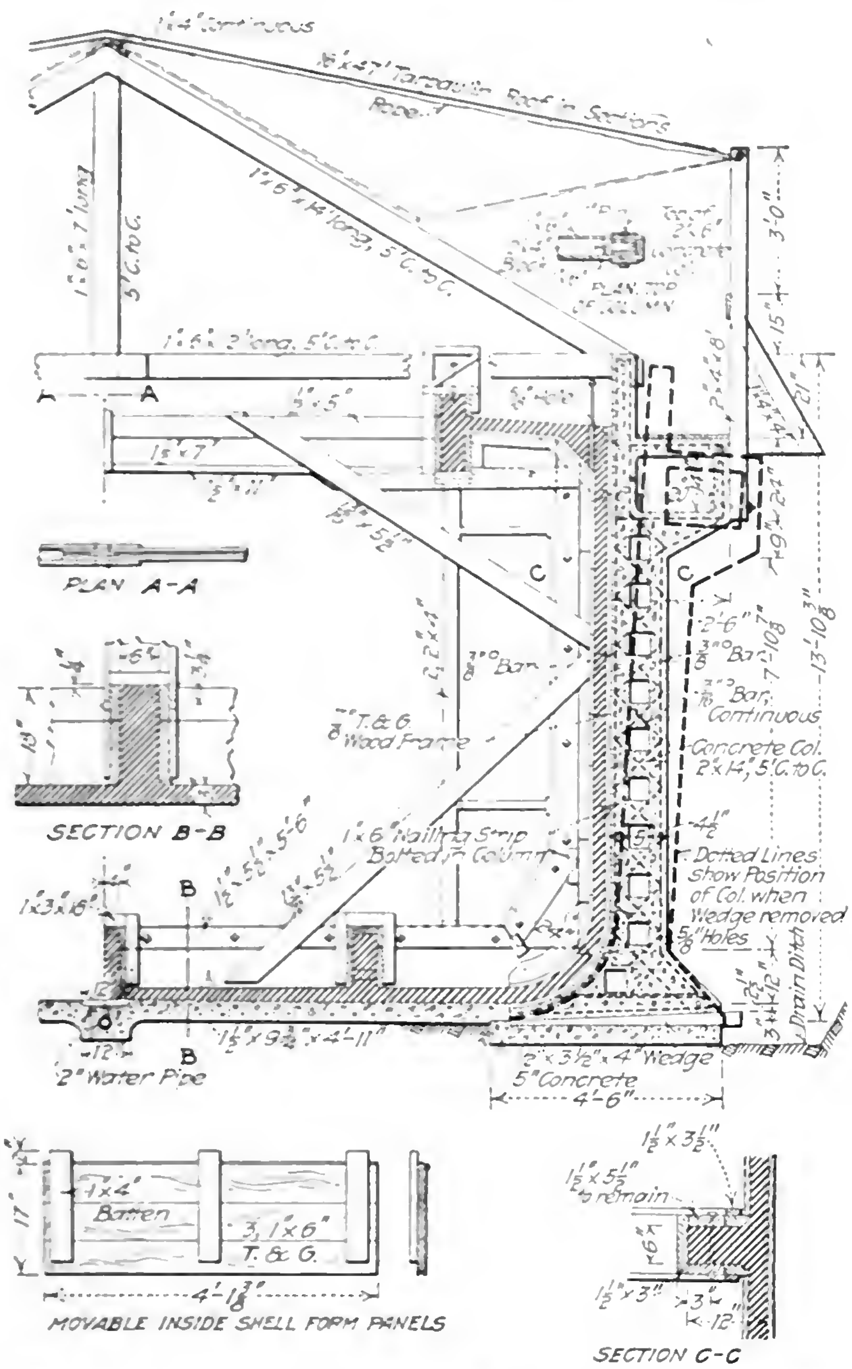


FOUR DRY DOCKS ON LAGOON MAKING IN FROM DETROIT RIVER ARE WAYS FOR BARGES

having a depth of 7 ft., a total inside bottom length of 172 ft., and a bottom width of 30 ft. The main lagoon was then dredged to a depth of 10 ft. For the time being the gates consist merely of earth dikes which will be dug out when the water is to be let in under the



BARGES ARE POURED FROM FLOATING PLANT WHICH MOVES UP AND DOWN ALONGSIDE OF BARGE



CROSS SECTION SHOWING FORM DETAILS IN BUILDING CONCRETE BARGE

boats to be launched, but it is intended to have permanent gates, of stop logs, which can be readily removed and replaced.

The concrete barges now being built in the yard were described in *Engineering News-Record* of Aug. 8, 1918, p. 271. Each boat is 150 ft. long, of 21-ft. beam, and 12 ft. deep. It is of simple type, with frames 5 ft. on centers, a 3-in. shell and an open hatchway crossed with deck beams every 15 ft. The bottom is flat, except for a 2-ft. quadrant curve at the bilge, but both bow and stern have framed lines.

Many innovations have been introduced in the construction of the barges. The principal points of interest are the use of precast concrete frames to carry the outside forms, a hydraulic pump device to give the completed barge an initial lift so that water can get under it for launching, the gantry crane control for the ways, and the use of floating equipment for the concrete mixing and placing.

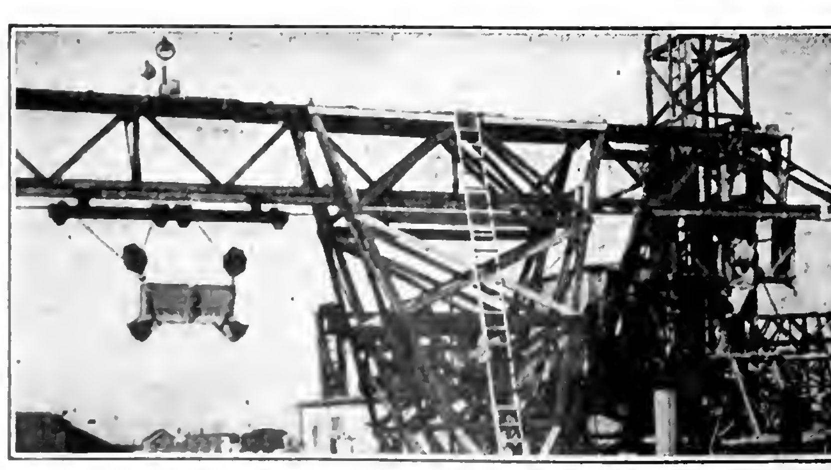
As shown in one of the drawings, the outside forms of the straight section of the barge, which compose the greater portion of its length, are made up of tongue-and-groove lagging which spans concrete jack columns spaced 5 ft. center to center and fastened with removable hooks to eyes let into the depressed concrete floor running along the outer edge of the dock. These jack frames are of precast concrete, with openings to save weight and also to provide spaces for trestle beams. They are 2 x 14 in. in normal cross-section, and are reinforced with $\frac{3}{8}$- and $\frac{3}{16}$-in. steel, as shown. Each frame has an extension at the top to carry the working platform, and has also a sloping bottom which is wedged up from the dock base. The outside forms—that is, the tongue-and-groove lagging—are carried as a continuous section for the entire straight length of the barge, about 120 ft.

This lagging is tacked to a 4-in. wood strip held to the concrete frame by bolts through holes left there for that purpose. Spaced on 1 ft. 8 in. centers between the frames are vertical intermediate 2 x 4's, supported directly on the dock bottom and intended to give additional bracing to the outside forms. The outside form of the bilge curve is made up of small slats laid longitudinally and coming flush at the lower end with the top of the concrete floor of the dock. The bottom of the barge is poured directly on this concrete base, which is oiled or soaped to insure easy removal after the concrete has set.

The outside jack frames also carry at their top a light truss which serves the double purpose of cross-bracing the frames and of carrying the inside forms. From the outside of the working platform there rise posts which carry, with the aid of the center post of the cross-truss, the tarpaulin roof which must be ready, according to the specifications, in case of wet or extra cold weather during the continuous pouring of the barge.

The outside forms between the beginning of the end curves are removed as one piece by the knocking out of the wedges under the jack frames. Thereby each frame is let drop 2 in. at its outer support, which means about 7 in. away from the concrete at the top of the shell. Once away from the shell, the whole side form is slid back along the concrete floor of the dock, until it is well out of the way. When a new barge is built the whole thing is wedged up again and pushed into proper position.

The end forms for the barge are of mortar molds. The stern, which is of somewhat complicated curvature, is in three sections divided along vertical lines. These three sections were set up in a shop with the frames

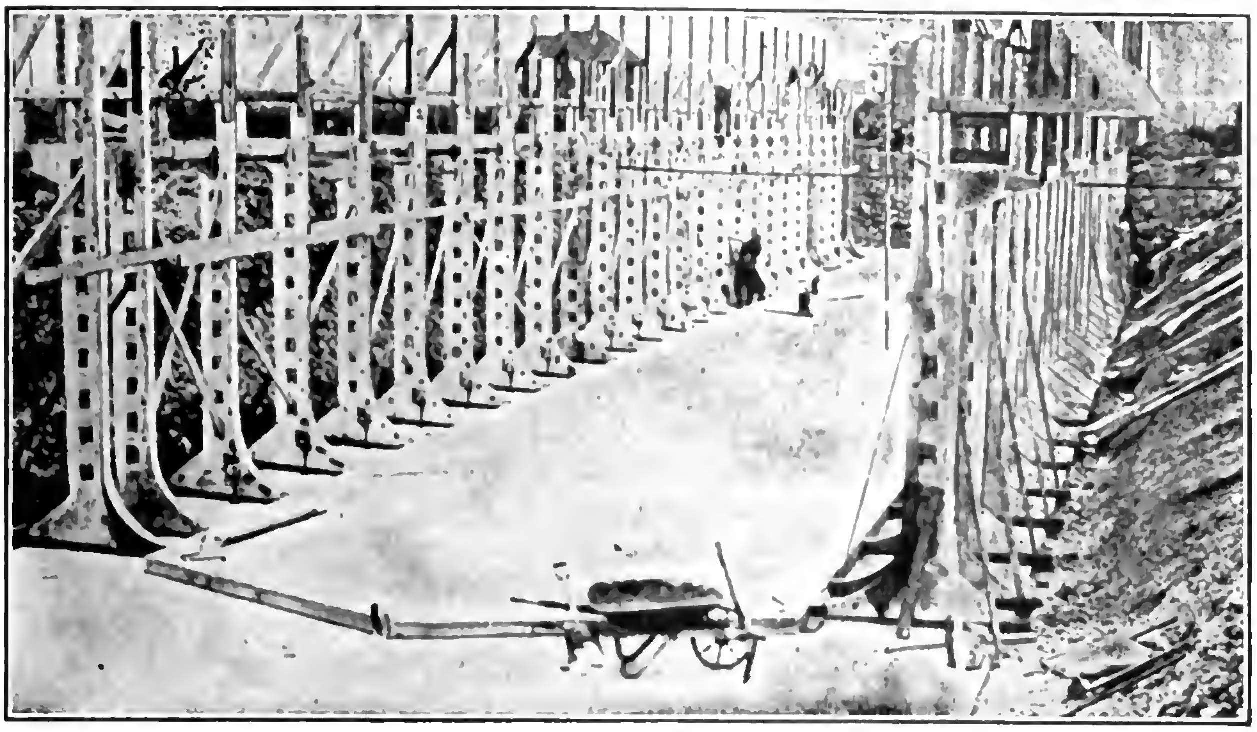


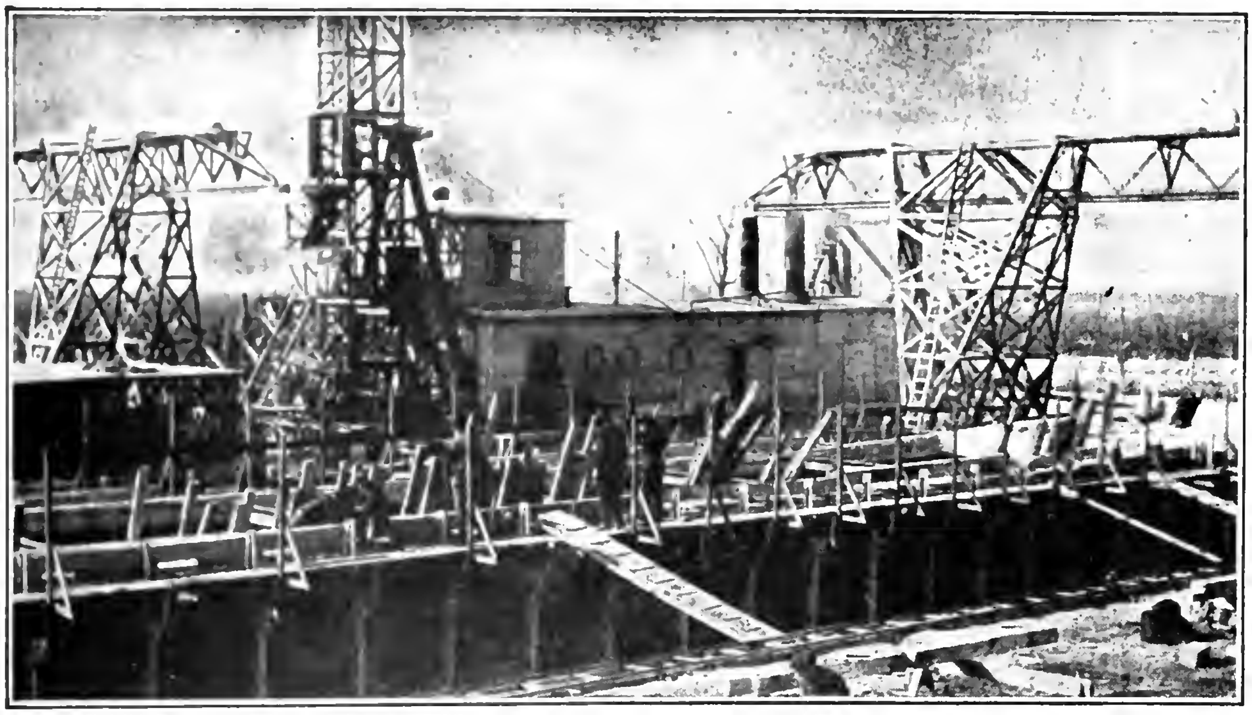
TWO-ENDED BUCKET DEPOSITS CONCRETE IN BOXES INSIDE BARGE

of timber cut to templets and a sheeting of wire mesh tacked to the proper curvature in each section. An interior and an exterior layer of mortar were then plastered onto the metal, forming a perfect mold for the curve. These forms were then blocked up on the con-

crete bottom of the dock and slid into proper place. When the section is cast they are dropped with wedges and slid out in three sections. The bow has a one-way curvature above the bilge curve, and this upper section was formed with the regular ⅞-in. tongue-and-groove material bent around wooden frames cut by templet to proper curve. Below the bilge curve, where there is double curvature, due to the turn of the stern and of the bilge, a mortar form similar to that employed at the stern was used.

The inside forms are thoroughly cross-braced, but are supported by small concrete pieces blocked up on the steel of the floor. The floor has no top form, of course, a proper thickness being screeded off level. The floor frames—that is, the keelsons and the cross-frames—are in boxes between the keelsons and the frames, and the connecting joints are nailed to the keelson box and screwed to the frame box, so that in dismantling wood screws can be readily taken out and the whole box slipped out. The forms for the side frames are heavy 1½-in. timbers held in place by cross-bracing attached to the bottom frame and to the hatch girders. The design of the barge calls for a wooden strip alongside of each frame, to be used as a nailing strip for the wooden sheathing of the barge. In the design of the forms for the Detroit yard the frame forms are in two pieces—the outer piece, 1½ x 5½ in. in section, being bolted clear through and left in place as the nailing strip for the sheathing. The inner piece, which is 1½ x 3½ in., forms a piece of the inside shell form and is removed when forms are dismantled.





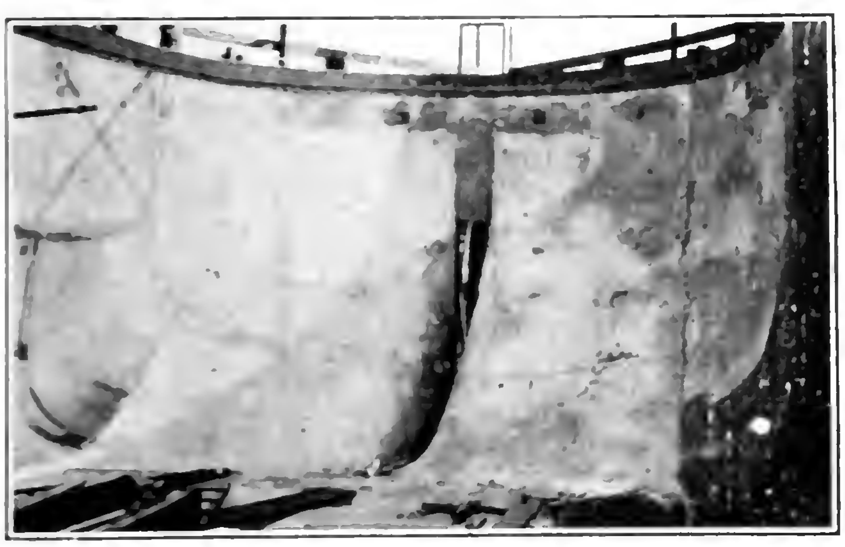
CONCRETE JACK FRAMES ARE FIRST SET UP ON CONCRETE FLOOR OF DOCK TO CARRY FORMS FOR CONCRETE BARGES — WOODEN GANTRY CRANES RUN OVER BARGES UNDER CONSTRUCTION AND DEPOSIT CONCRETE FROM ADJOINING FLOATING PLANT

Provision is made for concreting each of the barges from a dump bucket carried on a gantry crane traveling up and down over the barge. As shown on the drawings, on the top of each dike there is a 2-ft. industrial track. Traveling on this track, continuous along both docks on the same side of the central lagoon, is a timber gantry crane, one for each side of the lagoon. One of the views gives an idea of the appearance of this crane. It has an extending cantilever arm which reaches out over the water side of the dock. When the barge is to be poured the floating mixer plant, consisting of a power boat and a material scow, is brought immediately alongside of the dry dock and is fastened to the outside truck of the gantry crane by a heavy timber frame, so that any movement of the boat parallel to the dock communicates a similar movement to the gantry crane. In order to insure the parallel motion of the crane during any such movement, there is a continuous ⅝-in. cable running along the center of each track and around sheaves across the end of the dock. By the same mechanical motion which controls the well known drafting machine devices, the crane is thus kept moving parallel up and down the track over the barge whenever the material boats are moved up and down alongside of the dock, by hauling on lines to dead men at either end of the floating equipment.

In concreting, then, the operation is as follows: The

material scow, which is a wooden scow with bins let down into the deck, and has belt conveyors running under these bins to the end of the scow, is first filled with enough material to make the run and is lashed tight to the power boat. This, besides carrying the heavy engine equipment for all removing and mixing operations, has an apron with the concrete mixer extending out toward the material scow. Just inside the mixer is a concrete tower with an elevator bucket taking material from the mixer. The mixer and material scows are then fastened alongside of the dock with the gantry crane so that its traveling cross buckets can run on the extended arm directly under the spout of the elevated hopper. Material is fed to the mixer through the belt conveyor, and is mixed and carried up to be dumped into a double-mouth bucket which traverses the beam of the gantry and, controlled by the engineman on the power boat, is lowered into the barge.

Concreting is carried on from two ends of the boat simultaneously. After enough concrete has been dumped

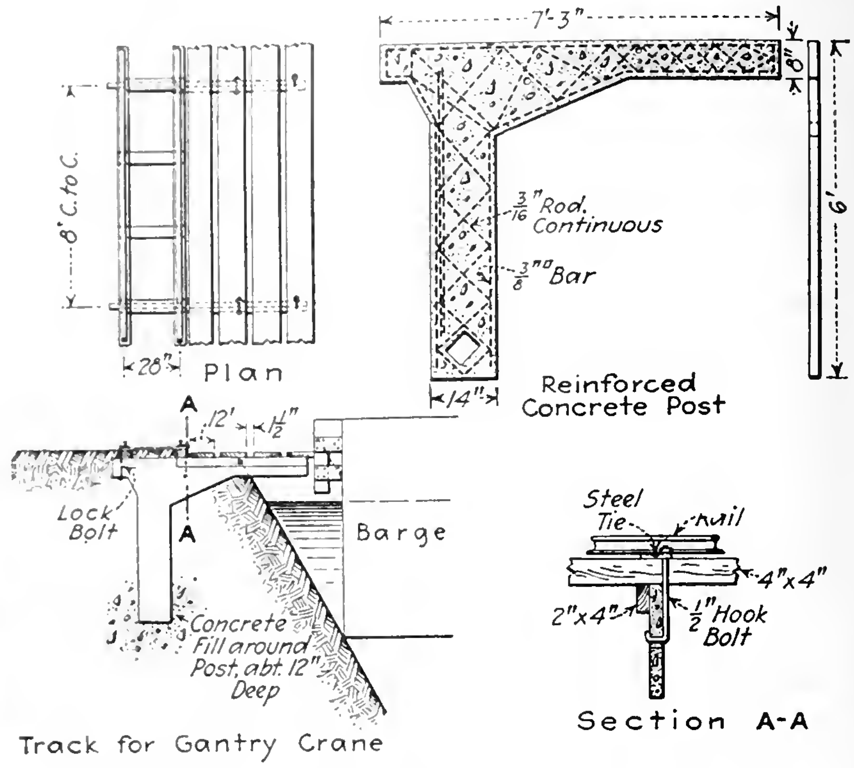


MORTAR MOLD FOR STERN FRAME IS IN THREE PIECES

BASE OF BOW FORM IS MORTAR MOLD

in the boxes at one end of the boat to keep the placers busy, the whole equipment—that is, the scow, the power boat and the gantry—is moved back to the other end of the boat, and the concrete is deposited there. Mixing the concrete and getting it to the boat are not the controlling operations in concreting a barge. The prime difficulty lies in getting the concrete into the narrow forms so that there is ample opportunity for the moving operations, without delaying the placing at either end of the boat.

An interesting detail in connection with the gantry crane is the small precast concrete frames which carry the track for the crane on the dike side. On the inside, it will be noticed, the tracks are on the original ground and do not require additional support, but over



GANTRY TRACKS ARE SUPPORTED ON PRECAST CONCRETE POSTS

the dike it was thought better to provide some extra base.

This has been taken care of by the use of inverted L concrete frames 14 in. wide in the shaft and 2 in. thick, with an extending arm carrying the wooden plank runway which extends out to the concreting barges. These frames are footed in concrete piled around the base and are spaced 8 ft. on centers. They carry longitudinal 4 x 4's on which the steel ties rest.

The final novel device is the lifting arrangement of the barge. It will be seen from the cross-section that the only buoyancy the completed barge will get when the water is let in is the lift under the bilge curve. This is not sufficient to float the boat. There is, therefore, provided along the center line a groove 2 x 12 in. in dimensions in which are set wood planks 9 ft. long, with slot spaces between. Under this groove is a continuous pipe with ¾-in. nipples rising up under the plank every 10 feet.

When the boat is to be launched water pressure is put on this pipe, which lifts the plank, and thereby raises the barge a sufficient height to allow the water to run under the barge and give flotation to the vessel.

The Grayhaven Shipbuilding Co., which built this novel yard and has the contract for the five New York State canal barges, has for its principal members Thomas E. Currie, a well known Detroit concrete contractor, and Edward Gray, engineer. Mr. Gray has recently been connected with the Ford Motor Co. in the capacity of construction engineer.

Other details of the concreting operations at the plant will appear in an early article which will compare the methods in use at four yards building the New York Canal barge.

Routing of Fabricated Ship Material at Bristol

Hull Construction Operated on Basis of Shop-to-Storage-to-Ship System Requires Accurate Timing of Material Supply, Shop Work, and Assembly—Routing Handled by Production Department

MAINTAINING coördination of material supply and shipbuilding, which has proved to be one of the key problems in high-speed shipyard work, is effected at the Bristol, Penn., yard of the Merchant Shipbuilding Corporation by a storage and routing system worked out to suit the plant operation. It is administered by a production department, separate from the technical and operating branches of the yard organization. The machinery of the system is simple, but it works effectively.

With material fabricated in distant shops, it has been found impossible to assure precise sequence of delivery at the yard. Incoming fabricated ship parts cannot be sent directly to the shipways, and therefore coördination of supply and consumption must be obtained by storage intermediate between shop and ship. The advantages of working through storage are so marked, moreover, that this system is applied at Bristol to the entire operation of the yard, including the punch shop and the steam engineering and equipment departments. In other words, the shop-to-ship system favored in the conventional yard practice of former days is eliminated throughout, just as it has been eliminated in all shipyards during the past two years so far as miscellaneous ship equipment is concerned.

Large storage yards for hull material, and storehouses for machinery and equipment, have been provided at Bristol to act as equalizing reservoirs. These, with a system of ordering, routing and handling between shop storage and ways, control the flow of material. The system as used for hull material is described herein, but substantially the same procedure is applied to the other parts of the yard work, as the handling of machinery, rigging and equipment.

Special pre-assembly facilities and space for finished storage have been found necessary to the best working of the Bristol yard. They aid in placing all operations preceding the hull erection upon a manufacturing basis in which the several units can work without mutual interference and delay.

Functional Conditions—Half a dozen different classes of material involved in the shipbuilding work had to be provided for in the operating system.

1. Fabricated material arrives from distant bridge shops, ten or more in number. These shops punch, scarf, countersink—and, to a certain limited extent, assemble and rivet—about 83% of the tonnage of the hull. Much of this material is ready for erection, but some must undergo further working in the yard shop. None of the material can go direct to the shipways, as it does not arrive at the exact moment when it is required and as the incoming cars contain material for several different ships. Therefore it must be delivered to storage—for unloading, sorting and marking with the proper erection marks—and piled where it will be instantly available.

2. Bridge-shop material requiring further work in the yard shop includes such parts as shell plates for the molded body, which must be rolled, and floor frames for placing forward and aft of the middle body, which require the shaping and riveting on of bent bottom angles. This material, drawn from main storage as the shop routine requires, must return to storage after final fabrication, as the work in the shop does not coordinate with that on the building berths.

3. A large amount of raw steel is required for the yard fabricating shop. This is stored close to the shop, and kept apart from storage for fabricated material.

4. Most of the yard shop production is made from templets, and is fabricated on stock so that erection need never be held up by shop delays. When fabricated, the material is in the same relation to the yard as incoming bridge-shop material, and, like the latter, goes to the main storage.

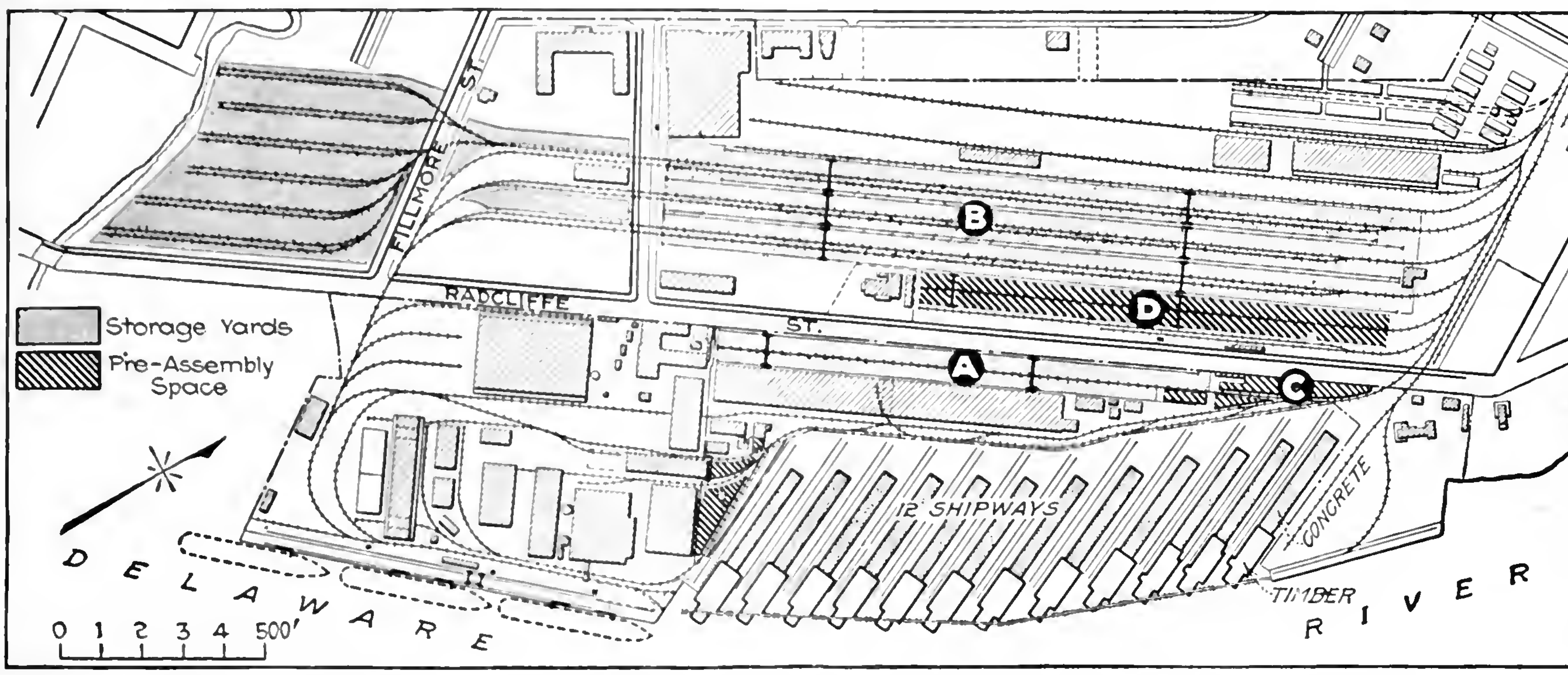
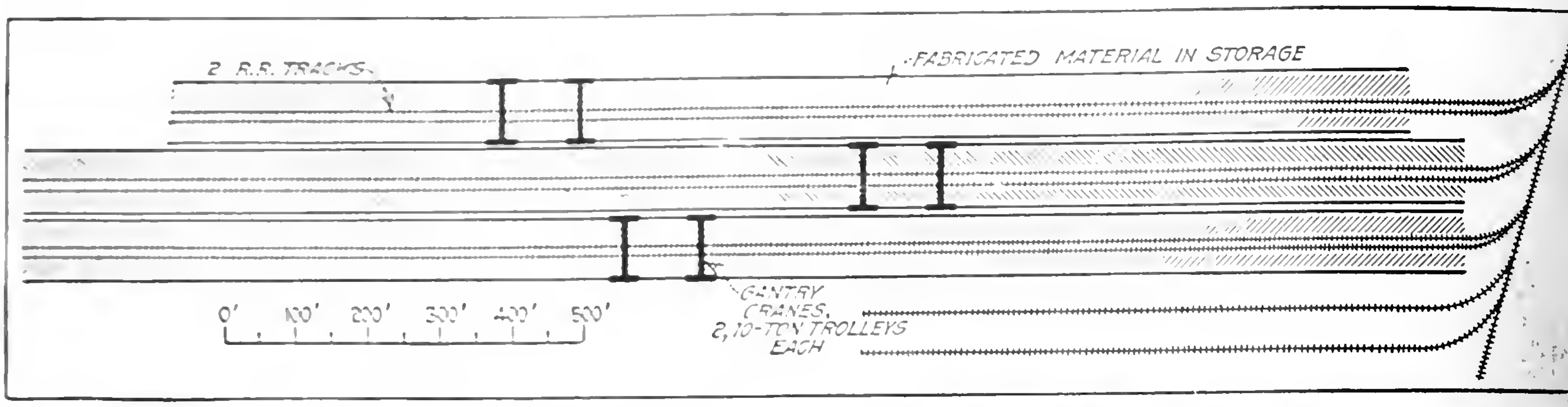
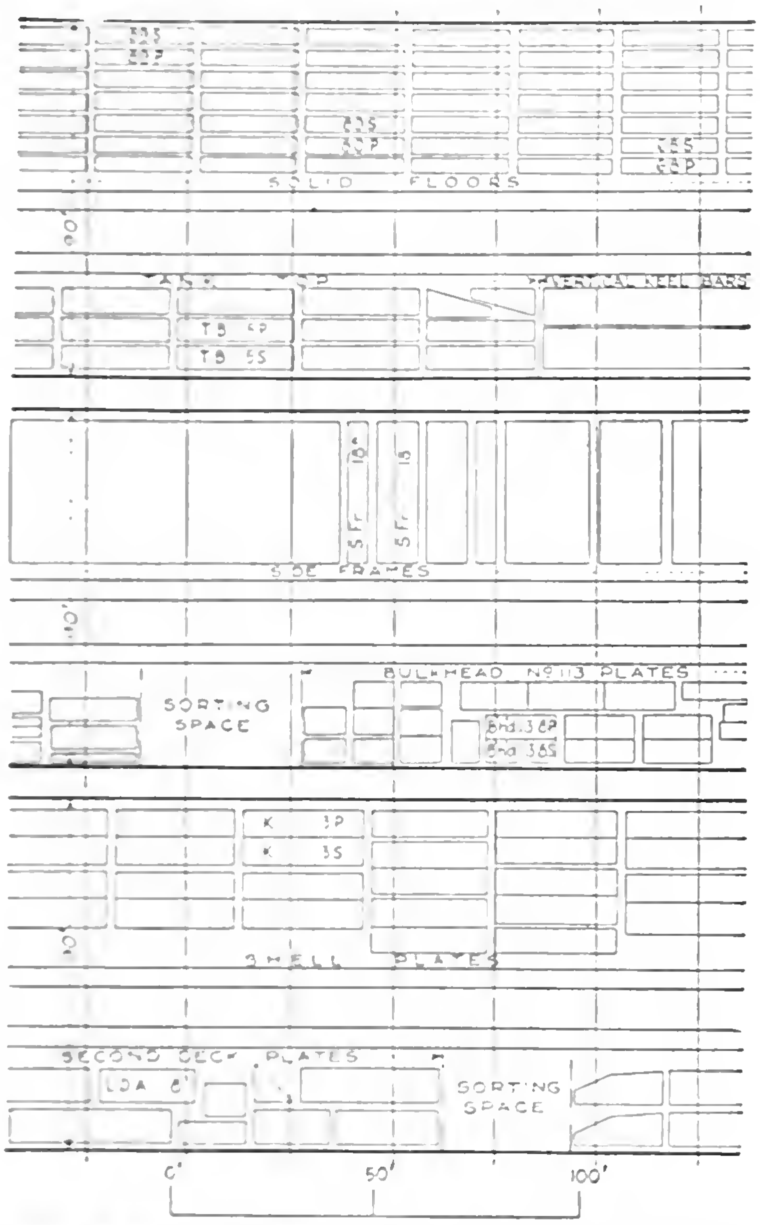


FIG. 1. LOCATION OF STORAGE AND ASSEMBLY FOR HULL MATERIAL AT MERCHANT YARD





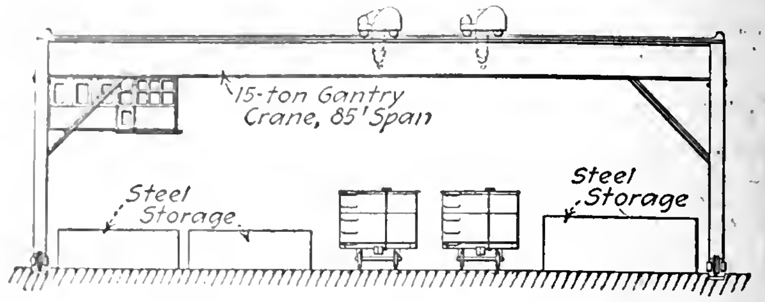


FIG. 2. CROSS-SECTION AND PART PLAN OF STORAGE FOR FABRICATED STEEL

5. A certain number of parts must be "lifted" from the ship. These, of course, require to be put through the shop without delay when the berth requires them. Storage is not involved.

6. Pre-assembly of fabricated material has undergone very great development at Bristol during the past year. It now includes possibly 25% of the total weight of the hull. Assembly of parts such as web frames, floors, stringers, girders, etc., has been carried on from the beginning, but in the expansion of the work deck houses and bulkheads were assembled complete, and assembly has been applied to the entire keel, the fantail, and some special groups such as the bow section of the keel with its frame. The material to be assembled must be drawn from storage, in order to keep the assembly work independent of the shop routine. The smaller assembled parts return to storage, while the larger units are held in the assembly space until needed by the ship.

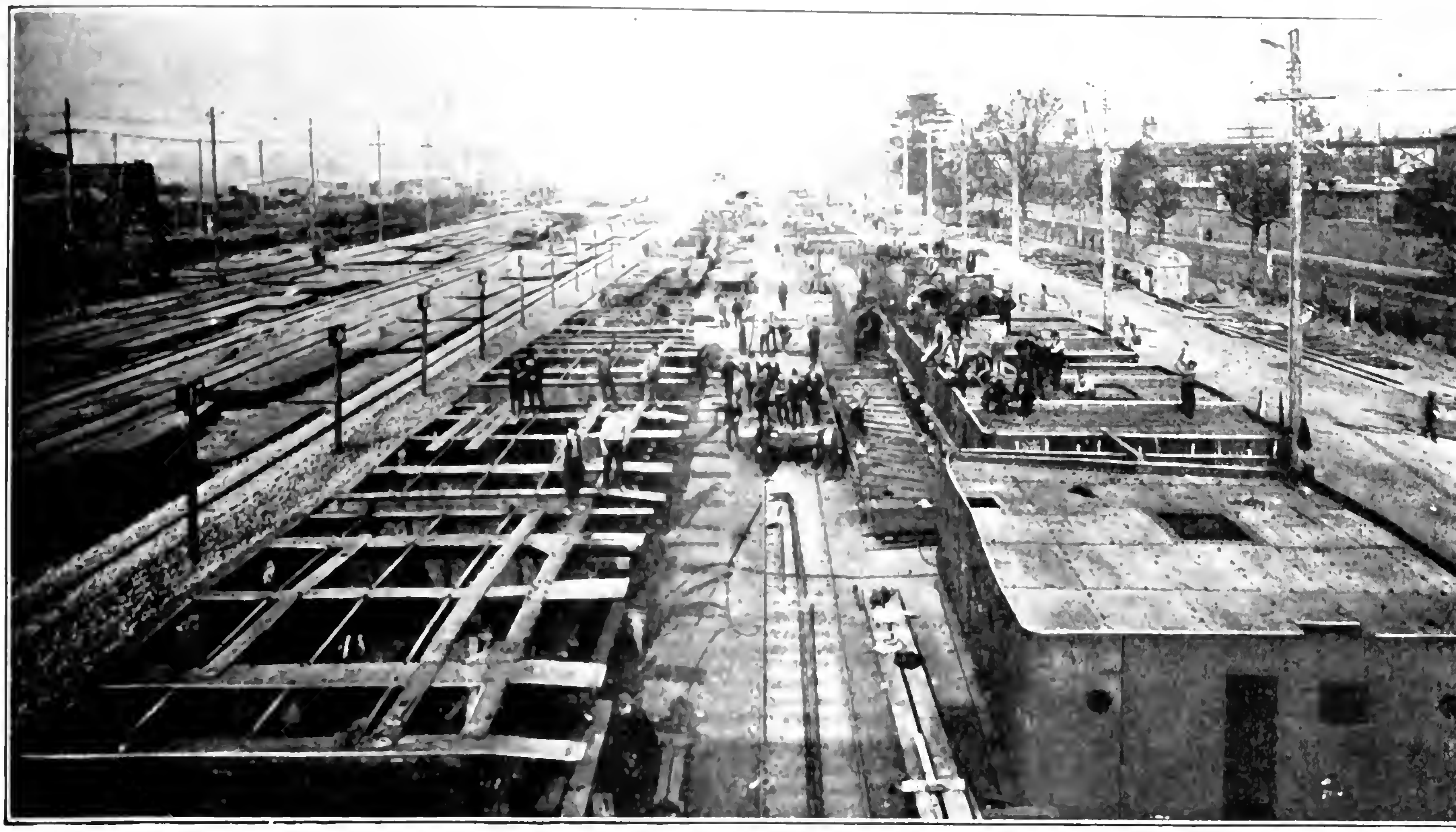
Storage and Assembly Yards—The main elements of the storage system are a raw-material yard directly adjacent to the plate and angle shop, and a large main storage yard for fabricated material. The latter has recently been extended southward, and a section for storage of pre-assembled parts thereby provided. The two main yards are located as indicated by the letters A and B in the sketch plan, Fig. 1. In each, material is handled by traveling gantry cranes, and the yards are therefore arranged as narrow, long bays corresponding to the craneways, 95 ft. wide. The raw-material storage consists of a single bay, while the fabricated-material storage has three bays side by side. Two railway tracks extend down the middle of each bay.

Flat piling is used in the main storage yard. The arrangement of this yard is indicated by the section and part plan, Fig. 2. A separate piling space is allotted to each special piece in the ship; these spaces measure about 20 ft. along the bay and 30 ft. transversely. The storage for assembled material, at the south end, is arranged like that in the northerly part of the yard.

Timber sills laid on the ground are the foundation for the piles of steel. In the plate portion of the yard a few racks have been set up, but in general the rack system was distinctly discarded when the yard was planned. The raw-steel yard is arranged in the same way.

A governing feature in the arrangement of the piling sections in the main yard was the erection schedule of the ship, which fixes the sequence in which the pieces are erected. The piling sections, beginning at one end of the yard, were arranged approximately in accordance with this erection schedule, so that picking up pieces and sending them to the shipway could be done as nearly as possible by a slow, progressive movement of the crane along the length of the yard during the shipbuilding period. The six cranes of the three storage-yard bays correspond to the 12 shipways, with two ways at the same stage of erection.

An important element in the working system is a space for working storage at the head of each shipway. This space is about 50 ft. square, and racks and sills have been placed in it. Originally, the intention was to do some pre-assembly work in this space; parts delivered from storage to the ship were to be stowed under the crane trestles between the shipways. But stowage



MAIN PRE-ASSEMBLY YARD AT BRISTOL IS COVERED BY GANTRY AND SERVED BY TWO RAILWAY TRACKS

under the trestles has been found less convenient than using the head of the way for the purpose.

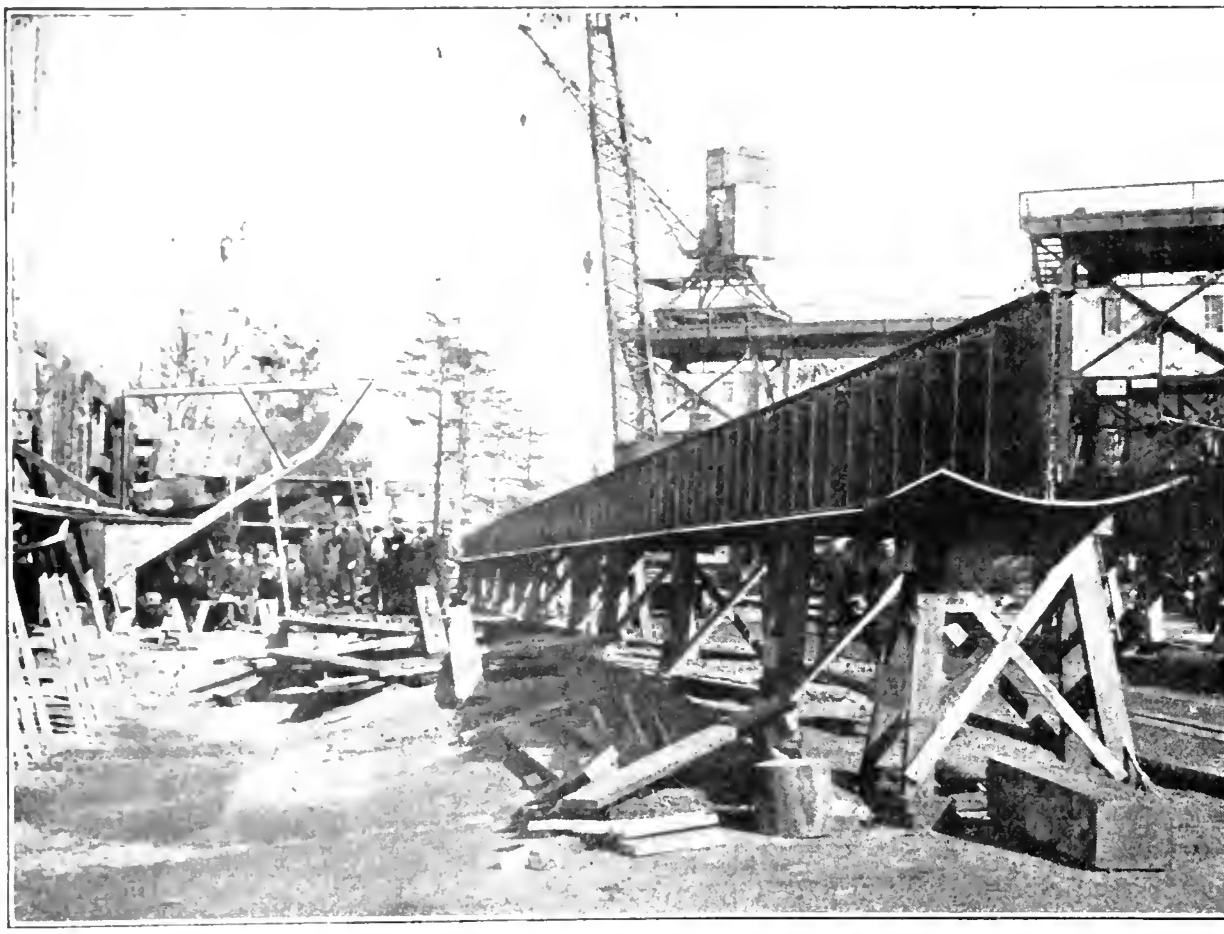
Assembly work was at first provided for by turning over to it a triangular space north of the raw-steel storage, marked C in the sketch plan, Fig. 1. Subsequently it was found necessary to turn over to this work a large area forming the continuation of one of the bays in the main storage yard, as marked by the letter D in the plan. A view of this space is shown by Fig. 4. Crane service is provided by a gantry like those of the storage yard. Compressed-air outlets are arranged along the sides of the supply tracks along the middle of the bay. Assembly of small parts is facilitated by the provision of two Hanna compression riveters under a shelter roof near mid-length of the yard. Other assembly riveting is performed by air hammers.

Deck-houses and bulkheads are assembled entire. The most distinctive novelty of pre-assembly at Bristol is the riveting up of keelson and flat keel plates in continuous lengths of 70 to 100 ft., these lengths further being fitted together and the splices reamed before the sections are taken to the shipway. This is done in the assembly space marked C.

Here also the bow section of the ship is assembled with eleven pairs of frames to form one erection piece.

Erection Schedule Governs—Planning the sequence and timing of all parts of the work, on the shipways and in the shop, was governed by an erection schedule to which the berth work is required to conform. The schedule was made out early during the past year, in conference between the different departments concerned. Thereafter all orders for the bridge shops were timed correspondingly, the storage yard was laid out in the erection sequence, and all work in the shops and on the berths was made subject to the same schedule. A small part of the schedule diagram is reproduced in Fig. 5.

As this diagram indicates, the units of the schedule



FULL-LENGTH KEELSON AND FLAT KEEL ASSEMBLED ON HORSES

are not individual pieces, but "erection groups." These are lots of material equivalent to approximately a carload each, required at substantially the same time. These erection groups are the items by which the shipway places orders for steel with the storage yard.

Adjoining each shipway is a production clerk's office. Here is kept on file a complete set of Material Order sheets (Fig. 2), covering the successive erection groups

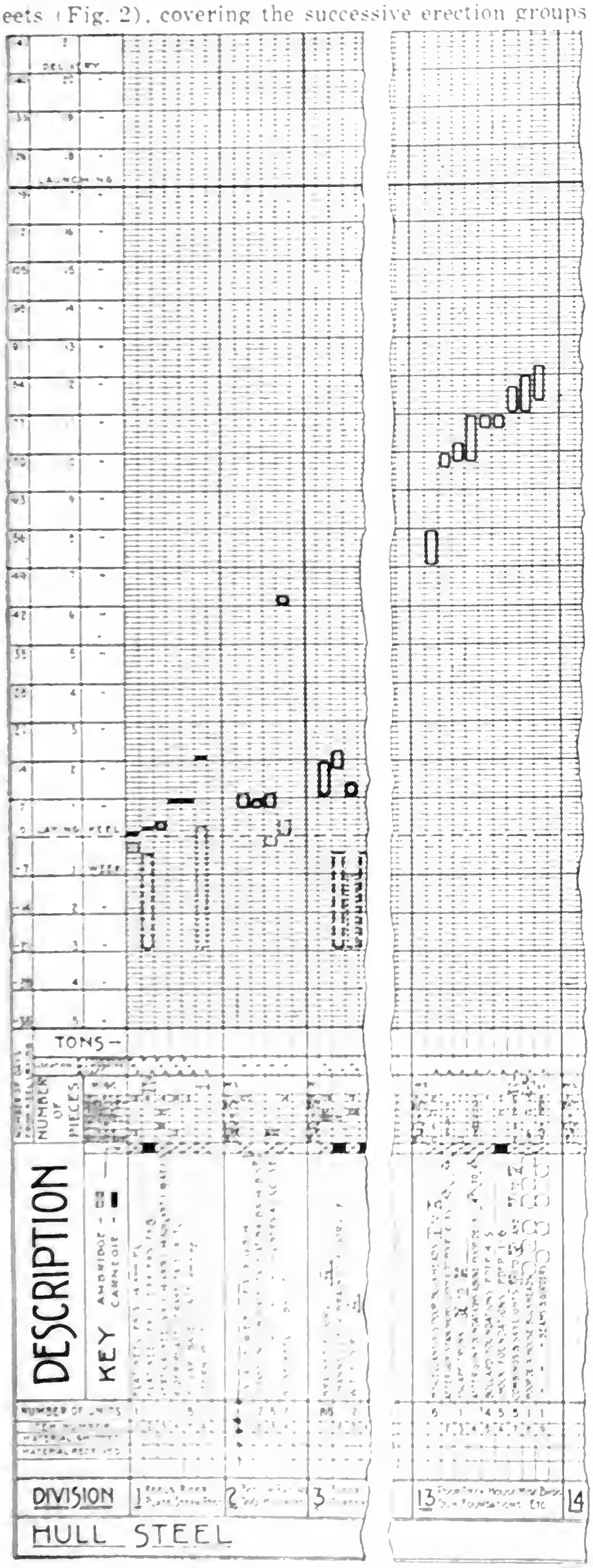


FIG. 5. PORTIONS OF STANDARD SHIP ERECTION SCHEDULE USED AT BRISTOL

MERCHANT SHIPBUILDING CORPORATION
AGENT FOR
UNITED STATES SHIPPING BOARD EMERGENCY FLEET CORPORATION

MATERIAL ORDER

HULL No. ______ ERECTION ______ DATE ______
SHIPWAY No. ______ GROUP No. ______ SERIAL No. ______

Line	Quantity	Name of Part	Piece Mark	Location on Ship	R. Sheet	Unit Weight	Yard Location	Manifest No.	Date Filled
1									
2									
3									
23									
24									

SIGNED ______ Shipping Clerk. SIGNED ______ Order Clerk.

MERCHANT SHIPBUILDING CORPORATION
AGENT FOR
UNITED STATES SHIPPING BOARD EMERGENCY FLEET CORPORATION

SHIPPING MANIFEST

Dept. ______ Date ______
Car No. ______ Serial No. ______
Ship to Shipway No. ______ For Hull No. ______

Line	Quantity	NAME OF PART	Piece Mark	Unit Weight	Material Order No.	REMARKS
1						
2						
3						
23						
24						

Signed ______ Prod. Mat. Checker Signed ______ Stores Dept.

FIG. 6. SHIPWAYS SUPPLIED WITH MATERIAL ON WAY ORDER (UPPER FORM); STORAGE YARD SENDS MANIFEST (LOWER FORM) WITH EACH CAR OF MATERIAL SENT TO THE WAYS

composing the ship; these forms are filled out in advance in the main office of the production department, and, arranged in proper sequence, are turned over to the way clerk. They serve automatically as orders to the storage department, when dated, signed and issued by the clerk. Interleaved with these material-order sheets in the way clerk's file are placed Advance Notifications with respect to certain other work required in the construction of the hull, to provide for having such work

Form 344-B-1 10-18-5m.

MERCHANT SHIPBUILDING CORPORATION
AGENT FOR
UNITED STATES SHIPPING BOARD EMERGENCY FLEET CORPORATION

SERIAL NO.

STEEL REQUISITION

Hull No ______ Charge No. ______ Date ______

QUAN	PIECE MARK	DESCRIPTION	A F R	TOTAL WEIGHT	UNIT PRICE	AMOUNT

CODE KEY.—
A—Assembled Material
F—Fabricated by American Bridge
R—Raw or all material from Yard Shop.

ABOVE MATERIAL
is listed on Master Bill of Material on
Page ______ Line ______

Signed—
______ Prod. Order Clerk

FIG. 7. STEEL REQUISITION CARD MADE OUT FROM MANIFEST FURNISHES BASIS FOR COMPLETE ERECTION RECORD

prepared for and carried out in proper timing for the needs of the ship erection. This applies, for example, to lifted shop material and to assembly work.

By use of the file of material orders the way clerk keeps a supply of material in the way storage, without special attention. He places his orders in accordance with general instructions to keep about three carloads on storage at the head of the ways. As there are 71

MASTER BILL OF MATERIAL FOR STEEL

DESCRIPTION ______ PAGE ______

Line No.	[illegible]	PORT	STBD	PIECE MARK	NAME	LOCATION	Section	DIMENSIONS	FAB or RAW	Lin. or Tons	Weight in Lbs.	MATERIAL FOLLOW UP: Date Allot	Ordered In: Date	Ordered In: Order	Delivered to Way: Date	Delivered to Way: Location	Delivered to Way: Req'n	ERECT	RIVET	Schedule Date to Ways	Am. Br. Dir.	Dwg. No.	Group	REMARKS
1																								
2																								
3																								

FIG. 8. FINAL BILL OF MATERIAL FOR COST DEPARTMENT MADE OUT FROM STEEL REQUISITION CARDS, TRANSFERRED AFTER ERECTION OF CORRESPONDING PIECES

rection groups in the entire hull, the average amount f material per group is about 40 tons, representing ather more than a day's consumption.

When the clerk issues an order to the storage deartment, the latter fills the order as detailed on the

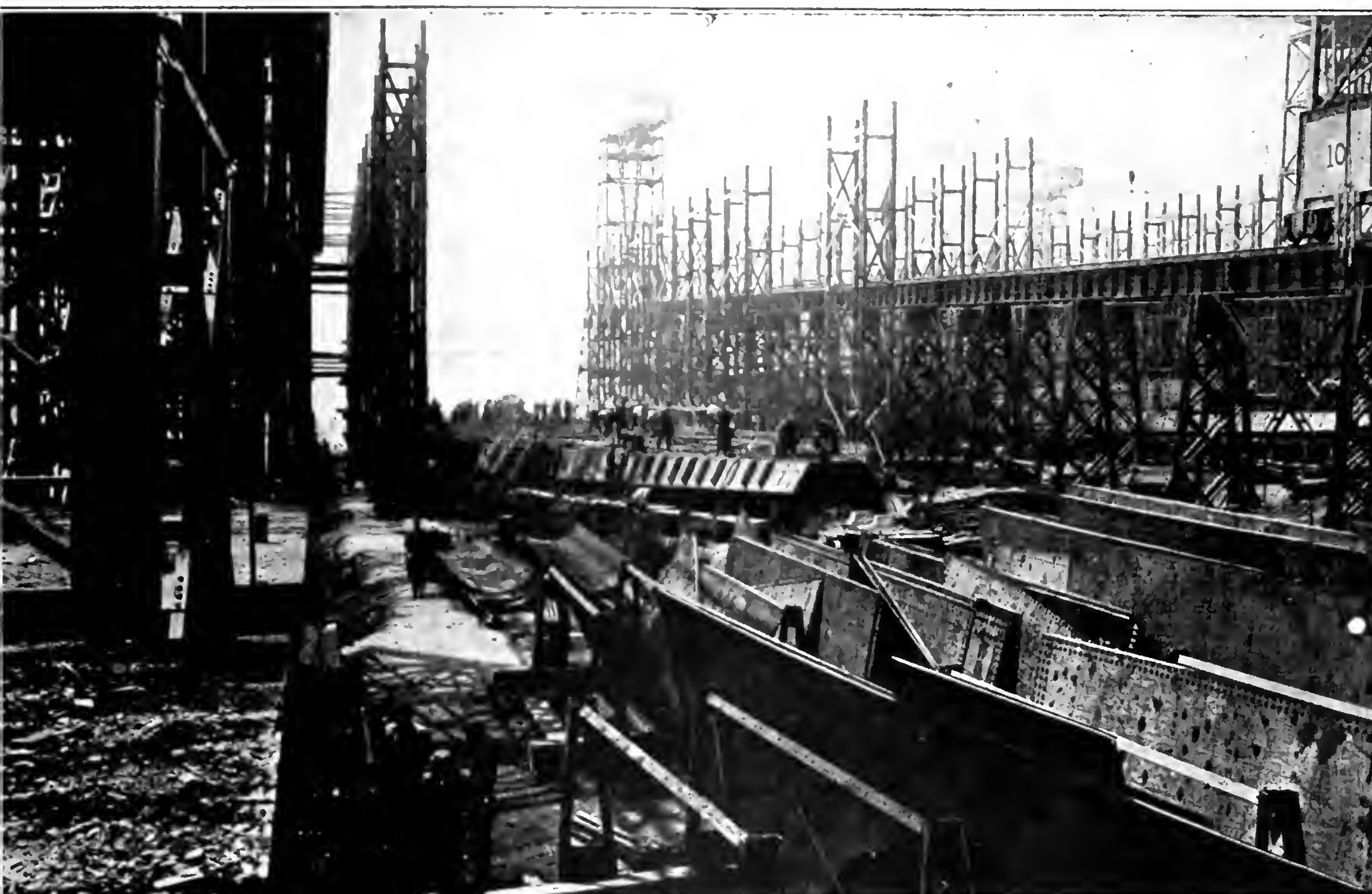


FIG. 9. SHIP ERECTION WORKED FROM WAY-HEAD STORAGE GIVING TWO OR THREE DAYS' SUPPLY

heet (no partial shipments are allowed), and at the ame time makes out a Manifest (see the form, Fig. 6). The material is delivered into custody of the boat foreman, who thereafter erects it as the requirements of his vorking force dictate. The manifest goes to the way lerk and is made the basis for the subsequent erection ecords.

Each piece entered on the manifest is transferred by he clerk to a Steel Requisition card, represented by Fig. . Horizontal numbering along the upper edge of this ard, 1 to 31, guides the attachment of a tickler tab ndicating the approximate date on which the piece hould be erected. These steel requisition cards, placed n a file case, form the clerk's check on the erection operation, and are the basis for the final cost sheet. A card s taken out of this file when the foreman's daily erection report shows that the corresponding piece has been erected in the ship; it is dated with the date of erection, and the piece mark and weight are entered on a Master Bill of Material, Fig. 8, which, when complete, goes to the cost department.

A check on the foreman's erection reports is had by noting when any steel requisition card remains in the file for some time after the estimated date of erection. The clerk can then take this card, locate the piece on the ship or in the way storage racks, and make corrections accordingly in his bill of material.

Advance notification, interleaved with the way orders as already described, are so placed as to allow about 10 days before date of erection for lifted material, and 18 days for assembly sections. The clerk sends these orders forward to the shop and assembly departments, each of which has an independent organization. The assembly department is organized in effect as a hull, with a foreman in charge. More elaborate organization is represented in the shop.

A clerk of the production department is located in the

shop, for handling the orders by which all work is initiated and routed. The shippers of the shop also are under control of the production department, and govern their reports and correspondence accordingly. Incoming orders arrive either from the way clerks (for lifted material) or from the dispatching office of the production department (for templeted material). In either event, the routing of the material through the shop is set forth on a standard form for the piece in question, on which are noted the successive operations required for its fabrication.

The ship erection schedule (Fig. 5) serves not only for control of the yard operations, but also for scheduling the bridge-shop orders. Basing the calculation on the time when a given piece will be required on the shipway, according to the erection schedule, successive allowances are made for storage (three days minimum), transportation from the bridge shop, time of fabrication in the bridge shop, transportation from mill, and time in mill.

These calculations are all recorded graphically on a series of charts, and the mill and bridge-shop orders are made out to correspond. Prints of these charts are allotted to each hull, and the actual mill and shop shipment and receipt times are marked in red on these charts, thus giving a graphical comparison with the scheduled or order time. One of the interesting results of an examination of these charts at Bristol is their showing the lag of mill and shop fabrication behind schedule time in spring and early summer of the current year, and the rapid improvement of these conditions, up to a marked lead over the schedule at present.

System Similar for Other Departments

All other departments of the yard—machinery, rigging, fitting-out, and the like—are controlled by systems which are similar to that described for the hull construction, and modified to suit the needs of the particular service. This is true not only of the installation of these parts in the ship, but also of the shop and store elements.

Orders for certain parts of the work of the equipment departments are interleaved with the hull construction orders, in the way clerk's order file. Thus, most of the ship tank piping is installed during the erection of the hull, and a certain amount of other equipment is put in. In addition, a distinctive practice of the Bristol yard is to install boilers and turbines in the hull before launching. This practice was followed for the first four ships built and will be continued, except in case of delay in the delivery of machinery. The parts in question can all be handled by the ship erection cranes, which, with an individual capacity of 15 tons, can handle 30-ton loads when two cranes are worked together. The added weight of the machinery is considered an advantage in launching, besides which a great amount of time is saved at the fitting-out dock.

A. H. Cooke, production manager, is in charge of the scheduling and routing work briefly sketched in the preceding. The principal officials of the company in active charge of shipbuilding operations are R. H. M. Robinson, president; W. T. Smith, vice-president; G. C. Thayer, general manager, and D. D. Smith, assistant general manager. H. E. Frick is authorized representative at the plant for the Emergency Fleet Corporation, representing Admiral Francis T. Bowles, assistant general manager of the Emergency Fleet Corporation, who is in charge of the fabricating yards and has general supervision also of the Delaware River district.

Conveyor Handles Freight at River Port

A FREIGHT-HANDLING conveyor for transferring freight between boats and cars at the Mississippi River port of Alton, Ill., is shown in the accompanying view. The carriage or frame travels on a track at right angles to the freight tracks, and carries a 45-ft. conveyor boom, which can be adjusted to the level of the deck or cargo hatch of the barge or steamer. At the head of this conveyor is a 20-ft. horizontal conveyor extending to the freight cars, and the farther end of this can be raised so as to load the car to its full capacity. A third 15-ft. section, not shown in the view, forms an extension for reaching cars on another track. When the carriage is run to the outer end of its track the boom can reach a barge or steamer outside the one moored to the dock.

Two classes of freight are handled by the conveyor, half of its width forming a continuous flat traveling apron or platform for boxes and other packages, while the other half has crossbars bent in concave form to receive barrels. The conveyors travel at a speed of 80 ft. per minute, and are all operated from a 15-hp. motor on the carriage. This conveyor was built by the Brown Portable Conveying Machine Co., Chicago. It is installed at the new waterfront dock and terminal, of the Illinois Terminal R.R., which was described in *Engineering News-Record* of March 7, 1918, p. 448.

FREIGHT CONVEYOR FOR TRANSFER BETWEEN BOATS AND CARS ON MISSISSIPPI RIVER AT ALTON, ILL.

Are American Engineers and Contractors Wanted in France?

Reports from French and Belgian Sources Show That Preference Will Be Given to Native Organizations and Men

AMERICAN engineers and contractors are asking to what extent they will be called upon to help reconstruct France and Belgium. Inquiries made by *Engineering News-Record* at all the official sources in the United States indicate that, although a large amount of American and foreign construction machinery will undoubtedly be used, participation on the ground by American engineers and contractors will probably not be encouraged by the two countries. The purchase of raw materials and semi-finished products, will, it appears, be confined as far as possible to home markets. Large-scale production of certain construction materials has already begun in Belgium.

Engineers on the staff of the French High Commission are unable to say what the reconstruction policy of France will be, because the recently organized Ministry of Reconstruction has not had time to forward plans. The impression prevails in both the New York and Washington offices of the commission that the ministry is awaiting some indication of the trend of the peace conference. The Washington office states that, although American engineers would be welcome in France as citizens of a country with which the warmest ties of friendship existed, French engineers, on account of their long service and great sacrifices in the war, will naturally receive preference. It is believed, however, that the supply of engineers will be ample, because of the comparatively short time during which it was necessary to use engineer regiments in front of the fighting lines.

Same Conditions in Belgium

The same conditions exist in Belgium. The Belgian information bureau in Washington states that the services of those engineers only who possess extraordinary ability or highly specialized talent will be needed, but both the French and Belgian officials say that there will probably be a call for engineers familiar with such American construction machinery as may be bought. But American engineers as well as machinery are desired by Belgium in the development of her African possessions.

The United States Bureau of Foreign and Domestic Commerce says that the question is largely one of credit. Purchases will be made in those countries holding the largest credits, and since it is probable that the United States will be the leading country in this respect it will also be the leading country supplying machinery and materials. As mentioned above, however, the local supply of raw materials in France and Belgium will probably be ample. Figures quoted by a German investigator in the Berliner *Tageblatt* recently, in discussing the Lorraine iron supply, give an index of the amount of iron available to France due to the recovery of that territory. The German writer stated that in 1913 the Lorraine and Luxemburg mines (the two industries being closely related) supplied 28,500,000 tons out of a total of 35,000,000 tons of iron ore used in the whole of Germany. He pointed out, however, that in the utilization of this large amount of raw material the French are handicapped by lack of furnaces and mills, they having been more concerned in selling the raw ores to foreign countries than in reducing it to the finished or semi-finished state themselves. He also stated that lack of available coke in France, (Germany having obtained it from her own sources) was another obstacle. These conditions, it is pointed out in Washington, will require a large amount of machinery and plant of a highly engineering character.

In commenting on the problem Richard L. Humphreys, chairman of the Construction Material Section of the War Industries Board, pointed out that before any extensive purchases could be made or work done a revision of credits would be necessary. The present war credits will cease to exist when peace is finally established. Measures will also be necessary to revive the purchasing power of the various European monetary units, Mr. Humphreys said.

Congo and Home Country

A student of Belgian home and colonial affairs, who resides in Washington, states that the finances of Belgium were in an anomalous condition in that although the home country is in financial difficulties, the colonies on the Congo have immense reserves of money and wealth. The Congo Free State was originally the personal property of the late King Leopold of Belgium, who, he explained, bequeathed it to the state at his death. The country, however, accepted the bequest in such a way that the revenue could not be used directly by the state, and although there are ample funds in the colonies they are not available for use in reconstruction work. The accumulation of this revenue, he stated, is very large, and the Government is working on a solution of the problem, through parliamentary or other action. It will therefore be some time before the work can be commenced on a nation-wide scale.

Other factors that will delay the final rehabilitation of the industrial life of Belgium are indicated in a recent United States commerce report. Industrial rehabilitation is vital, it states, yet the repair of the damaged ports, railways, highways and canals will be necessary before industrial reconstruction can be started. The railway equipment and rolling stock saved from the German invasion have been worn out from continuous military use on the French railways, and the network of canals will be out of use until it is repaired and the barges are replaced. The Belgian ports capable of accommodating seagoing vessels are not yet available for commerce, and the shipping itself has either been destroyed or diverted to other routes. Port equipment has been badly damaged or completely destroyed by the Germans, and the bridges and roads connecting the ports with the interior have been wrecked—so that even if sufficent shipping facilities were to be had the means for discharging and distributing cargoes is not available. The problem of the reconstruction of Belgium, the report points out, does not mean solely the furnishing of goods which she will need, but the complete rehabilitation of trade, industry and agriculture, as well as the actual rebuilding of devastated cities, towns and villages and rural regions.

It is also reported that extensive preparations for the further development of the Belgian Congo have been in progress for some time. A hydro-electric plant has already been erected, and the electrolytic reduction of copper commenced. The dumps of the copper workings that have been in existence for thousands of years are being worked over, and in the first four months of the plant's operation 40,000 tons of copper were shipped to England. It was found that the copper content in these dumps averages from 40 to 50 per cent.

Edmund Laplae, professor in the University of Louvain, and director general of the colonial ministry of Belgium, has been in the United States studying American methods and machinery. He has returned to Belgium to make his report, but will come back soon to engage American engineers and to purchase American machinery to be used in the development of the Congo colonies. It is also stated that he will not make any effort to interest capital. The development of the Congo had already been started before the end of the war, and as much equipment as could be gotten through the various embargoes has been sent over. A steamboat, similar to those used on the rivers of the Western United States, was needed for the upper Congo. M. Laplae found one in Pittsburgh ready to be shipped on a South American order, but held up on account of lack of cargo space. He bought it from the original consignees and managed to have it shipped to the Atlantic coast, where he obtained cargo space for it by an agreement with the Federal Government to ship a cargo of rubber in return. The steamboat is now in operation on the Congo.

Representatives of the Department of Commerce who have been studying the problem state that the people of France and Belgium hope and expect that preparations for the forwarding of needed supplies will begin promptly, especially since the invaded portions of the two countries have been reoccupied and it is possible to get definite particulars as to their requirements. The Belgian consul at New York states that information regarding his country may be had from the *Comptoir National pour la Réconstruction de la Belgique*, 15 Rue Louis le Grand, Paris, France, and that it has requested duplicate catalogues. Information regarding France may be had from the French High Commission, Washington, D. C., and catalogues should be sent in duplicate, in care of Lieut. Maurice Boyer, of the commission.

Four Methods of Sewage Treatment Studied at New Haven Testing Station

Miles Acid Process Advised for First of Four Permanent Works Rather Than Fine Screens, Imhoff Tanks (Each with Chlorination) or Activated Sludge—Results of Analysis, and Cost Estimates

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AND

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Eleven months' experiments at the sewage-experiment station established by the City of New Haven, Conn., have led to the conclusion that for the particular and somewhat unusual local conditions there prevailing the Miles acid process of sewage precipitation, with recovery of grease and fertilizer, is the best available method for one of the four plants necessary, and may prove advisable for the other three. The reason for the tests, the results obtained and the conclusions drawn are here presented, except that the Miles acid process is not taken up in detail because it was treated separately and at length in *Engineering News-Record* of Dec. 5, 1918, p. 1034.

New Haven has a population of approximately 160,000, and is sewered on the combined plan. The water consumption is very high, and the total sewage flow is estimated at about 35,000,000 gal. per day. Thirty million gallons are discharged from the main sewers of the city at five different points about the harbor. The present outfalls are all above low-water mark; the upper harbor is shallow (averaging less than 5 ft. in depth outside of the main channels), and the sewage as it spreads over the flats and deposits sludge upon them produces in many places a condition of gross nuisance. The pollution of bathing beaches and shellfish layings constitutes a very real danger to public health. The United States Bureau of Chemistry in 1915 forbade the shipment in interstate commerce of oysters taken from large areas in the harbor "unless such oysters were purified by transplanting them in nonpolluted water for at least seven days before shipment." In the following year the United States Public Health Service made an exhaustive study of harbor conditions. This resulted in the conclusions that the harbor was grossly polluted, that shellfish taken therefrom are filthy, dangerous and unfit to be eaten as taken from the area, and that bathing and swimming in the upper harbor are unsafe.

As a result of these conditions, an aldermanic and citizens' committee was organized in the spring of 1916 to study the problem. The committee consisted of Prof. C.- E. A. Winslow as chairman, Prof. S. E. Barney, A. B. Hill, H. B. Sargent and Aldermen J. W. Murphy and F. S. Nelson. It was assumed on the testimony of those most familiar with the local situation that it would not be economically advisable to attempt to intercept the sewage from the various outfalls and treat it at a single point, but that at least four different treatment plants must be contemplated, all discharging into the inner harbor. It appeared essential, however, to provide for outfall sewers to carry the sewage to submerged outlets in the main channels. The digestive capacity of the harbor waters is such as to render the production of a nitrified effluent unnecessary; but it was felt that a substantial removal of suspended solids and of sewage bacteria was demanded in order to avoid sludging up of channels or pollution of bathing beaches and shellfish layings.

To determine what methods of treatment were best

adapted to the solution of the local problem, as outlined above, an experiment station was operated for 11 months—June, 1917, to April, 1918. The total cost of the investigation was slightly less than $18,000. The immediate direction of the experiments was in the hands of the chairman of the committee, with Dr. F. W. Mohlman as chemist in charge and W. S. Sturges, Jr., as bacteriologist.

The experiment station was located at the outfall of the East St. sewer, which is not only the principal sewer of the city (flow of approximately 15,000,000 gal. a day), but also the most important one to study on account of its high content of industrial wastes. Special studies of certain processes were also made during the spring of 1918 at an outfall serving a residential district.

The processes studied were (1) fine screening; (2) Imhoff treatment; (3) activated-sludge treatment, and (4) Miles acid precipitation—all but the last followed by chlorine disinfection. The sewage for the experiments was obtained in a somewhat original manner, in order to avoid the breaking up of sludge solids by pumping. A considerable part of the flow in the sewer was diverted through a forebay from which the sewage needed for the experiments was withdrawn by means of a bucket elevator. This device proved highly successful and yielded an entirely normal fraction of the sewage flow suitable for accurate screening tests.

The sewage was distributed to the various devices over movable notch and rectangular weirs from a weir box in which the head was controlled by a Wallace & Tiernan regulator, operating a butterfly valve in the raw-sewage flume.

Peculiarities of the Raw Sewage

The sewage of the East St. sewer proved to be highly abnormal in several respects. It was very dilute, averaging for the 11 months 4.4 ppm. of ammonia nitrogen, 97 of total suspended solids, and 63 ppm. of volatile suspended solids. It contained during the first seven months of operation over 1000 ppm. of chlorine, which condition was traced to a million gallons a day of sea water used as condenser water in an industrial plant. Its bacterial condition was most peculiar. Samples collected on Sundays, Saturday afternoons and at 8 a. m. on certain week days gave normal results (1,470,000 bacteria and 143,200 colon bacilli per cubic centimeter); but samples collected during the industrial day showed only 160,200 bacteria and only 9600 colon bacilli per cubic centimeter. This condition we found to be due to the antiseptic action of copper salts derived from the washing of shells in a large munition factory Such a phenomenon appears not to have been previously recognized in the literature of sewage disposal, although recent studies by the Connecticut State Department of Health indicate that it is by no means unique, and that certain peculiar results noted in the Waterbury experiments in 1909 must have been due to the same factors. The effect of antiseptic wastes of this kind upon biological processes is of course a profoundly important one. The raw sewage showed an average "relative stability," or pseudo-stability, as we preferred to call it, of 58, when measured in the usual manner.

Screening studies were made with stationary screens 2 ft. wide by 3 ft. long, placed on cleats inclined downstream at an angle of 45° in a screen chamber 8 ft. 10 in. long by 2½ ft. wide and 2½ ft. deep. Two types of screen were tested, one of 30-mesh monel-metal wire cloth, and the other of galvanized-iron plates perforated with slots 1¼ in. long and $\frac{1}{16}$ in. wide. Sewage was in all cases passed through the screen under test at an initial rate of 100,000 gal. per day. As the screen clogged, the sewage gradually built up behind it, and in from 15 min. to one-half hour, when the loss of head had reached 2 ft., a second screen of the same type was placed in the chamber, resting on cleats 2 ft. below those on which the first was placed. After the second was in position, the first was pulled out of the chamber and allowed to drain. The second screen was kept in position until the loss of head had again reached 2 ft., when the sewage was bypassed, and the sewage remaining in the screen chamber was removed by the opening of vents in the side of the tank. After the sewage had been drawn down to within ½ in. of the bottom of the tank the second screen was removed and drained. The amount of sewage passed through the two screens in each experiment averaged about 3000 gallons.

TABLE I.—AVERAGE RESULTS OF SCREENING EXPERIMENTS

Sewer	Screen	Wet Screenings, Lb. per M.G.	Solids in Screenings, Lb. per M.G.	Solids, Per Cent. Volatile	Suspended Solids ppm Influent	Suspended Solids ppm Effluent	Suspended Solids Per Cent. Reduction	Settleable Solids, Per Cent. Reduction
East ..	Wire mesh	1,367	178	71	145	123	15	41
	Plate. .	665	86	82	137	126	8	29
Boulevard	Wire mesh	1,347	138	78	134	117	12	43
	Plate	386	28	82	135	132	3	29

After draining, the screenings were brushed off the screen and weighed, and the moisture content was determined. The effluent was sampled frequently during screening, and the suspended solids in the composite sample determined. Knowing the quantity of the sewage screened and the weight of the dry screenings, the parts per million of suspended solids removed and the per cent. of removal could be calculated.

Such studies of screening by the use of stationary screens is open to criticism on the ground that it permits a much greater clogging than would occur in practice with a revolving screen cleaned automatically during the process. The clogged screen will of course effect a greater purification than one that is kept clean. If the head were allowed to increase beyond a certain point, the pressure would operate in the opposite sense by forcing an undue proportion of solid matter through the meshes. With a loss of head never rising above 2 ft. this criticism cannot be made, since this is a range within which commercial screens are supposed to operate Our method of experimentation was therefore exceedingly favorable to fine screening, and working with an unusually fresh sewage we expected to obtain good results. As indicated in Table I, however, even the wire-mesh screens effected only 15% removal of suspended solids in the case of the East St. sewer, while the Boulevard domestic sewage (in which the solids were in a more finely divided state) gave an even lower degree of purification, the plate screens proving in each case inferior to those of wire mesh.

Altogether, it seems evident that fine screening, with

either wire screens (30 meshes to the inch) or plate screens ($1\frac{3}{4}$ x $\frac{1}{16}$-in. slots) cannot be expected to accomplish any important degree of purification with either of the sewages studied. Such screens will, of course, remove the grosser and more obvious floating solids and, where it is only necessary to avoid visual offense, they may be of great value. Where a substantial removal of suspended matter is desired, such as is accomplished by tank treatment, fine screens will not serve.

Our results are in accord with the general conclusions of conservative sanitary engineers. George W. Fuller, who is a firm believer in fine screening for situations to which it is adapted, estimates a removal of only 10% of suspended solids by such treatment. It is quite certain that a full-size installation of moving screens would accomplish less than the purification indicated by our tests. At Cleveland, several years ago, preliminary studies, made like our own with stationary hand-operated screens, gave a removal of 25 to 28%, while an actual Reinsch-Wurl installation (on another outfall sewer of the city) took out only 4% of the suspended solids present. Any such degree of purification as was indicated by our studies, or by the Cleveland experience, would, in our judgment, be inadequate for an effluent to be discharged into a shallow harbor with a narrow dredged channel, like that at New Haven.

Results of Imhoff Treatment

The Imhoff tank used in our experiments was constructed of tongue-and-groove spruce, with calked seams. It was 16 ft. long, $4\frac{1}{2}$ ft. wide and $11\frac{1}{2}$ ft. deep. The flow chamber extended for the full length of the tank, with gas vents 8 in. wide on each side. The flow chamber was constructed of heavy galvanized iron, with a triangular beam below the vent. The vent was 8 in. wide, and the seal overlapped each side 2 in. The sides of the flow chamber sloped at 60°, so that no difficulty was encountered from solid matters clinging to the slope. The capacity of the flow chamber was 840 gal. The detention period was theoretically 2 hours when treating 10,000 gal. of sewage per day. The linear velocity of the sewage was 0.15 ft. per minute.

The sludge compartment was out of proportion to the flow chamber, being relatively much larger than would be designed for a full-size plant. It was assumed that a large sludge compartment might be needed on account of the shallowness of the tank. The bottom of the tank was built in the form of two inverted pyramids with the sludge draw-off pipes just above the apices. When the tank was first filled with sewage it leaked badly. It was made tight only after many trials and was finally placed in service in November, 1917. It was unfortunate that operation should have been begun in winter, but by the end of April the increasing warmth of the season should have brought about normal conditions. Yet the results were at no period satisfactory, and they became worse as time went on. The average removal of total suspended solids for the six months' period was only 43 per cent., of volatile suspended solids only 38 per cent., and of settleable solids only 69 per cent. Sludge drawn from the tank at the close of the experiments was reddish-brown in color and highly offensive and dewatered badly, having in no respects the characteristics of a normal Imhoff sludge.

It seemed evident that with so weak a sewage as that studied sedimentation would not yield a very high degree of purification (this was confirmed by one month's study of plain sedimentation, which showed only 41% removal of total suspended solids) and that some factor, presumably the presence of the antiseptic industrial wastes, prevented the normal digestive action of the Imhoff tank. In view of the latter fact, it seems inadvisable to recommend this method of treatment for a disposal plant in a thickly settled district, on account of the danger that the operation of the tank and the removal of sludge therefrom, with a sewage of so abnormal a character, might be productive of local nuisances.

Activated-Sludge Treatment

Our activated-sludge experiments were made on the continuous-flow basis. The aërating tank was 16 ft. long, 4 ft. wide and 8 ft. deep. At the bottom of the tank the sides sloped at 45° to a trough 1 ft. wide, running the full length of the tank. An iron frame in which were cemented 15 filtros plates was cemented into this trough. The air was admitted at the inlet end of the trough, and the water which filtered through the plates could be drawn off at the outlet end. The air was compressed to 3.5 lb. pressure by a hydro-turbine having a capacity of 20 cu.ft. of free air per minute, the flow being measured by means of a venturi tube.

The settling tank was 4 x 4 ft. in plan, and 12 ft. deep to the bottom of the hopper. This hopper sloped at 60° to a sump in which was cemented a 3-in. ell connected to the suction of an air-lift pump. The sludge deposited here could be pumped back to the aërating tank, being measured on the way in an orifice box. A baffle $7\frac{1}{2}$ ft. deep extended across the center of the settling tank. This baffle was first placed 3 ft. from the inlet weir and 1 ft. from the outlet weir, but the upward velocity of the effluent was too strong and carried particles of sludge over the outlet weir. After the baffle was placed in the center of the tank no sludge was lost in this way, the theoretical upward velocity being decreased by this change from 4.8 in. to 2.4 in. per per minute. The capacity of the aërating tank was 3100 gal., that of the settling tank 1150 gal. While treating 17,000 gal. of sewage per day with 50% returned sludge the aëration period was 3 hours, the settling period 66 minutes.

The activated-sludge process was studied less as an oxidizing than as a clarifying process, in the same way in which it was used at Cleveland. It was thought that activated-sludge treatment and chlorination might compete with Imhoff treatment and chlorination if the air and tank space required for the former process could be cut down considerably, and if the amount of chlorine required for disinfection were much less in the former case than in the latter. For this reason small amounts of air and short periods of aëration were used and no attempt was made to obtain full nitrification of the effluent.

The process was at first studied with an aëration

period of 2.5 hours, a mixture of 73 parts of very dilute sludge per 100 volumes of sewage, an air supply of 1.3 cu.ft. per gallon of sewage, and a sedimentation period of 55 min. All of these variables were modified at different times, the aëration period being varied between 2.5 and 10 hours, the proportion of sludge from 50 to 73 volumes per 100 volumes of sewage, the air supply from 1.1 to 2 cu.ft. per gallon of sewage, and the sedimentation period from 30 to 78 min. At no time and under no conditions could really satisfactory results be obtained. The sludge accumulated slowly, was rarely well flocculated and did not settle well. The effluents never showed a normal clarity. The removal of total suspended solids averaged only 55 per cent., and of settleable solids only 74 per cent. The nitrogen content of the sludge averaged only 3.23 per cent. The failure of the process no doubt was due in part to the design of the settling tank, the small size of the sludge pipes and the lack of a separate sludge-aërating tank; but we are satisfied that the primary reason for the poor results obtained was the presence in the sewage of the antiseptic industrial wastes which would render hazardous and uncertain the use with this sewage of any process depending on biological activities.

Experiments on Chlorination

The effluents from the screen chamber, the Imhoff tank and the activated-sludge process were conducted by wooden flumes to small baffled tanks, giving detention periods of 2 to 5 min. in which they were treated with liquid chlorine delivered from a special Wallace & Tiernan solution-feed apparatus. The samples of chlorinated effluent were held in the sample bottles for 30 min. before plating, to reproduce the action of the small storage tanks that would be required in an operating plant.

To interpret our results, it was necessary to fix on some tentative standard which might be considered adequate and satisfactory. For this purpose we have assumed as the ideal to be attained that the final disinfected effluent should contain not over 10,000 bacteria per cubic centimeter, and not over 1000 colon bacilli per cubic centimeter, as a general average. This represents a purification of over 99% for the normal sewage and about 90% for the day sewage at East St. containing the copper wastes. Activated-sludge effluent required 3 ppm. of chlorine to produce this result, and screened sewage, five parts, while Imhoff effluent showed average counts somewhat above the standard even after treatment with six parts, and crude sewage after treatment with 8 ppm. In making estimates as to the cost of chlorination of screen and Imhoff effluents, we have assumed that five parts of chlorine would produce a fairly satisfactory degree of purification, basing this assumption chiefly on the results of the colon test, which is of greater significance than the count of total bacteria. This amount might very probably have to be increased in practice, however, particularly in the case of the Imhoff effluent.

The process of precipitation with sulphurous acid, patented by George W. Miles, and reported on so favorably by Prof. R. S. Weston of the Massachusetts Institute of Technology (*American Journal of Public Health*, 1916, VI, p. 334) seemed deserving of special attention in our experiments, in view of the fact that such a process would not be interfered with by antiseptic wastes and would be favored by the low alkalinity of the East St. sewage, and also because it yields a clarified and disinfected effluent such as was desired in view of local conditions. [These tests were detailed at length in an abstract of a paper by Professor Winslow and Dr. Mohlman, printed in *Engineering News-Record* of Dec. 5, 1918, p. 1034.—Editor.]

Comparison of Various Processes Studied

The general average results of the various processes studied are indicated in summary form in Table II.

Of the various processes available for the treatment of city sewage, it is obvious that any form of filtration would be out of the question for a disposal plant located at the East St. outfall. Our studies have indicated that activated-sludge treatment cannot be considered, on account of the presence of industrial wastes which prevent the bacterial activities upon which this method of treatment depends. In order to secure the results desired, a substantial removal of suspended solids and a reasonably high degree of bacterial purification, there remain three possibilities: (1) Fine screening followed by chlorination; (2) Imhoff tank treatment followed by chlorination, and (3) the Miles acid process. It has been pointed out above that fine screening gave us a removal of suspended solids which we did not consider adequate for the protection of the harbor, and that the character of the sludge formed in the Imhoff tank was so abnormal as to threaten the possible production of a local nuisance. We have nevertheless given careful consideration to all three of these processes and have prepared for each of them preliminary cost estimates which are shown in Table III. (See next page.)

TABLE II.—COMPARATIVE RESULTS OF VARIOUS PROCESSES: GENERAL AVERAGES OF PER CENT. OF PURIFICATION

	Ammonia (N)	Turbidity	Solids: Total Suspended	Solids: Volatile Suspended	Solids: Settleable
Wire-mesh screens	..	...	15	...	41
Plain sedimentation	—30	23	41	34	86
Imhoff treatment	—12	14	43	38	69
Activated-sludge treatment	13	44	55	50	74
Miles acid treatment	0	36	61	54	90

The estimates are based on the production of SO_2 gas by burning sulphur (assumed to cost $36 a long ton) and on drying from 85 to 10% moisture (coal assumed at $7.50 per ton). We have estimated a very high cost for the construction of Imhoff tanks ($20,000 per 1,000,000 gal.) on account of peculiar local conditions of the outfall, since the tanks would have to be built for the most part below tide water. The cost of chlorination is based on the use of five parts of available chlorine per million parts of sewage, an amount which we have found essential for the treatment of either screened or clarified sewage. It is very probable that in actual practice more than five parts might be necessary.

It appears from these estimates that the acid treatment of the sewage from the East St. outlet should

be materially cheaper than either Imhoff treatment or fine screening, under existing local conditions. With a fall in the price of grease after the war the outlook would be less favorable. Even if all revenue from the sale of grease and fertilizer were eliminated, however, the cost would not be very much greater for acid than for Imhoff treatment. Other conditions make the case for the Miles process at this outfall almost irresistible. Our studies have shown that fine screens will remove only a small proportion of the suspended matter from either the East St. or the Boulevard sewers, and we are of the opinion that the purification so effected would not be adequate to prevent sludging in the dredged channel into which the effluent must be discharged. On the other hand, our experiments with Imhoff treatment of the East St. sewage have been most unpromising, as noted above, on account of the antiseptic action of the copper present in the sewage.

Above all however, the thing that counts most heavily in favor of the Miles process under the conditions obtaining at New Haven is its freedom from nuisance. If heavy costs for interceptors and pumping are to be avoided, the sewage of the city must be disposed of at four different points, all of them in thickly settled areas where offensive odors must be prevented at all costs. Furthermore, the problem of disposal of sludge and screenings would present peculiar difficulties. A process of treatment which should be free from local nuisance and which wholly eliminates the problem of sludge disposal is ideal for such a local condition.

Normal Sewage at New Haven

Aside from a short series of screening tests and a month's operation of the Miles acid process on the Boulevard sewer, we have conducted no experimental work on the sewage discharged from the other main outfalls of the city. We know, however, from the United States Public Health Service survey and from analyses of sewage from the other outfalls made under the direction of Prof. S. E. Barney, that the sewers of New Haven, aside from that at East St., carry a fairly normal flow of domestic sewage. From the conditions of the case the processes likely to prove successful are limited to the same three combinations tested at East St.; and we know pretty well what fine screening and Imhoff treatment are likely to accomplish with an average American domestic sewage. Activated-sludge treatment could no doubt be applied successfully to such sewages as those in question, but the operation of four small units of this type would certainly be expensive, since the cost of power in New Haven is high and the sewage of the city is in general so weak that a relatively small revenue could be estimated from the recovery of nitrogen in the sludge.

To obtain an idea of the relative cost of the three processes which seem most suitable for local conditions, we prepared preliminary estimates for the treatment of the sewage of the Sea St. outfall, based on our studies of its principal tributary, the Boulevard sewer. These figures [$9.60 for Miles acid, $12.14 for Imhoff tanks and chlorination, and $12.35 per 1,000,000 gal. for fine screening and chlorination—Editor], which should be fairly typical for the other New Haven outfalls, show that the Miles process in this case is considerably more expensive than at East St.—first, because of the higher alkalinity of the sewage, and, second, because of the fact that the plant would be smaller (6,000,000 gal.) and costs per unit volume therefore larger. In particular, the cost of superintendence rises to a high figure, since we are convinced that a chemical industry of this nature cannot be carried out without expert guidance. Imhoff treatment is slightly dearer, for the same reason, in spite of lower construction costs.

TABLE III.—ESTIMATED COST OF TREATMENT OF EAST STREET SEWAGE PER MILLION GALLONS

	Miles Acid Process	Imhoff Tanks and Chlorination	Fine Screens and Chlorination
Tanks and buildings (interest and depreciation)	$2.47	$5.28	$4.50
Acid treatment	6.93	.....	.....
Drying sludge	2.09	.....	.....
Degreasing sludge	1.78	.....	.....
Redrying tankage	.17	.....	.....
Superintendence	1.06	.46	.46
Labor on tanks and screens	1.00	1.20	1.42
Disposal of sludge or screenings	.....	1.00	.50
Chlorination	.....	4.05	4.05
Gross cost	15.50	11.99	11.03
Revenue	7.09	.....	.....
Net cost	8.41	11.99	11.03

No allowance has been made in these estimates for royalties on the Miles acid process, which is a patented one. Before definite plans are made proper assurance should be obtained that such charges would be reasonable. In the case of Imhoff treatment, royalties in the past have been small as compared with the total cost of treatment.

The same objections which militate against screens at East St. limit the promising possibilities at the Sea St. sewer to Imhoff and acid treatment.

The gross cost of the Miles process is very high, and with a new procedure of this sort, never yet applied to purely domestic sewage on a practical scale, it must be recognized that many factors, such as the difficulties in distillation and the deoxidation of diluting water caused by the contained chemicals, may cut heavily into the assumed revenue.

If the problem of the Sea St. sewer stood by itself, we should be somewhat in doubt whether to favor Imhoff or acid treatment, with the facts in mind. Since, however, the case for acid treatment seems so clear for the East St. sewer, we are of the opinion that it would be wise to delay construction at other New Haven outfalls until the acid process has been tried out on a practical scale at the point where it promises best results. If an acid treatment plant at East St. is successful, the drying and degreasing of the sludge from this and other plants could be conducted at one central location, the costs estimated for Sea St. would be materially reduced, and acid treatment might well prove economical for all the main outfalls of the city.

Lincoln Highway Maintenance in Pennsylvania

Pennsylvania has expended $747,505.78, during the past year in maintaining the Lincoln Highway, according to a statement prepared for the Lincoln Highway Association by J. Denny O'Neil, state highway commissioner. The main items of maintenance covered by this expenditure are: Surface treatment, 248 miles; reconstruction, 22½ miles; building of seven modern concrete bridges, and the necessary oiling. The report adds that this large sum was made necessary in great part by the thousands of United States Army trucks which used this highway during the year.

Aërial Cableways Successful in Northwest Shipyards

Similar to Loggers' Cableways—Ability To Get Men Expert In Handling Them Is One Secret of Success—Well-Planned Installations Are Fast and Flexible

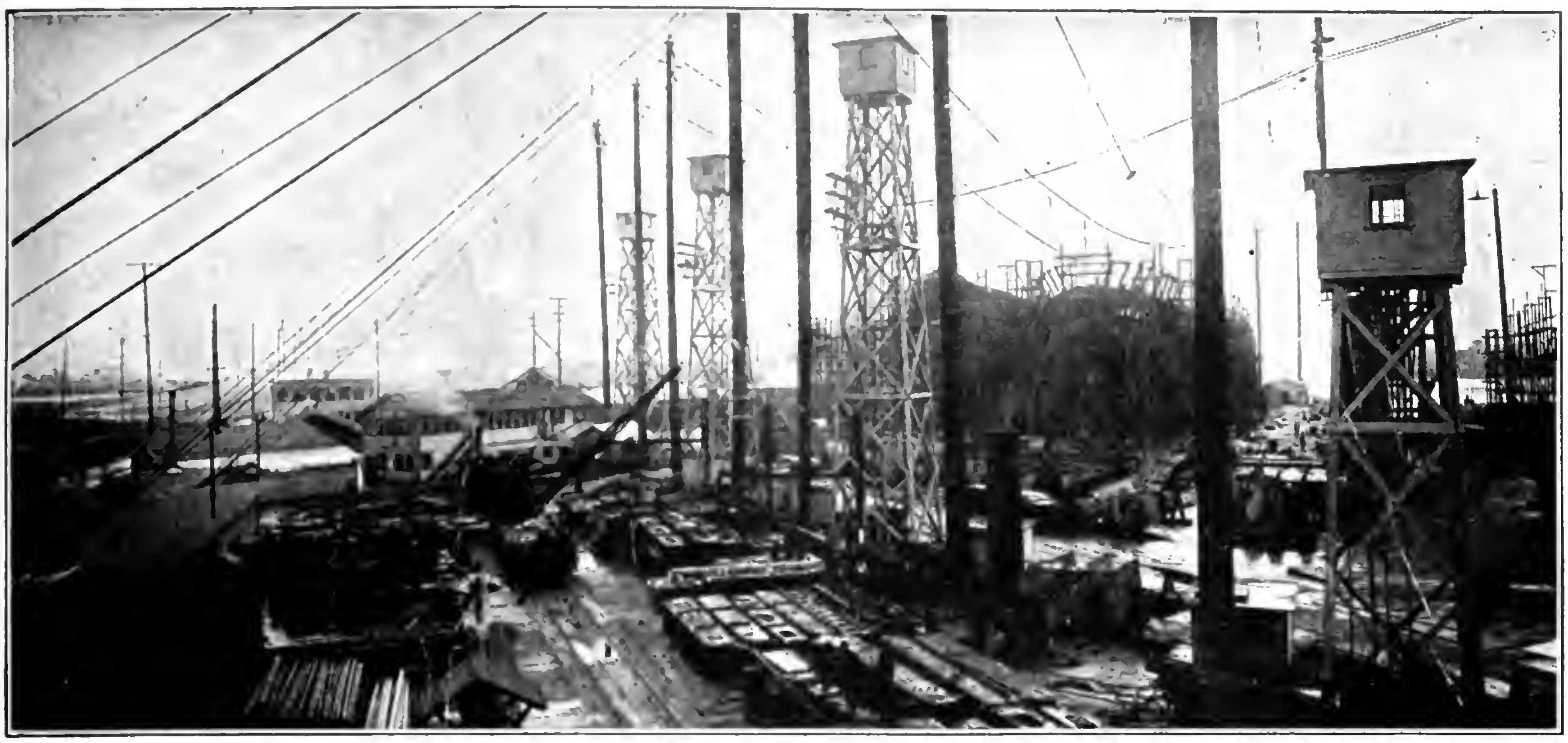


FIG. 1. THESE 125-FOOT TOWERS AT THE AMES YARD IN SEATTLE ARE FOR THE HOIST OPERATORS ONLY; THE WINCHES ARE ON THE GROUND

WORLD records in ship construction have been broken on the Pacific coast by yards handling materials with aërial cableways, a method which many shipbuilders do not regard with favor. Disfavor may be justified by the installations in some yards, but the good records of some of the well designed cableway systems and the high speed attained in placing steel speak for themselves. For example, the Skinner & Eddy yard at Seattle has recently launched fifteen 8800-ton boats in an average of 54.4 working days, and delivered them ready for service in an average total of 72.3 working days.

Moreover, the strong preference for cableways shown by managers of several successful steel shipyards indicates that the method will be for some time a factor in shipyard design. In fact, cableways are now being used in nine of the ten steel yards in the northern Pacific district of the Emergency Fleet Corporation. The first cost of an aërial cableway system is only a small fraction of the cost of overhead cranes, and the former can be built with materials quickly available on the Pacific Coast.

The aërial cableway idea was first applied in the Northwest early in 1915. When the Skinner & Eddy plant at Seattle was laid out in 1916 the system was installed on a comprehensive basis. Members of this firm had previously used cableways extensively in logging operations, and the methods employed in the woods were adapted to shipyard service. Expert riggers and operators were available from logging crews. Since that time the idea has been adopted by many of the new yards. Of course, the use of cableways presupposes the endwise delivery of material—that is, the cableway systems pick up material from storage inshore of the shipway and move it parallel to the keel. Thus, the system is best suited to yards in which the ways have to be built close together, and no storage alongside is available.

The layout and detail of design of the cableway systems vary greatly, but throughout the Northwest, in the more successful yards, there is a notable uniformity of main features. The most common arrangement is to have two cableways for each shipway, with bow and stern masts about 650 ft. apart. The bow and stern rows of masts are each tied together by cables at masthead, and are steadied by backstays and guys, as required. A three- or four-sheave tackle is usually put in the backstays to take up the slack in the main cables. The bow masts are usually set plumb, and the backstays are run out as far as anchorages can be conveniently placed. Where the ways front on deep water and it is inconvenient to use long guy lines astern, the stern masts are inclined outward, to increase the stability that may be obtained from short backstays and to keep the anchorages in shallow water.

It is the common practice to use counterweights on the dead end of the hoisting line and also on the carrier line, instead of making them fast to the masthead. This automatically prevents overloading the trolleys, and takes up slack in the carrier line. About one ton is used as the carrier-line counterweight; the hoisting-line counterweight equals the maximum load, usually about 2½ tons. The main cables are kept pulled up taut, with a sag not to exceed 3% or 4% of their length.

In one of the Northwest plants a temporary guy line was removed during construction before the permanent connection had been effected, and, as these ways were on an acute angle with the shore line, the entire row of bow masts fell over, doing considerable damage. In another plant the bow masts collapsed when one of the

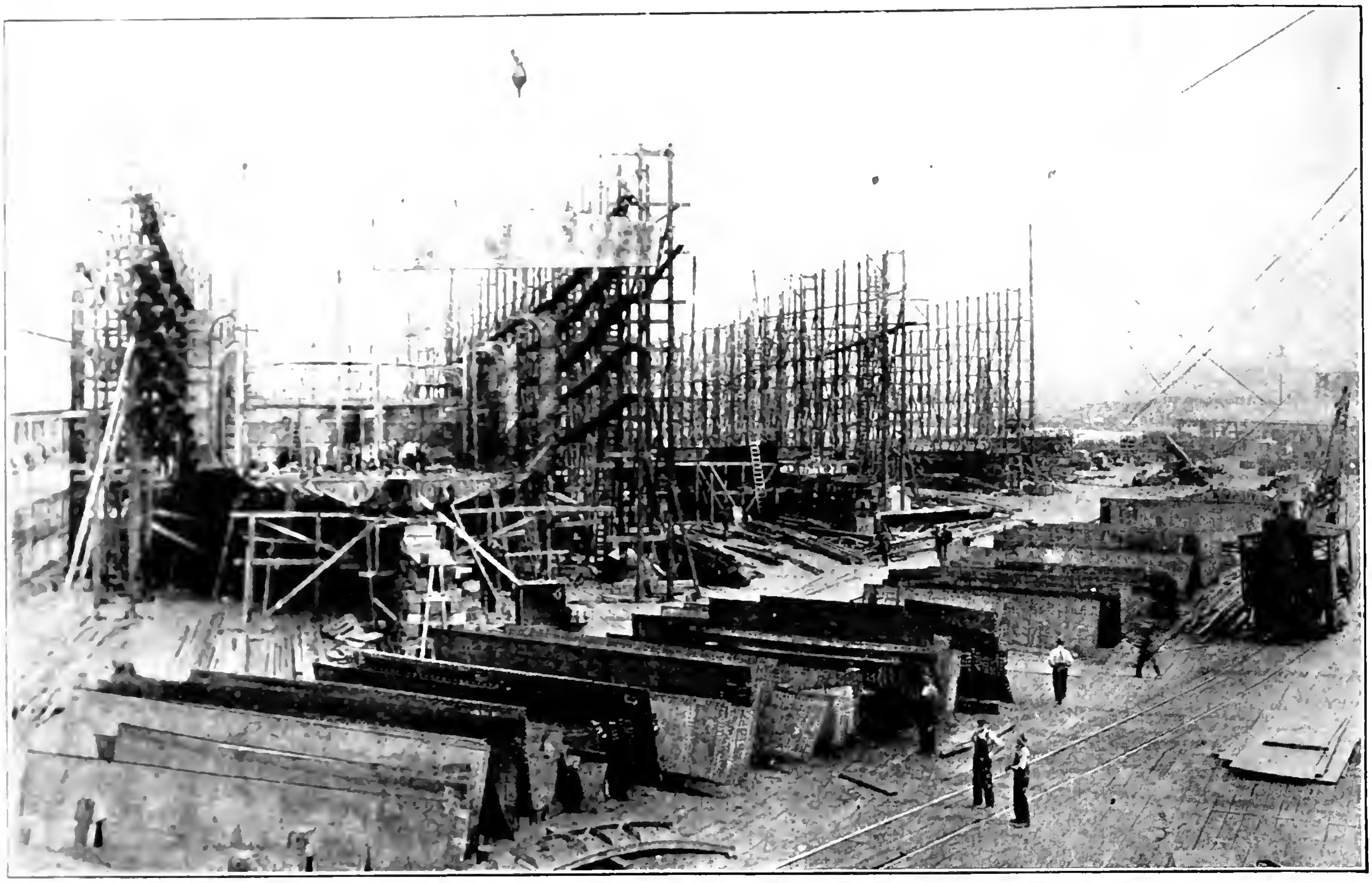


FIG. 2. TWO CABLEWAYS PER SHIPWAY USUALLY WORKED TOGETHER IN PLACING STEEL

main cables parted. This occurred, however, within a few weeks after the system had been installed, and is regarded as a failure to exercise sufficient care in design and inspection, rather than as a reflection on the cableway system.

The masts used vary from 105 to 125 ft. in height. The bow masts are usually 5 ft. higher than the stern masts, so loads are handled downgrade. The taller masts are conceded to have advantages over the 100- and 105-ft. masts which probably more than offset the additional cost. The 115-ft. masts are 3 to 4 ft. in diameter at the bottom and about 2½ ft. at the top. They cost at tidewater in Portland and Seattle between $300 and $400 apiece. Steel masts for this purpose have not been used in Pacific coast yards. The main cables are almost all 1¾ in. in diameter. A notable exception to this is the system of the Northwest Steel Co. at Portland; this yard, which has been in operation for two years, uses a 1⅜-in. main cable of six strands, with hemp core. When one cableway in this plant had built three 8800-ton vessels, in each of which approximately 2800 tons of steel had been placed, the main cable was found to have been flattened somewhat on top. It was then replaced with a line of the same size having a steel core, thus increasing the strength without necessitating a change of trolleys. These stronger cables last for about six boats, after which the mechanical wear shown warrants their replacement. The ½-in. hauling cables average only three to four boats.

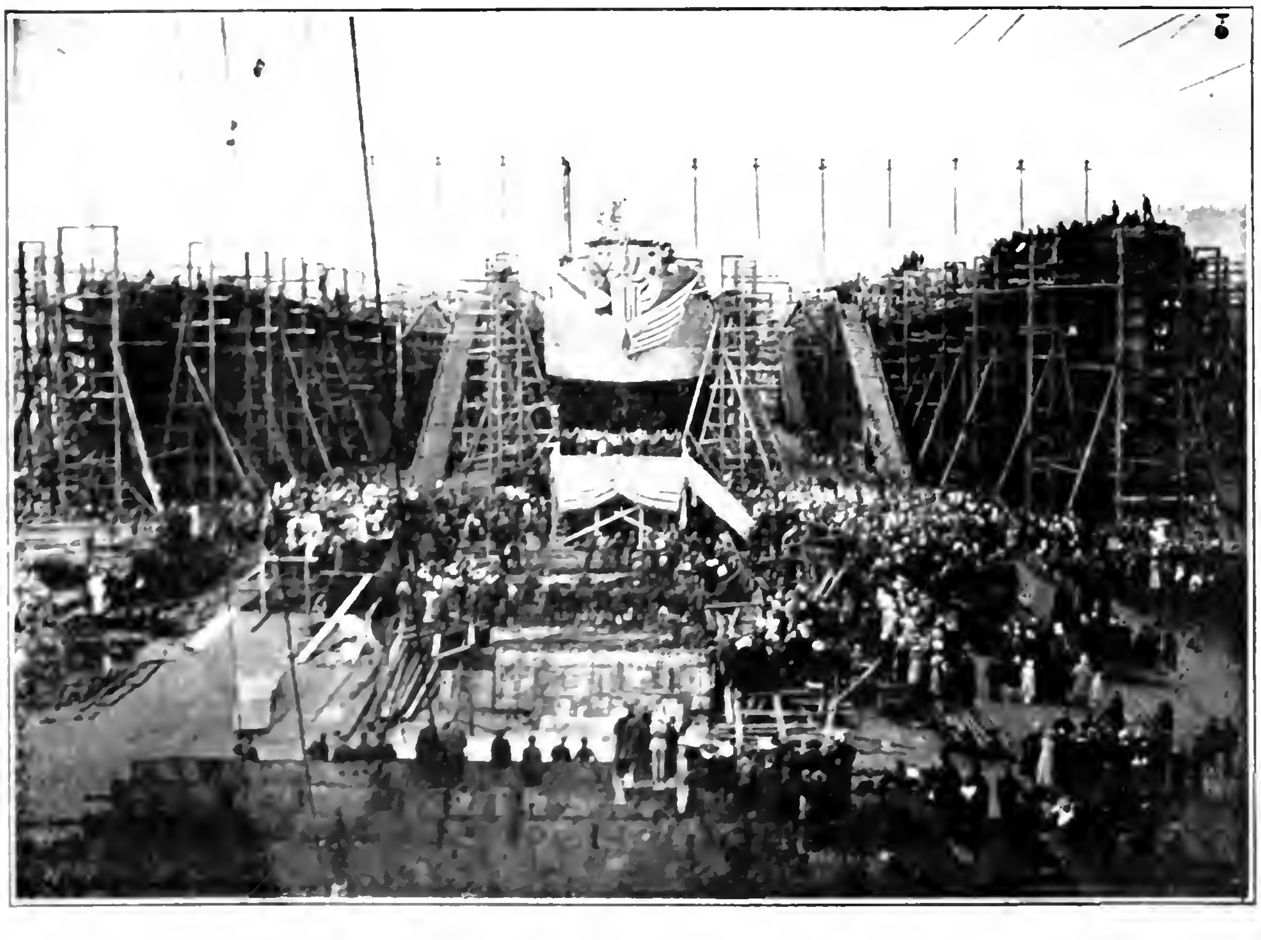


FIG. 3. CABLEWAY SYSTEM SEEN FROM WINCHMAN'S HOUSE ON PLATE SHOP, TODD YARD, TACOMA

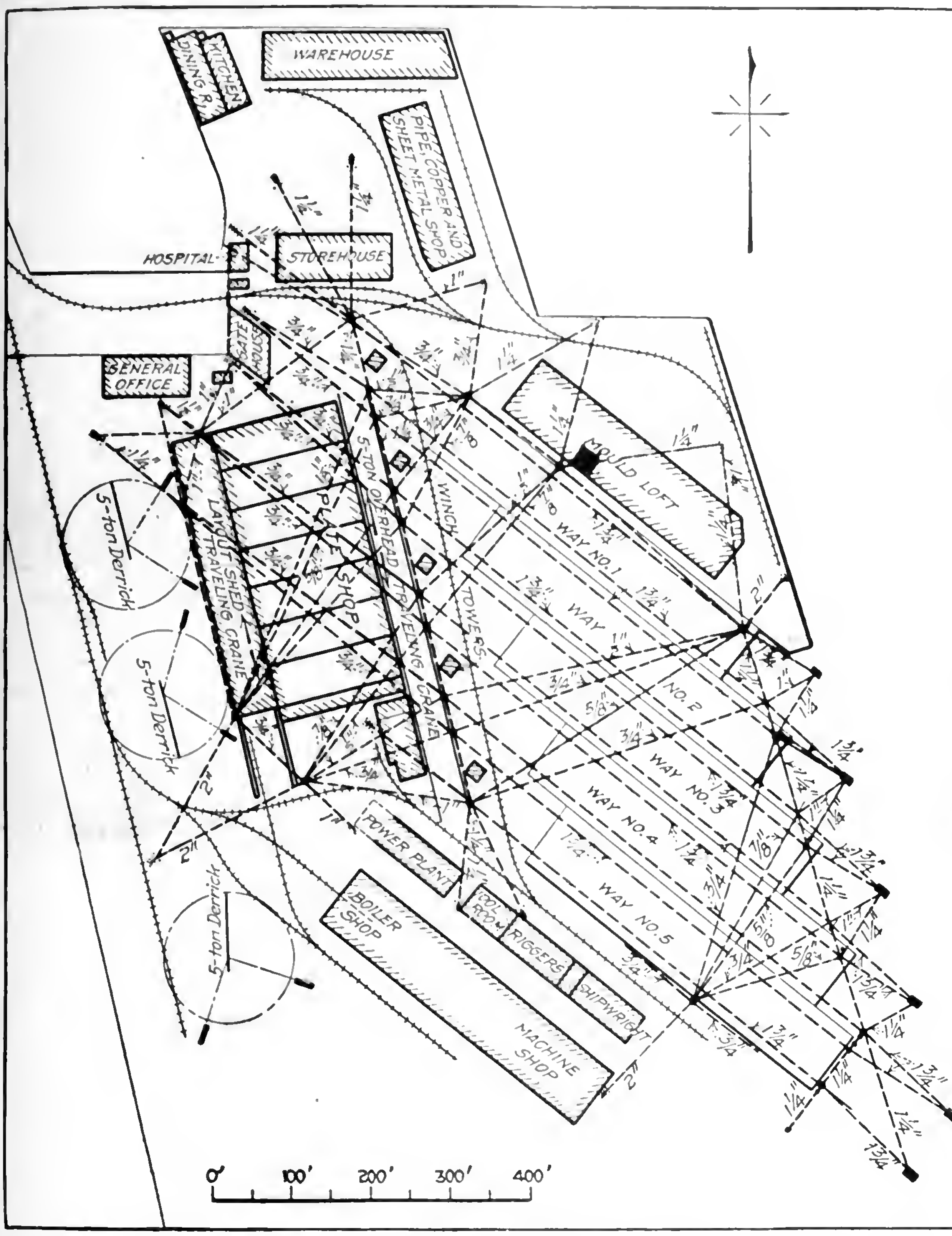


FIG. 4. PLAN OF SKEW CABLEWAY SYSTEM, SEATTLE-NORTH PACIFIC SHIPBUILDING COMPANY

Operating Control—An important operating feature of the cableway design is the location of the hoist controls. Most of the yards deem it essential for best results to have the operator where he has an unobstructed view of the work. Where there are no buildings located so that it would be convenient to set the hoist controls upon them, towers are built specially for this purpose. Most of the yards have the winches also in the towers; the cables run first to the ground and thence to and up the masts. At the Skinner & Eddy plant the winchmen are set on the ground. They are provided, however, with a telephone head-set with which they can hear a bell located well down the way, and which a signalman rings to indicate just how the load is to be moved.

Where a cableway is provided on either side of the way, towers are set on the center line, near the bow masts. Except for one steam-winch plant at Portland the hoists are all electrically operated, a separate motor and pair of drums being provided for each cableway. Where the two hoists for each way are mounted side by side, a single operator only is required. The two hoists in each tower are frequently so arranged that their traveling frictions can be locked together and the two trolleys operated at uniform speed, controlled by a single controller and brake. In this way one operator, handling both lines, can utilize the combined capacity of the two on a single lift or can separate them for independent operation.

Ordinarily, the two hooks are coupled together by a header cable about 14 ft. long, and the carriers are operated together for every load, to give the greatest precision in placing. It is generally reported by yard foremen that the two lines operating as one can deliver the material faster than it can be placed in the ship. The trolley speeds range up to 250 ft. per minute. In one of the Northwest plants the eight-hour operating record stands at 110 lifts with travel averaging 300 feet. The motors range up to 25 or 30 hp. and loads up to four or five tons can be handled by a pair of hooks combined.

Not all of the yards, however, use two cables per way. Some are using three and some four. In these cases one stern mast (on the way center line) has to be removed before each launching. A crew of six men does this in about half a day, without disturbing the other masts, thus leaving the two outer lines free to operate separately or jointly. Where four cables are used the central mast carries two cables separated by a spreader near the mast head. With the four-cable arrangement two winchmen are used in each tower, each man operating two carriers that can be coupled together or operated singly; all four hooks could be combined, but it is seldom done. Where three lines are used the two outer ones are usually worked together, the central cable being used for lighter loads. This three-cable system is commonly installed where oil tankers are to be built, because of the amount of material to go into the holds.

In the Ames yard at Seattle the towers are 125 ft. high and contain only winch controls, the winches themselves being set on the ground at the base of the masts. Under this plan the winches cannot be coupled together, and a separate operator is required for each carrier. Some of the shipways have three cableways each, and three operators are required in each tower constantly.

Although this is expensive in labor cost, it has the advantage of making the winches very accessible, and delays from breakdowns and maintenance costs are reduced.

In the Seattle North Pacific yard, the plan of which is shown, the ways had to be set at an acute angle to provide sufficient space for launching. This called for a more elaborate system of cross-guying than is usually provided, and required high masts so that the cross-cables could clear the main cables. The superintendent in this yard reports that the system is very easy to maintain, and riggers are always available when needed. The responsibility for the maintenance of the cableways is placed upon one man, who is expected to inspect personally all parts of the system as frequently as necessary.

The masts in this yard are particularly fine sticks, ranging up to 4½ ft. in diameter. They rest on a cluster of piles, on top of which a nest of timbers was built up for the foot of the mast. When the J. F. Duthie plant was built, masts of the desired height could not be obtained promptly for all the ways. Shorter and lighter masts were therefore used at the bow, and footings were built up above the planking 8 to 12 ft., as required to give them the desired height. These masts were strengthened by wrought-iron truss rods with turnbuckles for drawing them taut against struts placed at about mid-height.

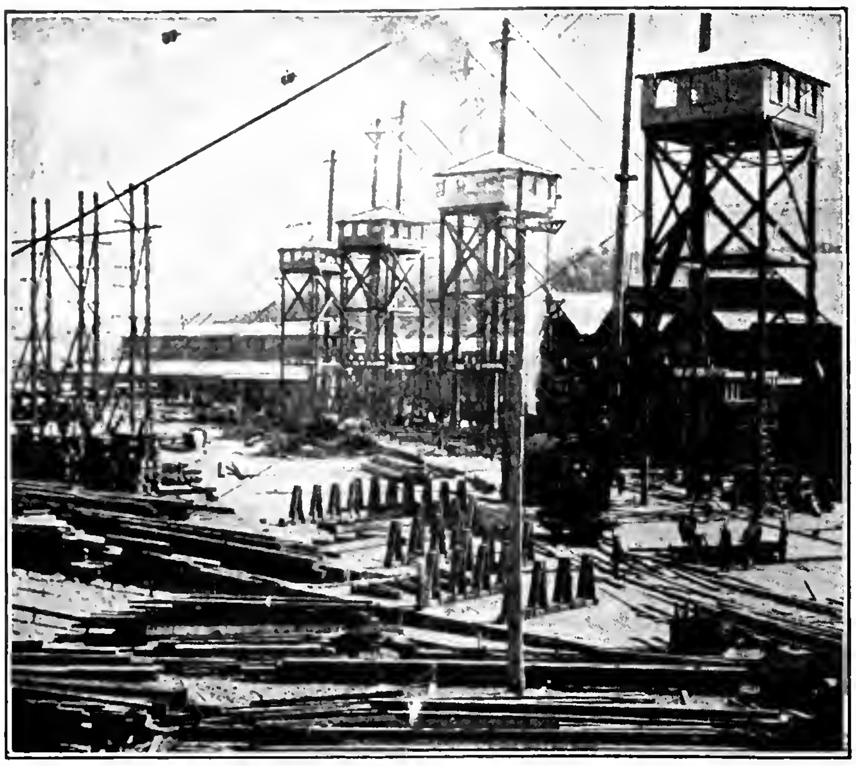
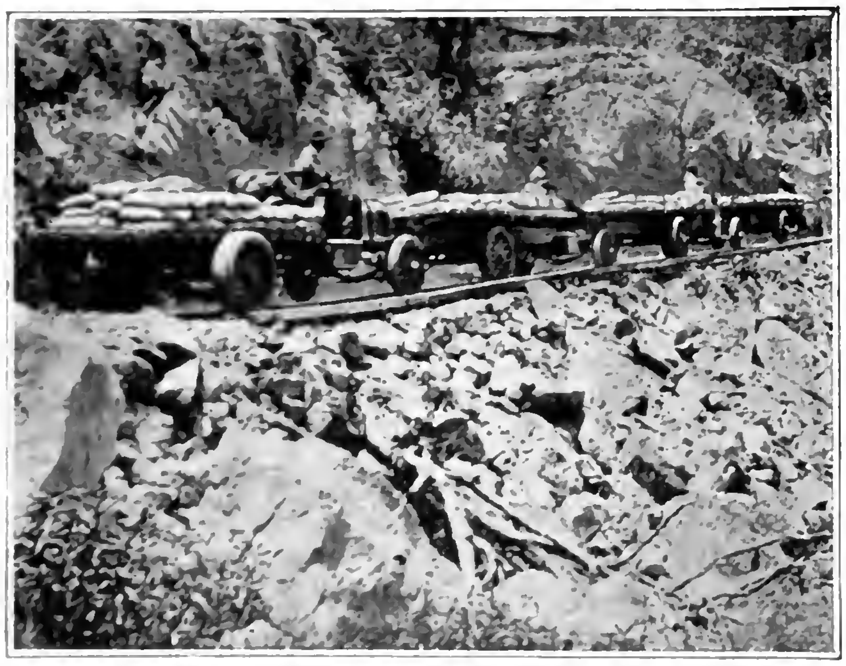


FIG. 5. CABLEWAY WINCHES IN CONTROL TOWERS, SEATTLE-NORTH PACIFIC SHIPBUILDING COMPANY

Motor Trucks Operate Over Steep Grades on Hetch Hetchy Project

TRANSPORTING of materials to the Eleanor Dam on the Hetch Hetchy project in California was an important factor in the construction problem. A fleet of motor trucks was used to haul materials over the 12 miles from the terminus of the Hetch Hetchy R.R., and was found to be entirely satisfactory, despite the rough trip involved. The costs worked out at about $10 per ton.



HAULING CEMENT ON THE LONG 15 PER CENT GRADE

A 68-mile railroad built by the city terminates at the Hetch Hetchy dam site, and from this point a wagon road had to be built to the Lake Eleanor site. In order to get out of the valley, it was necessary to locate the road with continuous grades ranging up to 15% for the first three miles. In this distance there are seven very sharp turns, which usually require a truck to reverse about three times in order to get around. Making these turns wider would have greatly increased the cost, because of the uniform slope of the hill along which the grade is located. Beyond this rise the grades and alignments are much better. The entire road was built in the three months between Apr. 20 and July 20, 1917, at a cost of about $6000 per mile.

In the hauling contract the basis was a 70-sack load of cement, and the price was $35 per round trip of the truck. It was found, however, that by special agreement with the drivers each truck could make two trips a day. From a rough check on costs kept by the city it is estimated that the contractors' net profit has been about $5 per day per truck. There were eight trucks in the fleet and sixteen drivers. Most of the trucks were rated at 3½ or 4 tons capacity.

The work is being carried out by the City of San Francisco under the direction of M. M. O'Shaughnessy, city engineer.

Regulates Bottled-Water Traffic

Two hundred dollars fine is the penalty which Florida purveyors of bottled water must pay if they do not follow the stringent regulatory measures of the State Board of Health. First, there must be furnished to the board on Jan. 10 of each year the name of the water sold and the exact location from which it is obtained; chemical and bacterial analyses, or formulas, if the waters are manufactured. A permit must be obtained, and the board may revoke this if the water "appears to it to be a menace to health." Two bottled samples as prepared for sale are to be supplied to the board for laboratory examination every two months.

Engineering Educators' Opinions Reflect Past and Predict Future Conditions

Now that the Students' Army Training Corps has been disbanded and educators are actively engaged with the problems of the transition period of readjustment to peace conditions, the opportunity is being seized to initiate changes of far-reaching importance. In order to reflect these changes and present the trend of opinion among engineering educators "Engineering News-Record" sent to the deans of various engineering colleges a communication containing the following questions:

1. What was the influence of the S. A. T. C. upon the engineering colleges? Did the experience affect the educator's viewpoint, and if so, how?

2. Will the return to peace mean a return to pre-war courses without essential modification? If not, just what changes are contemplated? What considerations determined these changes?

3. Have you embodied in your plans for after-war courses any of the suggested solutions brought out by Dr. Mann in his "Study of Engineering Education"? (See "Engineering News-Record" of Oct. 24, p. 782). If so, just how are they to be applied?

4. What is your estimate of the new needs and opportunities in engineering education developed as a result of the war? How can they best be met?

The replies which are here presented indicate the wide divergence of opinion which still persists through the war experience It is hoped that practicing engineers will also coöperate in this vital matter of developing the best possible future for engineering education, and send us definite suggestions, in the nature of specifications for the desired graduates, in the light of war experience.—EDITOR.

Illinois To Make Readjustments, but No Permanent Changes Now

BY C. R. RICHARDS
Dean and Director of the College of Engineering, University of Illinois, Urbana, Ill.

IN REPLY to your letter asking my opinion concerning certain matters in connection with engineering education, I will undertake to answer your definite questions as follows:

1. If the war had continued for a year or two longer, it is possible that the organization of the S. A. T. C. would have had a decided influence on educational institutions. The signing of the armistice so soon after the organization of this corps has interrupted this educational experiment, to its detriment. It does not seem possible to estimate at this time the influence of this organization on the engineering colleges, although I have no doubt that in those institutions which undertook the instruction of mechanics and tenchnicians there will be an increased appreciation of the possibilities for intensive training of men for highly specialized work.

2. For the remainder of the current academic year, the College of Engineering of the University of Illinois has been compelled to make certain readjustments in existing curricula to permit the students to continue without being seriously penalized as a result of their experience with the S. A. T. C. Very little real work has been possible during the first quarter, and we have found it necessary to take this into account in outlining our program of studies for the remainder of the present academic year. At the present time, no permanent changes in the curricula are contemplated or are considered necessary or desirable. This college is alive to the need to keep in touch with changing conditions, but it does not feel justified as yet in making any revolutionary changes in its work.

3. During the past three months, as a result of the serious interruption to our work, the more or less complete disorganization of the university and a reduced staff of instructors, together with the extraordinary demands made upon the staff, we have had no time to give serious consideration to Dr. Mann's report. This report is to receive the careful consideration of the faculty during the year, and I have no doubt we shall make such use of the suggestions which Dr. Mann has made as may seem wise and practicable under existing conditions. I may frankly say that it would seem to me to be very unwise for any technical school to effect a complete revision of its curricula as a result of Dr. Mann's report, without giving the matter very careful thought and study.

4. In my opinion, there will be a greatly increased enrollment of students in the technical schools of America as a result of the war, for the importance to the nation of men with technical and scientific training has been demonstrated. It seems to me, therefore, that the industries should show an increased appreciation of properly trained men and of scientific research. Both in Europe and in America the need for research to enable the industries of these countries to meet new conditions which have arisen has been so strikingly shown that I anticipate that more attention will be given in the future to research in the colleges and in the indus-

tries. I have no doubt that there will be some disposition, as a result of the experience with vocational training in the Army, to assume that short courses of intensive training may be profitably substituted for the longer and more complete curricula of instruction given in the engineering schools. While I believe that vocational education should be stimulated in every possible way, I should consider that the substitution of such training for the broader training which the American colleges have developed would be little short of a calamity.

Rensselaer Polytechnic to Make no Radical Changes

By Palmer C. Ricketts
President, Rensselaer Polytechnic Institute, Troy, N. Y.

Replying to your four questions on the war education experience at Rensselaer Polytechnic Institute, I would give the following opinions:

1. The S. A. T. C. did not have a fair trial at this institution. The influenza affected the work seriously, and after the influenza came diphtheria. Many members of the Corps lost weeks of time. I hoped that the Government would be able to continue the corps in existence until June, in order that this form of military training at our educational institutions might have a fair trial. I hoped this in spite of the serious difficulties we had had, from an educational point of view, during the three months just ended. Since this experiment could not be tried in this way, I am at a loss what to say regarding military training in institutions of this character. Last year we had a paid instructor who gave military drill three hours a week to the students who elected to take it. We may have some such arrangement in the future. I do not expect that we shall establish a unit of the Reserve Officers' Training Corps here. What we want just now is a rest for some months before we decide this matter.

2. The return to peace will mean a return to pre-war courses without essential modification. We shall give five weeks' review here, beginning Jan. 2, and we shall give our second term as usual.

3. We have not embodied in our after-war courses any of the suggested solutions brought out by Dr. Mann.

4. We all know that the war has shown very forcibly the value of an engineering education to many persons who never before gave the matter much thought. Increased attendance at the engineering schools may result. It will be our business constantly to improve our engineering courses in the future, as they have been constantly improved from year to year in the past, but we certainly do not expect to make any radical changes in our methods.

General Effects on Middle West Universities Are Profound

By M. E. Cooley
Dean of the College of Engineering, University of Michigan, Ann Arbor, Mich.

Having been away from Ann Arbor since the middle of October, in charge of collegiate training of the S. A. T. C. at the universities of Illinois, Wisconsin and Michigan, I can only make a general statement in reply to your questionnaire. Engineering educators probably have the same opinion as other college teachers, the general verdict being that the S. A. T. C. was a failure, and that it is a pleasure to return to the old status. My own belief is that the S. A. T. C. was a pronounced success, considering it as a gigantic enterprise in operation less than 12 weeks and seriously handicapped by influenza. Another 60 days would have seen smooth sailing.

I further believe that educational institutions were stirred to their foundations, and will never return completely to the old status. Something was needed to jar them from their complacency, and the S. A. T. C. did it. Teachers have had an opportunity to adapt their courses to immediate practical needs, which should result in greater directness in the courses of the future. More important is the changed attitude of people toward the kinds of education desired. I hope and pray military training may be desired, for its discipline and leveling effect. What the country needs is escape from slavery to the almighty dollar, and education should strive to impart another ideal—such as responsible citizenship, for example.

Engineering education should be broadened and not narrowed; the biggest problems of the world today require men of vision, and the engineer of today is nearsighted. He can do one specific thing splendidly, and usually only one.

The above general statements answer your fourth question. In reply to the other three I would say: (1) The effect of experience with the S. A. T. C. is not yet crystallized, but the educators' viewpoint is undoubtedly changed; (2) yes, but not permanently; (3) no changes based upon Dr. Mann's report are yet proposed here.

Wisconsin to Return to Pre-War Courses

By F. E. Turneaure
Dean of the College of Mechanics and Engineering, University of Wisconsin, Madison, Wis.

Referring to your request for opinions regarding the effects of experience with the Students' Army Training Corps, I have the following to suggest:

1. The S. A. T. C. has, during the past quarter, interfered very seriously with the academic work of the College of Engineering at this institution, but it is generally conceded that the work of the engineering students has been better than that of the students of the College of Liberal Arts. This is probably due to the fact that the engineering students were pursuing studies more in accordance with the work they came to do than was the case with the other students. It is the judgment of the engineering faculty, I believe, that the lack of success of this experiment, from the academic point of view, was due partly to accidental circumstances and partly to the nature of the system itself—a combination of military and civilian life under two separate heads. The S. A. T. C. had a very considerable effect on the attendance, the number of freshman students being more than twice as large as the normal. Many of these will not return after Christmas.

2. With the demobilization of the S. A. T. C., the college will promptly return to its pre-war basis, without essential modification for the present year.

3. Due largely to the extra labor involved in the S. A. T. C. work, there has not been time for serious consideration of the suggestions contained in the report of Dr. Mann. This report will, however, receive careful consideration during the year.

4. I believe that the needs and opportunities which will be developed in the near future will not be radically different from those in the past, although they will doubtless differ considerably in degree. It seems apparent that engineering graduates have thoroughly made good in all kinds of war activities, and I do not anticipate any radical changes in engineering education. It is probable, however, that additional emphasis will be laid upon humanistic studies such as economics and sociology.

Missouri Sees Change in Spirit of Presentation of Courses

By E. J. McCaustland

Dean and Director of the School of Engineering, University of Missouri, Columbia, Mo.

Answering your questionnaire in categorical detail, I would say:

1. On the whole, I believe the influence of the S. A. T. C. upon the engineering colleges was good. While a great deal of friction developed, due to an overlapping of authority, yet the results were, on the whole, helpful. The experience has affected the educators' viewpoint in regard to the possibility of holding the student up to a higher standard of accomplishment than has ordinarily been done in the colleges. This result, however, can only be accomplished through special effort on the part of the teacher, and I believe that all wideawake teachers of engineering have come to appreciate their opportunities more fully from having observed at first-hand the effects of insistent demands on youth even though such demands come from young and inexperienced military instructors.

2. Whether the return to peace will mean a return to pre-war courses without essential modifications, is a crucial problem facing the engineering schools. For ourselves, we feel that the change most desirable is a change in the spirit of presentation rather than in the substance of the courses offered. We must show the student wherein he is rendering a service to the community and to the state by his more earnest attention to his preparation. Since the main motive actuating the members of the S. A. T. C. was the consciousness of making preparation for definite service as officers in the Army, we must show them that preparation for professional fitness will be as great a service to the state in times of peace as the other preparation would be in time of war.

3. We have not yet fully discussed the possibility of embodying in our courses some of the suggested solutions brought out by Dr. Mann in his study of engineering education, but our men are examining this report very carefully, and I believe we shall feel the reaction from such study in the coming term's work.

4. Two points will be emphasized in future engineering education, as a result of the war. First, the arousing of more interest in and furnishing greater opportunity for research. In general, research is sadly neglected in the engineering schools or restricted to very high-class work. I believe that recent experiences indicate that we need to develop a wider interest in research, so that latent research ability may be brought to the front and receive an opportunity to develop. Second, more than ever before there has been impressed upon us the supreme value of a thorough training in the fundamentals of science and in covering a broad field, to serve as a basis for later specialization. I think both of these points can be met only gradually as the point of view of engineering educators begins to concentrate more and more on these needs.

Curriculum Changed at Tufts College

By Gardner C. Anthony

Dean of the College of Engineering, Tufts College, Mass.

In the engineering school of Tufts college a most interesting and somewhat radical departure from previous curricula will be made. It is in line with the suggestions made by the Joint Committee on Engineering Education (Dr. Mann's report). Some of the recommendations made by this committee are not entirely new to the Tufts Engineering School, and the new curriculum which is offered to the freshmen already entered, and those about to enter Jan. 2, 1919, will embody details which have been tested before, but never properly correlated.

During the past year intensive courses were tried out for freshmen, and it was observed that high-grade work and enthusiastic application to studies can be obtained by giving them courses of a laboratory character which shall serve as introductory to the special courses leading to the several degrees, and accompanying such courses by such mathematics and physics as may be necessary for the logical development of the subjects.

Very recently, too, a readjustment of the five courses in engineering has made it possible so to combine them as to reduce the number to three; namely (1) civil engineering; (2) mechanical and electrical engineering, and (3) chemical engineering. Furthermore, the faculty had already postponed some of the more advanced mathematics to the junior year and had proposed postponing some of the physics until a more appreciative period of student development.

On registering for the next term the freshmen engineers will choose an introductory course in one of the three engineering departments. This will require nearly one-half of the total time allotted for study. In addition to this major course, the student will pursue but two other studies, which in the second term will be English and mathematics, and in the third term English and graphics.

By this plan, the attention of the student will be confined to but three, or at the most four, subjects, which will be properly correlated and pursued intensively. One of these, the main introductory course, is designed to give a proper perspective of the relation of the professional courses to the theoretical studies.

In the second year, each of the three engineering departments will offer a second and more advanced course accompanied by the necessary mathematics, physics and other subjects, which latter will be taught as a part of the departmental course. But the student

must elect an introductory course in another department; thus, it is designed to require introductory courses in at least two engineering departments, insuring a broader type of education than can possibly be obtained by specializing in one department.

This plan will postpone the main course in physics until the junior year and the most advanced mathematics until the senior year. It will also admit of considerable more election in the junior and senior years than has previously been possible. The modern language course will be conducted with special reference to the study of the commercial relations between the United States and foreign countries. To this end prominence will be given to the study of Spanish.

[*Several have replied that they felt it was too early to make definite statements on the questions raised, as they are still considering changes and studying Dr. Mann's report. Other replies will be printed in a later issue.*—EDITOR.]

Beam Deflections Under Distributed or Concentrated Loading

New Algebraic Method Proposed for Cases Usually Solved by Graphical Calculation Gives Accurate Results

BY J. B. KOMMERS
Madison, Wisconsin

DEFLECTIONS of beams can be calculated by an algebraic method that compares favorably with the graphical method both in time required and in accuracy. It is intended for use in those cases of combinations of uniform and concentrated loads for which the ordinary algebraic method would become very long and tedious. Simple beams, cantilever beams, beams fixed at one end and supported at the other, and beams fixed at both ends, will be discussed.

Suppose a simple beam has upon it a concentrated load, P. When P is at the center of the span the maximum deflection occurs at the center; when P is at the right support the maximum deflection occurs $0.577L$ from the left support. This means that no matter where the concentrated load is placed on the beam its maximum deflection will always be very near the center of the span, and therefore that the midspan deflection will be practically equal to the maximum deflection. This latter fact is utilized as the basis of the new method.

DEFLECTIONS OF SIMPLE BEAMS

In Fig. 1 the maximum deflection due to the two concentrated loads is to be determined. According to Maxwell's theorem, the deflection produced at the center, O, by the load at A equals the deflection produced at A by the same load placed at O. Therefore, place the 7000-lb. load at O, calculate the deflection it produces at A; place the 8000-lb. load at O and calculate the deflection it produces at B. The sum of these two deflections will be the deflection that the two loads at A and B produce at O and, as shown above, a very good approximation to the maximum deflection.

The deflection which a central load P on a simple beam produces at a point distant x from the nearest support is,

$$\text{Defl.} = \frac{Px^3}{12EI} - \frac{PL^2x}{16EI} \qquad (1)$$

Applying this equation to the case of Fig. 1, in order to get the maximum deflection by the method outlined,

$$\text{Max. Defl.} = \frac{7000 \times 60^3}{12EI} - \frac{7000 \times 180^2 \times 60}{16EI} + \frac{8000 \times 36^3}{12EI} - \frac{8000 \times 180^2 \times 36}{16EI} = -0.1971 \text{ inches.}$$

As a check upon this method, the correct maximum deflection was calculated; it was found to be 0.1970 inches.

If the beam in Fig. 1 is loaded with 13,000 lb. at A and 2000 lb. at B, the approximate result is 0.50% too small.

If the beam carries distributed loads on parts of its length as well as concentrated loads, the method is applied by breaking the distributed load into several sections and replacing these by concentrated loads at their centers of gravity. In Fig. 2 is shown a uniformly loaded beam. Such a symmetrical case would not require special treatment, but is chosen here to illustrate the method. Consider the load divided into four parts; then calculation by the approximate method gives 0.2525 in., while the exact value of the deflection is 0.2462. Thus, the approximate result is 2.56% too large. The load can easily be broken up into six parts instead of four, and then the approximation will be only 1.21% too large, a precision comparing favorably with that of graphical work.

If the beam in Fig. 2 is loaded over the left half of the span with a uniform load of 21,000 lb., and this is then broken up into three sections, the approximate method gives a result which is only 0.44% too large.

DISTRIBUTED LOADS ON CANTILEVER BEAMS

In a cantilever beam any load will produce its maximum deflection at the free end, so that the method described involves no approximation for concentrated loads. Distributed loads are broken up into sections, as before, and replaced by concentrated loads. The deflection produced at the free end of a cantilever by a load at A, Fig. 3, is

$$\text{Defl.} = -\frac{Pb^2}{6EI}(3a + 2b) \qquad (2)$$

Applied to the numerical case shown in Fig. 4 it gives 1.438 in. (correct deflection 1.443), so that the approximate result in this case is 0.35% too small.

If the same beam is loaded with 7500 lb. uniformly distributed on the half next to the fixed end, and this load is considered broken up into two sections for applying the approximate method, the result is 5.2% too small. Greater accuracy may be obtained by breaking the load into a larger number of sections; if four sections are used the deflection at the free end is only 1.5% too small.

It should also be noted that when there are several loads on the beam the uniform load near the fixed end produces only a small part of the total deflection. In the case of a uniform load over the whole beam, the half next to the fixed end produces only 14.6% of the total deflection.

BEAMS FIXED AT ONE END

Fig. 5 shows the case of a beam fixed at one end and supported at the other. For the case shown the absolute maximum deflection occurs under the load when $a = 0.414L$. When $a = 0.95L$ the maximum deflection oc-

curs at a point $0.568L$ from the left support. When $a = 0.05L$ the maximum deflection occurs at a point $0.332L$ from the left support. It will be assumed that for all ordinary combinations of loading the maximum deflection will occur at $0.414L$.

In order to determine the maximum deflection, it is necessary to determine the reaction, R, at the support. To do this, treat all loads as though on a cantilever beam, and determine the deflection they would cause at the left end. The deflection due to R must be exactly equal to the deflection of the loads. Therefore, solve for R from the following formula:

$$\frac{RL^3}{3EI} = \text{Deflection due to the loads} \qquad (3)$$

The deflections due to the loads will be found, of course, by the approximate method for cantilever beams heretofore described.

When R is known, the downward deflection caused by the loads at $0.414L$ is calculated, and from it is subtracted the upward deflection caused by R at $0.414L$. The difference will be a good approximation of the correct maximum deflection.

The formulas to be used for calculating the deflection at A in Fig. 6 are as follows:

$$\left.\begin{array}{l}\text{Due to}\\ \text{Load to}\\ \text{left of A}\end{array}\right\} \text{Defl.} = -\frac{P_1b^2}{6EI}(3a + 2b) \qquad (4)$$

$$\left.\begin{array}{l}\text{Due to}\\ \text{Load to}\\ \text{right of A}\end{array}\right\} \text{Defl.} = -\frac{P_2d^2}{6EI}(3c + 2d) \qquad (5)$$

$$\left.\begin{array}{l}\text{Do to}\\ \text{Reaction}\end{array}\right\} \text{Defl.} = \frac{0.1382RL^3}{EI} \qquad (6)$$

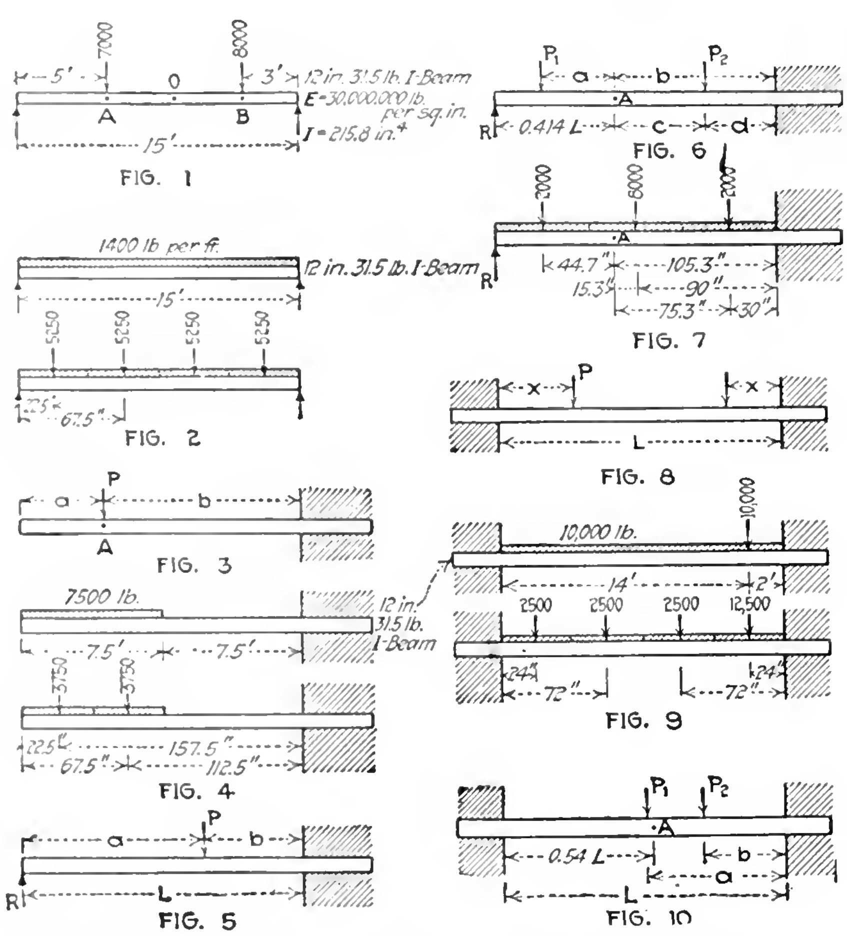
The method will be illustrated by working a problem which can be easily checked. Fig. 7 shows the loading. The deflection at the left due to the loads is 1.2262 in. Then $R \times 180^3/3EI = 1.2262$, and $R = 4087$ lb. Using this value, the deflection at A due to R is found from formula (6) to be 0.5088. By formulas (4) and (6) the deflection at A due to the loads is computed as 0.5865 in. Subtracting, the net deflection at A is 0.0777 in. This result is 1.27% too small.

If the beam in Fig. 7 is loaded with a uniform load of 15,000 lb. on the left half of the span, and this is then broken up into three sections, the approximate result is 1.64% too large. If the same load is placed on the right half of the span the approximate result is 4.02% too small. Thus, for uniform load near the fixed end the degree of accuracy is not as great as for the same load near the left support.

Investigation shows that for the load near the left support increased accuracy can be had by breaking up the load into more than three sections. For the uniform load near the fixed end, however, the error is due to the fact that the maximum deflection occurs near the center of the beam instead of at $0.414L$ as assumed. It is recommended, therefore, that for those cases in which all the loads, both uniform and concentrated, lie to the right of the center of the beam, the deflections be calculated at $0.47L$ instead of $0.414L$. In this case the deflection at $0.47L$ due to the reaction is

$$\text{Defl.} = \frac{0.1155RL^3}{EI} \qquad (7)$$

If in the case of the beam loaded on the right half of the span the deflections are calculated at $0.47L$, the result is only 0.17% too small.



BEAMS UNDER DIFFERENT CONDITIONS OF SUPPORT AND LOADING ADAPTED TO ALGEBRAIC CALCULATION OF DEFLECTIONS

Fig. 8 shows a beam which is fixed at both ends. The absolute maximum deflection for a concentrated load will occur under the load at the center of the beam. Even if the load is distant from the right support only $0.05L$, the maximum deflection will occur at $0.653L$, or still quite near the center. This, of course, is an extreme case, and as in the case of simple beams it will be assumed that the maximum deflection occurs at the center. The deflection which a load P, in Fig. 8, causes at the center is given by the formula

$$\text{Defl.} = -\frac{PLx^2}{16EI} + \frac{Px^3}{12EI} \qquad (8)$$

The sum of the deflections found in this way will equal the maximum deflection.

Fig. 9 shows a numerical case with the concentrated load quite far to one side of the center. The approximate result in this case is 0.69% too small.

When the beam in Fig. 9 is loaded with a uniform load of 15,000 lb. over the right half of the span, and this is then broken up into three parts, the approximate method gives a result which is 2.85% too small. Investigation shows that the error is due to the fact that the maximum deflection falls to the right of the center instead of at the center, as assumed. It is recommended, therefore, that for those cases in which the loads, both uniform and concentrated, are all on the right side of the center of the beam, the deflections be calculated at a point $0.54L$ from the left end. For this purpose two formulas are necessary. The deflection at A, Fig. 10, is,

$$\left.\begin{array}{l}\text{Due to}\\ \text{Load to}\\ \text{right of A}\end{array}\right\} \text{Defl.} = -\frac{0.06707}{EI}P_2b^2L + \frac{0.09332}{EI}P_2b^3 \qquad (9)$$

$$\left.\begin{array}{l}\text{Due to}\\ \text{Load to}\\ \text{left of A}\end{array}\right\} \begin{array}{l}\text{Defl.} = -\dfrac{0.06707}{EI}P_1a^2L + \dfrac{0.09332}{EI}P_1a^3\\ \qquad\qquad -\dfrac{P_1}{6EI}(a - 0.46L)^3\end{array} \qquad (10)$$

When the left half of the beam is loaded the distances a

and *b* in the formulas are measured from the left end of the beam.

When these formulas are applied to the beam shown in Fig. 9 with a uniform load of 15,000 lb. over the right half of the span, the result is only 0.17% too large.

The examples which have been worked show that the approximate method here suggested gives results which are at least as accurate as would be obtained by a graphical method. In the matter of speed in getting a solution, the method suggested will be found much superior in a great many problems.

Alaska Government Railway Nearly Half Completed

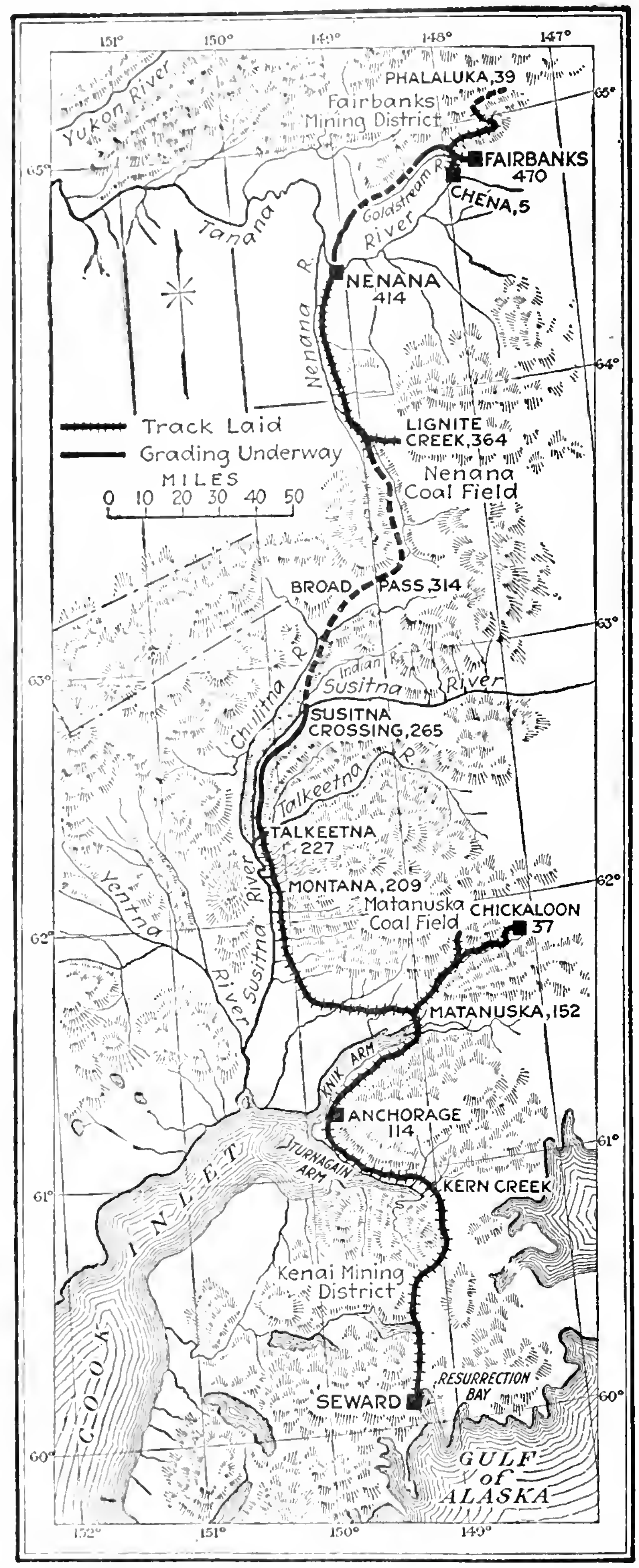
Main Line Open for 227 Miles, with 38-Mile Branch —Summit Elevation 2319 Feet—Grading By Stationmen

PROGRESS of construction on the Alaska railroad by the United States Government is called to attention by the recent completion of a 16-mile link which gives a 190-mile rail route from the Matanuska coal fields to tidewater at Seward, on the Gulf of Alaska. This was noted in *Engineering News-Record* of Sept. 26, p. 600. An extended article on the work up to 1916, by Thomas Riggs, Jr., formerly member of the Alaskan Engineering Commission and now Governor of Alaska, was published in *Engineering Record* of May 6, 1916, p. 600. The following brief review of this Government railway enterprise down to the present time is abstracted from a paper by Col. Frederick Mears, U. S. A., also formerly a member of the commission, in the *Alaska Railroad Record.* The route of the railway, with the parts completed and those under construction, is shown on the accompanying map.

An earlier commission, to study the transportation situation in Alaska, was appointed by the President in

GRADING ALONG SHORE OF TURNAGAIN ARM

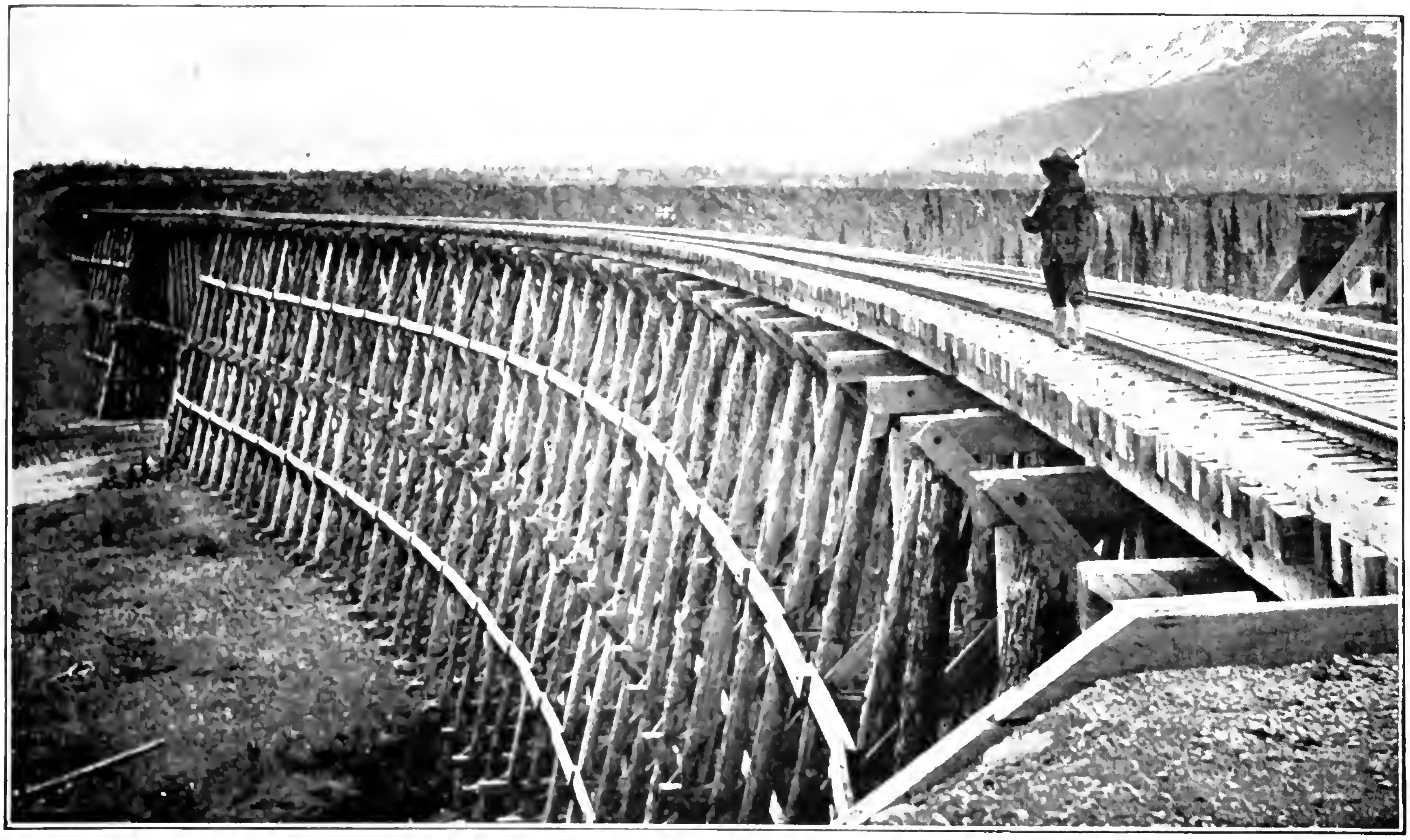
1913. This was headed by Maj. J. J. Morrow, Corps of Engineers, U. S. A., and its report was made in January, 1914. In March, 1914, Congress passed an act authorizing the President to construct and operate railways in Alaska and to acquire existing lines. The cost of the proposed system was estimated at $35,000,000.



MAP SHOWING TRACK LAID AND GRADING UNDER WAY

The present Alaskan Engineering Commission was appointed by President Wilson in the spring of 1914, with William C. Edes as chairman and chief engineer, to work under the general direction of the Secretary of the Interior. During the summer 13 parties were in the field, surveying mainly along two routes outlined by the first commission. Three bases of supplies were established: At Seward on the Gulf of Alaska (then the terminal of the Alaska Northern Ry.); at Anchorage, the head of ocean navigation in Cook Inlet, and at Fairbanks, the head of river navigation on the Tanana River. On the basis of the report made in 1915 the route from Seward to Fairbanks, 470 miles, was adopted, and in April the duties of the commission were extended to include the construction of the line.

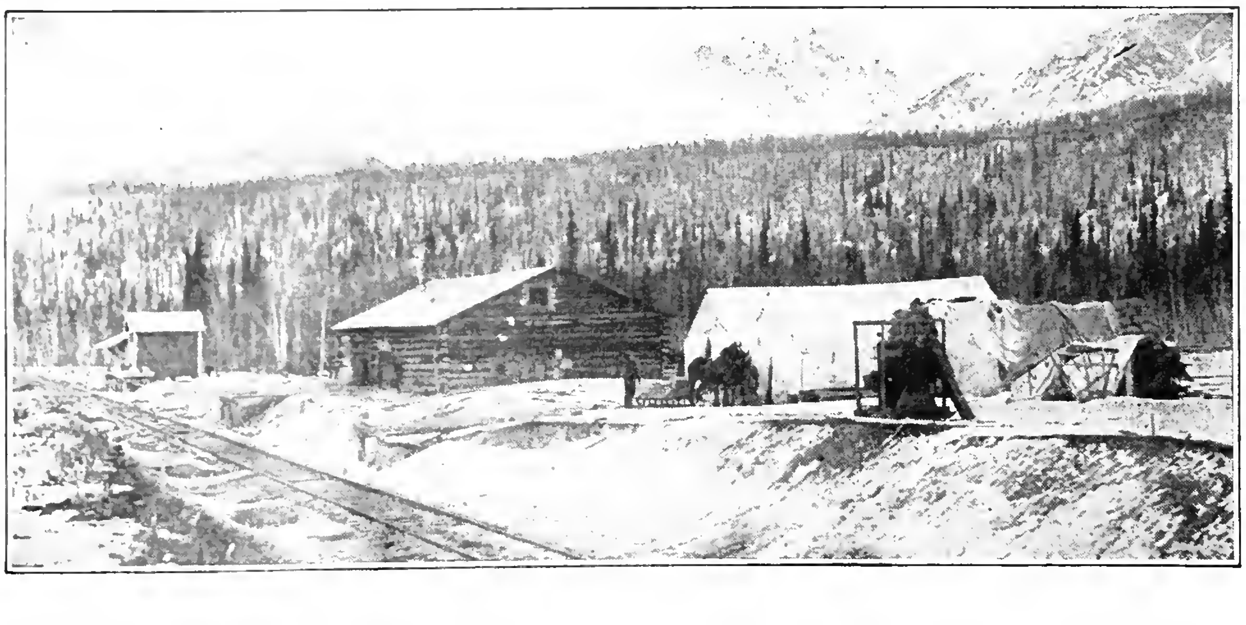
The Alaska Northern Ry. was a private enterprise,



TRESTLE WITH TIMBER TRUSS SPAN ON THE ALASKA RAILROAD—EAGLE RIVER, MILE 127½

started in 1904 but abandoned in 1909 with track laid for about 70 miles from Seward to Kern Creek, of which about 47 miles were operated in summer by gasoline cars. This line was purchased by the United States Government for $1,150,000, and its rehabilitation cost about $1,800,000. The location of the new Government line, north from Kern Creek, follows along the shores of arms of the sea to Anchorage and then to the mouth of the Matanuska River, whence a 38-mile branch extends to Chickaloon in the coal district. It then strikes west to the Susitna River, which it follows to mile 265, where it makes a crossing and then follows the Indian River and the forks of the Chulitna River. After crossing the Chulitna Pass and Broad Pass the line follows along the west bank of the Nenana River to mile 373, where it crosses and follows the east bank to the town of Nenana, at the junction with the Tanana River. It then crosses the latter river and follows the Goldstream valley to the terminus at Fairbanks.

A summit elevation of 2319 ft. is reached in Broad Pass (mile 314) on the continental divide. The max-



STATION BUILDINGS AT ANCHORAGE AND STATION BUILDINGS AND COMMISSARY AT KING RIVER, MATANUSKA BRANCH

imum grades are 2%, but on the greater part of the line they do not exceed 1%. Grading and clearing are done in short sections by stationmen, and Colonel Mears states that in view of the abnormal war conditions of high labor and material costs it is fortunate that the commission adopted this system instead of letting a general contract under the very different conditions of 1915.

Grading was classified as solid rock, loose rock, frozen material and common excavation. Clearing of right-of-way was let at $35 to $100 per acre. Piles, culvert timber, ties and poles were obtained from native timber, but lumber was imported for bridge trusses and decks. Track-laying was done partly by steam tracklaying machines.

The heaviest construction on the entire line is along the north shore of Turnagain Arm. Occasionally there are short benches which were utilized for the roadbed, but for the greater part of the distance the roadbed had to be formed along steep slopes. The country is so rough that it was impossible to avoid heavy work even by the liberal introduction of curvature. In many cases heavy sidehill fills were made to avoid expensive cuts in the precipitous rock bluffs. The slopes of these fills extend into the water and are subject to erosion by the tides and waves. Timber culverts and trestles are numerous, with timber truss bridges over larger streams. It is estimated that about 8000 ft. of snowsheds will be required in this district. These will have to be of substantial construction in order to resist the slides, which start from long distances up the cleared mountain side.

How Materials Were Distributed

For work north of Anchorage the camps were supplied largely by barges working along the east shore of Knik Arm. In order to expedite work on the Matanuska branch, materials were distributed for about 18 miles from the junction during a severe winter by bobsleds working on the bottom lands of Knik Arm and on the ice of the Matanuska River. Where the main line lies along the Susitna River for about 75 miles, materials and supplies were distributed along the first 50 miles by a stern-wheel river steamer of 100 tons cargo capacity, which had been used previously for construction work on the Grand Trunk Pacific Ry. On the next 25 miles the river is cut up into numerous channels, with intervening bars, so that navigation is difficult. For this part of the river three propeller boats of the tunnel type were used, having a draft of 12 in. when light and about 20 in. with a cargo of 30 tons.

In 1917 the Matanuska branch was completed, and in 1918 the tracklaying on the main line was pushed north to Talkeetna, the 16-mile link along Turnagain Arm also being completed. About 50 miles of track has been laid south from the Tanana River, and some work has been done around the northern terminal at Fairbanks, where the old lines of the Tanana Valley Ry. form branches to Chatanika and Chena.

William C. Edes is chairman and chief engineer of the Alaskan Engineering Commission. William Gerig is consulting engineer; F. D. Browne and R. J. Weir are engineers in charge; W. J. H. Fogelstrom is bridge engineer; F. A. Bailey and H. F. Dose are district engineers. The main offices are at Anchorage, Alaska.

Departures in Canal Design and Location Effect Saving

Minimum Excavation, Greater Bottom Width and Omission of Upper Levee—Full Tunnel Bore Used

By Everett N. Bryan
Chief Engineer, Waterford Irrigation District, Waterford, Cal.

DEPARTURES from customary practice in canal design and location have saved money for the Waterford Irrigation District, California. These departures have included changes in canal section, omission of the upper levee or bank, and grade changes in both canals and tunnels for the sake of economy. Canals have been satisfactorily located without using a transit. Mass diagrams have been used on excavation and embankment studies.

In one case the design of a canal of 100 sec.-ft. capacity which it had been proposed to construct with an 8-ft. bottom width, 1½ to 1 inner slopes and a 5-ft. water depth, had its bottom width increased 10 ft., its inner slope on the upper side changed to ¾ to 1, and the levee on the upper side entirely omitted. The prime reason for the change was that it was impractical to attempt to balance excavation and embankment quantities, because the materials to be excavated were largely talc, hardpan and soft sandstone, and wholly unfit for forming impervious levees. It was desirable instead to seek a design which would require the least depth of water above the natural ground surface with a minimum of excavation. The minimum depth of cut for the lower slope was fixed at 3½ ft. (except in the rare instances where the application of this minimum to the crossing of small washes would have introduced sharp and adverse curvature), and this minimum of 3½ ft. was increased to 4 ft. where outcroppings of hard material gave evidence of an unusually shallow earth covering and shortage of levee-forming material. Thus, in general, the maximum water depth above the natural ground surface was 18 in. and this was decreased to 12 in. or less when there was an exceptionally small amount of soil.

Greater Freedom for Scraper Movement

The advantages of the adopted design were found in greater freedom of movement for scraper teams in the bottom of the canal and a very considerable reduction in the quantity of excavation. An 8-ft. bottom width is a little narrow for easy operation of a four-horse scraper team in so deep a ditch in other than "cross-fire" work, and the alteration of the shape of the cross-section effected a reduction in the volume of excavation required, ranging from 6% for a 3½-ft. lower-slope cut on a ground-surface slope of 1 on 6, to 24% for a 4-ft. lower-slope cut on a ground-surface slope of 1 on 3½. The ground-surface slope for this particular canal varied between these limits on the sidehill location.

The omission of the levee on the upper side gave a considerable increase of materials for the levee on the lower side, where it was particularly important to strengthen that bank. There were few instances where the omission of the upper bank permitted the canal to spread out over more than a few feet. In addition,

the absence of an upper levee simplified to a great extent the problem of caring for drainage from above the canal. Had an upper levee been constructed, the number of passages through it or of culverts beneath the canal would have been very great and would have required a large expenditure. Without it, the drainage is collected by the canal and discharged at comparatively infrequent intervals through waste gates in the lower levee, where a minimum of damage will result.

Saving by Single Levee and Change of Location

The application of this plan of using a single levee was not abandoned in one extreme case where the water in the canal spread out to form a lake reaching back about 800 ft. and flooding several acres. At this point the original location followed the usual practice of a 3½ ft. minimum cut for the lower slope, and only a very small area was flooded. The location was changed when it was revealed by a new survey that by throwing a levee across the cañon at a lower point the length of the canal could be shortened 1700 ft., with attendant saving in grade and a 36% saving in construction cost over that of the original location, after paying for flooded ground and a levee of double strength.

The not uncommon practice of diminishing the section and increasing the grade was sometimes adopted for portions of canals lying in deep cut, but accomplishing much economy in this way requires a considerable sacrifice of grade, and this was not always practicable. In such cases another alternative was adopted—that of dropping the bottom grade and narrowing the section. This effected a considerable saving in excavation, with no loss in the water cross-section, and with the use of short, taper sections return could be made to the old grade at the lower end of the cut, without appreciable loss of head. A canal 4 ft. deep with an 18-ft. bottom width and ½ to 1 slopes may thus be narrowed to one of 13½-ft. bottom width and the same slopes, by dropping the grade only 1 ft. and creating a water depth of 5 ft. The water area will not be decreased, and the economy effected will vary from nothing for a 4-ft. level cutting to 10% for a level cutting of 20 ft. Still greater economy may be effected by a further lowering of the bottom grade.

The "jumping up" presents some difficulties to the lay mind, but it may be understood that it presents no real obstacles if one will but pause to study the bottom grade of any of nature's water courses. He will find there a grade which is not always continuous, but often adverse. Where the banks are obdurate, nature has a way of digging down for more room, and when again they offer less resistance than the bottom the grade of the bottom is "jumped up."

Saving Effected by Using Full Tunnel Bore

This method of economizing in the deeper sections of canal excavation is particularly applicable in the design and location of tunnel sections. Tunnels are often seen on irrigation, municipal and hydro-electric developments with the bottom grade located continuous with that of the canal above and below, and an area above the water surface almost equal to, if not greater than, the water area. In many of these cases it would have been practicable to lower the bottom grade so as to use the full area of the bore and thus save largely in the cost.

In one case, on a Waterford Irrigation District canal with a water depth of 5 ft., the bottom grade of the tunnel was dropped 3 ft. so as to fill the entire bore. The grade was not again "jumped up" until the lower end of the lower approach cut was reached. This was about 1300 ft. from the portal. The canal bottom in this approach cut was 8 ft. wide and the water depth was 8 ft., with side slopes of ¼ to 1. To have secured the same water area with an unbroken continuity of grade would have required a canal bottom width of 14¾ ft. and ¼ to 1 slopes. The center cuts of this approach ranged from 28 to 8 ft. To have constructed this canal with an unbroken grade would have increased by 23%, excavation for the average cut in this portal.

Wasteway Provided to Cleanse Pocket

To cleanse the pocket created by the dropping thus of the bottom grade in the tunnel and lower approach, a wasteway was provided at the lower end. This continued the low grade to an open spill. Materials sloughed from the sides of the canal or tunnel may thus be sluiced out by occasionally diverting the discharge of the canal through the wasteway.

That the pockets so formed will fill to any great extent is unlikely. Débris or silt carried in suspension in a canal will not deposit unless the velocity of the stream is arrested, and this does not occur in such a case. Particles being rolled along the bottom may find difficulty in negotiating the grade at the point where the "jump up" is made, but in most cases this will cause little trouble. The increased water depth on the canal sides and the saturation of the top of the tunnel may induce a tendency to slough. Both this and the likelihood that pockets will fill must always be considered.

Where the materials taken from the canal prism were suitable for forming levees, an effort was made, of course, to balance the cut section with the fill section. On the side-hill location with a single levee it was found that the lower-slope cut would vary only a very little in securing this balance. It increased slightly as the inclination of the slope of the natural ground increased. The proper depth of cut at the lower slope could be easily determined for the various ground-surface slopes likely to be encountered, and because this depth of cut changed so little it was easy at any time to locate it on the hill side and know that a reasonably close balance of excavation and embankment areas was secured. The center cuts for the various inclinations of the ground surface were also computed, and it was these which were actually most used in the location work. They changed rapidly as the inclination of the ground surface changed, but with a little practice rodmen soon acquired the knack of calling for the proper cut. It was but a moment's work at any time to correct or verify the rodman's judgment by stopping to catch the lower slope.

Transit Not Used on Location

A transit was not used in location, and the work proceeded somewhat as follows: Without particular attention to alignment or chaining, the rodman proceeded from station to station, setting temporarily the

center stakes at an elevation on the side hill which would as nearly as practicable give proper balancing quantities—the levelman assisting by placing him where the cut would be that called for by the rodman. When in doubt, the rodman stopped to test his judgment by finding the cut at the lower slope. When the limit of the range of vision for the level "set-up" was reached, the rodman returned over the line to the initial point, ironing out the abrupt changes in the alignment. Beginning there again, he worked forward over the line, carefully chaining in and establishing the center line and taking cross-sections—the tapeman lining him in always to the next temporary center peg ahead. When the limit of the levelman's range of vision was again reached he moved forward. If a line of check levels be excepted, only once was it necessary to run an instrument over the line.

Now that construction of these canals is complete, it is doubtful that any difference could be detected between these canals and those located with the aid of a transit, unless the former should attract attention by reason of the evenness of their construction, because of the perfect balance between excavation and embankment. Nature has a marked tendency to work in easy curves, and as has been aptly said by an eminent engineer of the older school, "Water is not very particular just how it goes, so long as it can keep sliding down hill."

Mass Diagram for Each Canal

A mass diagram was worked out for each canal as soon as the yardage could be computed. It was the aim always to have this curve climb a little, and thus show an excess of excavation, to provide for the shrinkage which will almost inevitably occur in moving earth from excavation to embankment. If the curve was found to vary unnecessarily, the matter was considered by the chief, together with the locator. An estimate of the cost of relocation was easily made, and this was compared with the possible yardage to be saved thereby. A 100% perfect relocation would effect a 50% reduction in the excess cut or borrow, but in practice it is impossible of course to secure such a relocation, even were it desirable, and it is needless to say that in many cases the 100% perfect relocation, so far as lack of excess cut or borrow is concerned, is not the best location.

The locators soon developed a keen desire to develop the best mass curves practicable, because these were "yardsticks" by which their skill was readily measured. A miscalculation on the original location was an interesting field for speculation as to the percentage of perfection which could be obtained by another try. If it were known that the cost of a relocation, with attendant office expense, would be more than compensated for by a reduction in the cost of excavation, the relocation was made, regardless of the layman's censure of another survey or the additional charge to engineering expense.

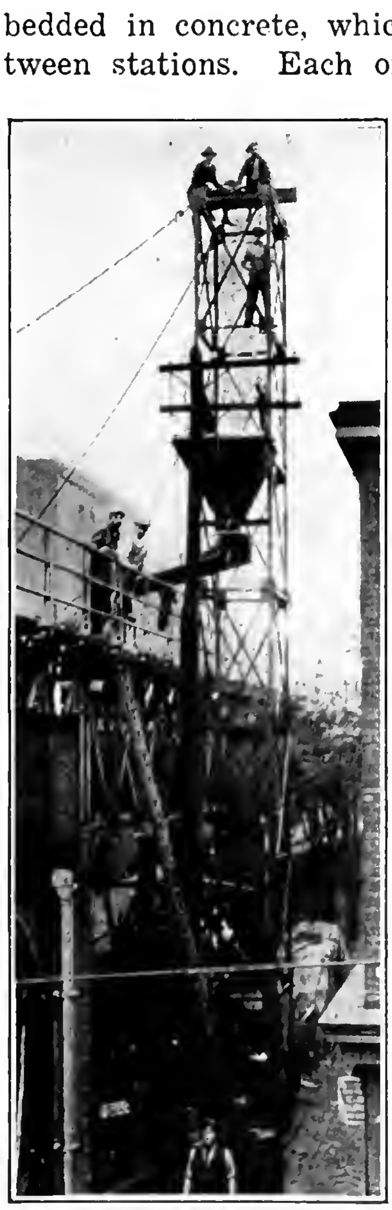
The mass diagrams were placed at the disposal of contractors bidding upon the work and were interpreted to them if necessary. In the preparation of monthly and final estimates they were found invaluable. Duplicates were furnished to the foremen in charge of the grading crews. At first they had some difficulty in getting away from the idea that these were some sort of modified profile, but they generally did get away from such idea, and it was not long before many were ardent students of their mass curves and were cutting their haul effort to a minimum.

These were but a few of the economies practiced in the matter of the canal location and design. With such savings, together with those practiced in other branches of the construction program, success was achieved in putting through, without diminution in quantity or quality, during the years 1916, 1917 and 1918, the work intended to be done by bonds voted early in the first-named year. This was accomplished in spite of the phenomenal rise in prices which began late in 1916 and raised the cost of most construction by from 10 to 60% of the original estimate on which the bonds were voted.

Movable Towers Concrete Deck of Philadelphia Elevated

Station Work and Straight Sections on Six-Mile Stretch of Frankford Line Divided Between Two Mixing Gangs

HAVING one crew organized and trained for the straightaway concreting work between stations, and another with a separate organization for putting in the different type of deck required at stations, is the method adopted by the contractor in concreting the deck of the Frankford elevated line in Philadelphia. The stations have a track section with short ties embedded in concrete, which ballasted track is used between stations. Each of these gangs uses a mixing plant on the street, with a 40-ft. steel tower to hoist the concrete to runways on top of the structure. Each gang has two towers and two hoists, so that one can be moved and rigged while the other is being used.



PORTABLE TOWER PLANT

The Frankford elevated line, part of Philadelphia's new rapid transit system, was well under way when the war broke out, and now is so nearly completed that it is hoped it can be put in operation at an early date. The steelwork has been erected from Callowhill St. in Philadelphia to Deyer St. in Frankford, and about half of the 27,700 yd. of concrete to go in the track deck over this six-mile stretch has been placed. The steelwork consists of two types. One has columns on the sidewalks, capped by transverse plate girders which support three lines of longitudinal lattice truss girders, one between

the tracks and two outside. In the other type the three rows of lattice girders are carried on a line of single column bents between the car tracks in the center of the street. The problem of concreting the deck is the same on both types, the deck consisting of jack arches between cross beams at right angles to the track carried by the longitudinal lattice girders. As may be seen from the photographs, the concrete deck does not extend quite to the center of the outside girders, being carried only 12 ft. out on each side from the middle girder.

Sheet steel forms, curved to fit the arch section, and flanged along the bottom edges to rest on the lower flanges of the I-floor-beams were used. Each form section is 3 ft. wide and is collapsed by two turnbuckles. There are thus four of these forms to one arch on each side of the central girder, and with an average progress of 100 cu.yd. or a little more than 100 lin.ft. of structure per day for each gang, enough forms for about 1000 lin.ft. of double-track structure were provided. When the placing is being done close to the tower, and the buggy run is therefore short, as much as 160 lin.ft. is accomplished in a day by one gang.

Work on the deck was begun at the end of October, 1917, with a traveling mixing plant mounted on top of the structure. This plant, before it was closed down for the winter, concreted about ½ mile on Front St., where the base of the rail is 45 ft. or more above the street level on account of several railroad crossings. The plant consisted of a ½-yd. mixer supplied by overhead bins holding material for about 8 yd. of concrete. On the rear end of the traveler was mounted a small derrick, which supplied the bins, using a dump bucket. Three buckets were used, being loaded by hand on the street with sand and gravel. The derrick also hoisted the cement. The entire rig was mounted on one set of timber stringers and rolled on another. It occupied only the east half of the elevated structure, and, on account of the design of the steelwork, it was difficult to move it. The central girder of the steelwork was

TRAVELING PLANT SUPPLIED BY DERRICK

at the same elevation as the outside girders, but sidewalk brackets carried on top of the outside girders prevented rolling the traveler on it. It was therefore necessary to use a platform of 12 x 12-in. timbers, extending from the center girder to the outside girder and resting on the latter between the sidewalk brackets to carry the stringers on which the traveler was rolled. These timbers were taken out and swung ahead by the derrick, which was placed so as to reach both ends of the traveler. It is stated that this plant proved to be slow, for its output was limited by the capacity of the one derrick.

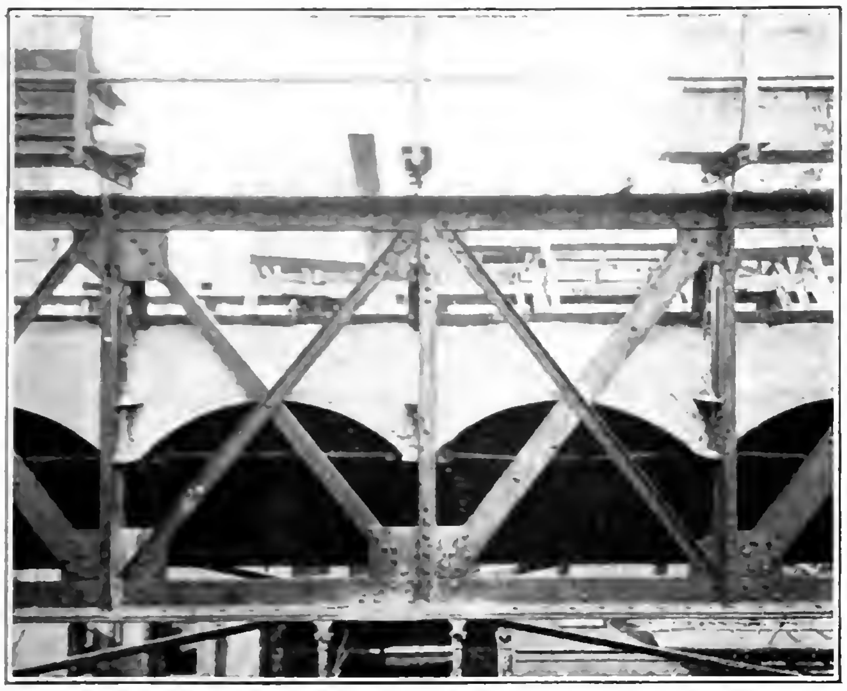
When work was resumed last spring this traveler was dismantled and four steel towers were placed on the job. These were set up at street intersections and a length of one block each way was concreted from each set-up. While the concrete gang is using one plant, the rigging gang takes down the last tower and hoist and moves them ahead to the next set up. The towers are erected in sections, with a gin pole and crab. The plant investment is reduced by using only two ¾-yd. mixers.

These are mounted on wheels and are pulled along the street by a truck. It is possible to move one of them and set it up while the gang is moving and reassembling the runways, buggies and forms. The mixers are of the type that is loaded by a charging hopper filled with wheelbarrows from material piles on the street. Sand, gravel, and cement are delivered in motor trucks by the material-supply firms, to the mixers.

The main runway is carried on the central lattice girder, the buggies being dumped down a movable chute into the section being poured. This runway is connected by a plank bridge about 12 ft. wide to the side of the structure at the tower, giving the buggies room to come up and turn under the hopper into which

CONCRETE PLACED BY BUGGIES FROM CENTRAL RUNWAY

the tower skip discharges. As the work progresses away from the tower, passing platforms long enough to hold about two buggies are put in at the side of



FORM COLLAPSED BY TURNBUCKLES

the main runway, being carried on joists to one of the outer girders.

The deck is divided into sections by the steel plate transverse girders which support the longitudinal girders, the spans varying from 42 ft. to 72 ft. It is usual to pour from two to three of these sections in a day, averaging about 100 yd. of concrete for each gang. The largest runs have been about 160 yd. The concrete gangs employ each from 38 to 40 laborers, four carpenters, three or four cement finishers, two to three foremen and two engineers. Each gang is under its own superintendent. While of about the same size, the gangs are organized differently.

The deck between stations is finished with a smooth top, on which a ballasted track is to be laid. The deck at stations is carried up to within 3 in. of the bottom of the ties, and paving stones are half embedded under each rail in the space between the ties, to form a bond between the deck and the concrete in which the ties will be set. When the station gang has finished all of these sections it will go to work on the curve sections, where the floor-beams spacing is irregular and special forms are required.

The erection of the steelwork was completed in 1917. The construction of the track floor, walk ways, and drainage provision was let to the Keystone State Construction Co., which sublet the concrete track floor to the Union Paving Co. The work is being carried on under the Department of City Transit of Philadelphia, of which W. F. Twining is director, and Henry H. Quimby is chief engineer. Construction is under the immediate supervision of M. Golder, division engineer.

New Law for Venezuela Railroad Concessions

A NEW law, states a commerce report, has been passed relating to railway concessions in Venezuela. New or changed provisions are as follows:

The Government will guarantee no interest on capital invested in the construction of railways.

A contractor for any railway must make a cash deposit proportionate to the length of the line and the width of gage—ranging from 600 bolivares per kilometer for 0.610-meter gage to 1400 bolivares per kilometer for 1.435-meter gage. The Federal executive may reduce this deposit at his discretion by as much as 15 per cent.

The Federal executive may or may not reserve in contracts the right of buying the railway and its equipment, with six months' notice to the enterprise. It is optional to the Government to make this purchase upon appraisal, paying 20% premium on the value of the enterprise, or by paying the price represented by value of the capital stock at the time of purchase with a premium of 10%. In all cases of purchase the appraisal shall be made by experts, and the purchase price shall be paid to the enterprise upon transfer of property.

The Federal executive shall have the power to require a reduction of rates when the annual tonnage transported by the road shall exceed a certain amount to be fixed in each case.

In contracts for building railway lines the following franchise shall be granted: Free duty on importation, during the first 25 years of the concession, of rolling stock, engines, tools, utensils and necessary implements for the building, exploitation and maintenance of the line and its branches, it being understood that said franchise shall lapse if it be proved that any of the exonerated goods have been designed to uses other than those of the company which obtained the contract, without express permission from the minister of public works. For the purposes of the exoneration of the custom duties the corresponding provisions of the code of finance must be complied with.

California Water Commission Advises Change

Abolition of the salaries of two of the three members of the California State Water Commission, making the remaining salaried commissioner the sole executive officer in water-right appropriation matters, with right of appeal to the full commission, is recommended in the second financial report of the commission. The recommendation is based on a study of water-control methods in 15 "irrigation" states, which study shows that in nearly all cases the plan recommended is in force. A vital need exists, the report states, for legislation giving an individual the right of eminent domain for rights-of-way for ditches, the same as is enjoyed by public utilities. This is necessary because it is required of anyone desiring to appropriate water that he have the right of access to the proposed point of diversion, and because of the frequency with which such rights have been withheld when an offer of reasonable compensation has been made. The commission began operations in December, 1914, and up to Sept. 1, 1918, had considered 1059 applications for water for agricultural, mining, power and domestic purposes. The commissioners are A. E. Chandler, Berkeley, president; W. A. Johnstone, San Dimas, and Irving Martin, Stockton.

Training 350.000 Men for the Shipyards: How the Fleet Corporation Met the Problem

By J. Will Parry

Lately Executive Assistant to the Director of Education and Training, United States Shipping Board, Emergency Fleet Corporation, Philadelphia

Building ships for the war emergency required many men, an army of skilled workers, to be assembled and trained in the shortest possible time. Ordinary methods of training were hopelessly inadequate for creating this force. The Emergency Fleet Corporation developed new methods by which it solved the problem. Personal training by working instructors made from intelligent yard mechanics is the core of the solution. Schooling for foremen and executives, to improve leadership, constitutes an important auxiliary development. Numerous other special fields of training called for the Emergency Fleet Corporation's labors. Mr. Parry, who was in close contact with the direction of the Education and Training Section of the corporation until his departure for Europe to take up educational work in the Army, sketches very briefly the methods used and some of the results attained.—Editor.

Early in the emergency shipbuilding the man-power problem was seen to be one of almost startling magnitude. There were about 40,000 shipyard workers in the country—not all of them in the shipyards. The full complement required to produce the ship output projected was about 400,000. Thus—disregarding that bothersome leak in the bottom of the pail, labor turnover—every shipbuilder had to be multiplied by 10, and that, too, at a time when all industries were bidding for skilled men.

Dilution processes, which depend on the survival of the fittest, could develop these men. But these are slow processes, and the men for the shipyards had to be developed rapidly. Furthermore, dilution would have involved, inevitably, a material loss in production, due to the skilled workers having to give time to instruction. Clearly, the task was hopelessly beyond the reach of dilution methods.

Three Sources of Labor

Labor could be obtained from three sources: First, skilled shipyard craftsmen not already employed could be impressed into the service (the supply from this source would be so soon exhausted as to make it a negligible factor in the problem); second, mechanics not trained in shipbuilding but skilled in crafts similar to the shipyard trades could be "converted" to the particular operations required in the shipyard. With men obtained in such ways might be considered partially trained mechanics in shipyards who could be developed to higher degrees of skill. Together, these groups could furnish a supply somewhat larger, but still hopelessly below the needs of the case. As the third and only remaining source, there was the supply of unskilled labor—green men with little or no knowledge of any mechanical trades. In view of the numbers required, this was the only source offering hope of meeting the needs of the case.

Thus, the kernel of the problem was, how to train absolutely green men and make them into shipyard workers, and do this rapidly enough to perform the work allotted to the yards.

Training men for shipyard occupations is not essentially different from industrial training of any other kind; and providing the men needed for quantity production of ships is essentially the same under emergency conditions of war time as under normal peace conditions. However, there was the magic bidding, "Do it quickly," and this, as a governing condition, did effectively stimulate decision, sweep away suspicion, and bring out into relief and place in proper grouping many facts and tendencies of training which under normal conditions of development come to light so slowly and in such scattered form that they are not easily distinguishable.

Nature of the Essential Training Task

When the shipbuilding program was planned, the shipyards of the country were forced to think in figures entirely beyond the customary in magnitude. Few of the managers could perceive all their problems clearly enough to be able to set them down in proper order and attack them consecutively. In consequence, plant construction got ahead of housing conditions, steel supply was now ahead of hull construction and now behind, and, in general, things moved by jerks rather than smoothly, as is inevitable with any great, unestimated project that is still finding itself. The man-power problem was one of the earliest and most obvious in claiming attention, and it remained the primary problem throughout the whole stage of shipyard development hardly concluded yet. The 61 shipyards, with 235 ways, of the early part of 1917, had grown to 198 yards, with 1083 ways, at the time the armistice was signed, and 80% of the ways were completed. This growth, and the numbers of men involved in both construction and in shipbuilding, will serve to define the problem of man-power, and hence that of training men.

The chief training problem was centered in the yards building steel ships. The seven concrete shipyards among the 198, for example, use, largely, unskilled labor. Wood shipbuilding, carried on in 114 yards, presents a much simpler labor development problem than steel shipbuilding. There is not so great a diversity of trades to deal with, and related trades of ready conversion possibilities are more numerous; also, dilution can be more readily accomplished, as the typical gang organization of the work is more nearly the

proper organization for training green men The 77 steel yards, therefore, presented the main bulk of the training problem. Again, in these, the hull construction trades constituted the most immediate need.

Ten trades called for trained workers in the largest numbers. These were: Bolters-up, chippers and calkers, drillers and reamers, erectors, rivet heaters, holders-on, riveters, shipfitters, ship carpenters, and electric welders.

Emergency Training Method Applied to the Main Problem

Two fundamental premises underlie the emergency plan of training developed by the Education and Training Section of the Emergency Fleet Corporation:

1. Learners must be instructed by work on production jobs, because: (a) Counterfeit jobs do not present a sufficient breadth of field for all-round effective training; (b) keeping learners off production work means waste of material and tools; (c) the stimulus of working on a job which will go to sea rather than on a play box is essential—as was recognized very early in the work.

2. Instructors handling gangs of learners must be men who are expert in the trade in which they are instructing, and who at the same time know how to teach it, and are free to produce skill rather than riveted plates. Training is essentially a production job, but its main product is skill, its byproduct is finished goods.

Production work, and working teachers, were thus the two essentials.

Any experienced training man will recognize at once that the critical element in this enterprise was the corps of instructors, the "skilled mechanics, who can teach." Teaching ability is sometimes called a gift. Emergency does not wait for gifts, however. It was necessary to develop the required number of yard instructors by training. The Emergency Fleet Corporation's training question, then, was to train yard instructors for training green men in yard crafts. The scheme developed for this work was to put selected mechanics through a training course designed to give them the necessary teaching ability. The success of the plan may be briefly indicated by saying that on Nov. 10 there were on the job 1100 yard instructors who measured up to their work about as well as do college professors or public-school teachers; and the training capacity of America's shipyards was somewhere around 15,000 men a month.

Mechanism of the Instructor Course—the Four Blocks

The mechanism of the instructor-training plan of the Emergency Fleet Corporation (shown by the diagram on the following page) is essentially this:

Selected mechanics of proved ability from various shipyards are sent to an instructor-training center for a six weeks' course. The class is under an instructor who knows teaching methods. His main function is to assist each man to classify his knowledge in such manner that he may be able to impart it effectively to others. The instructional material of the course is arranged according to a scheme developed by Charles R. Allen, superintendent of instructor training. Its characteristic is a division into four blocks, as will appear from the following outline.

Block 1—Job Analysis—Includes the analysis and arrangement of the occupational knowledge in an effective instructional order of jobs. The prospective instructor's knowledge of his trade is taken in the form and with the peculiarities as found; no attempt is made to impart trade knowledge or to teach standard practice.

Block 2—How to "Put It Over"—Telling what instruction is and how to accomplish it. The learner is made familiar with the successive steps in the instructing process, methods of approach and the like.

Block 3—Establishing an Effective Instructional Order—Teaching how to lay out operations in a difficult scale and establish checking levels for determining the progress of the learner.

Block 4—Instructional Management—Importance of good management for the emergency program; gang organization; meeting instructional conditions; getting along with production departments, and maintaining relationships.

Results of the Training Work Briefly Stated

Organized as suggested in the preceding, the training of instructors grew to remarkable proportions. The growth of training centers and of yard training departments has kept pace with the development of the shipyards and with their advance from the stage of plant construction to that of production.

On Apr. 15, 1918, three instructor-training centers were running; on Nov. 10 there were 36 centers. Thirty-eight shipyards had installed regular training departments, and 19 others had modifications of training departments. Training was proceeding in 42 trades and occupations.

The training capacity, based on the number of trained instructors, was not far from 15,000 men a month. Two yards were equipped to train 2000 green men per month each. Ten yards could train more than 500 green men a month.

What kind of instructors were being produced? The yard instructors went out from the training centers with the zeal of crusaders. They not only saw their trade or job in a new light, but they were fired with the consciousness of the power "to put it over"; and, not the least valuable characteristic, they had an entirely different—an almost impersonal—viewpoint as to the value and possibilities of the green man.

There had been an "instructor turnover." Instructors were lost through the yard gobbling them up for production foremen, for example. Training work has suffered from labor troubles, housing conditions, material supply slip-ups, and countless other difficulties. But so far no criticism has been made that the yard instructors could not "produce the goods."

An Experience: The Instructor's Faith—To a new yard instructor in a Great Lakes yard was assigned the job, as part of his practice teaching—before he got out from under the eye of the staff man—of instructing a green hand in laying off some angle clips. These had to be punch-marked and lettered with a brush, to conform to the mold. An especially green man had

PROGRESSION RECORD CHART

BLOCK NO. 1. The Analysis and Arrangement of Trade Knowledge in an Efficient Instructional Order of Jobs

Analysis	Trade Analysis	Classification	Blocks	Multi-Blocks

BLOCK NO. 2 How to Put It Over

1	2	3	4	5	6	7	8	9
The Instructing Process	Instructing Operation	Step One	Step Two	Step Three	Step Four	Lines of Approach	Technical vs. Production Lessons	Instructional Operation Sheets

Practice Lessons 1 Instructs 2 3 4 Yard 5 Groups

BLOCK NO. 3 Establishing an Effective Instructional Order

Instructional Difficulties	Difficulty Scale	Using Scale	Laying Out Instructional Order

BLOCK NO. 4 Instructional Management

1	2	3	4	5	6	7	8	9	10
War Situation	The Problem	The Plan	Instructional Management	Gang Organization for Effective Instruction	Instructional Conditions	Handling the Gang for Effective Instruction	Relation of Training to Production Departments	Instructional Bookkeeping	Sectional Problems of the Training Center

In Charge of a Group as Instructing Foreman on the Job

NAME.................................. .TRADE .... .INSTRUCTOR........................

been picked for this teaching practice. The learner completed the operations, but it was seen that he labored very hard over the lettering. On investigation it was found that he could neither read nor write.

Here was a difficulty which the old-time "breaker-in" would have given up in despair; not so the new instructor. Referring to the learner, he said, "But he's all right. He can *learn*. He showed it by the way he laid off the piece."

Instructor-Taught Men Efficient—In a certain North Atlantic yard the management was in a tight place with respect to riveting on a hull that was behind schedule. Ten riveting gangs still under instruction were pulled off the school work and put on the hull, along with 17 regular production gangs. The two sets of men worked side by side on the hull; there was no coddling or favored-job arrangement about it. The day's average for the new gangs was 278 rivets, that for the seasoned gangs 138. The highest drive of one of the new gangs was 318. The highest drive of one of the old-timer gangs was 240.

What the Professor Concluded—A former college professor who had deserted the field of economics to learn shipfitting passed through the "system," and, aided by native ability, advanced rapidly enough to become inspector on hulls. "I have never encountered a piece of teaching," said this specialist in instruction, "which took a fellow from where he was to where he was going by such direct and effective steps."

Improving Leadership the Second Great Problem

An army, no matter how efficient and well disciplined its troops, cannot be effective if it is not handled by capable officers. So, with the tremendous expansion of the shipyard working forces, the need developed automatically for more and better foremen, superintendents, quartermen, leaders and higher executives. This need was supplied in the time-honored way of picking a good mechanic, or a man with promise of leadership, and making him foreman. The results were as good as those in any industry using the same method of selection and bidding the new foreman "go to it"—and they were *no better*.

The foreman, using the term in its now common industrial application, makes or breaks the organization. Yet he is ordinarily left to his own salvation, to work out his own problems and plan his work. It was soon recognized that improvement in this part of shipyard operation was vitally necessary. The Emergency Fleet Corporation, therefore, organized classes in shop management and modern production methods.

These classes did *not* train men to become foremen; they trained foremen and executives already in the yard, to make them better foremen and better executives. No ready-made scheme or preconceived system could serve in this work. Each yard and its personnel were looked upon as a special problem, requiring its own individual treatment and solution, though of course the underlying principles of good management found application in each instance. As in the case of training the yard instructors, results were secured chiefly by guiding the individual through some of his own problems, and thereby imparting to him the ability to separate, analyze, lay out and schedule his own work in effective fashion.

Two very important and valuable byproducts developed: (1) A team spirit among the men, and a feeling that all were pulling together; (2) the successful solution in conference, sometimes in blood and tears but more commonly with gain of mutual respect, of certain "tough-nut" problems that had been in everybody's way.

Thus, in a New Jersey shipyard a certain group of men, all in the hull-construction department, and all from the same ways, had developed a tender spot over the use of the cranes. The men were more than merely touchy on the subject; they were completely at logger-

heads; each man cherished the idea that the other fellow was waiting just around the corner to "do him dirt." By devoting several hours to the matter, with the aid of the instructor as referee, carefully analyzing the problem, it was worked out to everybody's satisfaction, with the relief of much tension.

On Nov. 10 fifty-four foremanship classes were running. They were attended by more than 1800 men. One yard enrolled over 700 of its minor executives. In at least one case the coöperative spirit generated in these classes produced a most obvious result: By the action of the spirit of power and heave-together resulting from the foremanship conferences, a certain hull that had long been behind schedule and was daily slipping farther behind went into the water on the contract date.

Schooling the Trained Shipyard Worker

Manual instruction on the job gave little opportunity to provide the mechanics with that part of their equipment which may be described as the technical knowledge related to the trade. This knowledge is of vital importance in stimulating ambition, developing short-enlistment men into skilled and permanent employees, and creating in the individual a pride in his occupation. To aid in providing this knowledge, the Education and Training Section developed the Supplementary Training Branch. The work was done mostly through classes organized on the familiar plan of evening and part-time schools.

Over 8000 men in 38 yards have enrolled in such courses. The seven fundamental courses prepared and published for the work are: Elements of blueprint reading, blueprint reading for steel-ship construction, blueprint reading for wood-ship construction, elements of wood-ship construction, course for shipfitters, course for marine pipefitters, course for machinery erectors.

It is beyond question that such supplementary instruction succeeds in developing and holding craftsmen in all lines of industry. An extreme example comes to mind of the results that may be secured. The director of training of a certain Great Lakes yard organized evening classes. Among others there reported a man nearing 50, who had for 20 years been a common laborer in the yard. Instructors were skeptical of the chances of a man so old, and apparently so deep in a rut, ever climbing out. Nevertheless, he received a trial in the school. Today the man is a second-class shipfitter, and is still climbing.

Special Problems Handled by Specialized Methods

In many lines of war work it was found necessary to take craftsmen from various trades and make them into craftsmen for the specific war work in hand. In the shipyard field this "conversion training" was handled as a branch of the intensive training work.

Essentially, the method of handling it comprised analyzing the man's previous trade experience and, using this so far as possible, building up the training necessary for the new occupation.

Notable examples of such conversion were making ship riveters from structural steel riveters, ship carpenters from house carpenters, marine pipefitters from plumbers and steamfitters, coppersmiths from sheet metal workers, and outside machinists and machinery erectors from machinists. Careful and expert supervision and follow-up were essential in this instruction, chiefly in order to make sure that the men were getting just the type of jobs which would rapidly "convert" them.

Electric welding came up as a new problem. Its application to steel-ship construction, stimulated by the war program, has already passed through the experimental stage, and today it should be said, perhaps, that electric-welded ships are rather more than a possibility for the future. Here the Emergency Fleet Corporation found it important to work not only on the development of the art, but also on the training of men in this entirely new craft. To the latter task the plan of intensive training was also applied. About 100 craftsmen have been trained, in consequence, and some 200 are now in training.

Naval Architects Needed—In September the shipyards of the country made a call for 200 to 300 men of technical training in naval architecture and marine engineering. To meet this call, eleven-week courses were developed in two prominent universities. Only men of engineering training were admitted to these courses. As they already had the preparatory knowledge, as much naval architecture and marine engineering could be given to these men as is ordinarily given in a regular four-year course. Further demand for technical men by the shipyards will undoubtedly be met by the necessary response from universities and technical colleges.

That shipbuilding will live as the result of its revival under the stress of emergency—that it will adapt itself to peace conditions and remain an essential part of American industrial life—must today be regarded as assured. The need for trained shipyard workers therefore will continue. The national emergency has also brought out specialization in higher degree than known before. The trend will be toward the development of trades largely new to the American people. Whatever the course of coming development may be, however, shipbuilding will have the advantage of a more ample fund of training experience than any other industry in the country. This training constitutes a secure foundation for the future.

Omaha Public Works To Cost $2,000,000

An extensive program planned by the Department of Public Improvements of Omaha, Neb., will involve the expenditure of about $2,000,000 for sewers, paving and grading, and the extension of the park and boulevard system. The paving projects include the improvement of the main arteries leading into the city and the principal connecting streets, which will cost approximately $500,000. For parkway and boulevard development there will be acquired about 160 acres of wooded ravines, sparsely covered with dilapidated dwellings. The sewer work includes the construction of a trunk line system outside the city limits, and a disposal plant to serve the Saddle Creek drainage area. The planning and execution of these improvements are under the direction of John A. Bruce, city engineer.

Fabricating Shop and Berth Equipment at Sun Shipyard

Assembly Bay of Shop Delivers Finished Material to Shipbuilding Cranes—Multiple Punches and Roller Tables—Reinforced-Concrete Berths Served by Bridge Cranes

A FABRICATING shop specially planned along original lines for systematic working and direct routing of hull steel to the berths forms the central feature of the Sun Shipbuilding Co.'s new plant at Chester, Penn. The yard was designed 2½ years ago for building large oil tankers and cargo steamers; since December, 1916, when it began operation, it has put into the water 12 hulls of 10,000 to 13,000 tons, two of them said to be the largest freight steamers ever built. Among the features that give character to the yard, besides the shop, are concrete pile-bent shipways, bridge cranes on high runways serving the berths, a fixed hammer-head crane serving the wet dock, an excellently equipped boiler shop of capacity exceeding the needs of the yard, and a large engine and machine shop nearby—the plant formerly owned by Robert Wetherill & Co., Incorporated.

The enlargement and rearrangement of the fabricating shop are now being carried out to improve the balance of its departments. It is believed that when this work is completed the shop will rank second to none in the country for completeness of equipment.

In order to carry the idea of direct routing through from the raw-steel storage to the berths, the shipbuilding end of the Sun yard is arranged as a compact group. There are five shipways, and the shop stands immediately at the head of the ways, with a space of only 150 ft. between its delivery side and the bow of a ship on the stocks. The crane runways over the berths are extended to the shop wall, and the cranes take their material directly from the doorways of the shop, where the bridge cranes in the building deposit it.

Separate Layout and Assembly Bays.—As originally planned, the shop consisted of three sections forming one continuous building. The main section in the middle, 225 x 300 ft., is the fabricating shop, with its shorter side facing the shipways. Across the incoming end of this portion is a layout bay 80 x 500 ft., with a mold loft over it. In similar position across the outgoing end is an assembly bay 80 x 600 ft., so that the entire shop has an H-shaped layout. Some of the specially interesting structural features of the framing of the building were described in *Engineering Record* of Oct. 21 and Dec. 16, 1916, pp. 498 and 734. The layout and assembly bays are served by two bridge cranes each,

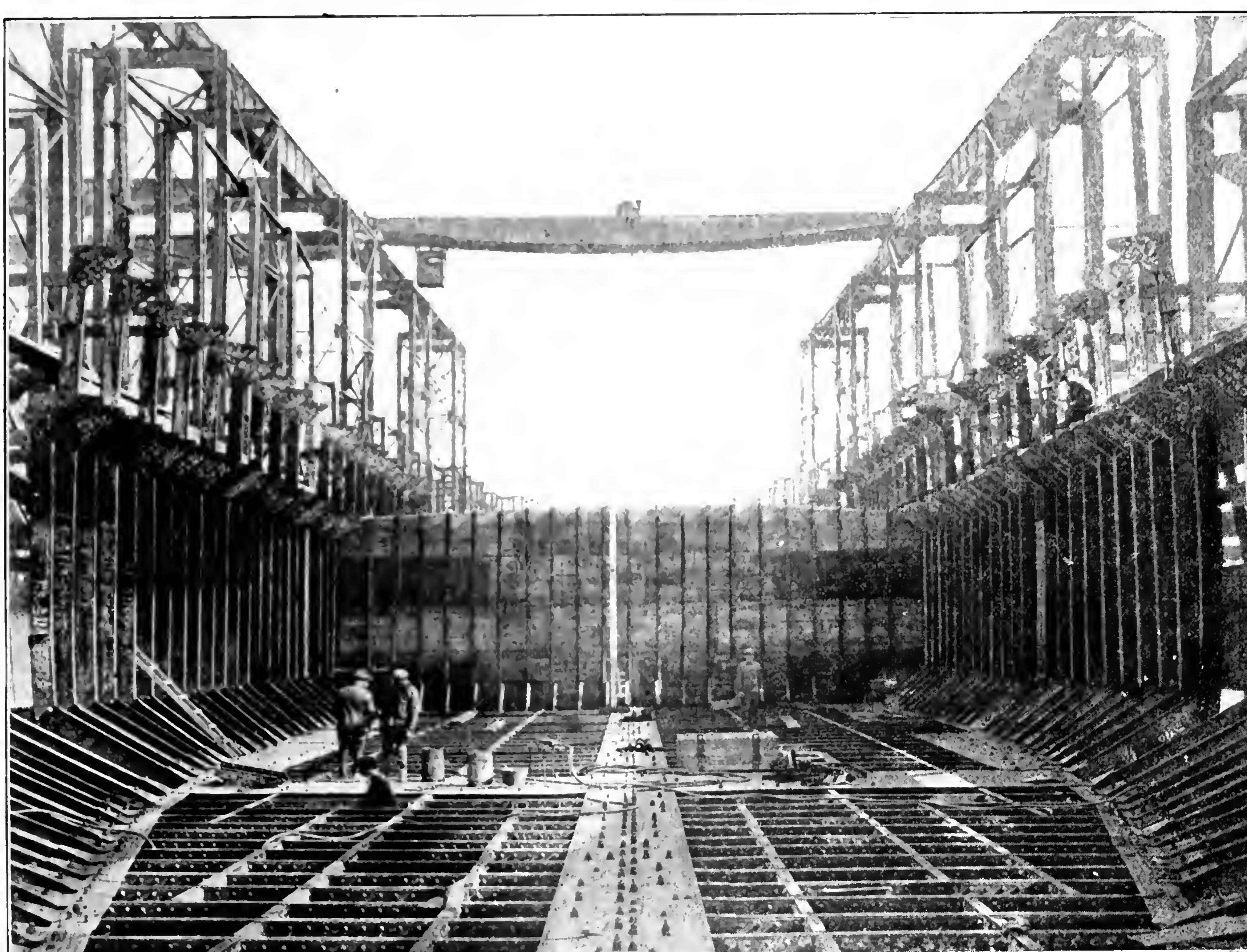


FIG. 1. AT SUN SHIPBUILDING COMPANY'S YARD CRANEWAYS 95 FEET HIGH COVER THE 80-FOOT WIDTH OF WAY; TWO CRANES ARE PROVIDED OVER EACH SHIPWAY

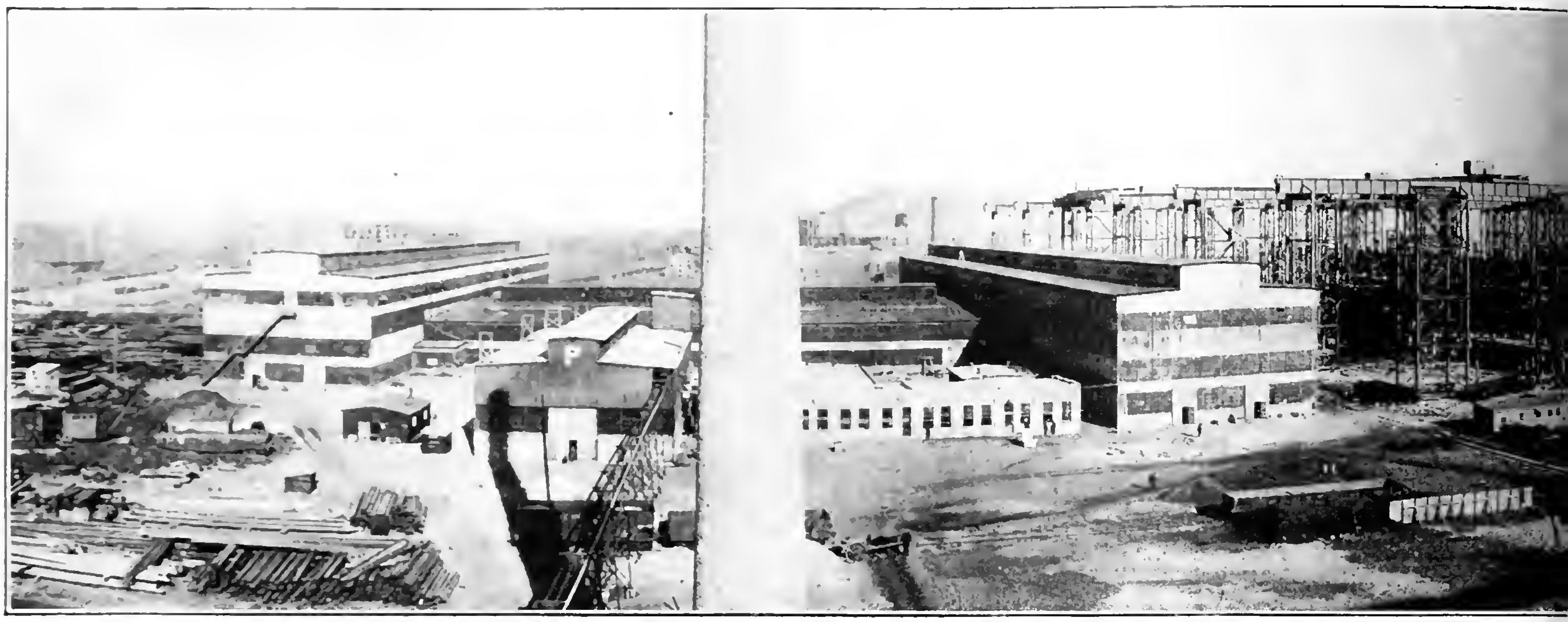


FIG. 2. LOOKING EAST TOWARD HULL CONSTRUCTION PART OF YARD SHOWS FABRICATING AND ASSEMBLY SHOP

spanning the full 80-ft. width of the bay and traveling its entire length. The fabricating portion of the building has no bridge cranes, but is equipped with a number of overhead I-beam trolley runways, and, in the plate side of the shop, extensively rollers beds for transferring plate.

Revision of the layout will consist in adding on the east side of the fabricating section a 115 x 300-ft. extension, making this section of the shop 340 x 300 ft.

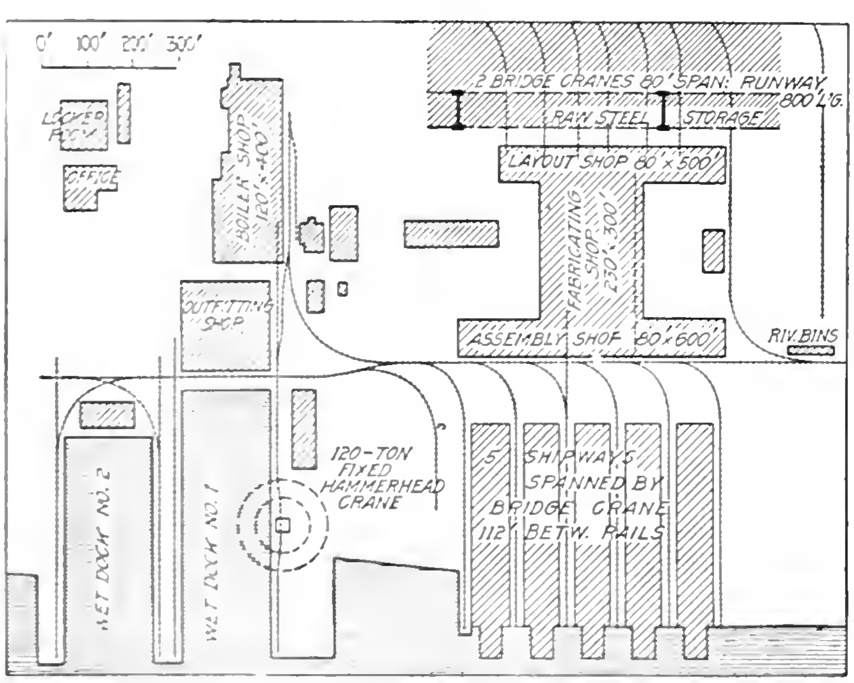


FIG. 3. GENERAL PLAN OF FIVE-WAY SHIPYARD FOR LARGE FREIGHT STEAMERS, SUN SHIPBUILDING

As indicated in the small sketch plans of the layout, Fig. 4, the addition will be devoted largely to furnaces and bending slabs, which will be moved from their present location separating the shape and plate fabrication. The shop as it now exists has ample plate capacity but inadequate shape capacity. The provision for straight shapes consists only of a single line of punches and shears along the east wall of the shop, with a longitudinal hoist trolley centered over the machines. Furthermore, the furnaces and slabs now separating the plate and shape sections not only interfered with any expansion of the shape-fabricating facilities, but also made it necessary to place a new plate multiple punch, acquired some time ago, in the layout shop. With the extension, and the furnaces and slabs accommodated there, the shape-fabricating section can be expanded as needed and room can be found within the area of the fabricating shop itself for the plate multiple and a new beam multiple.

The shop was designed for an ultimate capacity of 5000 tons of fabricated material a month. This would provide for a production of about 15 ships a year, counting 4000 to 4500 tons of steel per ship. It was thought, however, that a capacity of 150 tons per day per shift could be attained so that the day shift alone would be able to supply a production of 12 ships per year. It has not been possible to reach this output, but with the rearranged shop these figures should be realized.

Steady increase of the production of the shop has been recorded during the past season, through increasing efficiency of the working force. This is illustrated by the following figures for average daily output of the shop in four consecutive months, August to November: 180, 195, 222, 227 tons. All this is on two-shift work. The night shift has a materially lower output than the day shift, although the same number of men are at work and

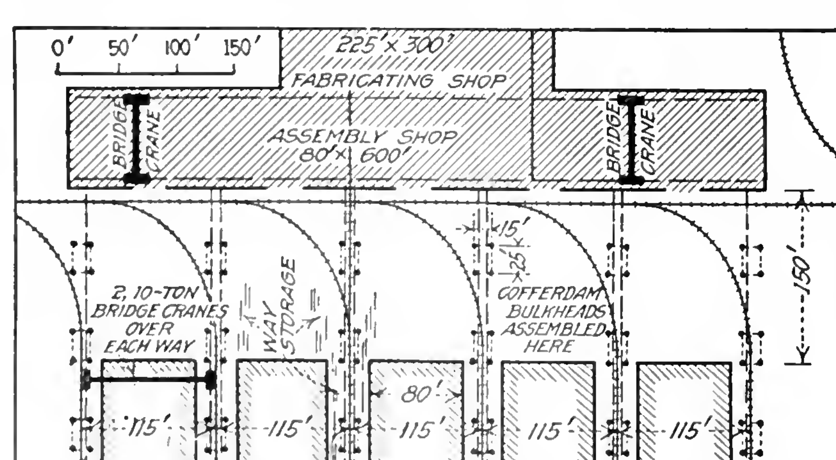


FIG. 4. SKETCH PLAN SHOWING RELATION OF FABRICATING SHOP AND BERTHS

Wet dock No. 2 is now under construction. Only the hull construction part of the yard is shown. An extensive machine shop and foundry plant belonging to the yard is located a quarter mile away

the working time is slightly longer. For November the total production of the day shift was 2866 tons and that of the night shift 1855 tons.

Handling Material Through the Shop—The roller-

(AT LEFT) AND SHIPBUILDING BERTHS WITH BRIDGE CRANES ON HIGH TRESTLES (IN CENTER) CLOSELY COÖRDINATED

bed equipment of the plate section of the shop can be seen in the view, Fig. 6. Originally these rollers served also for supporting and moving the plates at the punches, but during the past year ten Lysholm manually-operated punch tables have been installed, and the shop will be equipped with them throughout. A wide multiple punch is already in service, as indicated in the sketch plan, Fig. 5, and a 42-in. multiple punch for beams is soon to be installed. Material is supplied to the shop by way of six standard-gage tracks entering the landward side of the layout shop from the storage yard. The bridge cranes of the layout bay take material from the cars as delivered from storage, and transfer it as needed for laying out, straightening, etc. They deliver the material finally to the roller beds, the furnaces, or the hoist trolleys in the shape section. The extension of the shop now under construction will be equipped with a very complete system of overhead trolley runways, carrying in part electric hoists and in part hand hoists, and connecting with three transverse runways now in service in the plate section of the shop. With this handling equipment, all facilities for the movement of material through the shop will be supplied. The trolleys and roller beds deliver the fabricated material to the edge of the assembly bay, where it is taken up by the bridge cranes traveling along that bay.

All assembly bolting and riveting, from floors and frame brackets to bulkheads, is done in the assembly bay. This has proved a highly satisfactory feature of the original plan, though the officials state that an assembly area of twice the size could be used to advantage. The two 10-ton cranes in this bay suffice for handling assembled parts up to 20 tons in weight. This is enough to take care of all bulkheads (riveted up in half widths) except cofferdam bulkheads, which, with their stiffening girders, are assembled in the space between the shop and the head of the way.

Referring to the sketch plan, Fig. 3, it will be seen that there is a track along the outgoing side of the assembly shop and spur tracks leading out under the crane trestles along the shipways. These were laid out with a view to distributing much of the ship and other construction material down along the berths by railway cars, but the tracks have been used very little for such service, the bridge cranes proving ample for all handling.

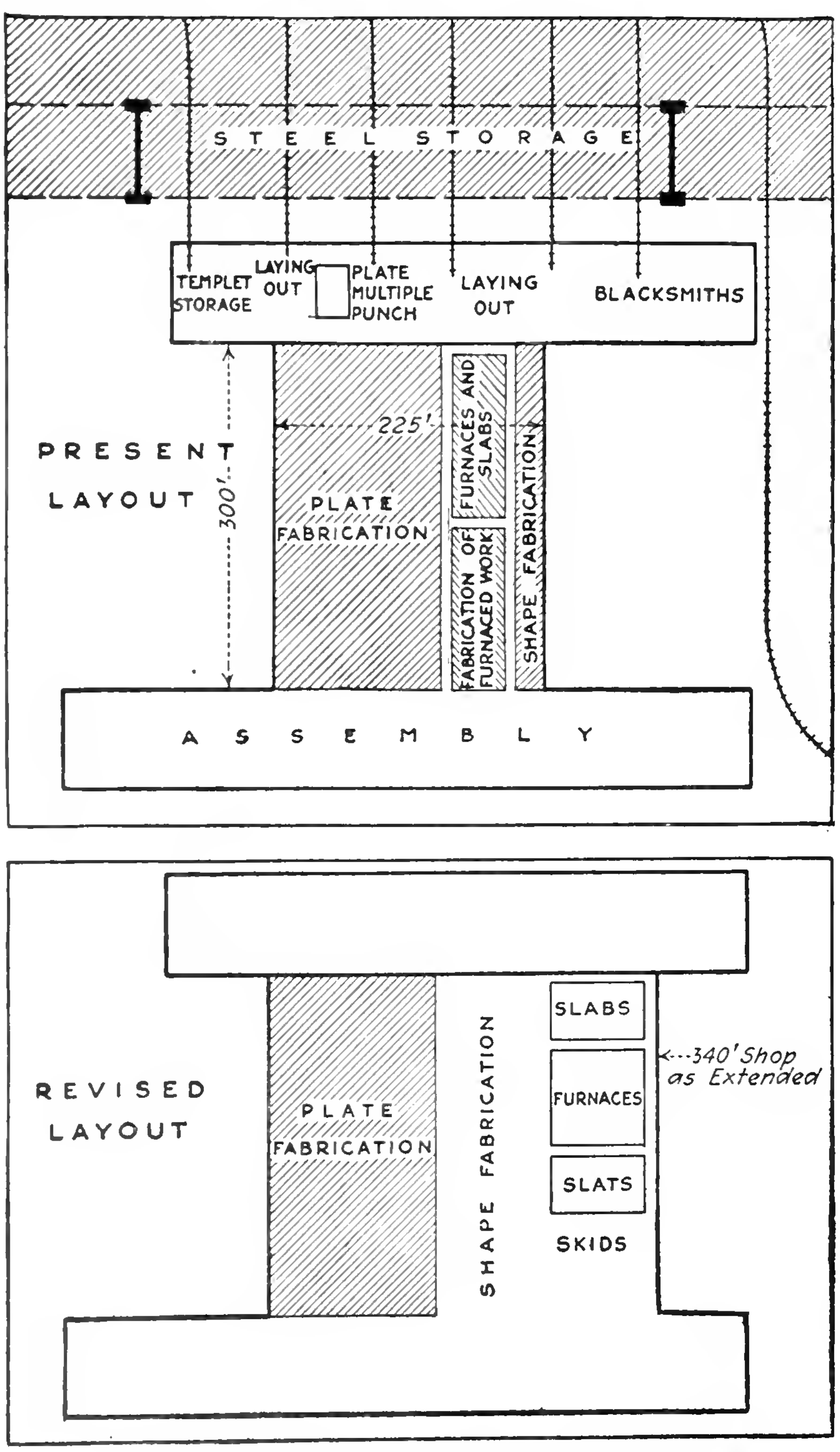


FIG. 5. EXISTING AND REVISED LAYOUTS OF FABRICATING SHOP

FIG. 6. ROLLER BEDS FITTED IN LARGER PART OF PLATE SECTION OF FABRICATING SHOP FOR EASY TRANSFER OF PLATE

Two Cranes Per Shipway—How the berths and cranes are arranged may be gathered from the view, Fig. 6, and the sketch, Fig. 7. The trestles are spaced 115 ft. on centers, allowing for an 80-ft. width of shipway, a trestle width of 15 ft., and 10 ft. of clear space between shipway and trestle. The trestles are built of towers 15 x 25 ft. in plan, spaced 50 ft. apart, so that the crane runway spans are alternately 25 and 50 ft. Each tower bent carries, by means of a transverse 30-in. girder, two crane run girders spaced 3 ft. apart and braced together for lateral stiffness. The crane girders in the tower spans are 30-in. I-beams, while the intermediate spans are 6-ft. plate girders.

The design of the shipbuilding crane runs, which is distinguished by the use of single H-sections for the columns and heavy sections for beams, up to 30-in. 200-lb. rolled girders for the transverse supports of the crane girders, was carried out by the Belmont Iron Works. The same concern designed and built the structure of the fabricating shop.

Small Way-Head Storage—Fabricated material completed in the shop—whether punched or assembled—is in part retained in the shop until wanted on the ship, and in part placed in storage at the head of the ways and alongside the crane trestles. The original intention was to take care of all this storage alongside the trestles, using the space at the head of the ways only for large assembly work, such as that of the cofferdam bulkheads. It has been found more convenient, however, to provide racks and stow material at the head of the ways, in small amounts. The heavy bulkhead assembly is carried on in this space, and stowage possibilities are therefore limited. It is expected that the way-head storage and supplementary storage along the trestles will provide for all requirements of equalization between shop and ship.

Reinforced-Concrete Berth Construction—What is virtually a copy of timber pile bent way construction was adopted by J. N. Pew, president of the Sun Shipbuilding Co., who is responsible for the principal features of the yard layout and construction. The Raymond Concrete Pile Co. designed and built the ways. Some essential details are shown in Fig. 8.

Over each pile a concrete column was molded. Transverse caps over the column bents, 80 ft. long over all, are connected by three longitudinal stringers near the center, and a spacer stringer along either side of the way. The center stringers are in the line of the keel blocks and the two launching ways. The transverse section in Fig. 7 makes their construction clear. For the rest, the bents are separate and wood flooring is placed over the caps to form a working surface. As the flooring is not fastened to the concrete the planks can be removed and replaced at any time.

At the site the present surface is all hydraulic fill. There was water over much of the present yard area at the time construction commenced. Hard bottom is found 25 to 45 ft. down, however. The piles were driven to a firm bearing in this. They were placed to develop a carrying capacity of 30 tons, or 50 tons at ½-in. settlement, but H. G. MacNees, plant engineer, believes that they would develop a 50-ton capacity with no appreciable settlement. The entire way structure

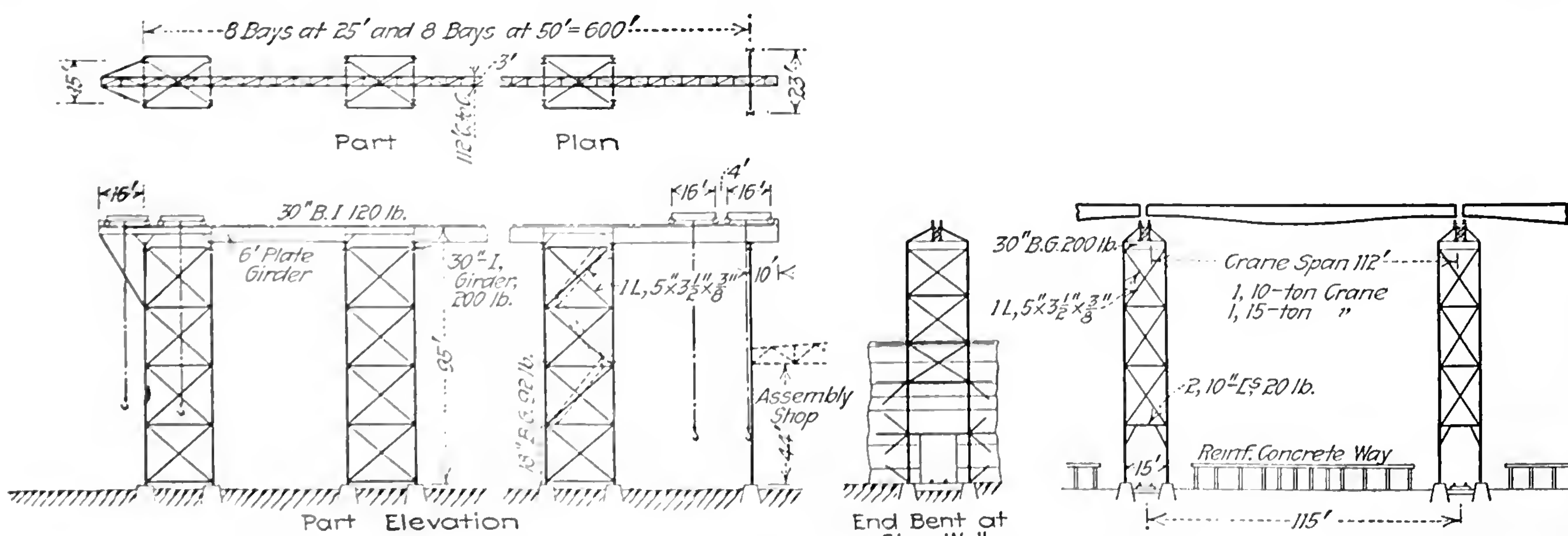


FIG. 7. SKETCH OF CRANE TRESTLES AND BERTHS

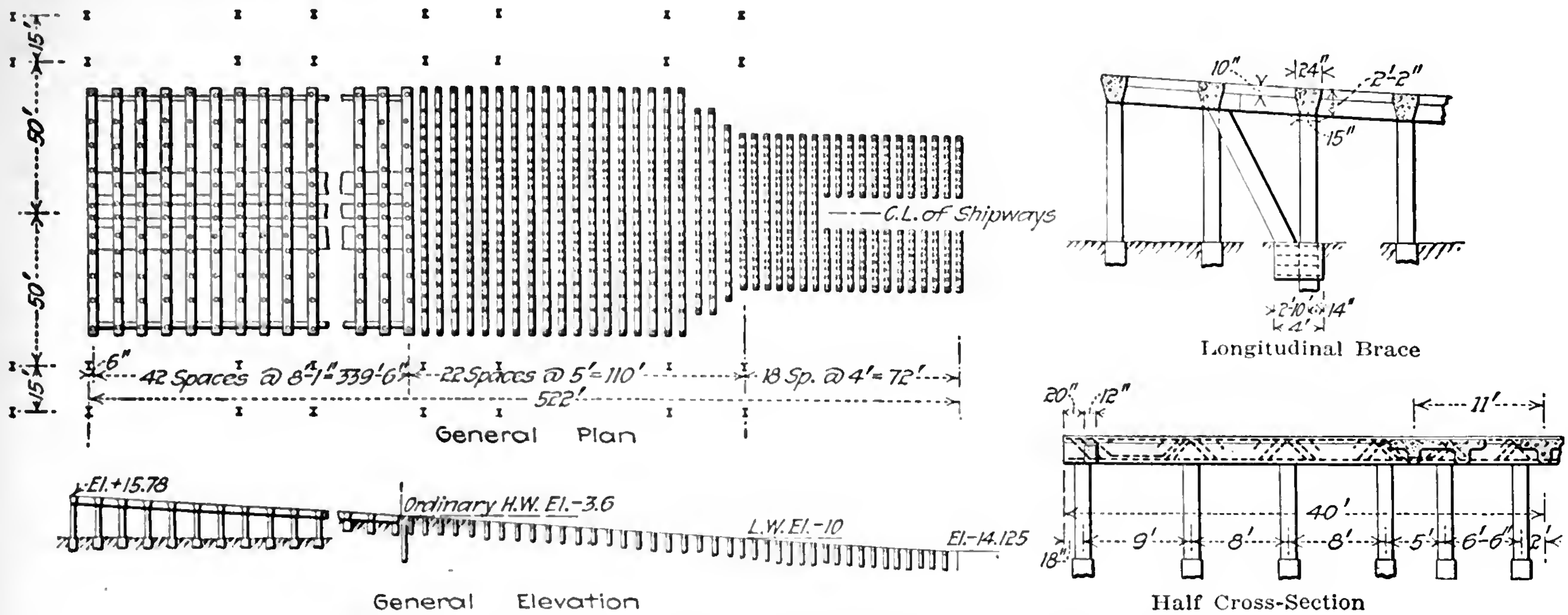


FIG. 8. CONCRETE PILE-BENT SHIPWAYS AT THE SUN SHIPYARD

is set on an $\frac{11}{16}$-in. slope, this inclination being the launching slope.

Excellent service has been given by these berth structures. No damage or settlement of any kind has been noticed. The principal change that has been made is the addition of a short timber platform blocked up directly on the ground, at the head of the ways, to form an extension for a longer ship than could be accommodated by the ways as originally built.

From high-water level down, the ways are wholly of timber construction, and consist of separate transverse bents of piles spaced 5 ft. on centers, for a total length of 182 ft. outward of the lowest concrete bent.

Storage Yard Rearranged for Bridge Crane Service—As originally planned, the area back of the fabricating shop was to be used for storing raw steel by flat piling on mud sills, the material to be handled by locomotive cranes from cars into storage and from storage into shop. A year's experience with this system made flat piling appear unsatisfactory, and racks were built. The final working out of the rearrangement is represented at present by a complete rack system covered by a bridge-crane runway spanning 80 feet and 800 feet long.

The standard rack developed for this yard consists of a 12 x 12-in. base timber to one side of which are bolted 6 x 4-in. angle standards, spread about 24 in. at the bottom and about 10 in. at the top, where they are conected by a gusset plate. These standards are stiffened by a short length of 8-in. channel at mid height. No longitudinal connection between parallel members of the rack is used.

Wet Dock Being Duplicated—The present wet dock is an excavated basin, 200 x 600 ft., walled by concrete retaining walls on pile-supported timber platforms. It is served by a fixed McMyler-Interstate hammer-head crane of 120 tons capacity. The machine is fitted with an auxiliary hoist of smaller lifting capacity. Engines and boilers (Scotch) are set in the ship here. The hammer head crane does all minor handling at the fitting-out dock also, no other lifting machines being provided.

To increase the dock capacity, a second basin, 100 ft. shorter, is now under construction immediately to the west. This will be served by a locomotive crane on portal base, of light load capacity but with fast motions, for handling general fitting-out work. The heavy lift will still be handled at the hammer-head crane, as described. The Sun Shipbuilding Co. was formed as an offshoot of the Sun Oil Co., whose main plant is only a few miles farther down on the Delaware River. Building large tank steamers for the oil company was the principal business at the start. Orders soon came for large cargo steamers, however, and the present program of construction at the Sun yard includes mainly cargo steamers. As already stated, the yard was planned and is being operated as a specialist institution for vessels of about 10,000 tons. For 1919 the intention is to work the yard at a rate to produce 18 ships in the twelve months. This means a building time of 100 days per ship. Such a rate of working could now be realized except for the fact that the fabricating shop has not reached full output capacity.

FIG. 9. ONE OF THE CONCRETE WAYS JUST AFTER CONSTRUCTION WAS COMPLETED, BEFORE PLANK FLOORING WAS PLACED ON CRANE RUNAWAYS

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

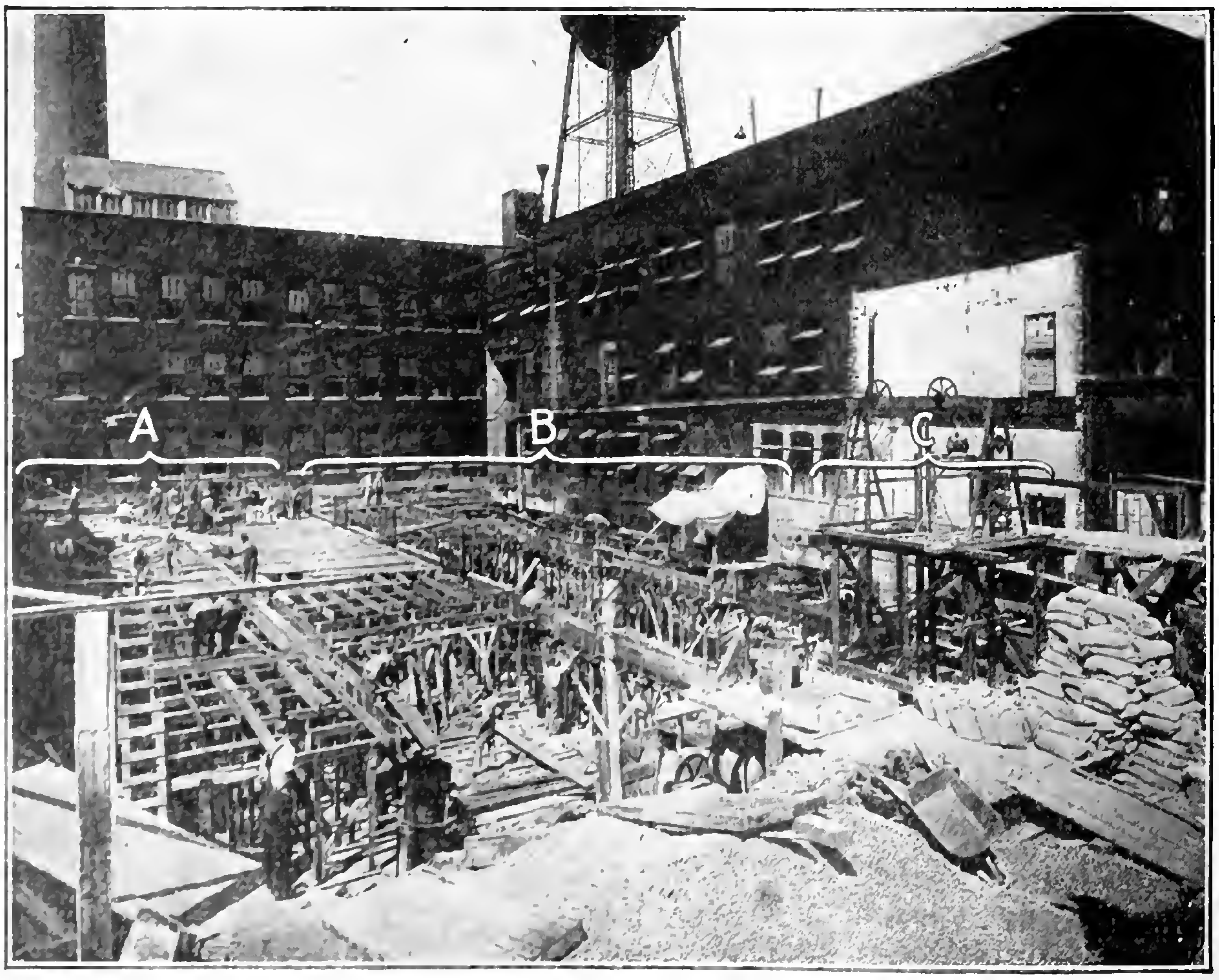
Close Sequence of Operations Cuts Construction Time

Caissons for War Work Factory Started as Soon as Steam Shovel Clears Sites—Construction Crews Scheduled to Crowd Each Other

CREWS purposely scheduled to crowd close on each other's heels were employed to speed construction on a concrete factory recently completed in Chicago. Occasionally, a crew was started even before work was ready for it, so as to increase the progress of the crew ahead. Clamoring for right-of-way, the concreting gang pushed the steel men and the steel men crowded the form carpenters, and behind all drove the contractor, with materials supplied and construction plans laid out well ahead of the best speed the workmen could reach.

War contracts required the completion of the building in four months. The ground dimensions were 108 x 76 ft. and the height was seven stories. The foundations were 24 open caissons sunk to rock at a depth everywhere less than 50 ft. Square outside columns and round interior columns carried longitudinal girders, between which were concrete joist-and-tile-fill floors of the Johnson type. A two-story building occupied the site. This had to be removed and a basement excavated. The work was let for a lump sum. Labor supply was the great problem, since war industries were offering workmen bonuses and unlimited overtime on percentage jobs.

Close sequence of operations was the plan devised to meet the speed requirements. As soon as a corner of the old building was wrecked, a steam shovel started excavating the basement, and as soon as the steam shovel had cleared sufficient space a single caisson was started. Caisson sinking proceeded by usual methods, except that, owing to quicksand and water, a large part of the lagging had to be driven and the wells were driven one at a time, using a hand windlass, as fast as the shovel cleared the site, instead of waiting until the general excavation had proceeded far enough to allow an engine to be rigged up to carry a number of wells at once. By this plan, the caisson work kept close behind the shovel, and the foundations were finished in prac-



FLOOR CONCRETING BEGUN BEFORE LATEST FOUNDATION CAISSON WAS FINISHED ON CHICAGO FACTORY

A. First-floor girder being poured in this corner, by use of temporary portable mixing plant. B. Form building and steel placing in all stages of progress proceeding in space between. C. Last foundation caisson being sunk in this corner.

tically the same time as was the general excavation. As fast as the caissons were ready, the foundation girders under the basement floor were concreted. At the same time, the adjacent building was shored. Retaining wall work followed as rapidly as the way was cleared for the forms. As shown by the view, slightly over one month after construction was started the old building was wrecked, the general excavation was completed, all but one caisson had been excavated and concreted, the foundation girders and the retaining walls were finished, concreting was in progress on the first floor girders, and column steel and floor forms were in various stages of erection. The view shows how close the sequence of operations was. It shows the last caisson being sunk in one corner, and the first floor slab being poured in the other corner. The procedure outlined saved two or three weeks' time at the start of the job.

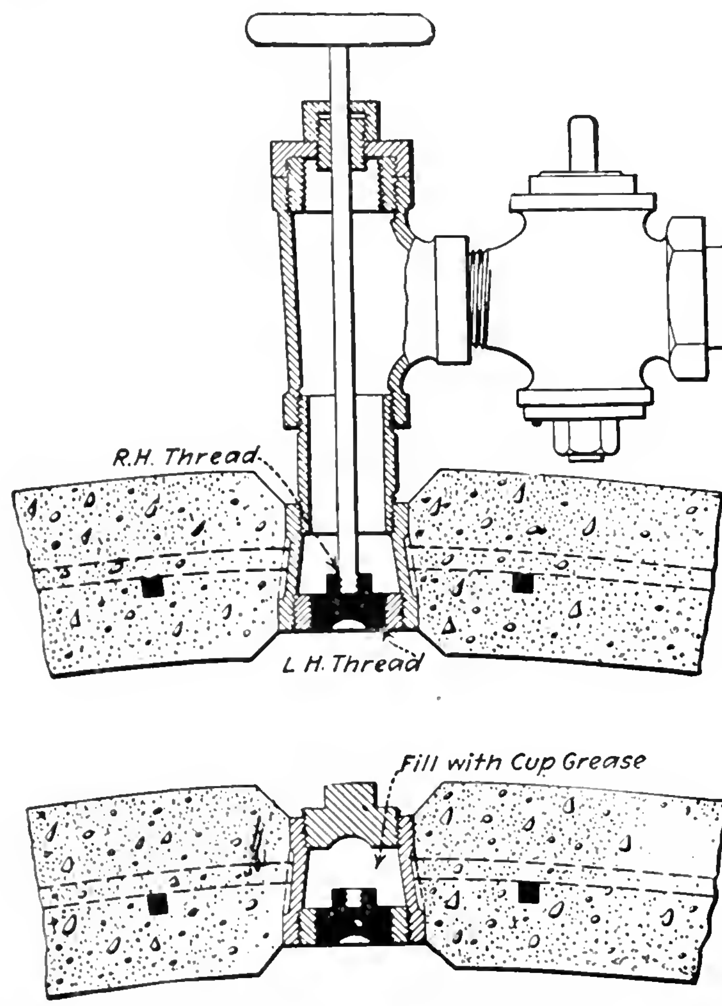
It was decided to handle the concrete by spouting from a tower at the end of the building to a hopper at the center of each floor, and to deliver the concrete from the hopper to the forms by carts. The ¾-cu.yd. mixer for the tower plant was used first for concreting the caissons, and was busy on this work until after the first floor concreting was begun. A small portable mixer was, therefore, installed temporarily to concrete the first floor and the retaining walls until the larger machine was free and the tower could be erected and the spouting strung.

Concreting of columns and floors followed the same close sequence as characterized the operations on the foundations and basement. As soon as carpenters had a section of floor forms ready, bridgemen were started laying steel and masons placing tile, and the concreting gang followed close behind. Each crew was kept close on the heels of the crew ahead, crowding it to get it out of the way. Often a gang was started even before the gang ahead was ready for it to take up the work. The fact that the job was war emergency work was kept constantly before the men. Constant pressure on the workmen by the means outlined was the secret of the progress made.

The building was designed by Holabird & Roche, architects, Chicago. Avery Brundage was the contractor. The contractor's superintendent was W. G. Nelson. Bauer & Black, Chicago, are the owners.

Service Connections to Concrete Water Mains

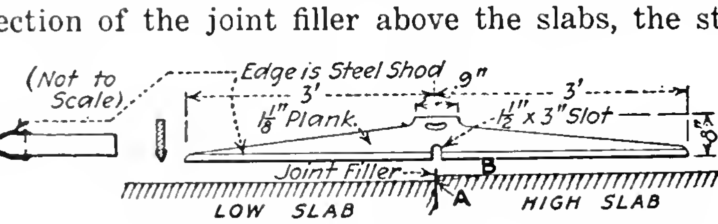
METAL pipe fittings, such as are kept in stock, can be used in making service-pipe connections to concrete pressure pipe for city distribution lines, by a device recently developed by the Lock Joint Pipe Co., Ampere, N. J. Malleable iron couplings are embedded in the original pipe when cast, as shown in the illustration. The inner end is fitted with a bronze plug inside of a malleable iron bushing. The outside end is fitted with a plug of malleable-iron, and the space between them is filled with grease. When everything is in readiness for connections, the outer plug is removed and the plug on the inner end is unscrewed by means of a stem inserted through a T, as shown in the sketch. The plug is then raised to and screwed into a faced bushing at the top of the T. The stem is unscrewed, along with the packing nut and perforated cap, and a solid cap is screwed on the faced bushing at the top. No tapping machines are required, and the excavation need be carried only to the top of the pipe.



REGULAR STOCK PIPE FITTINGS ONLY USED IN MAKING THIS CONNECTION

Split Straightedge Corrects Joint Humps In Concrete Pavement

HUMPS in a concrete pavement due to high slabs at joints are prevented in Wisconsin road work, according to F. M. Balsley, division engineer of the Wisconsin Highway Commission, by the use of the split straightedge shown by the drawing. Owing to the projection of the joint filler above the slabs, the strike board cannot be swept across the joint, and frequently, when it is lifted to start the next slab, exact elevation is not secured. The result is a high slab, as indicated by the drawing. Use of the split float at the joint will bring the edges of the two slabs to a common elevation, as at A, in the diagram, but there will still be a hump, as at B. The split straightedge, applied as indicated by the diagram, permits the detection of this hump or other irregularities in the planes.



STRAIGHTEDGE TO MAKE CONCRETE PAVEMENT JOINTS EVEN

The construction of the straightedge is simple. A 1⅛ x 8-in. plank is cut as shown, and the edge is beveled sharp and shod with sheet metal.

NEWS OF THE WEEK

New York, January 2, 1919

American Engineering Success in War's Test

Accomplishments by Engineers Cited to Rebuke Recent Utterances on Need for Training

That American engineers have succeeded in impressing the general public by the success of their work in the great war's crucial test is demonstrated by the comment of the Philadelphia *Public Ledger* in a recent editorial. This comment is so illuminating and informative that it is reproduced, as follows:

"This seems to be an odd moment for the recent pessimistic utterances of one of the professors at the Massachusetts Institute of Technology on the need of better training in all our engineering schools. For the fact is, not only have the professional engineers and their associates from West Point and Annapolis and all their amateur assistants who went into the Army and Navy covered themselves with glory in the war, but at this very moment, when the English University Commission has started back for home, its farewell opinion is more than usually flattering to American collegiate and university education. Moreover, what it particularly admired and marveled at was the splendid equipment of the technical schools and the physical laboratories in our larger institutions. In this it but confirmed English opinion as expressed in the friendly report of Alfred Moseley's unofficial commission, which made a survey of engineering training and practice in this country about a decade ago, a report that was a great tribute to the American trained engineer and to American schools.

"But if any confirmation of the value of the American engineer and of the technical training that has given him an efficiency recognized everywhere be needed, it will be found in Prof. William M. Sloane's brilliant account of his experience with the leading German magnates when he was one of our exchange professors. In his inimitable way, Professor Sloane has told how these German specialists fumed at the mouth because the American engineers were successful and beat the German engineers, when from the Prussian point of view, such a thing ought to have been impossible, since America was a wretched country, without standards of education and without individuals possessing any capacity for science or Kultur.

"Well, as the very modest recent report of President Vail, of the American Telephone and Telegraph Co., shows, in his discussion of the new

(Concluded on page 66)

Wide Building Campaign Involving Billions About To Be Started by Government

"Build Now for Better America" Is Slogan of Department of Labor in Beginning Movement

(Washington Correspondence)

A great building campaign, involving the construction of highways, public works of other character, homes, and public utilities, is about to be undertaken by the Government, largely for the purpose of making certain that employment will be found for demobilized soldiers.

An organization to conduct the campaign is now being created in Washington, with headquarters at 16 Jackson Place, under the general supervision of Secretary Wilson of the Department of Labor, and with the coöperation of the American Federation of Labor and other labor interests. The following slogan has been adopted:

"Build now for greater and better America. A billion for roads; two billions for public works; three billions for a million new American homes. What are you doing to help this campaign?"

City Officials Urged To Build

The Department of Labor, as one of the first steps in the campaign, is sending the following message to wage earners throughout the country: "Use your influence with your city fathers, your selectmen and other town officers to start at once municipal and town improvement." Cities and towns are being urged to build school houses, engine houses, roads, canals and other improvements. To those who believe that the cost of building will be less in a few years than it is now, the Department of Labor is replying that "probably 95% of the cost of a residence ultimately goes to labor whenever a house is built, so that the cost is almost immaterial to wage earners as a class."

Secretary Baker of the War Department is coöperating in the campaign, and has sent telegrams to the Governors asking them to urge in inaugural messages the immediate resumption of building of every character.

One of the first branches of the new activity of the Government to be organized is the "Own a Home" branch, which has been placed under the direction of the Information and Education Service of the Department of Labor, of which Roger W. Babson is chief. Mr. Babson is creating an organization of assistants, headed by Franklin T. Miller of New York City.

One of the arguments being used in favor of the "Own a Home" movement is the figures as to increase of population. The population of the United States normally increases, exclusive of immigration, by 3,000,000 persons annually. At this rate the population is supposed to have increased by 6,000,000 during the past two years, during which the building of homes has been largely suspended. It is estimated that it is necessary to build 315,000 homes each year to meet increased housing needs, and that the building of 630,000 homes is necessary now. Secretary Wilson's statement is as follows:

"I am of the opinion that from the time we restore ourselves to our normal post-war activities, the demand for peace-time production will be so great that there will not be the remotest possibility of securing any reduction in the wage rates from their present basis. I feel further, that the manufacturer who fails to take into consideration the prospects of the future and who, in a hope of securing a cheaper labor or cheaper raw material, does not build up his organization and maintain it during the possibly brief period of readjustment, will be handicapped in securing his share of the business afterward; because he will be handicapped through lack of working forces in his factory.

"It therefore seems to me that the situation resolves itself into taking care of the possible problem in the interim between our ceasing war activities and the time when we have assumed our natural post-war activities.

Labor Reservoir Suggested

"With the attitude of mind that I have expressed as existing on the part of some manufacturers relative to waiting for a lowering in the price of raw material and the price of labor, it may be that the restoration of industry will not take place as rapidly as the demobilization takes place. We are not sure of that. There ought to be provision made for a reservoir that would absorb the demobilized workers and the demobilized soldiers, not in doing the things which there is no need to have done, but in doing the things that ought to be done—that are valuable for peace-time purposes—a reservoir that will take care of them for the brief period between their dismissal from the Army or their dismissal from the war

industries until they can be reabsorbed into the natural post-war industrial activities.

"The Department of Agriculture is taking steps to accomplish part of that purpose in the matter of road improvement, highway improvements, on the theory Congress has acted on in the past, that for military purposes and for postal routes roads are necessary all over the country. Where men are employed in road-building, they do not have to be taken from their own home communities to engage in the work. The Department of Agriculture, therefore, has asked or is about to ask for an increased appropriation which will enable it, in coöperation with the respective states, to engage in a nation-wide project of road-building that will absorb, if need be, some of these workers temporarily, until industry resumes its natural course.

"During the period of the war, because of the shortage of workmen, there has been little or no municipal activity in building operations, in park extensions, in sewer extension, waterworks, or any other of the public utilities. They have been delayed and postponed because of the shortage of manpower and because of the inability to finance them. We are suggesting, through the Department of Labor, to the various municipalities throughout the country, the advisability of their resuming these activities at as early a date as possible.

"Whenever it is possible to utilize public means, wherever it is possible to undertake public work, or things that are valuable for peace-time purposes, they should be undertaken as promptly as possible."

Colleges To Train Reserve Officers

With the demobilization of the Students' Army Training Corps, various colleges of the country will turn their attention to the Reserve Officers' Training Corps. Before the war there were about 115 units of the latter, in as many colleges. About 100 of these are being reëstablished and applications have been received for the formation of about 200 new units.

Secretary of War Baker announces one important change in the organization which is now being worked out to allow the units to specialize in training officer material for the field artillery, engineer, signal, coast artillery, ordnance, medical, and military aëronautics corps, instead of the uniform training for infantry, which was the rule before the war.

The administration of the Reserve Officers' Training Corps has been placed in the hands of the Committee on Education and Special Training. The committee will attempt to make available a large amount of scientific and technical material which has been developed by the experience of the war, and in all units special emphasis will be placed on physical training and mass athletics.

Government Concrete Ships Now Building

Owing to Cancellation of Some Contracts Big Ships Have Been Cut From 42 to 14

In *Engineering News-Record* of Sept. 5, 1918, p. 471, there was published a list of Government concrete ships then contracted for. That list has since been curtailed, so that at present the tabular statement represents Government concrete shipbuilding at the end of 1918. The cut is entirely in big ships. Instead of 42 vessels, mainly of the 7500-ton class, to be built in the agency yards, the Emergency Fleet Corporation is reducing contracts to 14, distributed as shown in the table. In addition, there are a number of barges under construction for private account, though there is no record of any private ships being built.

construction of the two tankers was started the latter part of October. About 30% of the steel has been placed. The inside forms have been made and partly erected. First concrete will be poured in January. The cargo ship will not be started until after the first tanker has been launched.

The San Diego yard is building two 7500-ton concrete tankers. Construction on these was started early in December. Outside forms are now practically completed, and some steel has been placed. The first concrete will not be poured until the latter part of January.

Two 7500-ton concrete tankers and one 7500-ton cargo ship are to be built at San Francisco. The construction on the two tankers was started the middle of October. The outside forms on both ships have been completely fabricated. About 60% of the steel

TABLE SHOWING GOVERNMENT CONCRETE BOATS UNDER CONTRACT

Government Agency	Type of Boat	No.	Name of Contractor	Location of Yard
Emergency Fleet Corporation	3500-ton Freighter	1	Fougner Concrete Shipbuilding Co	Astoria, L. I.
	3000-ton Freighter	1	Liberty Shipbuilding Co	Brunswick, Ga.
	3500-ton Freighter	2	Liberty Shipbuilding Co	Wilmington, N. C.
	7500-ton Tankers	2	San Francisco Shipbuilding Co.	Oakland, Cal.
	7500-ton Freighter	1		
	7500-ton Tankers	2	F. T. Ley & Co	Mobile, Ala.
	7500-ton Freighter	1		
	7500-ton Tankers	2	A. Bentley Sons	Jacksonville, Fla.
	7500-ton Tankers	2	Scofield Eng. Co	San Diego, Cal.
Navy Department	500-ton Harbor Lighters	4	Ambursen Consn. Co.	Little Ferry, N. J.
	500-ton Harbor Lighters	4	L. L. Brown Co	Peekskill, N. Y.
	500-ton Harbor Lighters	4	S. H. Beskin	Beacon, N. Y.
Railroad Administration (Construction Supervised by E. F. C.)	500-ton N Y Barge Canal Barges	8	Holler-Davis & Flood Co	Fort Edward, N. Y.
	500-ton N Y Barge Canal Barges	4	Caldwell-Marshall Co	Tonawanda, N. Y.
	500-ton N Y Barge Canal Barges	5	Grayhaven Shipbuilding Co	Detroit, Mich.
	500-ton N Y Barge Canal Barges	4	Cummings Structural Concrete Co	Ithaca, N. Y.
War Transport Branch, War Dept	130-ft River Boats	9	(Contracts not completed)	
	100-ft Water Tankers	5	Gt. Northern Sbldg. Co.	Vancouver, Wash.
	265-ft Car Floats	6	Liberty Sbldg. & Transp. Co.	Cleveland, O.
		6	L. B. Harrison Co.	Athens, N. Y.

The status of construction in the large ships is as follows:

At Wilmington, N. C., there are under construction two 3500-ton concrete cargo ships on molded lines. The yard, with two ways, was completed sufficiently to start the construction of ships about Oct. 15. The outside forms of one ship are practically complete, and part of the steel has been placed. On the second ship the outside forms are about 40% erected. There has been some delay in construction in this yard due to the change in the Shipping Board's program, which originally contemplated the building of both tankers and cargo ships in this yard.

The present program of the Shipping Board contemplates the construction of two 7500-ton tankers at Jacksonville. Construction work upon these two ships was started about the middle of November. The outside forms are practically completed on both ships, and some steel has been placed in both ships. The first concrete will be poured about Feb. 10.

At the Mobile yard the construction of two 7500-ton concrete tankers and one 7500-ton cargo ship is now contemplated by the Shipping Board. The

has been placed. The inside forms are built and partly erected. The first concrete will be poured in January. The construction of the cargo ship will not start until the first tanker is launched.

The Brunswick ship has been launched and the Fougner ship is nearly ready to launch.

The status of construction of the canal barges is as follows: Concreting has been completed on eight barges. Five are now in the water and 19 of the 21 under contract are either completed or under construction. Of the other boats, three of the Navy barges have been delivered, two of the Army car-floats have been poured, and one water-tank steamer has been poured.

Army Will Sell Horses and Mules

Contractors who need horses and mules may be able to get some cheap at auction sales of surplus animals to be held at the various camps and cantonments during January. The schedule calls for four sales, Jan. 7, 14, 21 and 28, at which a total of 44,455 animals will be sold. These will include cavalry horses, artillery horses, draft horses, mules and pack animals.

American Engineering Success in War

(Concluded from page 64)

multiplex device for 'phone and telegraph, the invention, one of the greatest ever made, was not the freakish discovery of one mind, but the result of the team work of hundreds of men on the company's technical staff. Not only that, but suggestions from men trained at Annapolis and West Point also proved helpful. In other words, the discovery was the result of the high equipment of the average American trained in the average school of technology or in that of trade experience. And one naturally mentions this multiplex discovery, since, taken in connection with the resourcefulness and initiative which mark so much of the college-trained, school-trained and shop-trained Americans on the battlefield in which they completely outclassed their German opponents, it is a feather in our cap and calls for some little reassurance, if not complete optimism, as to the American methods of the present.

"Moreover, the English engineer has also shown up well in war, although Germany despised the English experts for years and also had a poor opinion of the Frenchman's ability. And yet the English tanks, the French baby tanks, the French guns, to say nothing of the supreme French airplanes—and also not forgetting the Italian engineers and mecnanicians who reached an almost super-excellence—have all achieved wonders in the war and beat the Germans point by point in every line of action.

"The fact is, we must stimulate our own and we must increase our facilities for training engineers and for reaching down and connecting and gearing up the various engineering trades with the technical colleges and universities. But while it is quite right not to relax or fall back, at the same time we should take a little satisfaction in the evidence that the German system of education and the state-commanded scheme of a standardized universal Kultur has proved a failure so far as the question of developing men with initiative and individual resourcefulness is concerned. That our laboratories are likely to attract English students is another thing we can take to heart with comfort. Aside from this, it is clear that as civilization in the future will demand more of the engineer than ever, this demand our schools and colleges must meet. That they will no one can doubt. And as a sort of first instance, the recent reorganization of the Yale Graduate School, by which the Sheffield Scientific School and the Arts are grouped under a common head, with an increase of the undergradute scientific course from three to four years, is proof of the pudding."

Six Highway Bills Introduced in Congress During December

Besides the $1,000,000,000 highway bill introduced by Senator Smoot (as reported in *Engineering News-Record* of Dec. 26, p. 1198), five other road bills were introduced in Congress during December. While Senator Smoot's bill provided for a complete reorganization of highway administration by the Federal Government, the other bills aimed at utilizing present agencies and were either amendments to the present Federal-aid highway law or utilized the organizations of the War and Postoffice Departments. A joint resolution was also introduced, which provides for the handing over to the Secretary of Agriculture by the Secretary of War of such war material as may be used in highway construction work.

Senator Smoot's bill provides for the formation of a United States Highway Commission, to be composed of the Chairman of the Senate Committee on Postoffices and Post Roads, the chairman of the House Committee on Roads and the Director of the Bureau of Public Roads. It proposes to issue bonds to the amount of $1,000,000,000, the proceeds of which will be distributed to the states in proportion to the average percentage of their percentages of population, total assessed valuation, and total mileage of public highways. When money is supplied to the states, they must deposit state bonds, drawing interest at 4%, to cover the amount advanced to them. The 4% interest shall pay the 3% rate on the United States highway bond issues, and also establish a sinking fund to pay for these bonds. Long-time payments are provided for the state bonds. It is further provided that the Federal Government shall pay yearly to the depositing states 2% of the amount deposited, to be expended in maintenance.

Of the four bills providing for the utilization of the present Federal highway administration, those by Senator Bankhead, and Senator Swanson, in the Senate, and Representative Browne in the House of Representatives, are practically identical. They are in the form of amendments to the present Federal-aid highway law and consist of a change in wording to permit a wider interpretation of the words "post road," to cover any road that might so be used. They also provide for the appropriation of $50,000,000, to be immediately available; $75,000,000, available July 1, 1919; $75,000,000, available July 4, 1920; and $100,000,000, annually to July 1, 1924. Another bill, introduced by Representative Shackleford, provides for a similar change in wording and for an appropriation not to exceed $150,000,000 per year.

The other bill was introduced by Senator Swanson, and provides for the setting aside of 50% of the net proceeds derived from the operation of motor trucks engaged in carrying parcel post, to be expended in the survey, construction, reconstruction, improvement, repair, maintenance and administration of such highways as might be selected by the Postmaster General for the transportation of mail.

Criticisms of Chicago Paving Administration Retracted

Some time ago Prof. Ira O. Baker, of the University of Illinois, made a report on pavements in Chicago (see *Engineering News* of Dec. 7, 1916), which contained criticisms of the engineers and inspectors of the Board of Local Improvements. Some of the statements made in this report were shown on investigation to be based upon incorrect premises, and the following statement was obtained from Professor Baker of the Illinois Society of Engineers:

"Under date of Nov. 20, 1916, I forwarded to the Committee on Finance of the City of Chicago the manuscript of a report entitled "Report on Pavements Recently Built by the Board of Local Improvements of the City of Chicago." That report implied that there had been a considerable shortage in the thickness of all concrete foundations of pavements, and also in the thickness of the binder course and of the wearing coat of all sheet-asphalt pavements, which statements have been strongly objected to by the engineers of the Board of Local Improvements.

Pavements Examined Representative

"In preparing those parts of my report, I inquired specifically of the engineers of the technical staff as to whether or not the inspectors selected pavements of particular contractors, or pavements that were known to be faulty, and received an answer that convinced me that the pavements examined by the inspectors were fairly representative. I next inquired of the staff whether or not the summary of observations by the inspectors included all the observations made, and I was informed that they did. I asked for the inspectors' reports, and compared them with my report and found them to agree with the summary which the staff had furnished me.

"I had no reason for believing that my report was in error in any of these three matters, until I heard the testimony of one of the inspectors during the progress of the investigation conducted by a board appointed by the Chicago Civil Service Commission, Mar. 5-9, 1917. I then learned for the first time that, if the inspector found any defects in a pavement, he prepared a somewhat elaborate report from his field notes and filed that report; but, if he found no defects, he filed no report thereof. The data furnished to me were a summary of these special reports, and did not include any statement that other pavements had been inspected and found to be according to the specifications.

"All of my intercourse with the staff engineers convinces me that their only desire was to have the facts correctly presented, and I feel quite sure that they were entirely innocent of wrong intention in the matter.

"It is plain that as a number of observations were made and defects found

in only some cases, it was wrong to assume that the observations in which defects were discovered were representative of all the work done by the board during that season. I am very sorry that my report was not correct in these particulars; and am sorry to have made erroneous statements which have been considered as reflecting upon the honor of engineers of the Board of Local Improvements. I intended no such reflection.

"Public acknowledgment of the errors in my report has been delayed for a year and half on account of the fact that three investigations of the report have been pending. I believed, that, awaiting the outcome of these investigations, any statement concerning the matter by me might be considered as an attempt to forestall the verdict of the investigating body. I do not think that the delay in this acknowledgment has done any serious harm, since in the investigation conducted a year and a half ago by the board appointed by the Chicago Civil Service Commission I freely acknowledged my error, and since the findings of that board have been given wide publicity.

"IRA O. BAKER."

Louisville Club To Draft Bill For Licensing Engineers

The Engineers' and Architects' Club of Louisville, Ky., at its December meeting, unanimously passed a resolution providing that a committee of three be appointed to draft a bill licensing engineers and architects, and submit the draft to the board of direction. Then it is to be sent to every engineer and architect in the state of Kentucky of whom the committee can learn—including consulting engineers and architects and men holding salaried positions—with the request that the men addressed indicate whether they are in favor of licensing engineers and architects, and if so, that they suggest any desired changes in the bill as drafted.

The resolution also provides that the committee shall make such revisions in the draft as it may deem wise, submit it to the board of direction and then to the club, and, after approval, that a copy be sent to every member of the Kentucky legislature with the request that the bill be passed, and with a statement of the number of men in the state who expressed an opinion for or against the bill.

Rivers and Harbors Bill Reported

The current rivers and harbors bill, reported to the House of Representatives Dec. 21, contains items totaling $27,000,000, made up, practically, wholly of the usual project improvements. Large items are $4,000,000 for continuing the East River improvement at New York City, $2,500,000 for the Delaware below Philadelphia, and $3,000,000 for the Chesapeake & Delaware canal.

Wood-Preserving and Tie Men To Meet in St. Louis

The 15th annual meeting of the American Wood Preservers' Association will be held in St. Louis, Jan. 28-29. On the following two days a meeting of the tie producers of the country, to effect a national organization, will be held under the auspices of the tie and timber division, St. Louis Chamber of Commerce, in order to bring together both producers and users of cross ties.

In order to correlate the programs of the two bodies, the meeting of the American Wood Preservers' Association has been curtailed to two days, with three sessions on the first day and two on the second, concluding with a joint dinner with the National Tie Producers' Association. A session on the first day of the meeting will be devoted to consideration of the preservative materials situation, and a session on the second day to the tie problem.

War Committee on Technical Societies Handled Many Problems

As stated in the final report by D. W. Brunton, chairman, before its disbandment on Dec. 31, the War Committee on Technical Societies coöperated with the Naval Consulting Board and issued two bulletins, one on "The Enemy Submarine" and one on "Problems of Aëroplane Improvement." Before these bulletins on concrete problems were issued, only four-tenths of one per cent. of the matter received was adjudged by the committee of technical examiners to have sufficient merit to go before the final examiners of the Naval Consulting Board. Since that time the percentage has risen to 4.7%. The material received ranged from airplane superchargers and fuel for high altitude flying down to submarine detectors and depth bombs; from long-range guns to trench knives; from observation balloons to tunneling machines, and from caterpillar tanks to radium sights. More than 110,000 ideas, suggestions and inventions were received and passed upon by the Naval Department and the Naval Consulting Board, either separately or conjointly, while the Inventions Section of the General Staff, which is a much younger organization, has already handled over 25,000.

The inventions received may be roughly divided into four classes: (1) Those which have no intrinsic or suggestive value; (2) those which, while having no real value in themselves, suggest new lines of thought and investigations; (3) inventions which have considerable promise, but are not yet developed to a point where it is possible to pass judgment on them, and (4) inventions which are sufficiently perfected so that they can be investigated and tested. Ample facilities for testing inventions of the fourth class are provided by the Bureau of Standards and the Bureau of Mines, in Washington. The ideas, suggestions and inventions belonging to the second and third classes are, of course, much more numerous, and the necessity of providing some means for solving problems and developing inventions has long been apparent. In many instances, inventors have not the funds, the scientific knowledge or the mechanical skill to perfect their own inventions, hence aid in each of these directions is necessary in order that the country may reap the full benefit of the originality of its citizens.

Army Engineers Designated for Early Return

The War Department has announced that the following engineer units have been placed on the priority list for orders to return to this country:

Fortieth Engineers, placed on priority list Dec. 4, 33 officers and 623 men; 109th Engineers, Sappers, placed on priority Nov. 26; 311th Engineers and Engineer Train, Nov. 29, 57 officers, 1685 men; 312th Engineers, Nov. 26, headquarters, 24 officers and 29 men; headquarters company, two officers and 156 men; Co. A, three officers and 224 men; Co. B, five officers and 221 men; Co. C, five officers and 217 men; headquarters detachment, one officer and three men; Co. D, four officers and 245 men; Co. E, six officers and 237 men; Co. F, five officers and 241 men; 312th Engineers' Train, two officers and 74 men; 319th Engineers and Train, Dec. 4, four officers and 217 men; Co. E, four officers and 222 men; Engineer Casual Co. No. 1, Dec. 4, two officers and 223 men; Second Engineers, Dec. 6, Cos. F, I, K and Medical detachment, 20 officers and 760 men; Cos. D, E, G and H, 35 officers and 1000 men; 26th Engineers, Dec. 17; Co. A, eight officers and 253 men; Co. B, three officers and 181 men; 27th Engineers, Dec. 16, 46 officers and 1409 men; 29th Engineers, Dec. 12, headquarters detachment, two officers and eight men; Co. B, 14 officers and 238 men; Co. C, 11 officers and 185 men; Co. D, eight officers and 83 men; Co. E, 14 officers and 119 men; attached, three officers and 18 men; Co. F and detachment, 24 officers and 408 men; Engineer Casual Co. No. 1, Dec. 4, two officers and 223 men; 317th Engineers placed on priority Dec. 4, cancelled Dec. 16.

It was stated that the units generally arrive in this country from four to six weeks after being placed on the priority list.

New President for University of Wisconsin

Dr. Edward A. Birge was elected president of the University of Wisconsin Dec. 17 to succeed Dr. Charles R. Van Hise, who died on Nov. 19. Dr. Birge has been dean of the College of Letters and Science for the past 27 years, and a member of the faculty of the university for 43 years. He will assume the office of president at once, having been acting president since the death of Dr. Van Hise.

Notes From the Field

SOME OBSERVATIONS OF AN ITINERANT ENGINEER

In the issue of Dec. 5, *Engineering News-Record* told the story of the Spruce Production Division. The editorial tribute was well deserved, but I doubt whether the full spirit of that great job has been conveyed to the reader. I had the pleasure of seeing part of the railroad work on the Olympic Peninsula, one of the projects to which the article makes reference. I have never seen a job that for spirit and organization impressed me so favorably. One of the best railroad contractors said it could not be done in a year. It was completed in six months. Soldiers as well as civilians formed the working crews. Three shifts there were, and as one man laid down his pick, or quit his place, his successor took up the work—took it up immediately, with not ten minutes', not one minute's delay. Lunch was carried to the line to save time.

If the work was under high pressure, there was full compensation—good wages, model camps, excellent food. Throughout were enthusiasm and an unbeatable determination to put the job through.

Sometime all the men who were concerned with this great work will receive adequate credit. I wish I could name them, but I would have to start with the chief engineer, Mr. Kelliher, and the Siems-Carey Co., the general contractors, and continue down till I had named the last contractor's foreman.

And then, to be fair, I would have to go to each of the other Spruce Division's operations.

A great job, and I shall not soon lose its inspiration.

Linked with the memory of the job, too, are the hospitality of my hosts, Palmer, Pearson & Woods, one of the subcontractors, and the wonderful scenery of Lake Crescent, its waters rivaling those of Lake Tahoe and being reminiscent of the Italian lakes, its scenery recalling Champlain and George.

Last week I met two young engineers who have secured a return from a certain investment of time while in college that is well worth recording for the benefit of other engineers. They took courses in public speaking.

One of them, engaged in highway work, has made as rapid progress as any young engineer I have ever met, and he is pointed toward a great success. He recently played an important part in a bond-issue campaign, both through writing and speaking. To a large extent he attributed his rapid progress to the recognition that has come to him through his ability to speak in public.

The other young man, out of school only three and one half years, has built up a large acquaintance in his specialty — technical advertising — an acquaintance of direct and constant value to him in his work.

These men are at the entrance of their careers, but already they are beginning to reap returns from their ability as public speakers. As years go by and they talk from fuller experience, their speaking asset will develop in value in a rapidly increasing ratio.

Training and practice in public speaking are to the thinking man not merely exercises in overcoming bashfulness, though they are hardly more than that for the man who deals in platitudes and spread-eagleism. For the thinking man public speaking is a training in clear thinking and concise exposition. Success as a public speaker comes from having something worth while to say and saying it clearly and forcefully. The young engineers in question have not merely overcome stage fright. They have schooled themselves to analyze questions thoroughly so as to disclose the essentials, and have learned how to present these essentials effectively.

And the important things are yet to be said:

A little training in public speaking goes a long way;
It is never too late to learn.
Moral: *Go to the nearest Y. M. C. A. or similar institution and find out when the next course begins.*

E. J. M.

Aid for Highway Bridge Projects To Be Considered

Recent steps taken to organize a committee of bridge engineers as a Division of Bridges of the National Highways Association will be supplemented by a meeting of the committee Jan. 17 in New York City. A tentative outline of the program of work which this committee will undertake includes consideration of the subject of highway crossings over large rivers, advice and assistance in the broader preliminaries of highway bridge projects, and related matters in which special knowledge of bridge engineering may be made of service to highway development. The division will carry on its work on the principle of taking the initiative in any particular case only when called upon to do so. The functions of the committee are planned exclusively for service to the public good. Further development of the program of future work is expected to come about through the meeting on Jan. 17. G. Lindenthal is chairman of the division, and C. E. Fowler is secretary.

Promote Large Bond Issue for Missouri

A bond issue for $50,000,000 will be proposed for the building of public roads in Missouri, and will be urged upon the state legislature at the coming session by the Federation of Missouri Commercial Clubs. It is proposed to raise the funds for this construction, both principal and interest, from the motor-license tax.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan. 15-16, New York.

AMERICAN WOOD PRESERVERS' ASSOCIATION: F. J. Angier, Mt. Royal Station, Baltimore, Md.; Jan. 28-29, St. Louis.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

NATIONAL RIVERS AND HARBORS CONGRESS; 824 Colorado Bldg., Washington, D. C.; Feb. 5-7, Washington, D. C.

The Engineers' Club of Philadelphia will hold a joint meeting with the Society of Automotive Engineers Jan. 21, at which G. Douglas Wardrop, editor of *Aërial Age Weekly*, will present a paper on "War Aviation in Retrospect; Commercial Aviation in Prospect," illustrated with motion pictures and lantern slides. Mr. Wardrop will speak on his experiences in the war zone, including his participation in bombing expeditions and observation of aërial battles. Dr. Grover G. Huebner, University of Pennsylvania, will speak on "The American Merchant Marine" at the weekly luncheon Jan. 7.

The County Surveyors' Association, the County Road Superintendents' Association and the State Highway Commission of Indiana will meet at the fifth annual road school of the School of Civil Engineering, Purdue University, Jan. 7 to 9, 1919. Important highway developments are under way and need the coöperation of all officials and others interested in road problems, it is announced. Prof. R. C. Yeoman, of Purdue University, Lafayette, Ind., may be addressed for programs and information.

The Nashville Engineering Association was addressed Jan. 21 by J. F. Walters, Nashville, Chattanooga & St. Louis Ry. on "Railroad Water Supply." Dr. C. R. Mann's recent report on engineering education was discussed by J. P. W. Brown. The annual meeting and dinner of the association will be held Jan. 6.

The New England Water-Works Association will hold its annual meeting in Boston Jan. 8. The meeting of the executive committee on the morning of Jan. 8 will be followed by a luncheon at the Hotel Brunswick, and reports of officers and committees will be received in the afternoon. Among the committee reports to be presented are the following: "Standard Specifications for Cast-Iron Pipe"; "Statistics of Water

Purification Plants"; "Proposed Standard Schedule for Grading Cities and Towns of United States with Reference to their Fire Defences and Physical Conditions," and "A National Water Law."

The Western Society of Engineers' nominees for office to be voted on before Jan. 17 are as follows: For president, D. S. Baldwin; vice-presidents, Kempster B. Miller, William M. Kinney and J. L. Hecht; treasurer, C. R. Dart; trustee for three years, E. T. Howson. Herbert C. Hoover has been named as recipient of the Washington Honor Award presented by the society for the first time. It was founded by John W. Alvord for meritorious public service. The presentation will be made at the society's Washington Birthday meeting. The annual meeting will be held Jan. 22 at the Sherman Hotel, Chicago.

The Engineers' Club of Trenton, N. J., was addressed Dec. 30 by W. W. Colpitts, who read a paper on "Some of the Questions Involved in Determining the Compensation Due the Railroads While Under Government Control."

Personal Notes

MAJ. EDWARD C. SCHMIDT, Ordnance Department, U. S. A., previously professor of railway engineerign, University of Illinois, who was temporarily assigned to service with the United States Fuel Administration as assistant to the manager of the Fuel Conservation Section, has returned to service in the War Department.

WILLIAM B. LANDRETH has been named chief of the board of consulting engineers, New York State Canal System, succeeding Joseph Ripley, who has resigned to undertake irrigation and canal work in China. Mr. Landreth has been connected with the canal system of the state for many years and has served as deputy state engineer during the administrations of State Engineer Williams.

T. C. HUGHES, Tulsa, Okla., has been appointed consulting engineer to supervise the construction of hard-surfaced roads to be built by Tulsa County, under the $1,700,000 bond issue voted last year. He will coöperate with D. W. Patton, county engineer, who will be engineer of construction.

J. S. DODD, assistant road engineer of the Iowa Highway Commission, who has been taking the place of Maj. T. R. Agg as professor of highway engineering, Iowa State College, during the absence of the latter in the Army, has resigned and has returned to his duties with the commission. Major Agg has reassumed his teaching duties as professor of highway engineering.

H. T. SYMPSON, assistant division engineer, Eastern Division, Pennsylvania Lines West, with headquarters in Pittsburgh, has been appointed division engineer at Columbus, Ohio, succeeding G. R. Barry, promoted to division engineer, Chicago Terminal Division, as mentioned elsewhere.

GEORGE WESTON, assistant chief engineer, Board of Supervising Engineers, Chicago Traction, has resigned to become consulting engineer for the Philadelphia Rapid Transit Company.

W. J. ECK has been appointed signal engineer, Southern Ry. and associated lines, with headquarters in Washington, D. C.

V. I. SMART, formerly professor of railway engineering and transportation, McGill University, and J. A. Burnett, formerly electrical engineer, Grand Trunk Railway System, are now associated as consulting engineers, with offices at 821 New Birks Building, Montreal.

G. R. BARRY, division engineer, Pennsylvania Lines West, Columbus, Ohio, has been appointed division engineer, Chicago Terminal Division, Pennsylvania Lines, succeeding F. M. Graham, who was appointed supervising engineer, Southwest System of the Pennsylvania Lines, with offices in Columbus, as mentioned in *Engineering News-Record* of Dec. 12, p. 1102.

J. D. NEVILLE, county engineer of Lewis County, Washington, has been appointed division engineer of the southwest Washington counties for the Portland Cement Association.

HARLEY W. BRUNDIGE, Los Angeles, and Irving Martin, Stockton, Cal., have been appointed by Governor Stephens of the State Railroad Commission. Harry D. Loveland has been reappointed for another term.

MAJ. CLARK R. MANDIGO has returned to his duties as consulting engineer, Western Paving Brick Manufacturers' Association, with headquarters in Kansas City.

ROY J. FINCH, who for some years has been chief clerk of the New York State Engineer's office, has been appointed deputy state engineer to succeed William B. Landreth, who has been appointed chief of the board of consulting engineers, as mentioned elsewhere. Mr. Finch, a graduate of Rensselaer Polytechnic Institute, has been connected with the State Engineer's office since 1908, serving as supervising engineer and division engineer before taking the position of chief clerk.

ROSWELL M. ROPER, for the past year acting engineer for the water department, East Orange, N. J., has been appointed engineer of the department.

Obituary

CHARLES E. PHELPS, former chief engineer for the Public Service Commission of Maryland, whose death was noted in these columns last week, was born in 1871 and received his first technical training at Johns Hopkins University in 1891-1893. In 1902 he was retained by the City of Cleveland to report and estimate upon the cost of an electric street and commercial lighting project adopted by the city council. In 1903 he was retained by the cities of Johnstown, N. Y., and Rochester, N. Y., in litigation over the construction and operation of underground electric conduit systems, and by the city of Montreal to report and estimate upon an underground conduit system project. Two years later he was retained by the City of New York to assist in the investigation of charges for electric street lighting. Later he became chief engineer for the electric commission of the city of Baltimore, and was in charge of the construction of underground conduits. He also served as secretary of the Municipal Lighting Commission of Baltimore and as a member of the Sewerage Commission. In 1910 he became chief engineer for the Public Service Commission of Maryland, and five years later was appointed to the Maryland State Board of Health as engineering member.

GEORGE ALEXANDER JUST, president of the George A. Just Co., contracting engineers, Long Island City, N. Y., died Dec. 27 in New York City. He was born in 1850 and was a graduate of Rensselaer Polytechnic Institute. At one time he was associated with Cooper, Hewitt & Co. He had been in charge of the erection of many buildings in New York City.

DOUGLAS W. TAYLOR, formerly city engineer and superintendent of streets, Portland, Ore., died in that city Dec. 12, at the age of 68.

KARL A. FUNK, structural engineer, who for the past few months had been associated with the Deslauries Aircraft Corporation, Newark, N. J., died Dec. 11 in that city. He was graduated from the Massachusetts Institute of Technology in 1912 and had been in charge of the construction of several buildings in Boston.

Converts Waste Marble Into Valuable Byproduct

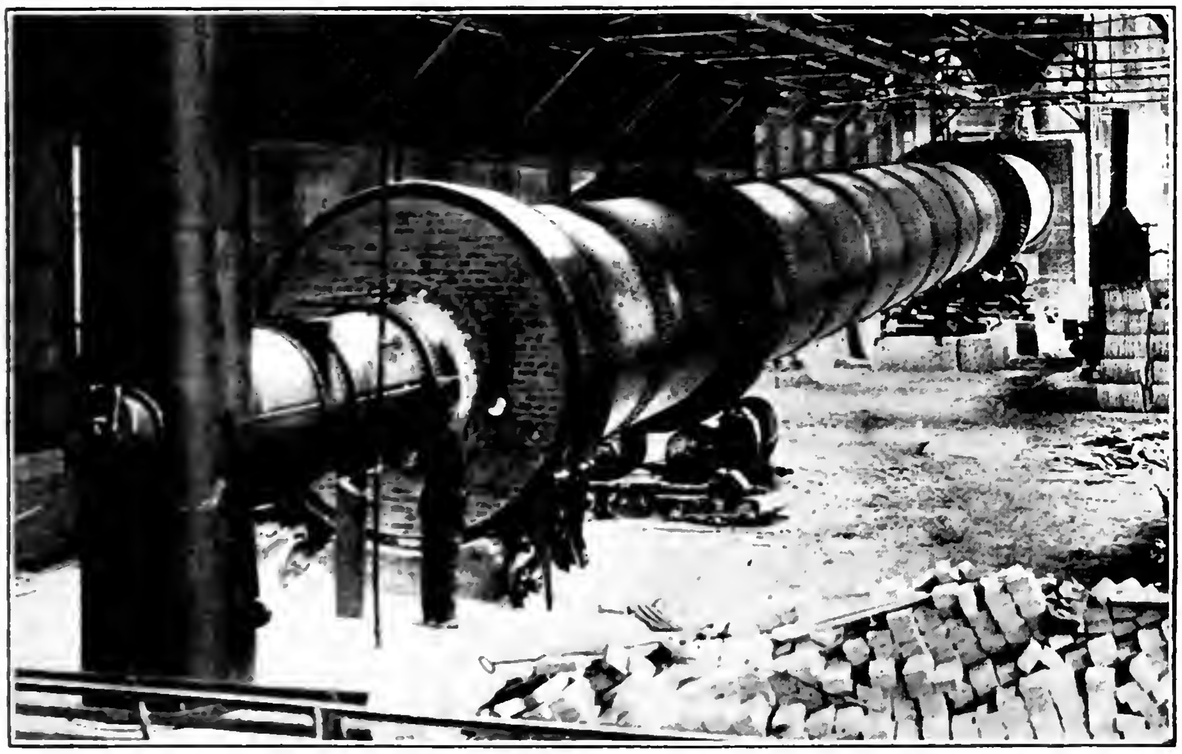
Vermont Company Now Produces Lime from Culls and Chips Formerly Discarded as Useless

During the past four years a large New England marble company has been experimenting with the stone usually wasted in its yards, with a view to converting it into a byproduct. Three years ago experiments were made on different grades of marble to determine the amount of lime obtainable by burning. The tests resulted in the company's building a modern well-equipped lime plant.

The raw material, as it comes to the plant, is in miscellaneous sizes. Blocks over 12 in. thick are conveyed in slings to a 60 x 48 jaw crusher, from which the material is conveyed by gravity through a gyratory crusher set to reduce all the material, including the sizes not sent through the jaw crusher, to 2 in. or less. The material is then elevated and screened, the screened product passing through a set of 36 x 16-in. rolls to reduce it to ½ in. or less. All of the material is then elevated and conveyed into storage or kiln bins, from which it can be drawn at any desired time.

The material from the kiln bin is sent into the kiln by a feeder. The kiln is patented after the familiar cement design, 8 ft. in diameter, 20 ft. long, installed with a 4% pitch. It is belt driven from a 30-hp. variable-speed motor, geared to give 10 ft. from 0.5 to 1.5 revolutions per minute, as desired.

The producer gas is introduced through a flue into the lower end of the kiln, and in burning furnishes the heat for calcining the stone as it gradually rolls through the revolving cylinder. A temperature of 2200 deg. F. is maintained, which drives off the CO from the stone, leaving the quicklime. The hot lime drops from the lower end of the kiln into a revolving cylinder, where it is cooled by the draft of air on its way into the kiln to support combustion. The cooled lime is elevated from the discharge of the cooler and is then deposited in lime-storage bins.



ELECTRICALLY DRIVEN LIMEKILN

Reduction of Labor Shortage Reported by Department

That the supply of labor is rapidly meeting the demand is indicated in a report received from the Department of Labor. The information in the bulletin, the department says, is received by telegraph from local representatives of the Federal Employment Service, and is used in making replacements, in allocating labor, in the curtailment and cancellation of war contracts, and in the demobilization of the Army. The bulletin shows that there is a surplus already in the Middle West, West and Far West, mostly in the cities, and some slight surplus in certain lines is reported from Boston, Buffalo and Rochester, as well as from Nashville, Tenn., and cities farther south. The greatest surplus reported, in Dayton, Ohio, amounts to 5000. The New England States generally report the supply and demand about equal, as do some of the Middle Western States and the South generally. Los Angeles, Cal., also reports the demand about equal to the supply.

Most of the shortage appears to be in the Atlantic States, from Connecticut to Florida. The greatest, amounting to 15,000, occurs in Philadelphia, but is 10,000 less than is shown in the preceding report. Although there are shortages in the manufacturing cities of eastern Ohio, the report states that they are reducing rapidly. Pittsburgh, Harrisburg, Scranton, Allentown and South Bethlehem, in Pennsylvania, all report shortages, more or less in amount, as well as the southern cities of Atlanta, Louisville, Baltimore, Lynchburg, Norfolk and Chattanooga.

Record Non-Stop Tractor Run

A run of 480 miles from Peoria, Ill., to Detroit, Mich., in six days, was recently made by a caterpillar tractor. This is said to be a record for tractors, and to mark a new milestone in tractor progress.

The tractor, which was of the 85 hp. Holt type, was delivered to representatives of the United States Government, and the run was made in the nature of a test of the machine. It followed highways of all kinds, many in very bad condition, and although the speed on road is rated at three miles an hour, it did a little better, covering the distance in 151 hours. Despite the bad roads, however, the tractor was in such good condition at the end of the run that it was immediately ordered overland to the Army Proving Grounds at Aberdeen, Md. There were no mechanical breakdowns, and inspection showed the machine to be in excellent condition.

Business Notes

The Maxwell Engineering Co., formerly at 156 Twenty-fourth St., Brooklyn, N. Y., is now completing its new yard, plant, and office building at 103 Thirteenth St., Brooklyn.

The Carbo Steel Post Co., formerly of Chicago Heights, Ill., has changed its address to 2600 West 111th St., Chicago, Ill.

The Chicago office of the Electro-Bleaching Gas Co., 11 La Salle St., which was temporarily closed on account of the war, is to reopen, and will be in charge of G. R. Ellis, as formerly.

Trade Publications

The Raymond Impact Pulverizer Co., Chicago, Ill., has issued catalogue No. 13, covering its equipment of roller mills and pulverizers equipped with air separation for grinding all kinds of materials to powdered form.

"Steel Pile Forms" is the title of bulletin No. 12-A issued by the Northwestern Steel & Iron Works of Eau Claire, Wis., builders of engines, concrete mixers and steel forms. It is an 8 x 10 twenty-page pamphlet illustrating and describing the product of the works.

The Milliken Brothers Mfg. Co., New York City, has issued a 23-p. 6 x 9 ½-in. booklet entitled "Space and Speed in Steel Buildings," describing the standardized truss unit system of building construction designed and manufactured by the company.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 82 — NEW YORK, THURSDAY, JANUARY 9, 1919 — Number 2

What Do You Want From Your Legislature?

THIRTY-THREE state legislatures meet this year. What do you, reader, want from yours in behalf of your city or state, the engineering profession, the returning soldier, or to better the relations between employees and employers, or to help solve the increasingly serious utility problems of the day? The question would be most appropriate for discussion before local and state engineering societies. Many of the latter will meet this month and next. Meanwhile, each engineer and contractor may well ask himself and his fellow, "What do you want from your legislature?"

Low Labor Costs With High Wages

OF THE two chief construction-cost factors, materials and labor, one is inflexible, the other flexible. Material prices are what they are, and there is no recourse. Wages are relative to what the laborer produces. Steel-erection costs in the vicinity of New York are very much lower today than they were ten years ago, *though wages have doubled.* The reason is simple: *The men are producing more per dollar of wage.* Labor leaders are recognizing that to maintain high wage levels production must come up in proper proportion. We know of one construction job on which labor leaders are working with the owner (in this case the Government) to bring up the admittedly large output per man. In consequence, costs have been reduced 30 per cent. as against what they were some months ago. With such a wage policy adopted generally by the labor unions, the labor costs, even with present wage scales, need not be above pre-war costs. Only high material prices would then remain to becloud the construction horizon.

Rural Development Urged by Governor of New York

IN HIS message to the legislature Governor Smith of New York has urged very strongly the coöperation of his state with the national Government in creating land settlements for soldiers. In doing so he heartily indorses the plans laid out by the Secretary of the Interior for coöperation between the Federal Government and the individual states. He well says: "It is becoming more and more apparent that the ability and the experience of our agricultural leaders should be mobilized to create a planned rural development which will include coöperative organization for buying and selling, a system of credit that will give broader opportunities for men of small capital to become farm owners, and a better social life." We have generally associated with Western conditions such rural projects as that so well described by the Governor, but every one familiar with rural conditions in the West realizes the need for well planned rural projects, even in the most thickly settled districts. Such projects would take advantage of all of the experience and experimentation which has resulted from Federal initiative or from successful local communities in every part of the country. The remarkable development at Durham, Cal., of the State Land Settlement Board is a pattern that can easily be duplicated if existing agencies are called upon for help. The entry of New York State into such a land settlement scheme would give an impetus for better agriculture throughout the entire East, and we sincerely trust, therefore, that the New York legislature will give attention to this feature of the Governor's message. While put forth principally as a reconstruction measure, it has promise of great influence as a peace-time measure.

War Control of Highways Here and in Great Britain

A COMPARISON of highway construction control in the United States and Great Britain during the war will be found elsewhere in this issue. It is written by an engineer who had close contact with the control work in this country and constant access to reports of the English Road Board's activities. His attitude toward the work of the United States Highways Council is quite favorable, while that of *Engineering News-Record* during the activities of the council was decidedly critical. There is all the more reason, therefore, why a hearing should be given to what may be interpreted as approximating the council's own view. Two points should be advanced in extenuation of the heavily restrictive activity of the council: First, that the narrowness of policy, the failure to recognize the war-function of highways, was due very largely to the attitude of one member of the council; and, second, that during the last month of the council's life there was marked progress in the direction of a more liberal policy. One man, it will be contended, should not have been able to hamstring the whole council; yet that was possible when the man in question held the whip hand—in his control over materials. In the matter of more liberal policy, the increase in the number of projects approved in the month before the signing of the armistice indicates that if the war had continued there is likelihood that the council's stand would have changed to full recognition of the highway's place in the war scheme. As it was, however, criticism lay heavily on the council for its too heavily restrictive attitude.

Will New York Engineers Fail in Their Civic Duty?

AS THIS issue goes to press there is grave danger of the engineers of New York City failing in their civic duty. Elsewhere in these columns are the details of the sudden discharge of 300 engineers of the Public Service Commission, resulting in the disruption of an excellent engineering organization and in a probable heavy loss, through delayed work, to the city. The situation calls for immediate and organized protest by engineers. The work being chiefly of a civil engineering nature and of a public character, responsibility for calling a meeting lies either with the organized body of civil engineers or with an organization designed to handle public questions of an engineering nature. There being no local society of civil engineers in New York, responsibility lies between the American Society of Civil Engineers and the Engineering Council. The society, holding that it had passed its civic functions to the Engineering Council, promptly, by telephone message of its secretary, urged the council to take the matter in hand. Up to this writing (Tuesday, noon), the executive committee of the council has refused to call the much-needed meeting of protest.

The reason has not been made public, but the weakness of the committee's position is shown by the known fact that it is ready to take action if it receives a *formal communication* from the Public Service Commission or from one of the Founder societies requesting action. *Formal communication!* when the story of the injustice and the disruption is spread in every newspaper in New York City, when an Associate of the American Society of Civil Engineers has spread the matter before the council in a letter, when the secretary of the same society has urged the council by word of mouth to act, when other engineers who know the situation thoroughly have orally put the matter before the council's executive committee. *Formal communication!* while meanwhile every engineer in New York City with red blood in his veins is boiling at the injustice to his fellows and the loss to the city. But the end is not yet. Before the week is out, we hope, the executive committee of the council will have acted, and the engineers of New York will have registered a ringing protest. Meanwhile, this weakness of engineering society organization in New York City needs to be recorded, this inability of the engineers to secure quick action in the discharge of their civic responsibilities. The Engineering Council will have its side to tell, but this fact is outstanding, that it has delayed action awaiting a *formal communication* on a pressing matter on which even the man in the street is informed.

Theodore Roosevelt and the Engineer

THIS is not the place for any extended comment on the personality or work of Theodore Roosevelt. For two of his activities, though, engineers have especial reason for remembering and honoring him—his vigorous backing of the Panama Canal work and the impetus he gave to the movement to conserve our natural resources. In both he displayed a keen appreciation of technical features and backed the engineers with a vigor that could be the result only of strong faith in men of professional training.

His interest in the Panama work, particularly, was of value to the nation. The project had dragged along in the report stage for years. With his accustomed desire for action, he put the job under way, first taking what was then the very sensational step of casting aside the majority report of the international commission, which favored a sea-level canal, and accepting the minority's view. We know now, as a result of the building of the canal, that he was well advised in his choice. What part he played, whether of action or acquiescence, in the Panaman revolution, the first step in the realization of the canal project, is not for discussion here.

In the conservation movement his ability to grasp problems was no less clearly shown, and with the emphasis that he so well knew how to put on things that he wanted cast into the public eye, he made conservation the most talked-of subject in the country in a few weeks' time. What the result of his work in this direction has been has not, so far as we know, been appraised. That it gave a new impetus to the engineers' work in trying to conserve our resources there is no doubt. The full vigor of the early propaganda seemingly is lost, but there is good reason to believe that much of it has been translated into effective machinery for investigation, administration and operation.

In respect to one of his activities the engineers of the future will have more cause than those of the present to remember Colonel Roosevelt. The social-justice program of his 1912 campaign was about six years ahead of the time. Belittled then and scoffed at, it has now been accepted by employers, in theory at least. There was clear evidence of that at the recent Atlantic City Reconstruction Conference. In the coming day those instrumentalities of industrial coöperation will be placed on a scientific, on an engineering, basis, and then some engineers will revert to the 1912 campaign and marvel at the foresight of Colonel Roosevelt and at the denseness of American business.

Administrative Ability in Technical Work

IN THE readjustment for peace conditions which is now just beginning, one of the serious mistakes made in the readjustment for war conditions, which was carried out in 1917, should be avoided. When the nation's resources were being mobilized, eighteen months ago, there was a great demand for engineers to fill places in the little rectangular spaces of numberless so-called organization charts. The harassed higher officials, with their utterly inadequate staffs, trained in precedents and fettered by red tape, had to create proper organizations while carrying on business with what they had. The Construction Division of the Army grew out of an unimportant section of the Quartermaster Corps into a most effective agency because it had the benefit from the outset of the advice of some of the most successful engineers and builders in the country. In the same way the Bureau of Mines, with the help of successful specialists, organized the Chemical Warfare Section, the most imposing aggregation of chemical technologists the country has seen. But there are other departments whose success has been less marked, which

brought into their organizations a large number of technical men of good reputation, but which nevertheless failed to make much progress. These conditions have caused much comment, and the general explanation of them, made by men who have been successful in private life and successful in Government work during the war, is full of warning to those who are taking up the readjustment to meet the requirements of peace.

Where a war-time agency has been successful, it has had an organization in which the difference between technical knowledge and administrative ability has been recognized in the appointments and the scheme of management. In a general way, everybody recognizes this difference, but practically few men, not themselves experienced executives, appreciate its importance. Bureau chiefs in Washington, whose salary lists were so low they could not obtain men of both technical and administrative ability in competition with private corporations, failed to realize that such men would be willing to serve the public in war times at Government rates of compensation. The new men they brought together often lacked administrative capacity, and needed so much overhead direction and control that progress was slow, in spite of the abundance of technical talent that was gathered together.

This is not the place to enter into a prolonged discussion of the administration of technical undertakings. It is enough to say that the war has proved beyond question that, while there is an abundance of technical talent in the country, the combination of technical and administrative talent necessary to make speed economically in war times is the same combination necessary to make profits in peace times, and it is far from plenty. It is the result of an astigmatic view of the duties of the average technical executive, which lays stress on his scientific knowledge and blurs the importance of his ability to plan and direct the work of others. Administrative capacity has a higher value than technical knowledge in many presumably technical positions, and as it is more difficult to obtain it should be examined into more carefully. The technical schools should also recognize this fact, and turn out graduates who know that the ability to direct others successfully has a big cash value, even in a scientist.

Political Piracy With the Engineer as Victim

POLITICAL piracy has many discreditable deeds in its book, but most of these are outdone by the action of New York City's governing body, the Board of Estimate and Apportionment, in tearing to pieces the Public Service Commission's engineering department on the eve of the new year. Certain consequences of this action, perfectly obvious and as well known to the board as to any citizen, have an ugly appearance. But because a great enterprise of engineering construction is involved, and a great engineering organization performing urgently necessary functions is made the immediate victim of the vicious act, the occurrence becomes one of peculiar concern to engineers.

By vote of the board in connection with a running-expense appropriation, the commission was ordered to dismiss a third of its staff. More than 300 engineers were thrown out on a few hours' notice, without apology or farewell. These men were and are badly needed, on rush work now under construction and on other work soon to be let. So far the bare facts—except perhaps the brief note that, as every one in the street knows, the board has for some time been engaged in bitter personalities with the commission as a whole and with individual members.

Now for the background, of justification or accusation. A score of subway and elevated railway contracts are under way. Some of them were being urged along as fast as possible, as closing links in lines shortly to be put in operation. Many other contracts for finishing work and equipment are also under way. Additional work was being prepared for contract, and this, besides its local importance in helping to bring the city's sadly deficient transit facilities up to requirements, would have been of national influence in aiding to restore the normal course of industrial life in the nation, momentarily checked and reluctant.

All of this activity under the Public Service Commission's jurisdiction is vitally dependent for its progress on the engineering department. A highly expert organization—now wantonly dismembered—had been built up in the course of years to perform this essential municipal service.

By contract stipulation, all engineering data, all lines and grades, all directions and instructions as to quality and quantity, all estimates for payment, must be supplied by the engineers. In much of the work the constant day-and-night attendance of engineering parties is required, aside from inspection. Without this engineering service, the contractors cannot proceed; their work will be delayed, their plant and organization expense continuing, and the city, in the end, must pay the bill. Delay in subway service means further cost—a week's interest on the idle investment already made will weigh up the three-month "saving" in salaries which the board accomplished.

It was known to the Board of Estimate, which itself passed upon the contracts, that the construction work cannot go along without the engineers. It was known to the board that New York needs the service of the new lines, and is paying tens of thousands of dollars daily in interest on idle investment. It was the board's plain duty to know that losses of great amount would fall upon the city if it delayed the work. Did the board, then, act in ignorance? Or must we entertain the hypothesis that it acted with deliberate malice?

So far as engineers are citizens merely, their interest lies in fighting the wrong done the community, and in coöperating with the rest of the community in answering the challenge of the recreant officials by the law and by the ballot. As technical men, however, they have a somewhat specialized duty.

It is their privilege as well as their duty to brand with proper opprobrium the baseness that uses a great engineering work as the plaything of personal antagonisms. It is theirs to write on the record a proper characterization of the outlawry that destroys a trained engineering organization, a municipal asset. And, we think, it will be their privilege to take this occasion for protesting against the subordination of intricate technical problems, and of men trained in their solution. to the whims of political chancemen.

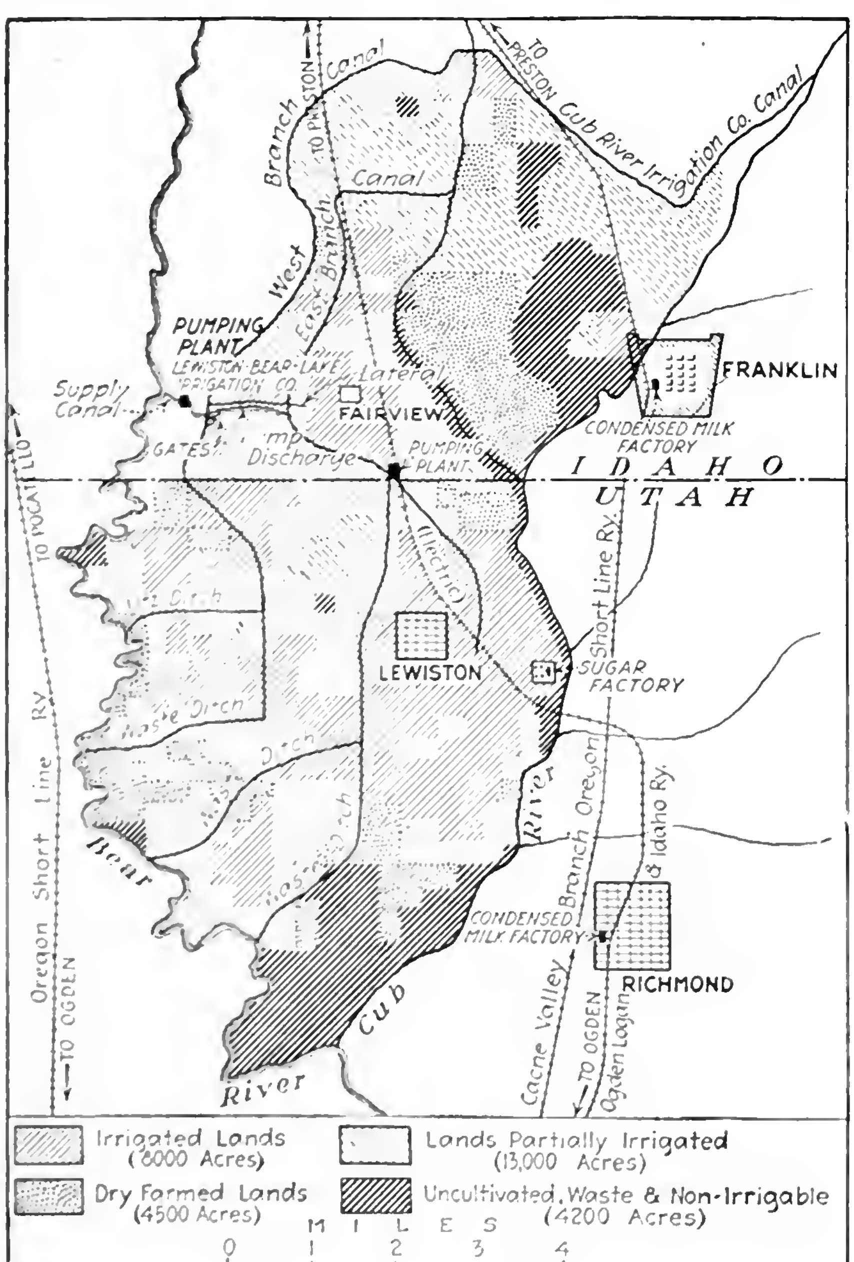
Electrically Driven High-Lift Centrifugal Pumps Supply Water for Irrigation

Water Forced Through Steel Manifold to Reinforced Concrete Conduit Leading Up to Canal—Design Features—Pump Tests Show Over 81 Per Cent. Efficiency Under 90-Foot Head—Construction Work

By B. P. Fleming
Mechanical Engineer, Member American Society of Civil Engineers, Iowa City, Iowa

EVERY year sees greater strides made in irrigation by pumping. This article describes a new high-lift irrigation pumping project with steel manifold and reinforced-concreted force main, put in successful operation in 1917 for supplementing the water-supply of a large area known as the "Lewiston Flat" in northern Utah and southern Idaho. This district is one of the most progressive and productive agricultural districts of the inter-mountain region, the products being sugar beets, dairy products, alfalfa, grains and potatoes. Two sugar-beet factories and two condensed-milk factories are located in the district, and the farming generally is on an intensive and profitable basis where and when water for irrigation is obtainable. Power at low cost as well as intensive agriculture make high-lift pumping feasible.

The irrigable area of the district has been estimated at about 30,000 acres, of which about 20,000 are under existing canals. For the past 40 years the water-supply has been derived from a small stream known as the Cub River, a tributary of the Bear River. The flow of the Cub varies from about 400 sec.-ft. in June to an amount not exceeding 60 sec.-ft. in July and August, during which months the valuable sugar-beet crop is most in need of water. In normal years about 8000 acres of the Lewiston district would be fairly well supplied with water over the entire season, 8000 acres would receive only sufficient to grow grain crops or mature one crop of hay, while 4000 acres might receive no water at all.



CLASSIFIED DISTRIBUTION OF LANDS IN LEWISTON FLAT IRRIGATION PROJECT, IDAHO, UTAH

The securing of such a supply of water as might permit not only of adequate irrigation of the area now farmed but also would lead to a development of the entire irrigable area, has been a very important public question in the district for many years. Various surveys both by Government and private agencies have shown the economic impractability of development of additional water-supply either by gravity flow from the Bear River or by storage developments on the Cub River, so that pumping from the Bear River seemed to be the only solution of the problem.

The Bear River lies from 85 to 90 ft. below the general level of the lands in question. Its natural flow has been entirely appropriated by agricultural and other interests along its course in Idaho and Utah, so that the only hope of the district was in securing a right to stored water. This, fortunately, was obtainable through the extensive storage developments begun by the Telluride Power Co. and completed by its successor, the Utah Power & Light Co., on the body of water known as Bear Lake, in northern Utah. This development comprised the construction of a large pumping plant of 1500 sec.-ft. capacity and control gates which, together with an artificial channel between Bear Lake and the Bear River, make it possible to divert floods into the lake and store them there, or, in case of long-continued drought, permits the pumping out of the waters of the lake to a depth of 17 ft. below the normal stage, and thereby augmenting the flow of the river.

The object of this development is to insure continuity of operation of the large hydraulic power plants established on Bear River, but, incidentally, it has assisted to a certain extent in the possibility of agricultural development, by providing some stored water for the use of those who are able to secure a right to it, and who can divert it below the power plants. The attractive rates for electrical power for pumping offered by the power company, together with the offer of a right to a certain amount of stored water, led to the inception of the project here described. The amount of water estimated as necessary to be supplied by pumping, to supplement gravity water, was 10,000 acre-ft. Since

this amount must be supplied mainly within a period of 50 days, the capacity of the plant became fixed at 100 sec.-ft. For flexibility in operation, it was decided arbitrarily to build a plant of four units of 25 sec.-ft. capacity each.

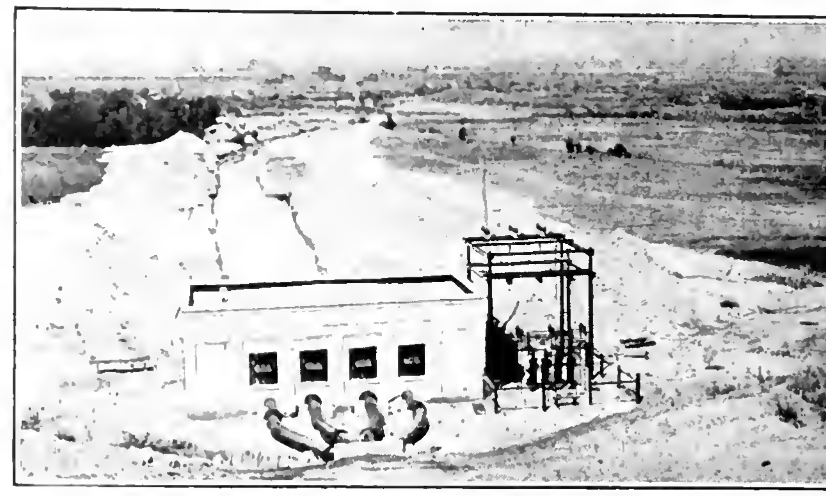
The plant was located directly west of Fairview, Idaho, at which point the Bear River approaches quite near to the present canal system of the Cub River Irrigation Co., into which the pumped water was to be discharged.

The site finally selected for the plant was on a hillside and flat adjacent to a V-shaped bend in the Bear River. Preliminary studies were made of the comparative cost and general suitability of a plant located at the river and discharging into a canal at the crest of the hill through a long wood-stave force main, and a plant located at the base of the hill and taking water from a supply canal leading to the river and discharging through a comparatively short concrete or steel pipe into the canal. Test pits dug on the line of the pump supply canal and at the proposed site of the pump-house structure seemed to indicate that although water would be encountered in large quantities, the necessary excavation required by the second plan could be carried on without serious difficulty. How far this surmise missed the true conditions is related under "Construction." The comparative studies made indicated that the second plan was the more feasible and economical, particularly since it was the desire to eliminate entirely the use of wood-stave pipe, which under the conditions of a pumping plant in use only a few months of the year, cannot be properly maintained. The distance through which the water would have to be carried under pressure, in the case of a plant located at the river, and the size required, seemed to indicate that only a wood-stave pipe could be considered from the standpoint of initial cost—and this fact was of the greatest weight in the decision to adopt the other type of plant.

Another factor having an important bearing upon the general design of the pumping station was the type of pump to be selected, whether vertical or horizontal. This matter was not decided until after bids had been received upon both types. It is significant of the favor with which these two types of units are regarded by the pump manufacturers themselves that, out of seven manufacturers represented, only one would offer a bid upon the vertical unit, and the others were most decidedly opposed to its use under the circumstances.

After various studies had been made, it was found that a concrete pipe was practically as cheap as a riveted steel pipe of the same internal diameter, so concrete was decided upon because of its greater permanency and lower friction loss, as well as the less difficulty in securing construction materials. The design of a reinforced-concrete manifold to receive the discharge from the four pumps proved to be so difficult that it was abandoned in favor of a riveted steel manifold. The full-discharge velocity throughout the manifold and the concrete pipe was limited to 5 ft. per second, and in the design of the manifold an attempt was made to give the easiest flow lines possible while yet maintaining a form providing a maximum of strength. The manifold has a circular section in every part, and in order to insure additional stiffness a vertical plate is riveted in the crotch of the breech-like portion. No leak of consequence was discovered in any of this riveted steel construction.

Some concern was felt by the designers as to the probable pressure effect in the steel manifold and the concrete discharge pipe resulting from sudden closing of the hydraulic gate valves on the discharge side of the pumps. If, for any reason, power goes off while the pumps are in operation, the pumps almost immediately begin to run backward, and the water in the discharge pipe attains a fairly high velocity backward down the pipe. Checking this flow suddenly by the closure of the gate valve would cause water hammer. Calculations, based upon the various formulas tried, while not giving consistent results, seemed to indicate that no dangerous pressures would be developed. A small relief valve was, however, placed at the end of the steel breeching. In the operation of the plant and in the deliberate creation of conditions favorable for water hammer at the time of testing, scarcely appreciable rises in pressure were noted.



WATER FROM RIVER IS PUMPED THROUGH STEEL MANIFOLD AND REINFOCED-CONCRETE CONDUIT

A vacuum relief valve was also placed at the top of the concrete pipe at Sta. 14 + 17, at which point there is a break in vertical alignment where vacuum conditions may be created by the rapid letting out of water from the pipe. The free area of the air valve is about 1% of the area of the pressure pipe.

Excessive temperature changes in the concrete and steel piping were anticipated, since, although backfilling over the concrete pipe was proposed, it was not of sufficient thickness to insure against considerable daily and seasonal temperature changes, while the steel piping was completely exposed. Expansion joints in the concrete pipe were considered, but the difficulty of construction and the possibility of leakage led to the rejection of expansion joints altogether in the concrete pipe and the placing of dependence upon the longitudinal reinforcement alone to prevent the formation of transverse cracks. It was planned also to construct the pipe in cold weather, and this was successfully accomplished by late spring, before hot weather had set in. No leaks of any magnitude have so far (April, 1918) appeared in the pipe although water was turned into it for the first time early in July, 1917, when there was probably 50° difference in temperature between the pipe and the water. Expansion joints were introduced in the steel piping of the manifold next to the pump-house, and the pump side of the joint was anchored securely to piers braced against the pump-house foundation.

The substructure of the pump-house is of reinforced concrete, designed to withstand a water pressure of 15 ft. The sump floors are designed to act as beams between the sump walls. The parts of the floor beneath the machinery were designed as beams heavily reinforced. Elsewhere the floor is 6 in. thick, well reinforced. The walls are 15 in. thick. The superstructure walls are of brick. They sustain a concrete crane girder, a 10-ton crane, and a flat roof supported by 12-in. I-beams. The roof is 3 to 5 in. of concrete on asbestos-steel corrugated roofing, and is covered with tar felt and gravel. The crane is provided with hand-operated lifting and racking mechanism.

Sump Drainage—Hydraulic Gates—Pumps

To drain the sump beneath each main pump unit, there is a 3-in. motor-driven side-suction centrifugal pump, with a valve-controlled 4-in. suction pipe. For priming the main pumps and the sump pump, a motor-driven rotary vacuum pump is provided, its suction being connected to a vacuum main from which branches lead to each pump. To the priming pump, immediately above each main unit, is attached a gage glass by which the operator can tell exactly when the unit is primed. Some difficulty was met in the initial operation of the priming pump, due to inexperience in adjusting the amount of water needed for water-sealing it. When finally adjusted, it would prime a main unit in from 5 to 7 minutes.

The hydraulic gate valves are 18 in. in size and are provided with a hand operating device for use when the pumps are first started and no pressure head is available in the discharge line for their operation. This device was found by no means satisfactory, since its design requires an entire dismounting before the valves can be operated hydraulically. The control of the hydraulic valves is centralized at a point near the switchboard, so that after priming a unit and starting the motor the operator merely turns a small pilot valve which opens the main valve. A reverse motion of the pilot valve likewise closes the main valve, so that the operation is very easy and rapid. Hydraulically rather than electrically operated valves were chosen because of their greater simplicity and much smaller first cost. Their operation in this plant has been eminently satisfactory.

Each main pump unit is an 18-in. double-suction split-case centrifugal pump with bottom horizontal discharge and vertical suction connection. The impellers are of bronze, and a bronze sleeve covers the shaft from the impeller out through the stuffing-boxes. The latter are water-sealed and were provided with bronze lantern rings.

Water for sealing was taken originally from the pumps themselves, which necessitated tightening the glands when priming. It is now proposed to utilize clear water from a spring near the station which will give sufficient water under pressure for water seal irrespective of the operation of the pumps.

The pumps are provided with ring oiling bearings in split babbitt cases. A flexible coupling attaches the pump to a 350-hp. induction motor on the same bedplate. These motors are three-phase, 60-cycle, of the squirrel-cage type, using current at 440 volts. Each motor is controlled from its own switchboard panel, the cable running in a conduit laid in the floor.

The switchboard is of standard slate construction and consists of six panels. Of these, four are motor panels, on each of which is mounted an ammeter, an integrating watt-hour meter, and the triple-pole single-throw oil switches. One panel is a totalizing panel, on which is mounted a totalizing wattmeter, a totalizing integrating watt-hour meter and a graphic recording frequency meter. On the sixth panel are a volt meter and the instruments of the auxiliaries and lighting circuits, comprising a watt-hour meter and the necessary single-throw switches for the house lights and auxiliary motors.

The current is transmitted to this station from the Preston substation, about six miles away, at 44,000 volts. Current is transformed into the 440 volts used at the plant by a bank of three 500-kva. transformers of the outdoor, oil-filled, air-cooled type. Four 44-kv. aluminum cell lightning arresters are provided for protection against line surges and lightning discharges, and the other equipment includes disconnecting and line switches, choke coils, expulsion fuses, etc. Serious difficulty experienced in times of electrical storms with high potential discharges on the secondary side, soon after operation was started, led to the installation of secondary arresters between the transformers and the switchboard, in addition to the more thorough grounding and transformer cases.

Tests

The contract between the pumping enterprise, or the Lewiston-Bear Lake Irrigation Co., and the Utah Power & Light Co., comprises many features intended to penalize peak-load conditions and to encourage an endeavor to economize on power consumption, although the base rate is only 1c. per kilowatt-hour. In the design of the plant, therefore, an effort was made to eliminate so far as possible hydraulic energy losses in piping and sumps, and in preparing the specifications an efficiency for the pumping units themselves of 81% was demanded. This figure was considered a not unattainable ideal, but one of the largest pump manufacturers in the country refused to bid upon the basis of this figure, and several other manufacturers were very loath at first to offer to attain this efficiency, particularly since the contract was so worded that a certain percentage of the contract price was to be withheld pending the attainment of the guaranteed efficiency. Inasmuch as this percentage amounted to $12,000, the contract provided for very complete tests of the pumps upon completion of the plant. Considerable thought was given to the matter of accurate water measurement. After rejection of other methods because of difficulty of operation or probable inaccuracies, it was decided to install a 14-ft. Cippoletti weir in the discharge canal, 200 ft. below the outlet of the discharge pipe and at the end of the concrete-lined section of the canal. The weir was constructed of 2-in. grooved and tenoned lumber with a thin steel plate for the weir crest, the weir being installed in a substantial concrete structure, with provision for removing the weir board upon completion of the tests. Heads on the weir were measured by a hook gage reading to thousandths of a foot, the zero of which was de-

termined by an engineer's level. Bazin's formula, as tabulated in Williams' and Hazen's tables, was used for calculating weir discharge. Although Bazin's formula is based upon the use of a weir without lateral contractions, it is recognized that the trapezoidal weir with side slopes of 1 to 4 gives a discharge "equal to that of the rectangular weir without end contractions"; hence Bazin's formula may be applied to the determination of the discharge of the weir in question and provides a very convenient method of computation, inasmuch as velocity of approach is taken into account in the formula and may be neglected when the weir conditions are comparable to those of Bazin, which it was the endeavor to secure in this case.

Pressure head on the pumps was determined by a calibrated Bourdon gage and suction head by a mercury manometer, both being referred to the axis of rotation of the pumps as a datum. Power input to the motors was measured at the motor terminals by an indicating polyphase wattmeter, current transformers only being used. Merely as a check, the readings of the switchboard instruments were taken during the test, but were not used in making calculations. Subsequent to the test the gages and electrical instruments were calibrated, and these calibrations were used in making the official calculations. In calculations of pump efficiency the motor efficiency was assumed as that shown by factory test at full load, 91 per cent.

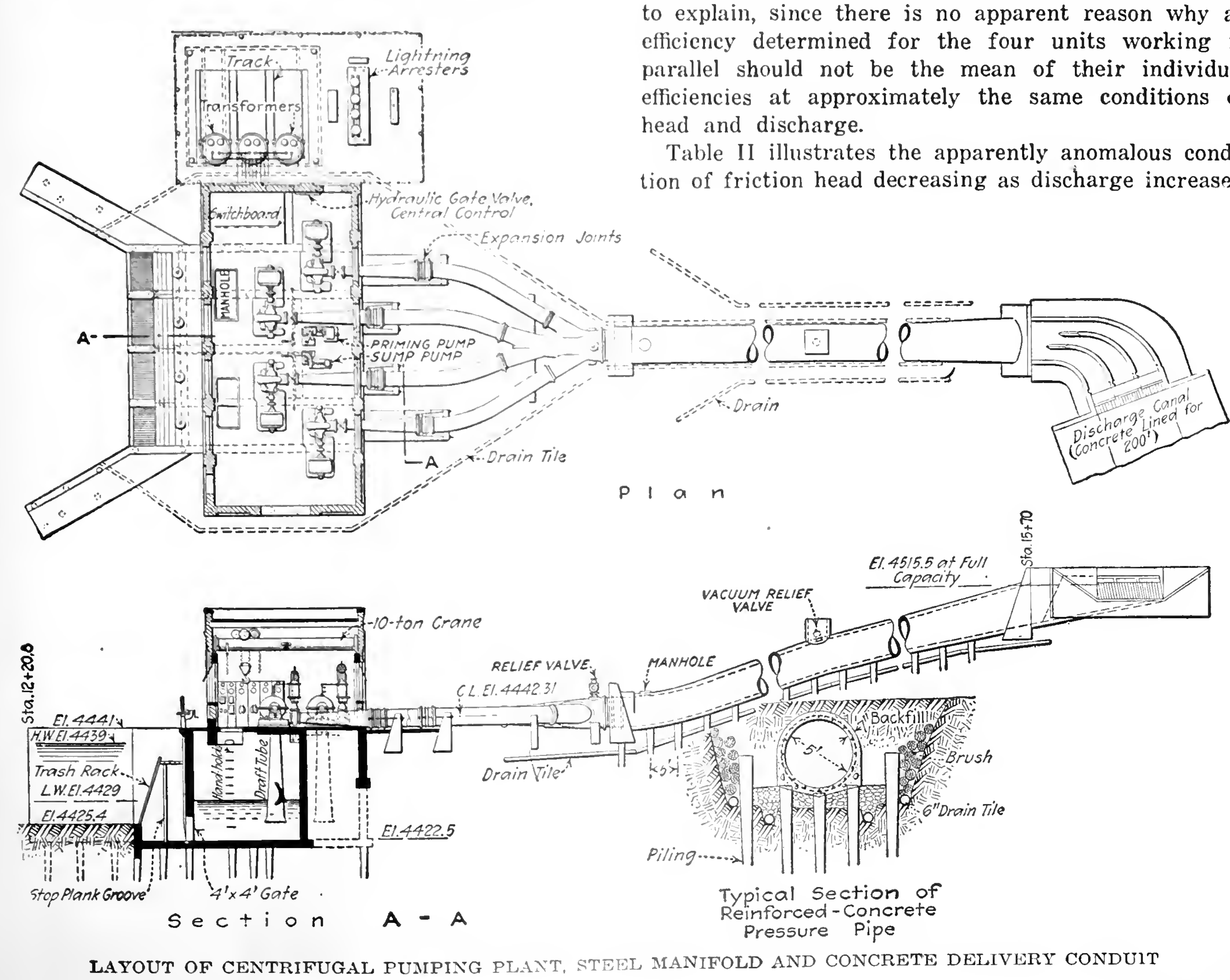
In testing (see Table I), the pumps were each run separately at three heads, the heads being varied by partly closing the hydraulic gate valves. Following the runs of the individual pumps all four were operated together to determine the action of the manifold as regards friction effect.

TABLE I. RESULTS OF CENTRIFUGAL IRRIGATION PUMP TESTS

Unit No.	Discharge Head, Ft.	Suction Head, Ft.	Total Head, Ft.	Static Lift, Ft.	Discharge, Sec. Ft.	Water, H.P.	H.P. Input	Pump Efficiency %	Speed
1	70.1	18.2	88.3	85.35	28.36	284.5	344.6	82.5	886
1	75.8	17.7	93.5	85.26	27.51	292.0	347.6	84.0	883
1	81.5	16.75	98.25	85.05	25.95	290.0	344.4	84.2	889
2	70.1	18.1	88.2	85.34	27.69	277.5	344.4	80.6	880
2	75.3	17.5	92.8	85.20	26.82	282.8	347.8	81.3	880
2	80.5	16.9	97.4	84.90	25.76	285.0	350.0	81.4	882
3	70.1	18.3	88.4	85.23	28.52	286.2	341.6	83.8	...
3	74.8	18.1	92.9	85.24	27.81	293.6	344.6	85.2	...
3	81.0	17.4	98.4	85.38	26.09	291.9	341.6	85.4	...
4	69.9	18.6	88.5	85.55	27.72	278.3	339.6	81.9	884
4	74.8	17.9	92.7	84.91	27.22	286.3	343.5	83.4	882
4	80.3	17.2	97.5	87.79	26.32	291.4	344.0	84.7	880
1, 2, 3, 4	71.1	17.4	88.5	85.8	108.01	1086.0	1421.5	76.5	

The most significant figures in Table I are those on pump efficiency. It will be noted that efficiencies of over 85% were attained by No. 3 unit, while all units are safely over the guaranteed efficiency of 81% at 90-ft. head. The lower efficiency of No. 2 unit is thought to be due to a small air leak in the suction pipe. This leak was not discovered until the tests had been completed. With all the pumps in operation there is noted a distinct falling off in pump efficiency which is difficult to explain, since there is no apparent reason why an efficiency determined for the four units working in parallel should not be the mean of their individual efficiencies at approximately the same conditions of head and discharge.

Table II illustrates the apparently anomalous condition of friction head decreasing as discharge increases.



LAYOUT OF CENTRIFUGAL PUMPING PLANT, STEEL MANIFOLD AND CONCRETE DELIVERY CONDUIT

This is probably due entirely to the better flow conditions established in the steel manifold when all four branches are discharging than when one only is being used, so that the saving of head here more than overbalances the greater loss in the concrete pipe due to the increase of velocity when carrying 108 second-feet.

TABLE II— FRICTION LOSSES BETWEEN DISCHARGE CANAL AND FOREBAY

Unit No.	1	2	3	4	Four in Parallel
Total static lift, ft.....	85.35	85.34	85.23	85.55	85.8
Discharge head, ft.....	70.1	70.1	70.1	69.9	71.1
Suction head, ft	18.2	18.1	18.3	18.6	17.4
Total head, ft.....	88.3	88.2	88.4	88.5	88.5
Friction head, ft	2.95	2.86	3.17	2.95	2.7
Discharge, sec.-ft.....	28.35	27.69	28.52	27.72	108.01

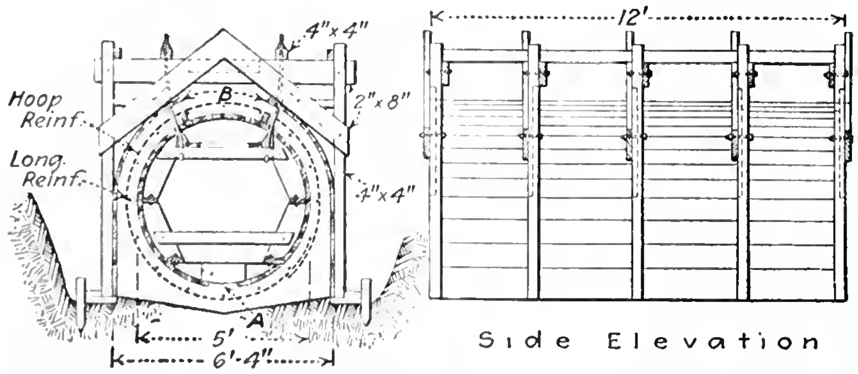
As a whole, the efficiency tests of this plant illustrate the recent very remarkable advance in centrifugal-pump design from the standpoint of efficiency, and give reason to believe that it is not too much to expect that in the case of large units, working under reasonably high heads, 85% efficiency may be obtained where the character of the installation is such as to warrant the extra expense of a pump designed for the special conditions under which it is to operate. It is to be noted that such efficiency can only be obtained by the use of small running clearances in the impeller at the wearing ring which prevent leakage from the discharge back to suction; and the water seal preventing air leakage into the suction passage around the shaft must be perfectly air-tight. Wear is to be expected in the course of time in the wearing rings, and the glands cannot be maintained in perfect condition after a long period of use, so that to maintain the high efficiency found when the installation is new it will be necessary to renew from time to time the wearing rings and the bronze sleeves on the shaft.

Construction

Active construction work was begun in September, 1916. To J. E. Wilson, Jr., of Logan, Utah, was awarded the contract for the pump-house building and foundations, the supply canal and all concrete structures, including the concrete pipe and the outlet, the weir and the various structures in the discharge canal.

The contractor's scheme of operation was to use a dragline excavator for the supply canal and for as much of the pump-house excavation as could be reached by such a machine. The excavation for the concrete pipe was attempted by teams and slip scrapers. The work had progressed only a short time when great and increasing difficulty was experienced with slides and cave-ins. The whole hillside was found to be in a completely saturated condition, and the site of the pump house and most of the supply canal was found to be underlaid to a great extent by an undetermined depth of quicksand. No progress could be made with the pipe trench until several lines of drain tile and brush drains had been put in and piling had been driven 5 ft. c. to c. almost the entire length of the pipe. Although the use of piling under either the pump house or the pipe had not been contemplated, the uncovering of the subsoil conditions made it necessary to use about 400 piles beneath the force main. Cave-ins in the pump-house excavation delayed the work greatly and increased enormously the amount of material to be moved. When the point was reached where concreting could be done it was midwinter. Most of the concrete in the foundation was placed when the thermometer never rose above freezing temperature. Forms frequently were overthrown or misplaced by cave-ins before concrete could be poured, and the water rose so rapidly in the excavation that a 3-in. centrifugal pump was kept going night and day. Nevertheless, in the face of such discouragements, the foundations were built and the superstructure was erected in time for the completion of the plant before the irrigation season of 1917 started. The pump-supply canal likewise involved serious difficulties in excavation, and it was found necessary to use side slopes as flat as 2½ to 1 to prevent slipping. This required the removal of excessive quantities of material and repeated dredging of the bottom, in order to establish a grade.

The construction of the concrete pipe involved form work of so interesting a character that it will be detailed. The hoop reinforcement was formed first to circular shape of the proper diameter, the ends being lapped about 18 in. and securely wired. It was then assembled in place and spaced by being wired to the longitudinal reinforcement. The inside form was then assembled inside of the reinforcement. The inside form was made in 12-ft. lengths, in six sections, five of which were bolted together at brackets. The sixth or top section rested on wedges supported on a cross-brace, and the whole inside form was hung by ½-in. rods, hooked on each end and attached to eye-bolts, passing up through 4 x 4-in. longitudinal stringers supported by the outside form framework. Thus the inside form could be raised or lowered into exact position by the adjusting nuts on these eye-bolts, the outside form first having been set to correct position and grade. The hoop reinforcement was supported in proper position by small blocks resting on the inside form. It will be noted that the bottom of the inside form was left open



FORMS FOR 5-FOOT CONCRETE DELIVERY CONDUIT

at A (see detail), and that an opening, B, was left in the outside form. The latter was held together by ½-in. bolts, to facilitate disassembling and moving.

Concrete was poured through a spout into opening B from a trough running the length of the pipe and supplied by a mixer established at the crest of the hill. The opening A gave an opportunity to see that the concrete was worked well underneath the inside form and completely filled the bottom of the pipe. After concrete had been poured partly up the sides of the pipe, the hooks supporting the inside form were removed and pieces of tin were tacked over the opening; the blocks supporting the reinforcement also were removed, so noth-

ing was left in the concrete to prevent the pipe from being perfectly tight, and no patching of the hole was necessary. Forty-eight feet of pipe was poured every alternate day. Care had to be exercised not to use too wet a mixture, as at the start some difficulty was experienced with the concrete running up through the bottom opening in the inside form.

The morning following the pouring of the concrete the first 12 ft. of inside section was taken to pieces and moved ahead through the other sections and reassembled. The other sections followed, until all were moved ahead and set ready for the pouring of the concrete the following day.

The conduit as finally completed was an exceptionally neat and smooth job inside, and when plastered with neat cement a surface was insured which, as subsequent tests showed, gave little frictional resistance to the flow of water. No leaks of any consequece developed in the entire length of the pipe—a mere sweating, which soon stopped completely, being noted soon after water was turned in near the lower end.

The joint at the junction of the concrete pipe and the manifold is worthy of notice. It is a section of steel pipe 5 ft. in diameter. A length of 3 ft. is bedded in the concrete block at the lower end of the concrete pipe, there being two 3-in. angles riveted around the steel pipe to act as cut-offs. The longitudinal reinforcement was passed through holes drilled in the flange of one of these angles and bent back to form a loop, thus being held securely to the reinforcement of the concrete pipe. No packing joint around the steel pipe between it and the concrete was provided, and no leak of any consequence has yet been noted at this point.

Design of Outlet—Contract Costs

The outlet at the upper end of the concrete pipe presented in construction some difficulties that were overcome. The curved interior walls are for the purpose of directing the flow of water as it issues from the enlarged end of the pipe so that it does not bank up against the outside wall.

To insure a minimum of leakage between the outlet and the measuring weir at the time of testing, the outlet canal for 200 ft. was lined with concrete. This has a thickness of 4 in., the bottom width being 12 ft. and the side slopes 1½ to 1 to a water depth of 4 ft. The concrete was laid in alternate sections about 12 ft. in length, and no special provision was made for joints.

The contract cost of the various items was as follows:

Supply canal, 23,485 cubic yards	$8,220
Pump house and foundations	13,534
Reinforced-concrete pipe and outlet	5,007
Delivery canal, 23,000 cubic yards	3,450
Light structures on delivery canal	3,461
All machinery and equipment, including erection	40,000
Total	$73,672

No extras of any consequence were found necessary on any but the first three items. The very difficult excavation for the pump-house foundations, concrete pipe and supply canal, and the greatly increased amount of material which had to be moved, due to slides and cave-ins, as well as the necessity of using piling under the pump house and pipe, increased the cost very materially. The final cost, therefore, of the completed project, including right-of-way, engineering and legal expenses, was $96,000.

The machinery and all the hydraulic and electrical equipment was furnished by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., through the Salt Lake Hardware Co., contractor. The erection of machinery was subcontracted to the Lynch Construction Co., Ogden, Utah. The concrete structures, including the pump house and the supply canal, were contracted by J. E. Wilson, Jr., Logan, Utah. The supervision of the work was under the immediate charge of T. H. Humphreys, hydraulic engineer, Logan, Utah, and most of the detailed plans and drawings were prepared by the writer.

Mixer Association Standardizes Mixer Rating

Wet-Batch Capacity Is Taken as Basis After Careful Study of All Factors and Submission of Questionnaire

By G. B. Arthur
Manager, Concrete Mixer Association

It is not necessary in this day to argue the advantages of standardization to anyone engaged, as engineer or contractor, in engineering work. For example, the field would be thrown into utter confusion if an electric motor rating meant one thing to one manufacturer and another to someone else. Intelligent design, intelligent purchasing, intelligent operation are not possible so long as the producers of equipment fail to agree on standard methods of designating their product.

What is true of electric motors or steam engines is equally true of concrete mixers. The output of the mixer usually controls the speed of the job. Intelligent "planting" of work, so far as the mixing is concerned, is impossible unless there is a standard rating or the contractor fortifies himself with knowledge of all the fifty-seven varieties of ratings used by as many manufacturers.

Realizing the need and advantages of standardization, the Concrete Mixer Association has adopted a standard method of rating concrete mixers. This is based on the "wet batch"—that is, on the amount of mixed concrete which a mixer will discharge.

Standard Rating Not Absolute

The adoption of a standard method of rating may suggest that such a rating will be absolute, but this is impossible. A No. 7 mixer may mean a mixer which will discharge 7 cu.ft. of mixed concrete of given proportions. But when other proportions are used the output will be the largest batch which is consistent with the use of whole sacks of cement, although when cement is used in bulk the maximum output of the mixer can be obtained with any proportions.

A system of rating can be established only by taking a mixture of given proportions as a basis, with the understanding that this rating can apply only to the proportions specified, and that the output, when other proportions are used, will vary with the size of the batch, which in turn is determined by the method of handling

the cement. And while any rating should be expected to state the capacity of the mixer, this capacity might be either in terms of loose, unmixed material—called "dry rating"—or, according to the "wet rating," in terms of mixed concrete in one batch as discharged from the mixer.

The "wet rating" was adopted by the National Association of Mixer Manufacturers before that organization was dissolved to form the Concrete Mixer Association, and it became so familiar to buyers and users that any change in the method would seem like throwing away a certain amount of capital; at least, the careful work which brought about the adoption of the method could not be disregarded easily.

On the other hand, manufacturers who were not members of the old organization, and therefore were not consulted when the "wet rating" was adopted, were now to be considered, and most of these manufacturers had used the "dry rating." Some of them made chiefly large mixers, the others made only small ones. The former had much in common with the members who had been parties to the earlier standardization; the latter group, who sold many of their mixers to small contractors, farmers and other individuals, had an entirely different problem. A thought-provoking element in their selling is the principle that when a mixer receives a "dry rating" the buyer is impressed with the "bigness" of the machine and feels that the bargain is highly satisfactory, whereas if it receives a "wet rating," making the rated capacity one-third less, this reduction has its effect on the mind of the customer—he thinks he is not getting as much for his money.

Questionnaire Used

The standardization committee carried its investigation far enough to make a convincing recommendation, but action was deferred until a questionnaire was mailed to a representative list of men and organizations who would be likely to have a preference for either the "wet" or the "dry" method. When the replies were tabulated as in Table I it was seen that the preference was in accord with the report which was ready for presentation. It will be seen that of the 283 replies which were made 80% voted in favor of the "wet rating" while 20% favored the "dry rating."

TABLE I. RESULTS OF QUESTIONNAIRE ON "WET" OR "DRY" METHOD

Classification	No. Mailed	Replies Voting "Wet" or "Dry"	"Wet" No.	"Wet" %	"Dry" No.	"Dry" %	Replies Not Voting: Neutral	Replies Not Voting: No Experience	Total Returned	Unclaimed
State highway officials	47	26	19	73	7	27	3	2	31	
Cement companies	82	35	26	74	9	26			35	
Engineering schools	109	32	28	87	4	13	2	3	37	1
Testing laboratories	20	6	5	83	1	17		..	6	
Engineers and consulting engineers	200	72	66	92	6	8	1		73	72
Engineering societies	26	1		.	1	100	2	1	4	..
Editors of technical journals	6	2	2	100			1		3	
Contractors	505	98	75	76	23	24	7	13	118	43
Other associations	15	11	6	55	5	45			11	.
Total	1,010	283	227	80	56	20	16	19	318	51

One factor probably outweighed all others and became the deciding one, when everything else had been considered: The advisability of using the "dry" method of rating could be disputed in the beginning because the volume of a batch of loose, unmixed materials when thrown together is a variable quantity, depending not only upon the kind but also upon the condition of the aggregates used. A careful reading of the replies which favored the "dry" method gives the impression that in the majority of cases this consideration was overlooked, the writers probably assuming that the volume of a batch of loose materials when thrown into the drum would be so nearly constant as to warrant its use as a basis for rating the mixer. It seems reasonably certain that, seeing that this is not true, many would change their preference to favor the "wet" rating.

As there is only one constant quantity available—the amount of mixed concrete which a mixer will deliver in one batch—the rating is established on this basis, with the following definition: "The standard association method of rating mixers shall be upon the basis of the quantity of mixed concrete which a mixer can deliver in one batch; assuming the use of one part cement, three parts sand and six parts 1½-in. crushed stone; with water at the rate of not more than 1¼ gal. to 1 cu.ft. of mixed concrete; the loose, unmixed batch to be approximated as 1½ times the mixed batch, or the mixed batch as ⅔ of the loose, unmixed batch."

A method of numbering was then adopted which requires that the size of the mixer shall be designated by a number indicating the capacity of the mixer in cubic feet of mixed concrete per batch, based upon the accepted method of rating. The practice of using the letters "S" and "E" to indicate side or end loading is discontinued, because in practice they seem to confuse rather than explain.

With these rules in force a No. 7 mixer can mean only one thing when found in the catalogue of a member of the Concrete Mixer Association—a mixer which will discharge, in one batch, 7 cu.ft. of mixed concrete of the proportions 1 : 3 : 6, using 1½-in. crushed stone, with water at the rate of not more than 1¼ gal. to each cubic foot of mixed concrete. The number 7 thus acquires much significance and becomes the natural beginning for a range of sizes of mixers.

Just before a war conservation program was put into effect in the industry the sizes 2½, 4, 5, 7, 14, 21, and 28 of building mixers were practically adopted for all members. But to conserve as much as possible the War Service Committee revised this, and the sizes 4, 7, 14, 21, and 28 in building mixers were recommended, with the understanding that manufacturers would put into these classes any mixers which were approximately of these sizes. In paving mixers the sizes 10 to 14 were recommended for adoption until it was possible to make the definition more particular. The tendency in the in-

TABLE II. OUTPUT OF CONCRETE MIXERS

Number of one-bag batches which will be discharged by mixers of different sizes, Concrete Mixer Association rating. (No. 10 is for paving mixer only) — Number: 2½	4	7	10	14	21	28	Proportions by Parts: Cement Sacks	Sand Cu. Ft.	Stone Cu. Ft.	Volume in Cubic Feet: Loose Cu. Ft.	Mixed Cu. Ft.
½	1	1½	2½	3½	5½	7½	1	1½	3	5.5	3.7
½	1	1½	2½	3½	5	7	1	2	3	6.0	4.0
½	½	1½	2	3	4½	6	1	2	4	7.0	4.7
½	½	1	2	2½	4	5½	1	2½	4	7.5	5.0
½	½	1	1½	2½	3½	5	1	2	5	8.0	5.3
...	½	1	1½	2	3½	4½	1	2½	5	8.5	5.7
...	½	1	1½	2	3½	4½	1	3	5	9.0	6.0
...	½	1	1½	2	3	4	1	3	6	10.0	6.7

dustries is to hold to sizes recommended by War Service Committees, as far as practicable.

Table II shows the output of these standard sizes for various proportions, and a little study of the variations in one-bag batches will throw all the foregoing statements into sharp relief. It shows also that the standards which have been adopted are practical and rational, and puts them beyond further argument. This table should be made a part of the information supplied for every job, to make sure that the mixer is doing all that should be expected of it; and these standards should not only make it easier to choose a mixer but should also go far toward safeguarding the integrity of the job.

Efforts to Consolidate the Engineering Profession

More Federation and Simplification Which Means Elimination Are Advocated—Problems Which Demand Solution Are Outlined

By A. D. Flinn
Secretary, Engineering Council, New York

THE organization of engineers in America is chaotic, complex and illogical. As consequences there are confusion, waste, inefficiency and dissatisfaction, which, however, are exaggerated in some minds. If no associations existed, it would be relatively easy to plan and create a system of organization that would satisfy demands much more effectively than does the present multiplicity of unrelated societies. But there have grown with the years traditions, and loyalties, and prejudices, clustering about the societies that now are. An answer to the problem thus created is not easy. To me the solution is not obvious, but some progress in the process is now appearing. There must be extensive consolidations, more federation and much simplification, each of which demands elimination. Steps are being taken, or preparations made for them, in various ways and places, and by a number of agencies. They will be accelerated as their benefits gain appreciation; but education, time, and patience are needed for attaining the goal.

The Problems Confronting a Consolidation Scheme

What are the present desirable limits to consolidation and federation? To what goal should they tend? By what methods and means can they best be brought about? These and similar questions are not being answered conclusively, because the necessary facts are not in hand. We have been muddling along in an unengineering fashion, attempting to plan and design and specify without a survey. On Sept. 12, Engineering Foundation by formal vote proposed to make the much-needed survey and preliminary studies, the four Founder Societies concurring. Of the necessity for this survey I have been more deeply convinced with the passing weeks, as I have listened to ineffective arguments and to misstatements based on ignorance which can be corrected only by the results of the proposed survey of engineering organizations.

Without the enlightenment of such a survey it now seems that the following elements of organization are desirable for the engineering profession in America: Excepting possibly three or four cities having large numbers of engineers, there should be in each community, having a sufficient group of technical men to be organized, one organization that embraces them all. Reasons for this are obvious. This organization may be an association of local societies and sections of national societies, or it may be a society admitting to its membership men of all branches of the profession. Examples of both forms of organization exist in a number of places. Local organizations should have large measures of autonomy, but should conform to approved types and standards.

Logically, the next step in organizing would be the combining of these local organizations into one or a few national societies, so that the loyalty, interest, comradeship, and activities naturally developed by the local organizations would flow to the national societies. But at this step the difficulties increase. Many engineers cannot become active members of local organizations, because of distances from headquarters; others do not desire local membership. If there were only one national society, many of the difficulties of scheming a system of organization would disappear; but there are, and probably for some years will be, several national societies of importance, and in each local organization there will be members of two or more national societies. A number of plans have been submitted to me for overcoming these difficulties. None is wholly acceptable. These problems lie at the bottom of the tasks of the Committee on Development of the American Society of Civil Engineers, and of the Committee on Aims and Organization of the American Society of Mechanical Engineers, and similar committees appointed by the other societies. Many engineers are giving them thought.

There are said to be approximately 400 organizations of engineers in America, of various kinds. Of these, about one-quarter are the leading national societies and their local sections. In general, the remaining societies have no official relationship, excepting the associations of local societies and sections in a few communities. Consequently, the engineering profession, before the public and Government, has no one organization which represents it as a whole, as have the medical profession, the lawyers, the chemists, the architects, the Chamber of Commerce and even labor. In the memberships of the Founder Societies, aggregating 35,000 engineers, there have been variously estimated to be only one-third to one-sixth of the total number of engineers in the country. The engineering profession lacks solidarity.

Not a little of the dissatisfaction voiced in various quarters as to the shortcomings of the national societies

grows out of ignorance or lack of apprehension of benefits actually received. In no small measure the complainants are at fault in not making better use of the facilities provided and the means of information put within their reach. Furthermore, some important benefits of membership in large technical societies are intangible and not capable of definition; not a few persons overlook these. Nevertheless, there are causes for reasonable dissatisfaction. The societies are endeavoring to remove these as they are recognized and remedies can be found. Humanity and its institutions will never be wholly rid of dissatisfaction, and to this truism engineers are no exception.

Quotes President Main's Address to Mechanical Engineers' Society

In this connection, a quotation from the presidential address of Charles T. Main to the American Society of Mechanical Engineers, December, 1918, is interesting reading:

In the *Monthly Bulletin* of the American Institute of Mining Engineers, March, 1918, there appeared the following:

"The vision dwells in the minds of many that ultimately these four great societies, lightening the emphasis they place upon their differences, may see the time when, for the solidarity of the profession, for their best interests, as well as for the increase of their influence on the country at large, they may become one great national association of engineers. With the gain in power and prestige inevitably following such an aggregation, freedom from individual development may be achieved through division along the lines of technical interests, which might either follow the present four grand divisions or be more minutely subdivided.

"An organization of this sort could and probably would be more strictly professional than any of the four have been heretofore, and through the prestige and power of its numbers could establish standards of ethical conduct for its members, violation of which would bring, grave consequence."

This great vision is worthy of the most careful consideration and might be carried with safety to a point where the national societies would be gathered in under one executive head, without any one losing any vital portion of its individuality.

This would be a great step in advance and perhaps as far as we should go for some time to come.

Whatever scheme of organization be ultimately selected, it must be flexible, so as to meet successfully constantly changing conditions, and it must provide for both technical and social requirements of the membership, while maintaining high standards. "Social requirements," is here used to mean, in addition to social intercourse among members, services of the organizations to Government and to the public, and services to engineers individually, such as assistance in securing engagements and better standing in corporate and Governmental employment. Technical and social functions probably will be best kept distinct. Some engineers even suggest separate organizations; but at present prefer separate departments of one organization or of a federated group of organizations.

The United Engineering Society

So far as known, none of the leading organizations has stated a definite policy on these questions. Opinions herein expressed are only personal. The statements in this paper are merely a contribution to the general discussion of this subject by one who for several months has had especial opportunities for learning the opinions of others and gathering a little information.

As regards the joint activities of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, the present organization seems involved; and even some members of the governing bodies of these societies have difficulty in keeping relationships straight. It is, however, not so complex as some persons assume. It may be simply stated as follows. The four Founder Societies named have joined in creating the *United Engineering Society* to hold and administer property and to perform other broad functions for them. At their request the United Engineering Society has established three departments—the Library Board, the Engineering Foundation, and Engineering Council.

The Engineering Societies Library has possibilities for active usefulness to the engineering profession and to the industries of this country. Its present passive services are good and of great value, but the library can do much more. Funds are needed at once for complete recataloging of the books, for strengthening the collection of books, and for instituting new lines of service. The books of the societies have been brought together, but they have not yet been assembled as one library. Never, except during the war, has it been so important that all useful recorded technical information should be fully and quickly accessible to engineers—not only to those in the New York district, but also to those scattered throughout the whole land.

Engineering Foundation and Engineering Council

The Engineering Foundation now has an endowment of $300,000, yielding an annual income of $15,000. It rendered vital financial assistance to the National Research Council at the latter's inception in 1916, and for the year terminating in September, 1917. That council performed services of great importance to the Government during the war. For the future it already has in hand many projects. One of the most important of these is the promotion of industrial research, in which the Engineering Foundation is coöperating. The Engineering Foundation investigated a scheme for spray camouflage of ships; is conducting long-time tests on the wear of gears, and is making a research into the selective control of wireless communication. It has offered to undertake a "survey of existing engineering organizations, and from information thus developed to formulate a series of constructive recommendations which may be serviceable in guiding the further development of local and national engineering organizations, in their relations to the profession of engineers, to the public, and to one another." Other projects are being studied, but cannot yet be announced. Engineering Foundation's policy is to devote its energies and resources to undertakings of broad application, such as bringing about and stimulating coöperation among existing agencies engaged in research and outlining programs and organizations for research in specific fields.

The Engineering Council, since its organization meeting on June 27, 1917, has made progress in exploring its proper field of activity and fixing some of its boundaries. It has accomplished much useful but negative

work. In other words, its rejections have been important and have consumed much time. But there are noteworthy constructive achievements, also, on the credit side of its records. During hostilities the Council rendered no small aid to the Government through the American Engineering Service, which procured thousands of engineers for the War, Navy, and other departments, and through the War Committee of Technical Societies, which assisted the Naval Consulting Board and the Army General Staff in examining scores of thousands of suggestions for naval and military devices. Through efforts of its public affairs committee, the Council aided in having the military draft adjusted to permit the continuance of training in the engineering schools of the vitally necessary technical men. Through the industrial affairs committee vigorous opposition was offered to "anti-efficiency" legislation in Congress. Ten days after the signing of the armistice, the Engineering Societies Employment Bureau, with the four Founder secretaries as its board of directors, was substituted for the war-time American Engineering Service. The fuel conservation committee acted in a consulting capacity to the Fuel Administration and the Bureau of Mines in securing war economies, and is continuing its much-needed services into the era of peace. The water-conservation committee is prepared to promote right, and to oppose wrong, national or state Governmental actions relating to water-power or other utilization of water, by supplying statements of facts rather than joining in controversial support of or opposition to any particular measure. The license committee, with members judiciously distributed throughout the country, is collecting information on the licensing of engineers by the various states, and is preparing to render proper assistance in these matters whenever needed. The patents committee, coöperating with other similar bodies, is preparing important action for the improvement of the patent law and practice. During the spring and summer, the secretary visited groups of engineers representing the local societies and sections of national societies in 20 different cities from the Atlantic seaboard to the Pacific Coast. In 30 or more communities local correspondents have been selected for direct communication between Engineering Council and engineers at distances from headquarters. Furthermore, important projects of interest to all engineers are in preparation and may soon be announced. One of these is the formation of a national service committee, which is to have an office in Washington, as the representative of American engineers at the national capital.

All aims and endeavors of engineers through their national and local societies and their joint instrumentalities must be pervaded by a sincere spirit of service, not alone of one to another, but by all to the community, the state, and the nation. Such public service by engineers, architects, chemists, scientists, doctors, lawyers, and clergymen is our professional obligation, the *noblesse oblige* of a free and democratic people. Each profession has its distinct service to perform. In each profession there are big men and small men; each must contribute according to that which he has. Service is the only true stepping-stone to that eminence which alone is worth attaining. Greater opportunities have never opened to American engineers than those which confront them in these rapidly passing years of war and "reconstruction."

Committee Analyzes Track-Elevation Costs or Rock Island Work in Chicago

Book Figures Are Redistributed, Freight Charges and Other Elements of Expense Estimated and Added In, to Obtain Complete Unit Costs for Fifty Items on $2,700,000 Improvement

UNIT costs of the track-elevation work of the Chicago, Rock Island & Pacific Ry. have been the subject of an extensive study by a committee of valuation engineers. An organization known as the General Committee of the Chicago Zone Railways has been considering for more than two years the special valuation problems presented by the network of railroads in the Chicago terminal district. Between Aug. 1, 1912, and Dec. 31, 1916, track-elevation from 72nd St. to 90th St., a distance of 2½ miles, was carried on by the Rock Island as a continuous operation, at a book cost of $2,703,196.75. The Rock Island completed an extensive study of the unit costs of this work, the results of which were reviewed and criticized by a subcommittee of the general zone committee, created for the purpose. The subcommittee is known as subcommittee 14, and Robert H. Ford, principal assistant engineer, formerly engineer track elevation of the Rock Island, is its chairman. The object of the investigation was to determine the correct methods for the distribution and probating of certain charges that appear on the books of the auditor, set up under account 43, later referred to, and the proper basis for estimating costs that do not so appear.

The report is divided into three books. Book 1 is simply an accounting analysis, or summary, of the auditor's records. Book 2 is an engineering analysis of the charges set up in book 1, which has been made for the purpose of obtaining the cost per unit of work. It embraces labor, material and work-train service costs as set up in book 1, and in addition freight on material over company lines. In this book the items in book 1 are analyzed and redistributed, and the units of work done allocated to the book charges for each class of work, such as filling, excavation and concrete. Book 3 is an addendum to the engineering analysis in book 2 and consists of added items of direct expense which affect the unit cost but which for various reasons have not been included in the book charges, these being added in order that the entire direct unit cost may be derived.

Book 1—Accounting Records

In book 1 the accounts are set up in conformity with the Interstate Commerce Commission classification—

(1) engineering; (2) land for transportation purposes; (3) grading; (6) bridges, trestles and culverts, and so forth. These are subdivided into the items of work—account 6, for example, containing 37 subaccounts, including such items as excavation, sand, cement, wood forms, drainage. Across the page these are divided into labor cost, material, quantity and cost, and work train hours and cost. The labor column includes only such labor as is covered by the pay rolls of the track-elevation forces. All amounts paid by voucher to contractors or others, whether for labor or material or both, are included in the material column. The material column does not include freight charges on the company's own lines. On July 1, 1914, the I. C. C. classification was changed to provide that thereafter such charges should be added on completion of the job, but as the work was still in progress when the analysis was being made the charges were not added in book 1. They were included in the material column in book 2. Under account 43, other expenditures and suspense, the company carried a large number of items that under a different policy would perhaps have been charged to other accounts, the company's policy being that doubtful items could better be classified upon completion of the work, after careful study. One hundred subaccounts, totaling $594,826.03, were carried under account 43.

Book 2—Engineering Analysis

The task in preparing book 2 was to subdivide and regroup the subaccounts of book 1 to cover actual inventory or physical units, adding in the computed freight charges for material hauled over the company's lines and allocating the suspense items in account 43, but otherwise retaining the I. C. C. classification. Thus, in accounts 3 and 6 the items for forms appearing in book 1 are incorporated in the concrete costs for book 2, and on the other hand the single item for concrete cribbing in book 1 is subdivided to cover the making and the handling and setting of two types of cribbing. "Drainage" in book 1 is replaced by "Drainage—4-in. Tile" and "Drainage—6-in. Tile" in book 2. Detailed statements of what the items in book 2 consist of, where the materials were obtained and how they were transported, are included in the report.

Numerous different bases were used in distributing the items of account 43 to the other primary accounts. General work-train service and repairs to material cars were allocated to benefited items in all of the other accounts, except engineering and land in the ratio of total costs of those items; handling material and general freight charges to benefited items in the same accounts as indicated above, in the ratio of the material

Item	Cost Unit	Book Cost Per Unit	Work-Train Cost Not Included in Book Charges	Various Omitted Items	Divisional Overhead	Total Unit Cost
Engineering	Per Cent	6.185%	.	0.408%	0.680%	7.273%
Filling (including construction trestle)						
Gravel	cu. yd.	$0.690	$0.088		$0.015	$0.793
Sand	cu. yd.	0.908	0.048		0.018	0.974
Cinders	cu. yd.	0.806	0.047	$0.051	0.018	0.922
Filling (excluding construction trestle)						
Gravel	cu. yd.	0.604	0.079	..	0.013	0.696
Sand	cu. yd.	0.823	0.040		0.016	0.879
Cinders	cu. yd.	0.721	0.038	0.051	0.016	0.826
Construction trestle	lin. ft.	9.211	0.274	.....	0.179	9.664
Excavation—foundation	cu. yd.	0.996	0.043	.....	0.020	1.059
Shoring	cu. yd.	0.496	0.009	....	0.010	0.515
	lin. ft.	1.062	0.189	.....	0.024	1.275
	sq. ft.	0.177	0.003	....	0.003	0.183
*Excavation and shoring	cu. yd.	1.492	0.052	.	0.030	1.574
Excavation—street	cu. yd.	1.017	0.016	.	0.020	1.053
Concrete foundation piles	lin. ft.	0.955	0.010	0.007	0.018	0.990
Creosoted foundation piles	lin. ft.	0.562	0.011	..	0.010	0.583
Excavation—caisson	cu. yd.	9.837	0.026	......	0.186	10.049
Concrete—caisson	cu. yd.	4.982	0.196	....	0.098	5.276
†Concrete — plain (forms in place)	cu. yd.	6.080	0.163	.....	0.118	6.361
Concrete — plain (traveling forms)	cu. yd.	5.192	0.155	.....	0.101	5.448
Concrete — reinforced	cu. yd.	8.737	0.218	....	0.169	9.124
Column and girder incasement in place	cu. yd.	18.081	0.399	......	0.349	18.829
Slabs and girders built in place	cu. yd.	9.025	0.221	....	0.175	9.421
Column and girder incasement in yard	cu. yd.	15.745	0.603	.....	0.309	16.657
Slabs and girders built in yard, including handling and placing	cu. yd.	10.145	0.514	0.042	0.202	10.903
Concrete railing	lin. ft.	1.297	0.039		0.025	1.361
Concrete cribbing ties						
Dowel type	sq. ft.	0.898	0.019	.	0.017	0.934
	no. ties	3.167	0.068		0.061	3.296
	cu. yd.	25.386	0.548	.	0.490	26.424
Lock type	sq. ft.	0.618	0.009	..	0.012	0.639
	no. ties	1.578	0.024	..	0.030	1.632
	cu. yd.	25.411	0.359	..	0.487	26.257

*Excavation and shoring for signal bridge foundation, $2.537 per cubic yard
†Concrete plain for signal bridge foundation, $11.995 per cubic yard

Item	Cost Unit	Book Cost Per Unit	Work-Train Cost Not Included in Book Charges	Various Omitted Items	Divisional Overhead	Total Unit Cost
Reinforcing metal	lb.	0.035	0.001	....	0.001	0.037
Structural steel (not painted)	lb.	0.030	0.001	....	......	0.031
Waterproofing						
Joints	sq. ft.	0.067	0.002	....	0.001	0.070
Walls and abutments	sq. ft.	0.017	.....	....	......	0.017
Decks	sq. ft.	0.250	0.006	....	0.005	0.261
Drainage						
4-in. field tile....	lin. ft.	0.126	0.001	....	0.003	0.130
6-in. field tile....	lin. ft.	0.316	0.003	....	0.006	0.325
Gunite-steel incasement						
Floorbeams and box girders—1¾	sq. ft.	0.108	0.003	....	0.002	0.113
Expansion joints—2 in. thick	lin. ft.	1.279	0.036	0.003	0.025	1.343
Girders—2¾ in. thick	sq. ft.	0.194	0.006	....	0.004	0.204
Bottom floor slabs—5 in. thick	sq. ft.	0.314	0.010	0.001	0.005	0.253
Box girders—8 in. thick	sq. ft.	0.500	0.014	0.001	0.010	0.525
Box girders—filling	cu. ft.	0.244	0.007	0.001	0.005	0.257
Crossties—new, treated	no.	1.142	......	0.512	0.031	1.685
Crossties—new, untreated	no.	0.808	....	0.265	0.020	1.093
Switch timbers—new, untreated	ft. b. m.	23.195	.....	....	0.438	23.633
Ballast						
Gravel base, 2 to 3½-in.	cu. yd.	0.743	0.086	....	0.016	0.845
Gravel top dressing, ½ to 1½ in.	cu. yd.	0.885	0.090	....	0.019	0.994
Cinders	cu. yd.	0.205	0.033	0.251	0.009	0.498
Tracklaying and surfacing						
Laying	miles	1274.64	218.94	....	28.04	1521.62
Surfacing	miles	2591.32	17.01	....	49.30	2657.63
Brick paving	sq. yd.	2.542	0.016	....	0.048	2.606
Asphaltic macadam	sq. yd.	1.402		0.240	0.031	1.673
Concrete sidewalk	sq. ft.	0.134	0.002	......	0.003	0.139
Sewers						
12 in., depth 6 ft.	lin. ft.	1.519	0.001	....	0.029	1.549
15 in., depth 6 ft.	lin. ft.	1.672	0.001	....	0.032	1.705
6 in. catch-basin connections	lin. ft.	0.514	....	....	0.010	0.524
9 in. catch-basin connections	lin. ft.	0.706	0.001	....	0.013	0.720
Manholes	no.	40.074	0.262	....	0.762	41.098
Catchbasins	no.	47.546	0.031	....	0.899	48.476

costs of those items; camp, repairs to small tools, to tool cars and to bunk cars, to benefited items in the same account as above, in the ratio of labor costs of those items; temporary trestle to "filling," account 3, and "concrete," accounts 3, 6 and 16, in the ratio of yardage; material yard items and temporary tracks to benefited items in accounts 3 to 27, in the ratio of weights of material; temporary tracks at source of supply of materials to "filling," account 3, "ballast," account 11, and all items in which sand and gravel were used in "concrete," accounts 3, 6, 15, 16, 26 and 27, in the ratio of yardage.

Book 3—Additions to Book Charges

Book 3, as previously explained, is an addendum of the engineering analysis shown in Book 2. "It consists," states the committee's report, "of added items of direct expense which materially affect the unit cost, but which, for various reasons, have not been included in the book charges." One element which is not included in these additions is general overhead charges—organization expenses; general officers and clerks; law; stationery and printing; taxes; interest during construction, and other expenses, general. Special studies have been made of the various items to determine whether the figures indicated in book 2 contain omissions. The same general classes of items, irrespective of the account to which they have been charged, are regrouped to show the average unit cost. Thus, the concrete items in the different primary accounts of grading, bridges, trestles and culverts, stations and office buildings, and so forth, were merged, but the different *classes* of concrete as plain, reinforced, etc., were kept distinct. On the other hand, certain items dependent on local conditions, such as station buildings, rail and other track material, were eliminated.

Engineering in book 2 was carried on a basis of percentage of all accounts except engineering itself and land, and was shown as 6.185%. Two additions were made in book 3. In connection with the inclusion of freight charges it was estimated that the additional work required the time of at least one accountant and one clerk during the period covered by the analysis, this amounting to 0.408%; the other addition was for divisional overhead, embracing charges for services of the chief engineer, bridge, signal, building and other staff engineers and their office forces. This was estimated by a special study to be 0.680%, and the two increments bring the percentage for engineering up to 7.273.

Special Studies

Following is the statement regarding the item for cinders. "Cinders have been included in the book accounts at an arbitrary rate of 20c. per yd. This is lower than actual cost, and an independent study is in process to determine the cost. Preliminary to this determination an estimated amount has been made based upon the switching rate directed by the Interstate Commerce Commission and the State Public Utilities Commission of Illinois, viz., 1c. per hundredweight (60,000 lb. minimum per car) to the originating line, plus ½c. to the delivery line, or equal to a minimum of $6 per car for the originating line, plus actual cost of handling on the delivery line, the latter being assumed as requiring four days' service for use of car at 35c. per day (demurrage rate then prevailing), plus the cost of switching, estimated as equivalent to 10 miles at ½c. per ton per mile. Computed upon 35 cu.yd. per car (which is the estimated average yardage of the loads of cinders covered in this analysis) and allowing 1500 lb. per cubic yard, the rates indicated above amount to $8.00 per car or 25.1c. per cubic yard. The difference between this cost and the arbitrary cost of 20c. per cubic yard or 5.1c. is added to class A cinders.

A special study of the cost of treated crossties resulted in an addition of 51.2c. per tie, the total cost including freight charges from the treating plant in Missouri to the distributing yard. Similarly, another study added 26.5c. per tie for untreated crossties.

Unit Costs Derived

The accompanying table shows some of the larger items—the unit costs (with freight charges) derived in book 2 and the estimated additions properly included. In some instances, costs in two or three kinds of units have been figured. In the use of the data, it is pointed out, judgment must be applied to evaluate the affecting conditions—not only the character and composition of the finished structure, but the hampering or facilitating conditions under which it was built. Thus, as concrete for retaining walls, it is pointed out, is ordinarily cheaper to place than concrete for abutments, because the work can be laid in larger sections, so all of the concrete work covered by the analysis is held to have cost less per yard than in the average track-elevation program in Chicago, partly because the right-of-way was less restricted and it was less difficult to prosecute the work and still maintain traffic, and partly because the Rock Island, having a large amount of concrete to place on the job, was especially organized for that class of work. On the other hand, it is thought that a similar study of track elevation on the Chicago & Western Indiana R. R., where filling is the principal item and the work has been organized for that, would show a much lower unit cost for grading and a much higher one for concrete. The report describes in considerable detail just what, as to materials and method of fabrication, was involved in each item, and the report, aside from giving a definite basis for fixing prices on the work it covers, aims to show the unreliability of undigested book costs, to suggest a method of analysis to determine correct figures, and to present a fair guide as to what those figures should be.

Besides Mr. Ford, chairman of the subcommittee, its members are Joseph Weidel, valuation engineer of the Santa Fé system; J. H. Roach, valuation engineer of the New York Central; E. B. Crane, assistant valuation engineer of the Chicago, Milwaukee & St. Paul; W. C. Bolin, pilot engineer of the Baltimore & Ohio; D. J. Brumley, valuation engineer of the Illinois Central; G. W. Hand, valuation engineer of the Chicago & North Western; A. Montzheimer, chief engineer of the Elgin, Joliet & Eastern, and L. S. Rose, valuation engineer of the Cleveland, Cincinnati, Chicago & St. Louis.

Supreme Court Fixes Responsibility of Contracts

Through oversight in the preparation of the article with above title published in our issue of Dec. 26, 1918, p. 1167, the author's name and title were omitted. The article was written by George A. King, of the Bar of the United States Court of Claims. Washington, D. C.

Emergency Shipbuilding on Lakes Handled By Erection Cranes of Many Types

Side Launching Imposes Special Requirements—Old and New Cantilever Cranes—Gantries Do Successful Work—Tower Cranes Installed During Past Year—One Crane Per Berth Now Thought Necessary

SHIP-ERECTION cranes of many forms are giving efficient service in the rush work of building ocean-going ships for the Emergency Fleet Corporation in the Great Lakes yards. Side-launching, which these yards practice exclusively, imposes on crane layouts and crane types requirements which lead to pronounced differences from the equipment found in the seacoast end-launching yards. As the building berth lies along a dock wall and the ship is launched over this wall, cranes and material cars can operate along one side only. This condition, and the common arrangement of grouping berths on a pier, have controlled the development of the shipbuilding cranes. Recent types, however, are such as to suit any berth arrangement equally well. The service obtained from the various cranes appears to depend more on the space layout of berth, craneway and storage facilities than on inherent characteristics of the cranes.

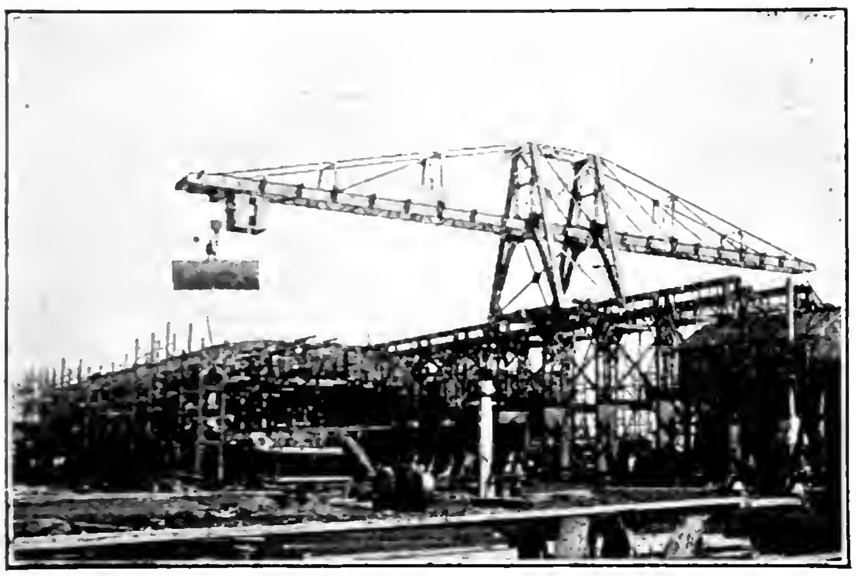


FIG. 1. DOUBLE CANTILEVER CRANE COVERING FOUR SHIPBUILDING BERTHS AT SUPERIOR YARD

Revolving-jib traveling cranes are newcomers in the Lakes yards. Many have been installed during the past year. They are traveling portal-frame towers on which are mounted revolving locomotive-crane or equivalent superstructures.

All the cranes built for Lakes shipyards prior to the present year are either gantry or cantilever trolley bridges. These machines had proved entirely satisfactory, but as additional crane service was needed at once revolving-jib cranes, which could be obtained most quickly, were introduced.

While even the oldest of the trolley machines, as that shown by Fig. 1, are meeting the demands of rush work, evidence of progress is given by the fact that the more

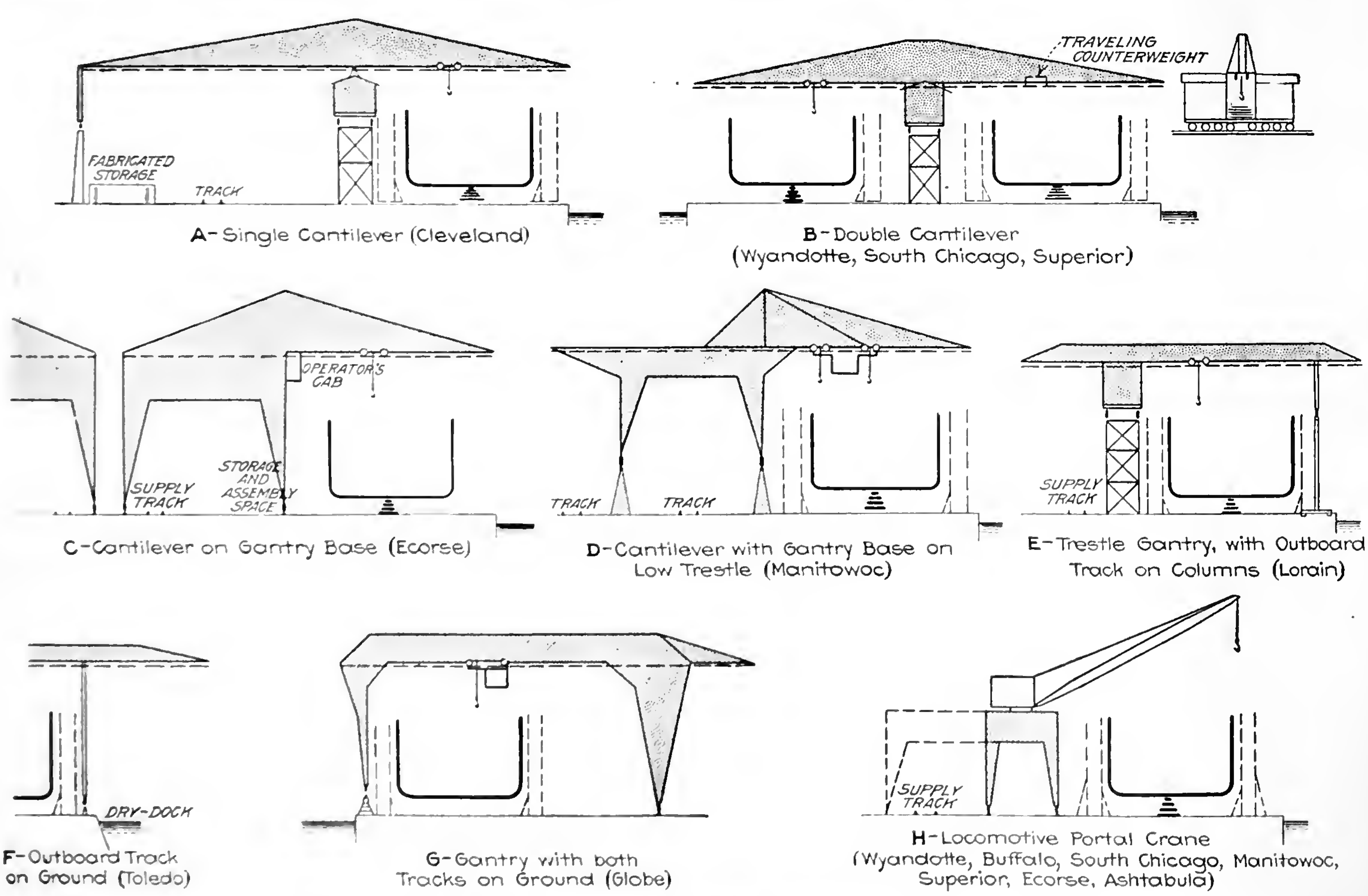


FIG. 2. SHIPBUILDING CRANE TYPES OF GREAT LAKES YARDS DEVELOPED DURING THIRTY YEARS
A-D, Single and Double Cantilevers; E-G, Gantries; H, Revolving Jib Cranes

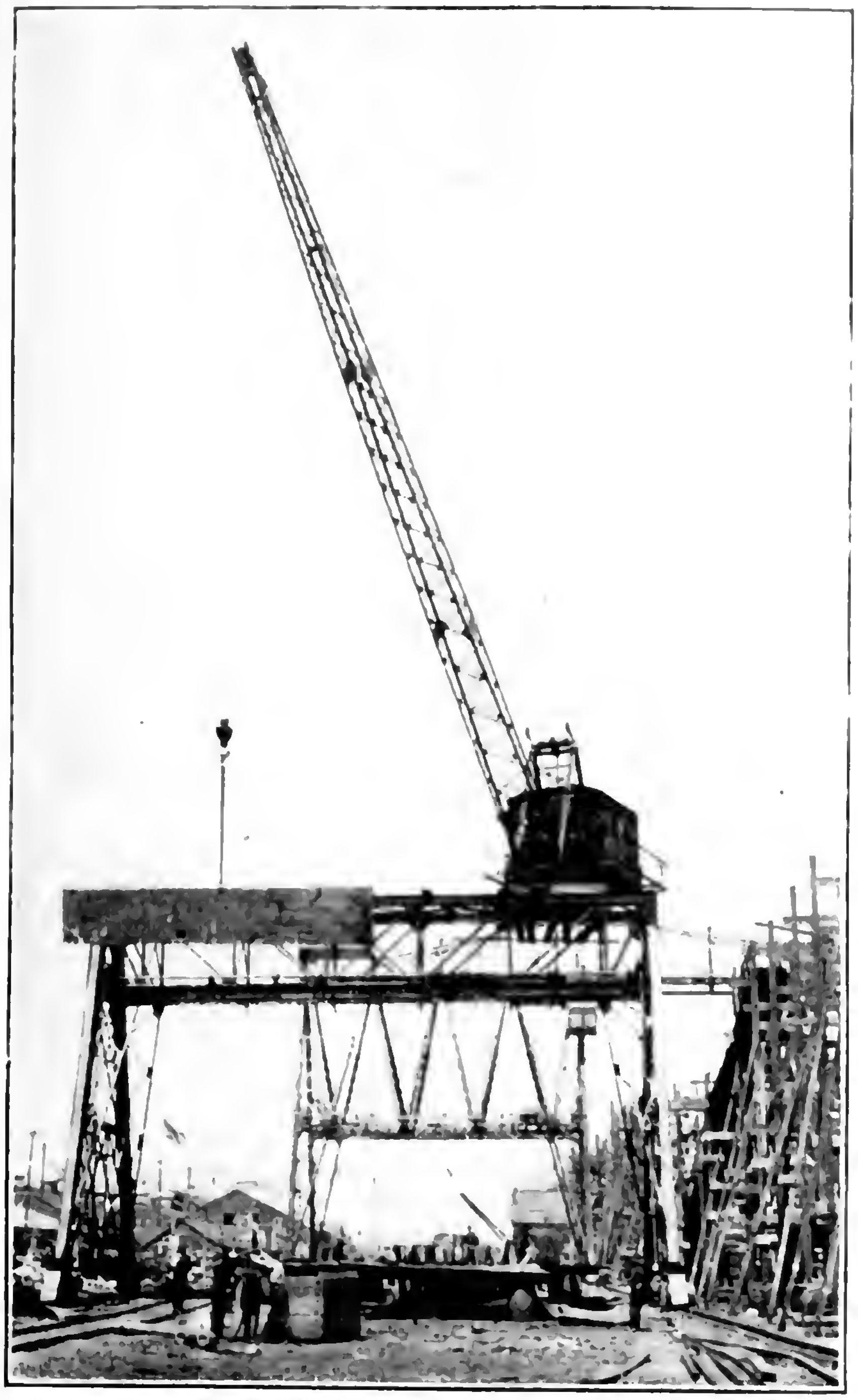


FIG. 3. LOCOMOTIVE CRANE ON WIDE GANTRY BASE, IN SERVICE AT ECORSE

recent ones have proved superior in speed and operating convenience. The best speed records have been achieved in yards equipped with cranes of relatively recent design. It is noteworthy that the cranes which made the two fastest shipbuilding performances were designed by shipyard men; and one of these performances made a world's record for shortest time from keel-laying to launching.

Three Main Types Represented in Various Forms—Except for the revolving cranes of the present year, the Lakes yards are equipped with (1) cantilever cranes reaching out over the berth from its land side, leaving the other side clear to permit launching, or (2) gantries which span the berth and find support on an outboard track removed at the time of launching. The operation of removing and replacing the track, together with the fact that the berth is without crane service in the interval, constitutes a *prima facie* argument against the gantry type, but this is invalidated by the successful work of the gantries. Moreover, gantries as well as cantilevers are represented among the new cranes added during 1918.

A. C. Payton, superintendent of the American Shipbuilding Co.'s Lorain, Ohio, yard, where gantries have been used since the foundation of the yard in 1899, states that the cost of removing the outboard track to clear a 261-ft. ship is negligible, as a gang of 11 men does the work in 1½ days, and in any event part of this time is required for taking down scaffolding. He considers the Lorain gantries the best ship-erection machines on the Lakes. C. B. Calder, president of the Toledo Shipbuilding Co., Toledo, Ohio, is equally pronounced in favor of gantries, of which the yard has three; the cranes can go into service within two hours after a launching. The Globe Shipbuilding Co., Superior, Wis., which began operations during the past two years, has installed gantries as giving the most efficient utilization of the yard space.

Cantilever cranes are the oldest as well as the newest of shipbuilding cranes of the Lakes, however. Four different arrangements are in use, represented by sketches A to D, in Fig. 2. Trestle-supported cranes with cantilever arm projecting to one side (sketch A serve riverside berths at the Cleveland yard of the American Shipbuilding Co. Similar trestle machines cantilevering to both sides (B) form the equipment of berths grouped on piers at three other yards of the same company, at Wyandotte, Mich., South Chicago, and Superior, Wis. All these machines are about 25 years old.

Recent cantilevers are shown at C and D. One-side cantilever bridges carried on gantry bases running on tracks on the ground (sketch C) are used at the Ecorse, Mich., yard of the Great Lakes Engineering Works; the berths are on piers, and two cranes set back to back on separate tracks serve the two sides of the pier. The Manitowoc Shipbuilding Co., Manitowoc, Wis., has cranes of the same structural type, but running on low trestles 6 to 12 ft., high (D); the berths here are arranged along the river bank, and, as supply tracks are located both within the gantry width and back of it, the trolley runway is cantilevered out backward a short distance, so that it commands both tracks. A gantry-base double cantilever similarly supported on low trestles (Fig. 8) is in use at South Chicago.

Gantry cranes, used in three yards, are of as many different forms, distinguished by their track arrange-

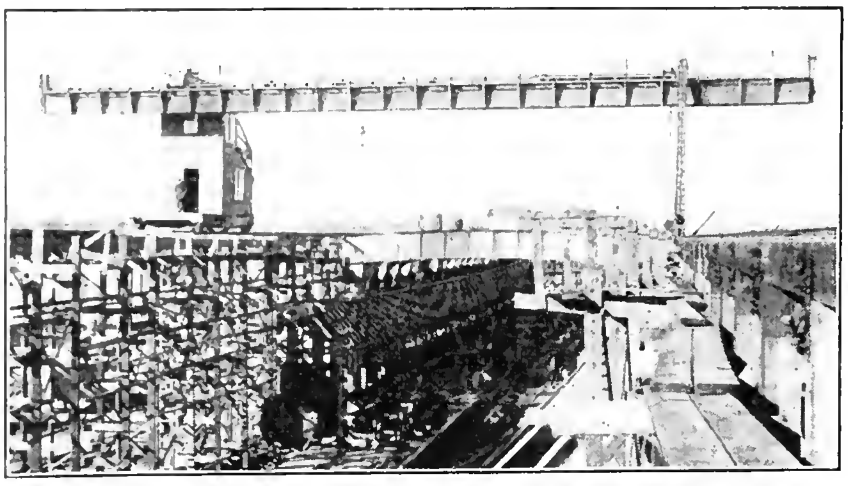


FIG. 4. ONE OF THE GANTRIES AT THE LORAIN YARD

ment. At Lorain the outboard track is carried on a line of columns (E, Fig. 2, and view, Fig. 4). The Toledo gantries have their outboard track on the ground (F). Both these have a trestle to carry the main or inboard track, and the bridge has pin or hinge connections to its supports at both ends. The cranes of the Globe Shipbuilding Co., however, are of true gantry type (G)

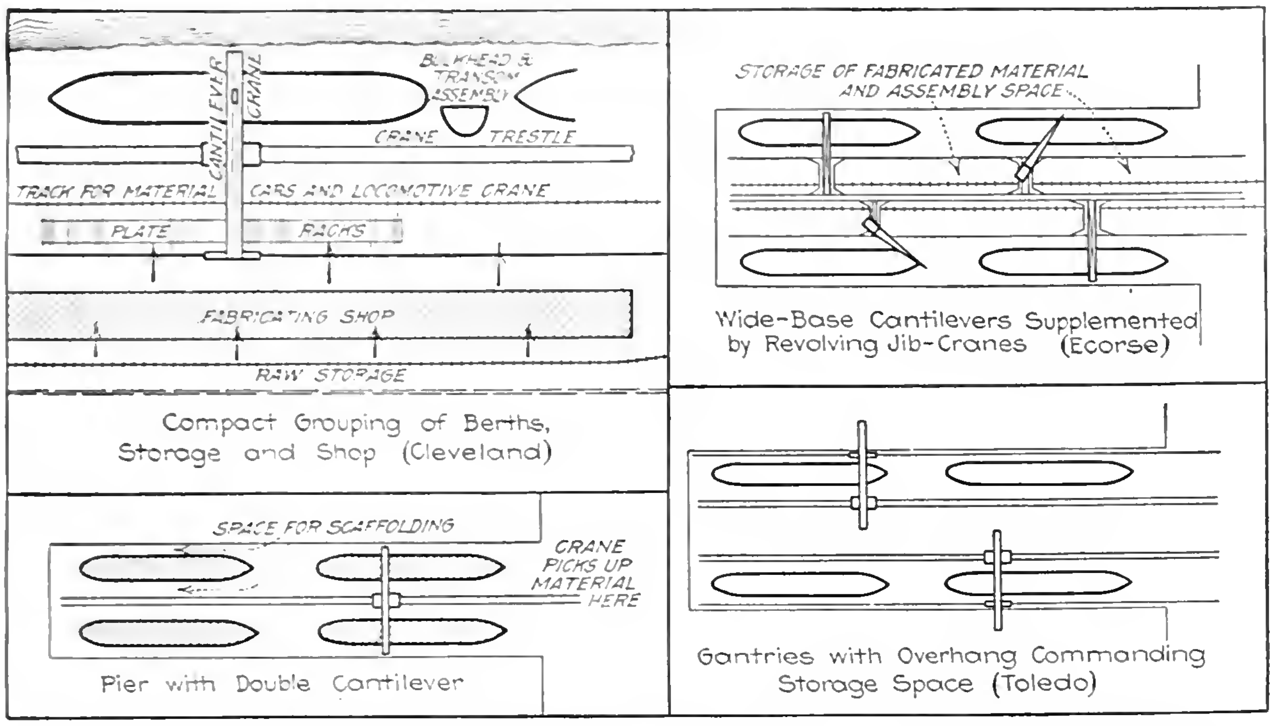


FIG. 5. STORAGE AND HANDLING OF MATERIAL AT BERTHS ARE AFFECTED BY CRANE TYPE AND ARRANGEMENT

and have both tracks on the ground. Removing and replacing the outboard track (and its supports, in the case of the Lorain arrangement) is in all cases done by the crane itself.

Revolving-jib cranes as installed during the past year comprise regular locomotive-crane superstructures, re-

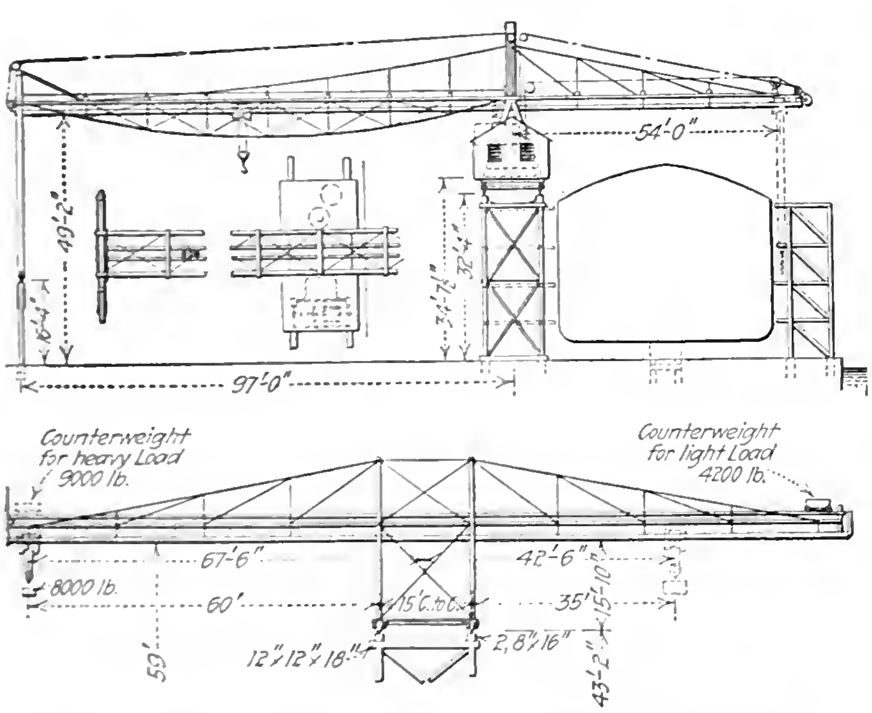


FIG. 6. EARLY SINGLE AND DOUBLE CANTILEVER CRANES STILL GIVING GOOD SERVICE

volving on a fixed turntable seated on a portal-braced tower (sketch H). Even where the supporting tower is widened out to gantry proportions as shown by the dotted line (new cranes at Ecorse), the jib hoist does not traverse on the tower. Such locomotive tower cranes have been installed by the American Shipbuilding Co. at Buffalo, Wyandotte, South Chicago and Superior, to serve new berths; and by the Great Lakes Engineering Works at Ashtabula and Ecorse, and the Manitowoc Shipbuilding Co., to supplement existing cantilever cranes. One of these machine is shown in Fig. 3. A slightly different type of revolving-jib crane was adopted by the McDougall-Duluth Co. late last year in equipping its yard at Duluth, Minn.

Old Cantilever Cranes Under Various Service Conditions—That the berth conditions and the arrangement of the surrounding space are of vital bearing on the results obtained from a particular crane appears in pronounced manner from comparison of the six old cantilever cranes to which reference has already been made—two one-side cantilevers at Cleveland, serving three berths, and four double cantilevers at Wyandotte, South Chicago and Superior, generally serving a group of four berths. All were built in the early '90's, and two of them are of the rod-braced light truss type characteristic of coal-handling machinery in that period. The Cleveland and Wyandotte cranes, Figs. 6 and 7, were built by the Brown Hoisting Machinery Co. for the F. W. Wheeler Shipbuilding Co.'s yard at West Bay City, Mich., and were removed from there later by the new owners, the American Shipbuilding Co. The Superior crane. Fig. 1, was installed about 1896 by the Wellman-Seaver-Morgan Co. when Capt. Alexander McDougall built his whalebacks at that yard.

At Cleveland the shop, berths and cranes are in closely-knit grouping, as sketched in Fig. 5. The shop lies directly back of the crane runway, and delivers either to the cranes or to storage racks in the runway. Material, therefore, has to move only a short distance in going from shop to ship, and a given crane capacity can erect more material than where a longer path is involved. Due to this fact, and also to unusually able and energetic management, the yard has been able to make an excellent shipbuilding record during the past two years, in spite of having much ancient, inadequate equipment and cramped facilities. Not only are the cranes old and of light capacity, and in need of very careful maintenance, but the shop, which is even older,

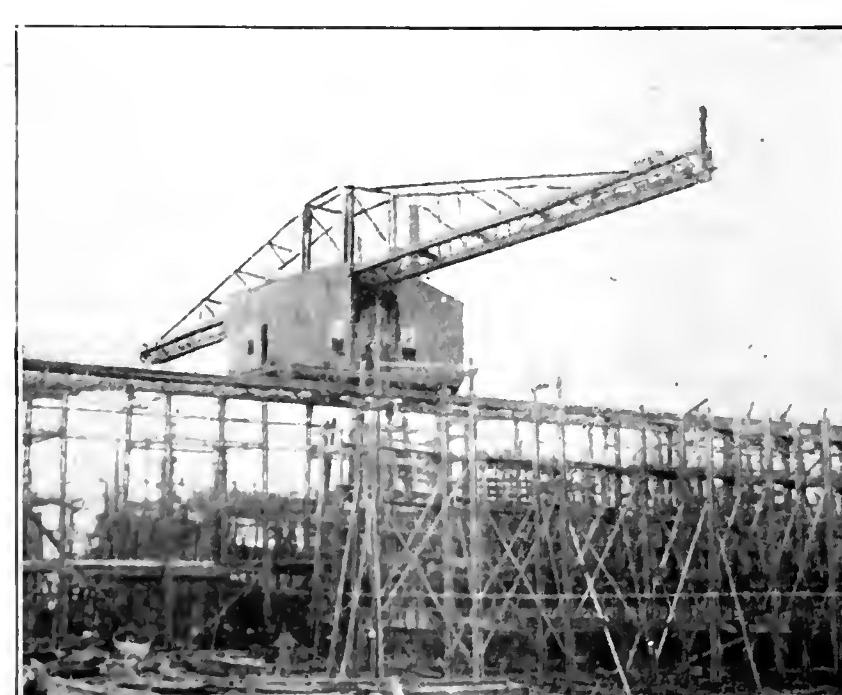


FIG. 7. WYANDOTTE DOUBLE CANTILEVER, ORIGINALLY AT WHEELER YARD, WEST BAY CITY

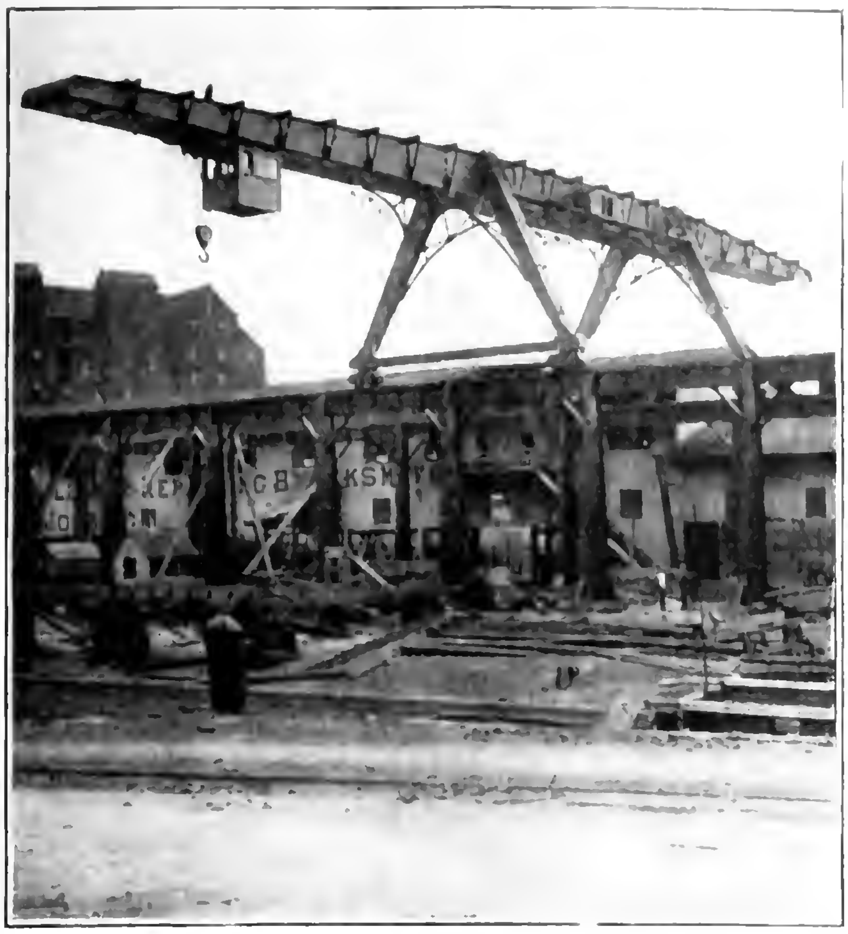


FIG. 8. UNEQUAL-ARM CANTILEVER CRANE ON GANTRY BASE, SOUTH CHICAGO

is badly cramped in layout and lacks handling facilities. The hoisting capacity of the cranes is three tons, and the speeds are: Lifting 250 ft. per minute, trolley travel 1000 to 1200 ft. per minute, bridge travel 300 to 400 ft. per minute.

Very different layout is found at the berths equipped with the double cantilever cranes, as Wyandotte and Superior. These are berths arranged in a group of four on a pier, down the center of which is placed the trestle of the double cantilever, as sketched in the small-scale plan in Fig. 5. No space is available for supply tracks between the ship and the crane trestle, or under the trestle. In fact, there is no way of bringing ship parts or other material from the inshore end of the pier except by the crane itself. Under this condition, and with only one hook for four hulls, these berths have crane service that is more limited than any other on the Lakes.

Experience in the South Chicago yard, where there is a Brown double cantilever similar to that at Wyandotte, is that shipbuilding on the berths served by the double cantilever is under a handicap in regard to crane service. Edward Morris, assistant superintendent of the yard, says that the crane is far from equal in capacity to the locomotive tower crane which has been installed to serve a new berth.

Surprisingly satisfactory service, however, has been given by the Wyandotte crane, according to the yard officials. A special method of operating the crane contributes to this. The crane platform is used as a magazine when material is handled from the shop to the berths, and this practice economizes in crane travel and saves time. Six or eight shell plates or other ship parts are piled at once on the truck platform of the crane carriage (see end elevation sketch at B, in Fig. 2) and are distributed to the ship in a single trip. While one plate is being run out on the trolley, the crane helper fastens lifting chains to the next plate, so that when the hook returns no time is lost in picking up a new load. The crane has a lifting capacity of 4 to 12 tons at speeds of 300 ft. to 80 ft. per minute; its trolley speed is 1000 to 1200 ft. per minute and its travel speed about 500 ft. per minute. It is reported to work as fast as the needs of the berth demand. At the time of writing, the yard officials were of the opinion that the double cantilever crane is equal in service to three of the tower cranes recently provided for the new berths of the yard, but called attention to the fact that the old crane has the advantage of skilled operators, the new cranes having been in service too short a time to have been brought up to best performance as yet.

An interesting change was made in the Wyandotte crane (Figs. 6 and 7) a few years ago. The traveling counterweight, which is equal to about half the maximum load capacity, was cut down to one-fourth or less of its original amount. Though this change decreased the stability of the machine, a 14-ton load has been carried at extreme reach without lifting the far wheels of the crane off the track.

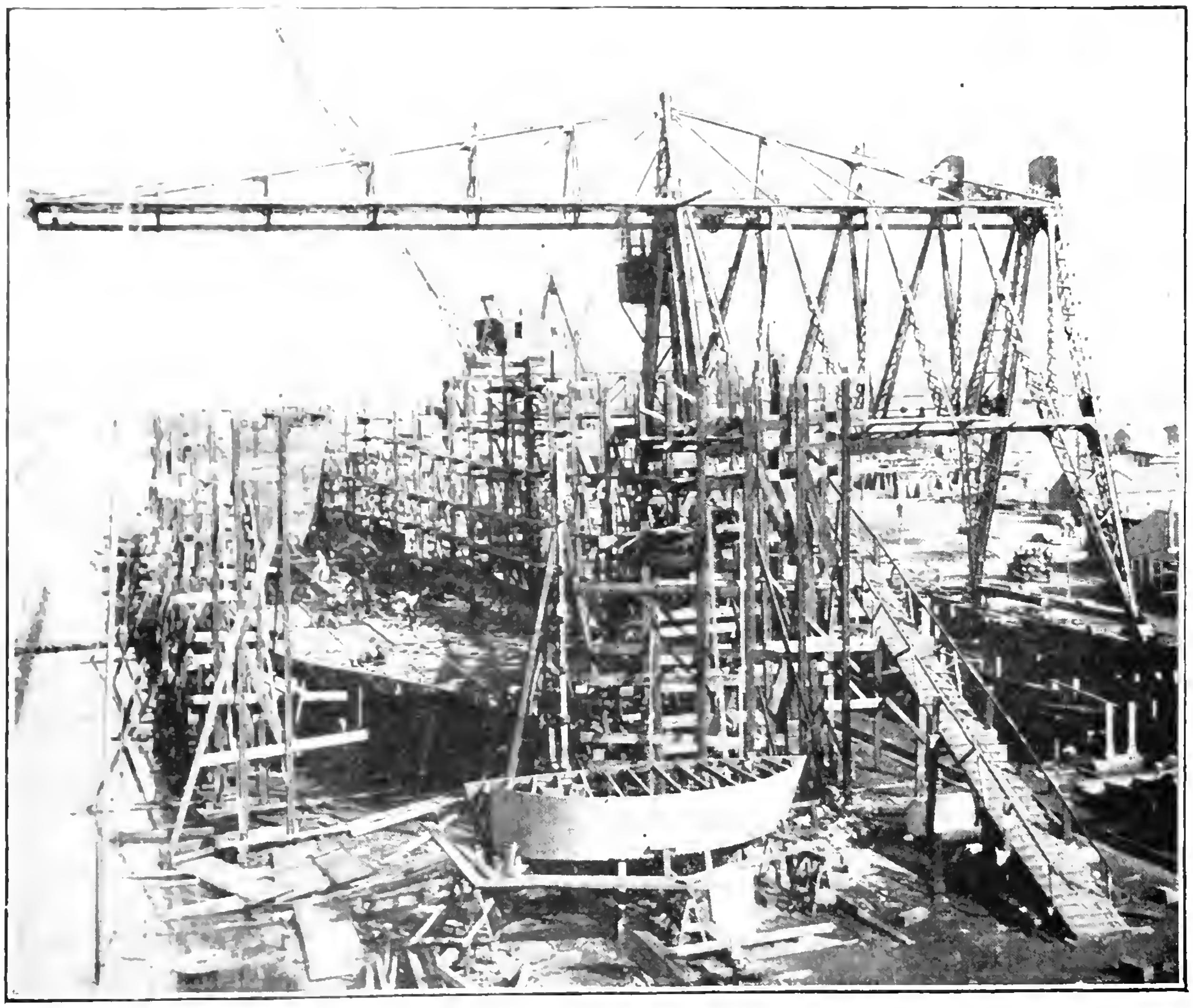


FIG. 9. GANTRY-BASE CANTILEVER AT ECORSE YARD

Another early cantilever, Fig. 8, shows more modern detail design, though built in 1898. Its trolley runway is supported by a gantry base resting on separate lines of columns. This crane is in service at South Chicago. Its structural parts are of plate-girder makeup, as commonly used by its builders, the Wellman-Seaver-Morgan Co. This machine, at present serving only a single berth, has been giving very satisfactory service. Its capacity is 10 tons, the maximum lift about 50 ft., the height of track rails above the ground 22 ft., and the total length of girders 195 ft. It was built for a Buffalo yard, and was later moved to South Chicago.

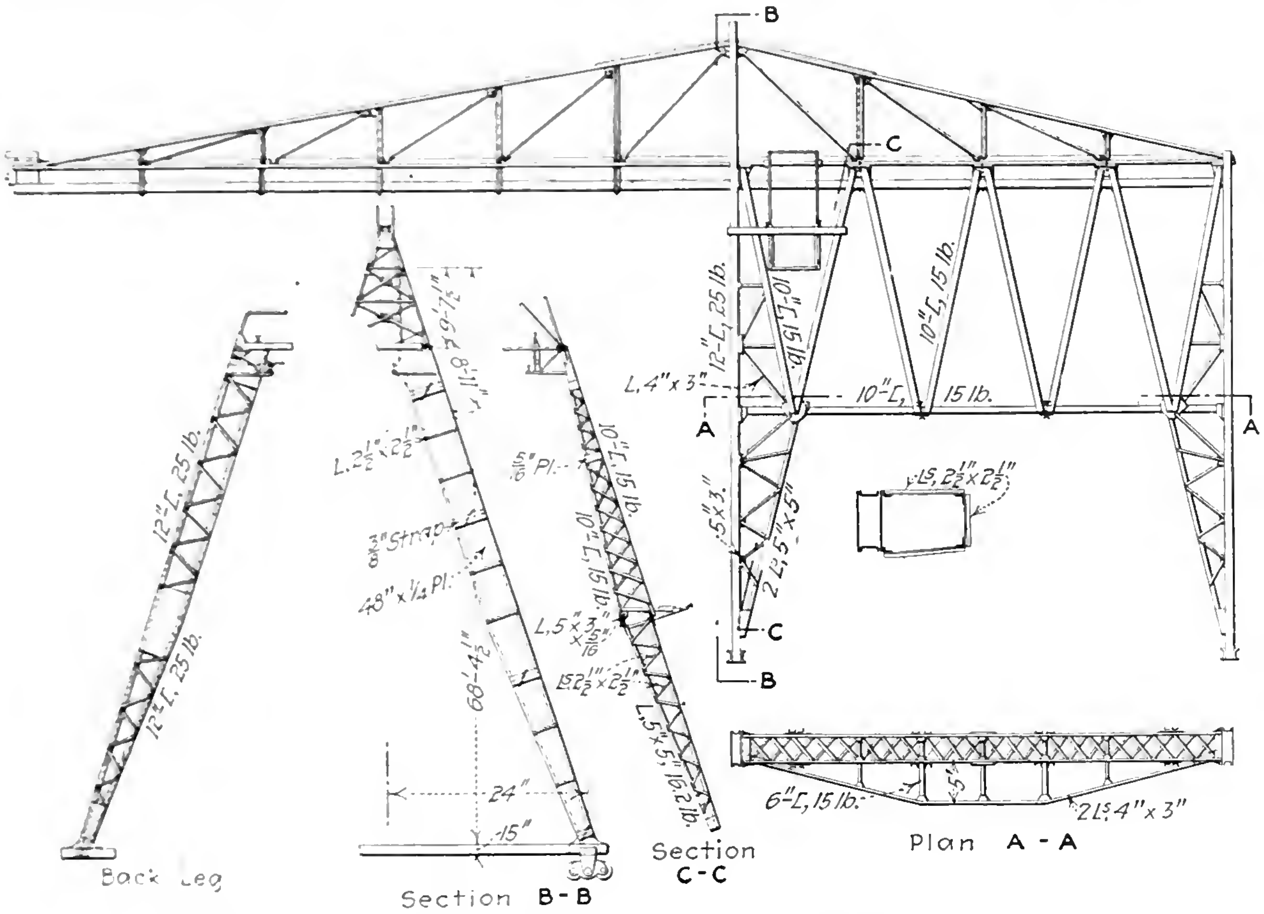


FIG. 10. OUTLINE DRAWING OF ECORSE CANTILEVER CRANE

Wide-Base Single Cantilevers Are Doing Fast Work—Remarkable efficiency was shown recently by the shipbuilding cranes of the Great Lakes Engineering Works at Ecorse, Mich., in building the 3500-ton steamer "Crawl Keys" in 14 working days. The berth system is such as to utilize most fully the advantages of short-travel material supply afforded by the layout. This feature, which was brought out in a description of the Ecorse pre-assembly system printed in *Engineering News-Record* of Dec. 12, 1918, p. 1076, is the determining factor in the performance of the cranes. The load capacity (seven tons) and the crane speeds compare closely with those of other ship-erection cranes in the Lakes yards.

The Ecorse cranes, Figs. 9 and 10, were originally designed by the Wellman-Seaver-Morgan Co., but the lower part has been rebuilt at the yard. Two were built in 1903 and the other several years later. Electric current for the operating motors is supplied by contact wires carried on short poles just back of the rear gantry leg. The control stand is in a cage at the forward end of the gantry frame, just under the trolley rail.

By combining the operator's cage with the hoist trolley, the Manitowoc Shipbuilding Co. has added a new operating feature to the gantry-base cantilever crane. The yard has four of these machines at present, all of them designed in the yard; the last was installed during the present year.

An old coal unloader was the starting point of the first crane, shown in the view, Fig. 11, Gantry legs were added to it, with the necessary travel machinery. The bridge was strengthened by trusses between the front and rear legs and by cable guys run from a frame erected over the forward legs down to the panel-points of the cantilever portion. An I-beam runway carries a two-hoist Pawling & Harnischfeger monorail trolley with operator's cage. This machine, built in 1903, has proved its value in the service it has rendered since then, and on the basis of this experience the same type was adopted for three new cranes installed during 1917 and 1918. Fig. 12 shows the structure of the latest of these cranes, built last spring by the Wisconsin Bridge & Iron Co. With forward and rear cantilevers of 80 ft. and 12 ft., it commands a supply area 59 ft. wide and a berth area 80 ft. wide. The two 1917 cranes, built for a double berth hitherto handled by the first crane, are of substantially the same design, but have a track gage of 58 ft., so as to be able to use the existing trestle. Berth 4, newly built, is served by the oldest of the cranes, transferred from the double berth, so that one crane per berth is provided, while berths 5 and 6, the newest, are equipped with a locomotive tower crane, which, together with a second one yet to be installed, will handle these berths and the adjoining fitting-out dock.

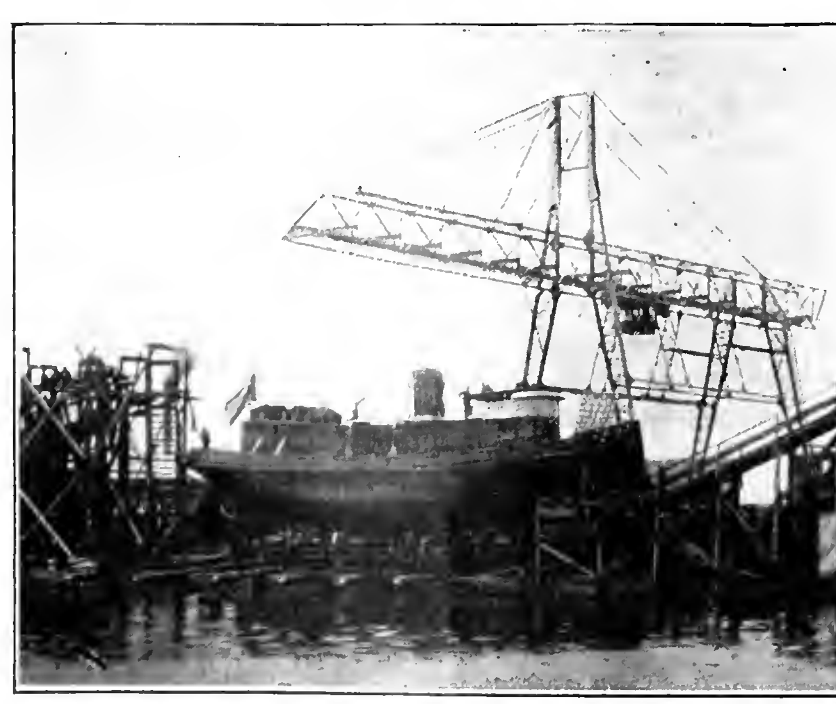


FIG. 11. CANTILEVER BUILT FROM AN OLD COAL-UNLOADING BRIDGE

A speed record in shipbuilding was made by the

Manitowoc cantilevers in July; on July 10 a keel was laid and on Aug. 7 the hull of the "Corsicana" was launched, after only 24 working days of building. Two cranes were used on the ship and a night crane force was run, but bolting and riveting were done only by the ordinary 10-hour day shift.

Gantry Cranes in Three Yards—During the same time exactly the same speed-record was made by the Lorain yard of the American Shipbuilding Co. The keel was laid July 1, and the fully riveted hull of the "Lake Deval," with tail shaft, propeller and rudder in place, was launched Aug. 8. Only one crane was available for this work. It was a gantry, of a type used at Lorain for 20 years. In a single 10-hour day this machine made 230 lifts, working up to its limit of speed, according to A. C. Payton and Charles Marlow, superintendent and assistant superintendent of the yard.

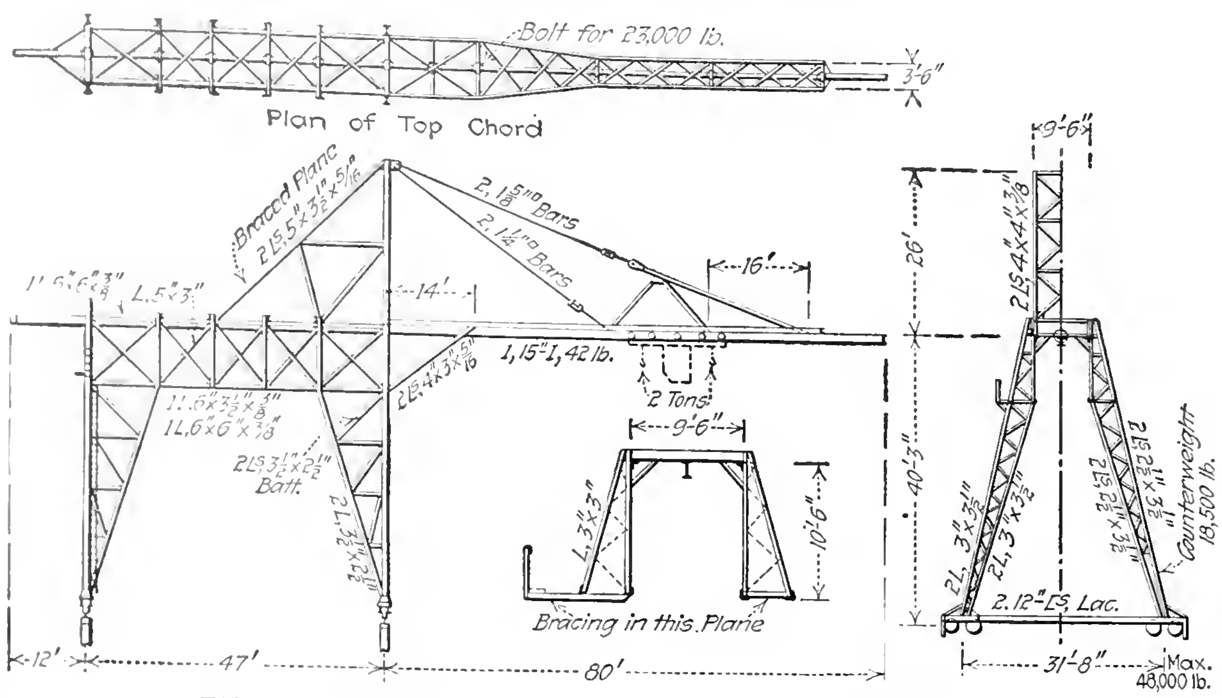


FIG. 12. NEW CANTILEVER CRANE OF MANITOWOC YARD

Berth conditions are substantially the same at all of the yards using gantry cranes. Material is picked up by the gantries from a rear cantilever extension of the trolley bridge in most cases. A few of the cranes have a span sufficient to cover a wide supply area alongside the berths.

Of the four gantries at Lorain, two built in 1899 and two in 1906, the later ones are represented by Fig. 13, from a drawing of the builders, the Wellman-Seaver-Morgan Co. The older cranes differ only slightly from these. Open-side main frame, gear drive of the travel wheels, and high travel speed distinguish these machines: trolley travel 250 ft. per minute, crane travel 500 ft. per minute. Steel columns support the outboard track of the 1906 cranes, while the earlier have 12 x 12 timber columns braced by the ship-erection scaffolding.

Figures on the time lost in removing and replacing the outboard track have already been given. The loss of time is reduced greatly at Toledo, where the crane serving a berth of reinforced-concrete construction has its outboard rail supported by an I-beam resting on chairs at a height sufficient to clear the fixed launching ways (see drawing in *Engineering News-Record* of Jan. 2, p. 9). Preparation of the ways, therefore, does not interfere with crane service.

At this yard three 10-ton gantries (Fig. 14) serve the six (short) berths. No speed records have been made here, but the gantries are specially interesting because of the flexibility of service which their design and location afford. They are designed so as to serve not only the berths which they cover, but also the dry docks which at this yard are used as launching slips (see sketch in Fig. 5). A 32½-ft. forward extension out over the dry dock enables the crane trolley to reach nearly to the middle of a ship in the dock. A rear cantilever extension of the same length covers a fabricated-storage and assembly space, and, as the layout of the yard gives a remarkably short straight-line route for material from receipt through the shop and to delivery opposite the ship, conditions for efficient hull construction are present. The travel speed of these cranes, however, is notably slow, being only 100 ft. per minute. A little boom is mounted on the gantry bridge to remove and replace the outboard track.

Two of the three machines were built by the Cleveland

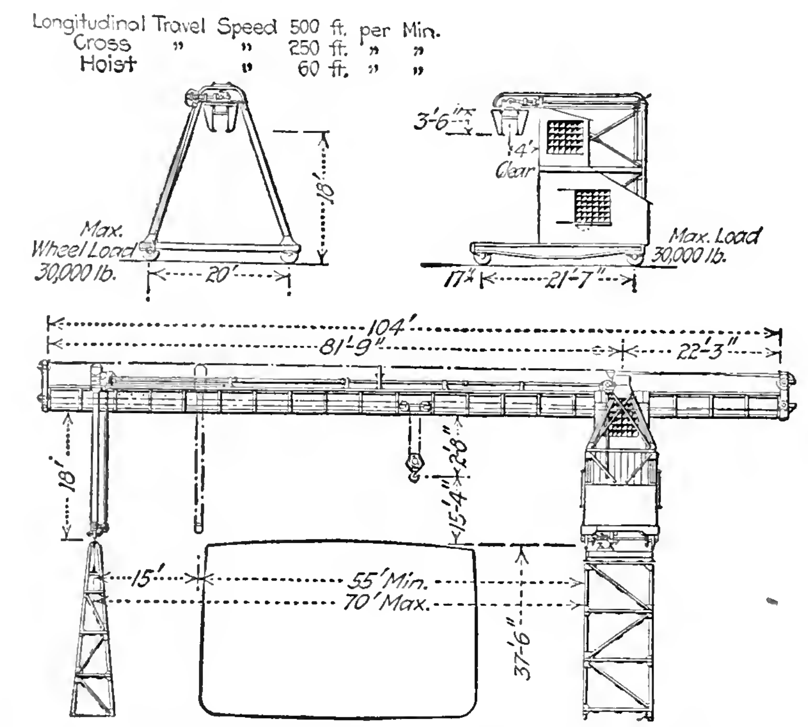


FIG. 13. GANTRY CRANES AT LORAIN EQUIPPED FOR HIGH TRAVEL SPEEDS

Crane and Engineering Co. about 15 years ago, while the third was designed and built by the yard. The spans are 75, 80 and 100 ft.; the long-span crane has no rear cantilever, as it is located close to the side property line, and has the storage and assembly space under the bridge, instead of back of the trestle.

The new Globe Shipbuilding Co. yard at Superior, Wis., has two gantries, which present an interesting difference in outboard rail supports. The first one built, of five tons lifting capacity, has its rail stringer seated directly on the cap timber of the dock wall. The launching ways, which rest on this same cap, cannot be placed until the stringer is removed. When the second crane, of 15 tons, was designed, this difficulty was avoided by raising the outboard track stringer on timber pedestals, about 3 ft. high. The ways can be placed

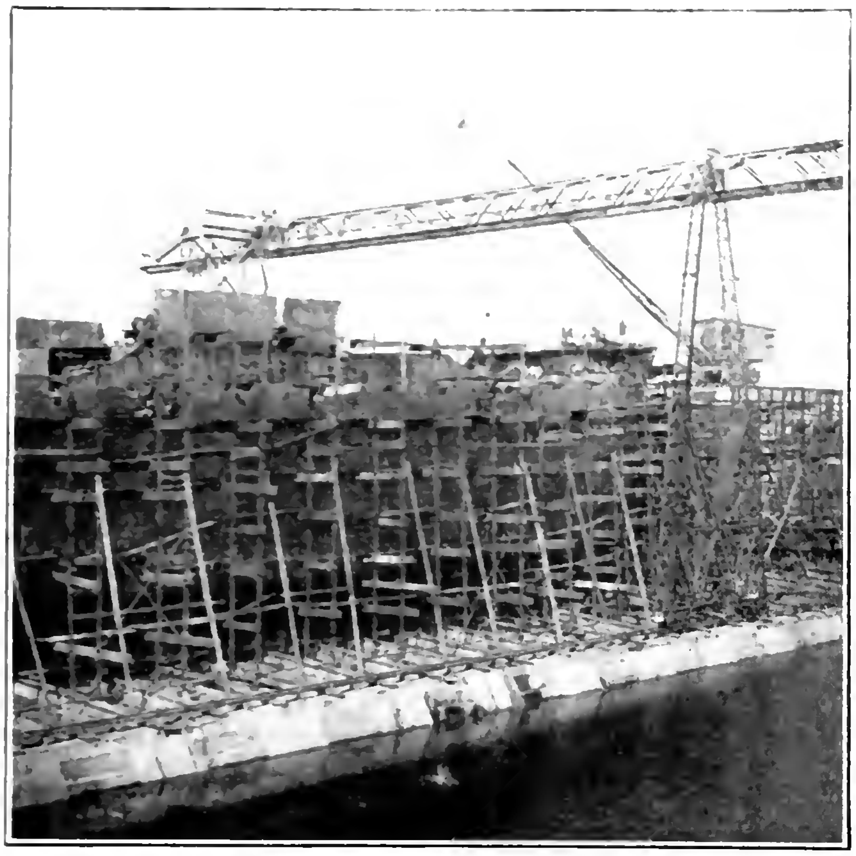


FIG. 14. TOLEDO GANTRY OVERHANGS DRY DOCK USED AS LAUNCHING SLIP

under this stringer between pedestals, and thus the crane can continue in service. James McKellar, general manager of the company, says that it takes about six hours to remove this rail before launching and about one day to replace it. The crane is operated up to within one day of the launch.

Ample width to cover supply tracks, storage and assembly space also distinguishes the newer crane. The first one is located so close to the side of the punch shop that the same arrangement was not practicable, and the inboard track was therefore placed close to the line of the scaffolding (Fig. 15); a cantilever extension of the trolley runway commands a supply track just inshore of the crane track. The new crane (Fig. 16) has a similar cantilever extension in addition to its large gantry width. Both machines were built by the Lakeside Bridge and Steel Co. of North Milwaukee, to outline designs of Mr. McKellar.

Some data of the larger machine are as follows: The span between the track rails is 100 ft., and its cantilever extensions are 18½ ft. and 43 ft. on outboard and inboard ends, respectively. The clearance height is 75 ft., the maximum lift 65 ft. Three speeds of hoisting and lowering are provided for, varying from 60 ft. per minute for a five-ton load to 20 ft. per minute for a 15-ton load. They are controlled from the cab, which, as in the Manitowoc cantilevers, is hung from the trolley, so that the operator has a direct view of his load. Power is supplied as 60-cycle three-phase current at 220 volts pressure. The crane travel drive is actuated by separate motors at the two legs. As the inboard leg carries about 60% of the total load with the trolley at midspan, and also takes all of the wind load, it was equipped with a larger motor; the drive has been found to work well with this arrangement.

Large-Capacity Tower Cranes Introduced This Season—In the pressure to increase crane facilities during the past year, locomotive tower cranes have become the dominant type of crane in some yards. The Wyandotte yard has its six new berths served by Link-Belt tower cranes, while the four old berths are served by the double cantilever crane previously described. One has been installed at Chicago. Ecorse has now four Orton & Steinbrenner tower cranes, against three of its regular cantilevers. Two McMyler-Interstate tower cranes have been added to the four cantilevers at Manitowoc. The McDougall-Duluth Co. yard has a tower crane of distinctive type, the superstructure being of derrick type; that is, only the boom and mast swing, while in the other machines the engine platform with boom is a unit, revolving on a center pin. The Duluth crane was built by the Clyde Iron Works.

One of the new gantry-base locomotive cranes at Ecorse is shown by the view, Fig. 3. It uses the same runway as the cantilever which hitherto served the two berths here. Each of the yard's three cantilevers has been supplemented by a machine of the kind shown, while berths 7 and 8, which are new, have been equipped with a locomotive tower crane alone, a narrow-base machine which will work from storage back of the track instead of between the rails. All four machines have booms 85 ft. long capable of lifting 3½ tons at full reach and 10 tons at 35-ft. reach. They are steam-operated, the boiler being oil-fired. With engines 9 x 10 in., they secure a high hoisting speed—110 ft. per minute with maximum load and 220 ft. per minute on single lines. The swinging speed is four revolutions per minute, and the travel speed 200 ft. per minute. The travel drive is actuated by double-friction clutches on the crankshaft of the hoisting engine. The super-

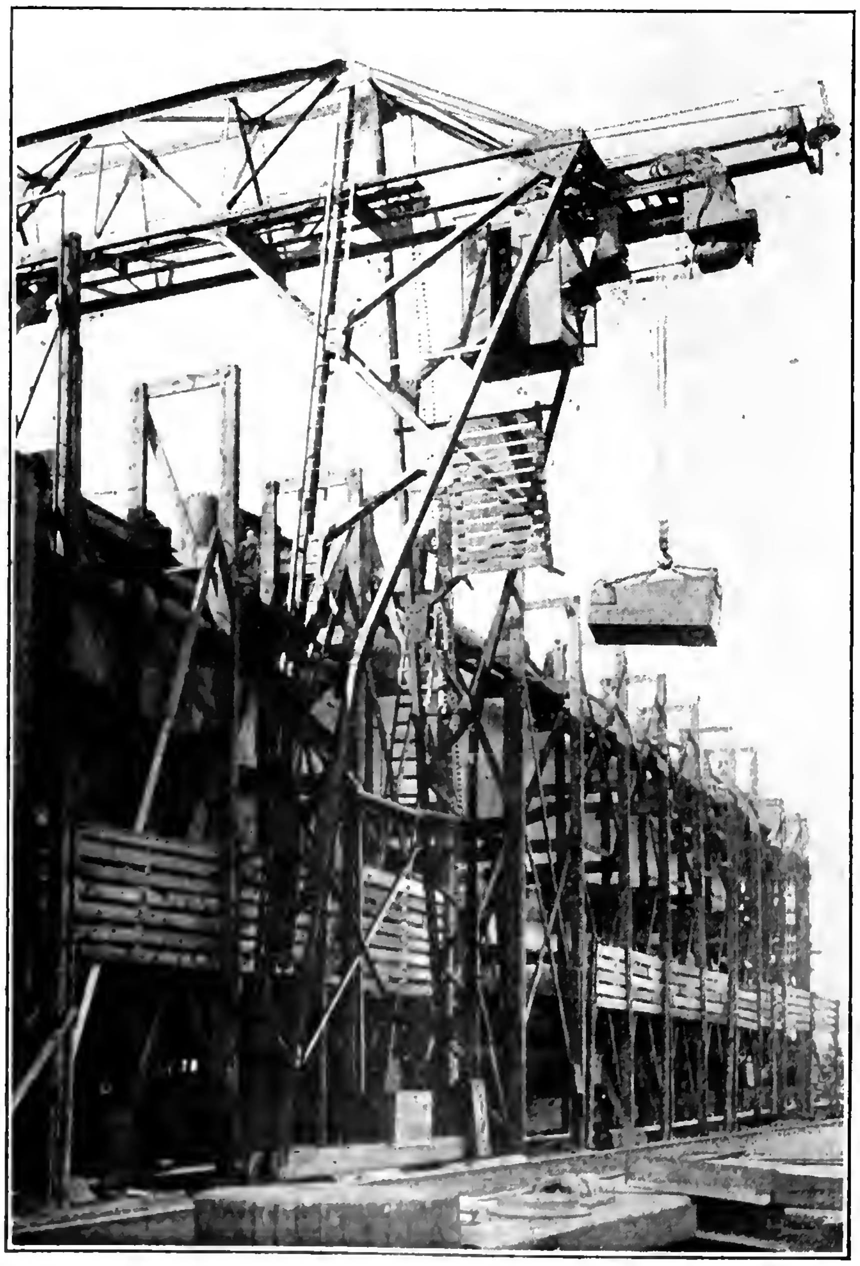


FIG. 15. INBOARD SUPPORT OF FIRST GLOBE GANTRY

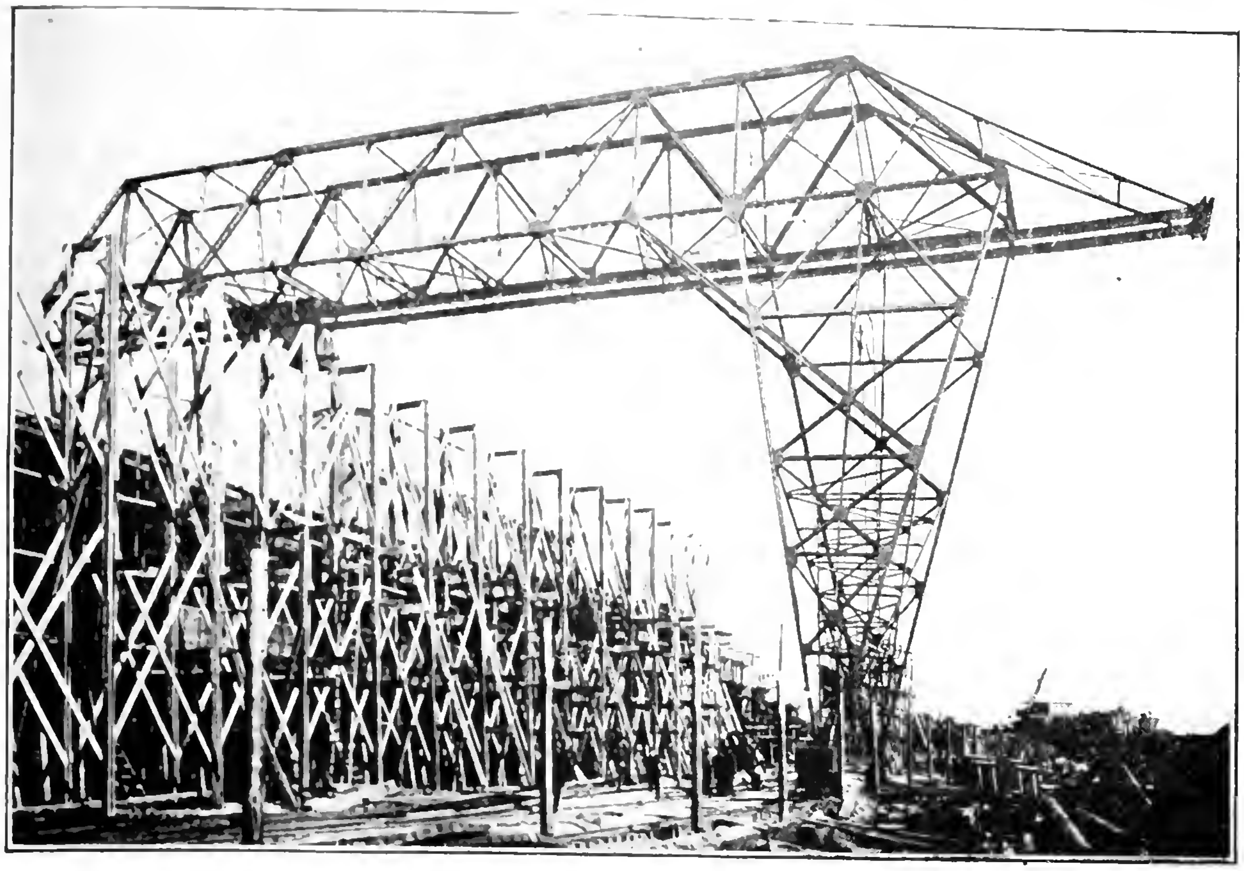


FIG. 16. LARGE GANTRY AT GLOBE YARD COMMANDS WIDE SUPPLY AREA

structure is simply the upper part of a standard locomotive crane of the same manufacturers. The turntable is formed of 28 chilled tread wheels 8 in. in diameter running on an 11-ft. circle of 60-lb. rail.

The Wyandotte cranes are of similar proportions, with boom length of 90 ft. and lifting capacity of about five tons at 50-ft. radius. A slightly more powerful machine

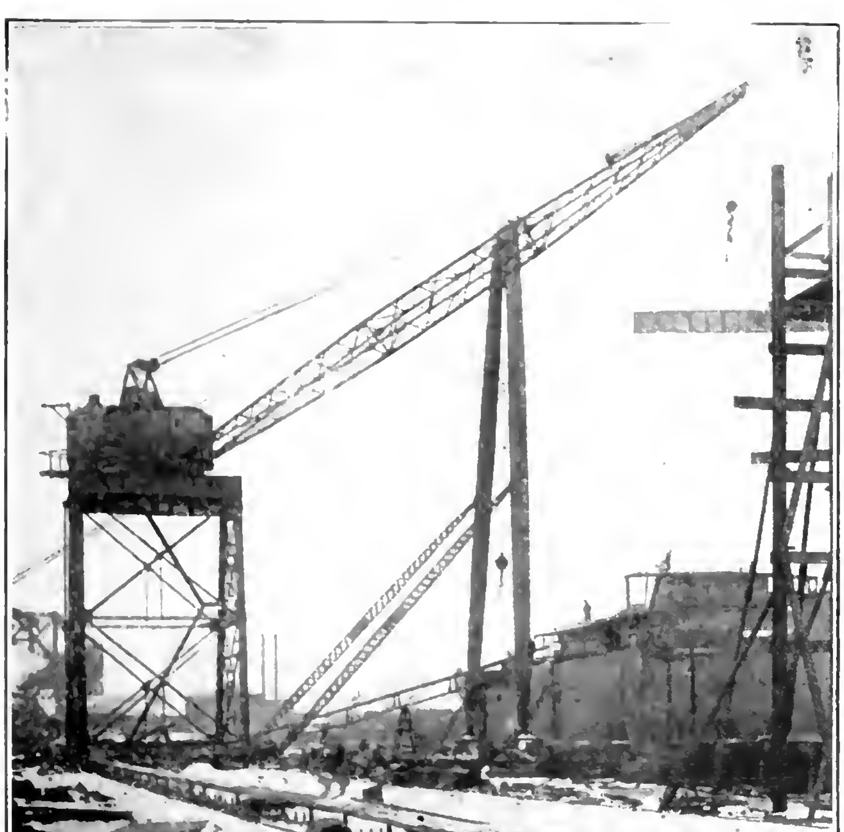


FIG. 17. LOCOMOTIVE TOWER CRANE RECENTLY INSTALLED AT ASHTABULA

has been installed at Manitowoc, and a similar one at Ashtabula (Fig. 17). The boom length of this crane is 98 ft. and the capacity at extreme reach is three tons. All engine parts are set by this crane, working at the fitting-out dock. Boilers do not have to be set at the yard, however, as the affiliated Manitowoc Boiler Works, about a mile away, has a river-front shear-legs for this work.

To carry on shipbuilding at maximum speed, as demanded by the Emergency Fleet Corporation's program, the erection equipment of all the yards, as well as other departments, required expansion. While the existing cranes in most cases were able to handle material fast enough to keep up with the *average* rate of shipbuilding during the past year, irregularities in material supply and fabrication frequently unbalanced the work sufficiently to call for a large excess, temporarily, of erection capacity. The pressure for output therefore led most of the yards to increase their crane equipment to practically double its former amount. All yard extensions made during the year have been provided with one crane per berth, and virtually the whole Lakes district will enter on the 1919 work so equipped.

Chinese, United States and Other Railways

China has 5193 miles of railways, according to a recent commerce report issued by the United States Department of Commerce, giving statistics for 1915. The lines under control of the Ministry of Communications aggregate 3703 miles (including the Hsuchow-Kaifengfu line completed in 1916), of which 150 miles are owned by private companies. Railways operated under concessions to foreign nations total 1490 miles. China has about 460 square miles of territory and 107,000 population per mile of railway, as against 40 and 8600 for India and 12 and 3800 for the United States. The report states that China's extensive system of canals tends to keep the proportion of mileage lower than in other countries. The locomotives on the Chinese government railways total 629, and are of various types introduced by the different nations which have built or provided capital for lines now forming parts of the national system. The necessity for standardization is becoming apparent, as the Chinese policy is to prolong the life of the engines by extensive repairs and renewals, partly on account of the heavy freight charges and agency commissions on imported locomotives. The passenger and freight cars total 1280 and 10,652 respectively. The freight cars averaged 69 tons per ton of capacity, or 69 loads per year, as compared with 99.3 for Japan and 23.7 for the United States. The average haul per ton was 89, 84 and 146 miles for the three countries, respectively. The cost of operation absorbs 53% of the total revenue; while 30% covers interest and other income charges. The remaining 17% is for the Government, of which 10% is the return on investment and 7% is business profit. The total investment is given as about $512,500,000, of which construction and equipment represent about $507,000,000. The total operating revenue for 1915 was $36,000,000.

Road Signs for Amexforce Trucks Save Gasoline

In the Army's Intermediate Section East, in France, It Is Almost Impossible to Take Wrong Route

By Robert K. Tomlin, Jr.
War Correspondent of Engineering News-Record

A CERTAIN adjutant on the staff of an American brigadier general here in France has the reputation of being lightning-quick in detecting mistakes and letting their authors know of them promptly. It is only in exceptional cases, however, that he has been known to praise work. One of these occurred recently after he had finished his first long automobile trip in

Photograph by "Engineering News-Record"

IN FRONT OF HEADQUARTERS SPECIAL SIGN INDICATES BEST ROUTES TO PRINCIPAL TOWNS

the Intermediate Section East. Returning to his general's headquarters he happened to encounter there the major of engineers who is acting as superintendent of roads for this district.

"Are you the man responsible for all those road signs which have been put up in this section?" he inquired. The major admitted that he was. "Well," replied the adjutant, "you've done a damned good job."

The marking of the roads in the Intermediate Section East of the American Expeditionary Forces has been carried out in a manner so thorough that one can now travel from one end of the section to another without once stopping to ask questions and without taking the wrong route. But while the new signs would justify themselves from the point of view of convenience alone, the important feature of this whole business is the enormous saving in gasoline which has been effected by the placing of wooden signboards at frequent intervals along the roads which are now carrying so heavy a volume of Army motor-truck and automobile traffic. Through the Intermediate Section East is moving, day and night, train after train of motor trucks, to say nothing of passenger automobiles, motorcycles and side cars. Gasoline in France today is a costly commodity, and it is imperative to conserve it in every way possible. In this campaign the road signs of the Intermediate Section East are playing a silent but effective part.

The plan of marking the roads embraces other features than the indication of direction. With the long-haul motor-truck trips which have now become so common, as a result of congestion of railway transportation, a train of vehicles may be on the road many days. Gasoline and oil supplies must be replenished en route, and occasionally it is necessary to know where spare parts and extra tires can be obtained. Special signboards are placed to give this much desired information. Then, too, in that part of central France covered by the Intermediate Section East, the old macadam roads were built primarily for slow moving traffic. Curves much sharper than would be considered good practice today are very common. Almost invariably they are built without any superelevation, and with the trees and foliage so general along French roads, one arrives at a sharp turn before realizing it. To prevent accidents at such points, all curves are marked by warning signboards located several hundred feet back from the curve, so as to give the motor-truck driver ample time to slow down.

In July, about 2500 road signs had been placed in the Intermediate Section East. As a general rule, they are squares, 15 in. on a side, and are made of wood salvaged from broken packing cases. They are given three coats of white paint and are lettered in black. When possible these signs are nailed in place, but in cases where they must be affixed to a metal support they are wired. The sign-placing problem, however, is a simple one, and generally it is not necessary to place any post or standard, as all French roads are flanked by trees. Since our Signal Corps has been busy establishing communication by wire between all important Army centers, there are, in addition, lines of telegraph poles to which road signs may be attached. The American Army road signs are recognizable as such because they are always set up with a diagonal vertical instead of like the existing French road signs, which generally have a rectangular form. When an American truck driver sees a white, diamond-shaped sign he knows that its message is for him. There is no confusing our Army's signs with anything else to be seen along a French road.

During a recent trip through central France with the superintendent of roads of the Intermediate Section East I had a good opportunity of observing how the roads have been marked. To begin with, there is in front of headquarters a large rectangular special sign, 4½ ft. long and 2 ft. wide, listing the names of the principal towns and indicating the best routes to them. One of these signs is shown in one of the photographs. On this sign the location of gas stations also is indicated. A driver entirely unfamiliar with the

VARIOUS SCHEMES OF LETTERING FOR ROAD SIGNS USED BY AMERICAN ARMY IN FRANCE

surrounding country can start at this sign and, without questioning anybody, proceed to any town in the section. If his gasoline supply should run low he would know where to replenish it, as a result of the information given on the headquarters signboard.

The matter of getting out of a French village and on to the main road leading somewhere else is no simple matter. The streets twist and turn in the most unexpected manner. A route that looks like a back alley may actually be the connecting link to the *route nationale* for which you are looking. On the other hand, you may, if your French vocabulary has not yet been recruited up to war strength, turn into a street with a name like *Impasse de l'Univers*, only to pull up sharply at its end when you discover that you have been navigating in a blind alley. Another confusing situation is presented to the motor-truck driver by the *place*, or square, which is abundant everywhere. Sometimes half a dozen streets radiate from one of these centers and when you try to choose the right one you begin to realize how overwhelming are the odds against you. I can think of no better way of describing the complex street plan of the small French town than to say that it follows lines that are as regular as those of a dish of Italian spaghetti.

There is one other point about the marking of roads over here which cannot be fully appreciated in the States. Take the case of a motor-truck driver arriving at a cross-roads. He may have two or three choices of route to follow, and all of them may appear to be main roads. Without road signs, what is he to do? The obvious solution would be to stop and inquire at the nearest farmhouse. This sounds simple, but in reality it is not. Many names of French towns as pronounced by the American truck driver mean absolutely nothing to the French peasant. The poor chap whose destination may be, let us say, Pougues-les-Eaux, or Monteignet-Escurolles gets in over his head when he tries to make known orally the name of one of these tongue-twisters. As one driver expressed it recently, after trying out his limited stock of French words on an old farmer whom be encountered plodding along the roadside:

"These guys can't understand you even when you talk to them in their own language."

Direction signs are placed at all crossroads and at intervals along all main routes. They are of several types, as shown in the drawing. If a town happens to be a "gas station" these words are placed in small letters above or below the name of the town. In addition to the direction signs are many others, of which the following are samples:

Road closed to U. S. Motor Vehicles.
U. S. Vehicles Must Not Cross This Bridge.
Bad Curves and Grades—Suitable Only for Passenger Cars and Light Trucks.
Slow! Railroad Crossing—300 Yards.
Loaded Trucks Use This Road.
Slow—Danger—Bad Curve—Sound Horn.

In the case of so long a title as that in the third group above the 15-in. diamond-shaped signboard is too small, and a larger rectangular one is employed generally for these special notices.

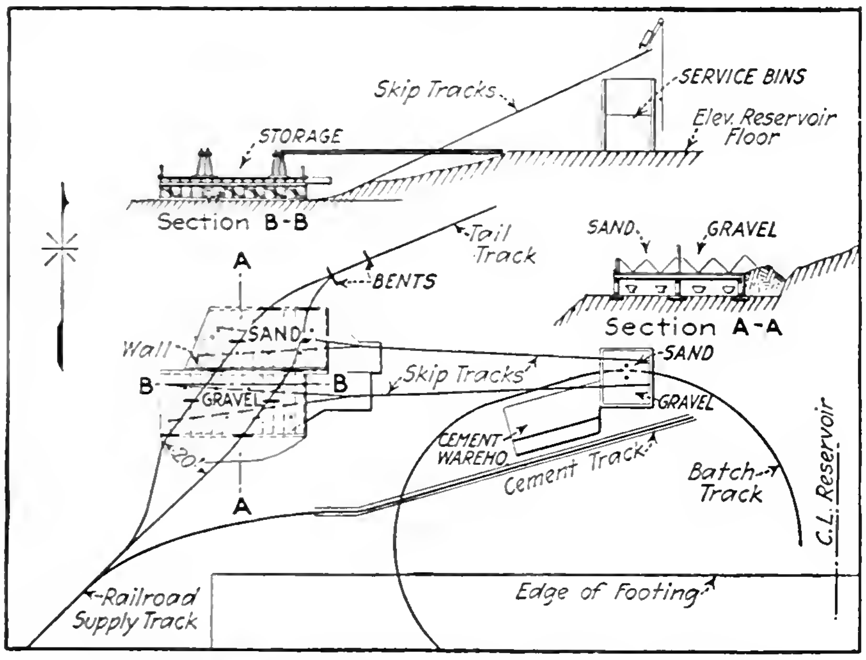
Photograph by "Engineering News-Record"
THE AMERICAN ARMY'S SIGN IS DIAMOND-SHAPED AND EASILY RECOGNIZABLE

Superintendent of roads for Intermediate Section (right) co-operates closely with the departmental engineering representative (left) of the *Ponts et Chaussees*

War Wage Increase Met by Revising Construction Plan

Concrete Output Multiplied Sixfold on New St. Paul Reservoir by Changing Method of Operating Traveling Mixing Plant

WELL-PLANNED plant met the handicap of labor scarcity and rising wages, in the construction of the new concrete high-service reservoir for St. Paul, Minn. Transportation was the governing operation. Not far from 150,000 tons of materials, including excavation, had to be moved. For the concrete structure alone 40,000 tons of materials had to be transported some two miles from the railway to the work. At the work these materials had to be assembled into a structure covering 2½ acres. By careful plant selection and layout, material handling both to the site and into the structure was made largely mechanical. Everything was put onto wheels. All raw materials were handled by cars. Concrete when not chuted directly into place was distributed in buggies over runways. The mixing plant was truck-mounted, and even complex forms for groined arches and buttressed walls were shifted by travelers on wheels.



CONCRETE MATERIALS FOR ST. PAUL RESERVOIR HANDLED HUNDRED PER CENT BY CARS

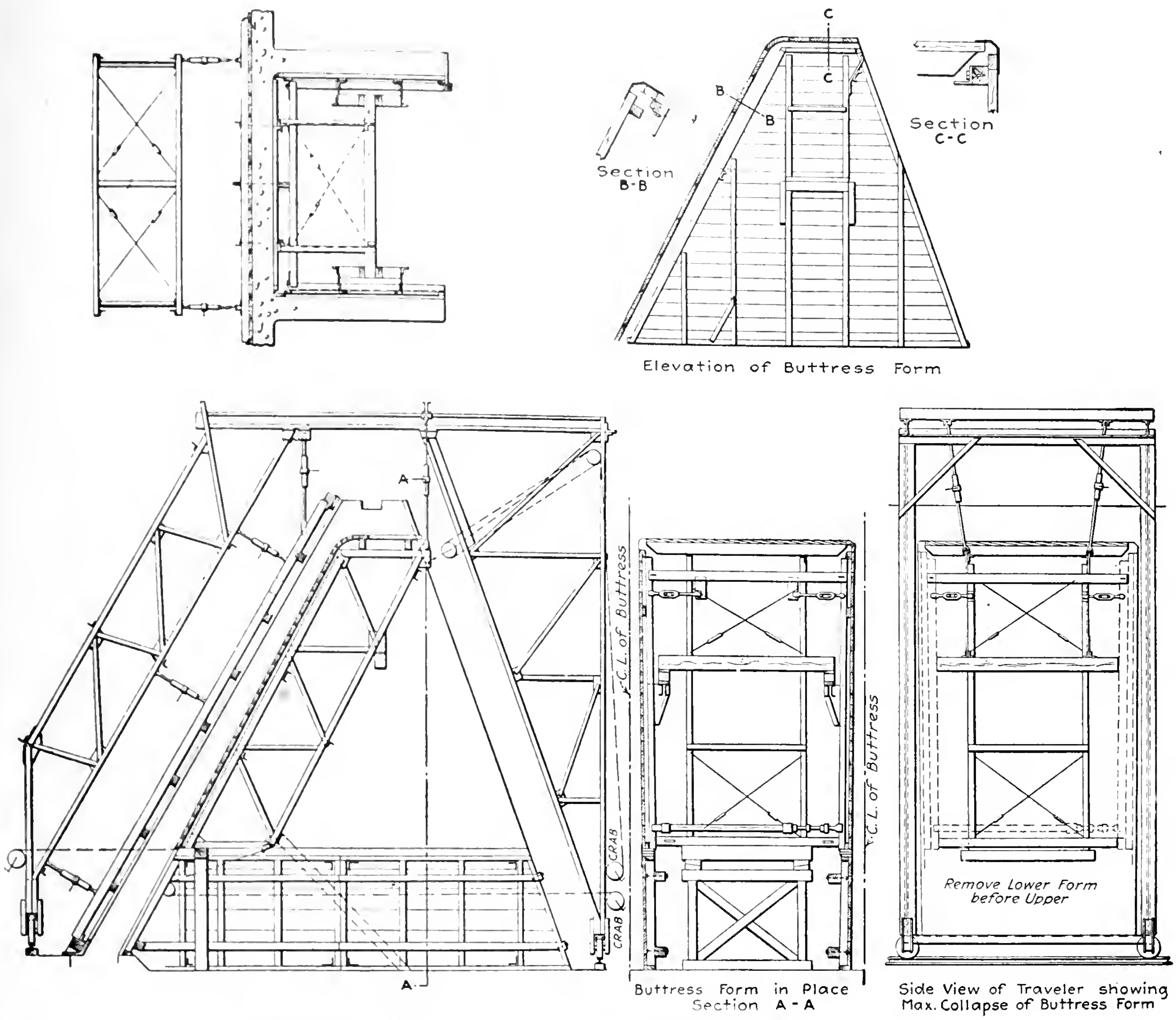
The plans and structural details of the new reservoir were illustrated and described in *Engineering News-Record* of Nov. 15, 1917, p. 927. The plans provided for a structure 452 x 446 ft., so located that a second unit of the same area can be added when required. Structurally, the reservoir consists of an inverted groined arch floor carrying columns which support a groined arch roof. On three sides, the walls are inclined slabs braced by buttresses. The fourth side wall, which will be the dividing wall when the additional unit is built, is a cantilever gravity wall. Included in the main structure are gate chambers, aërator chamber, sluice gates, conduits, valves, etc. The roof and sides are covered and banked with earth.

Located 300 ft. above city datum and two miles from the nearest railway, the reservoir site, despite its proximity to the city, was isolated in respect to available means of transportation. Estimates were made of the cost of tractor haulage. Including a necessary concrete road up the reservoir hill, a figure below $1.20 a ton could not be had. Surveys for a narrow-gage railway connecting with the contractor's yards and gravel plant on the railway two miles away, and passing a clay pit, gave a more reasonable figure, and the railway was built. It was 2¼ miles long, with a 1000-ft. trestle and a maximum grade of 2½ per cent. Turnouts and yard tracks at the reservoir were provided. The road cost $12,000, this figure not including rails and some other materials in stock. This railway, as events proved, did not reduce haulage cost below the original estimate, but it did cut down haulage time. Without it the construction probably would not have been completed in the specified time.

Construction began with the building of the railway and simultaneous excavation of about 90,000 cu.yd. of earth to level the site. Excavation was by steam shovel and narrow-gage cars, wasting the spoil on the sloping sides of the hill. About 32 days were required for these tasks. When the reservoir site had been graded the clay blanket was placed. In this blanket, and later for banking the walls and covering the roof, some 15,000 cu.yd. of clay was required.

All construction materials came in over the narrow-gage railway and was stored as indicated by the sketch map. Incoming tracks ran over the sand and gravel storage bins and to the cement house. From under the sand and gravel bins skip car tracks rose on a 50% grade to sand and gravel service bins with measuring hoppers. Under these bins and alongside the

COMPLEX WALL FORMS ARE MOVED SUCCESSFULLY BY TRAVELER



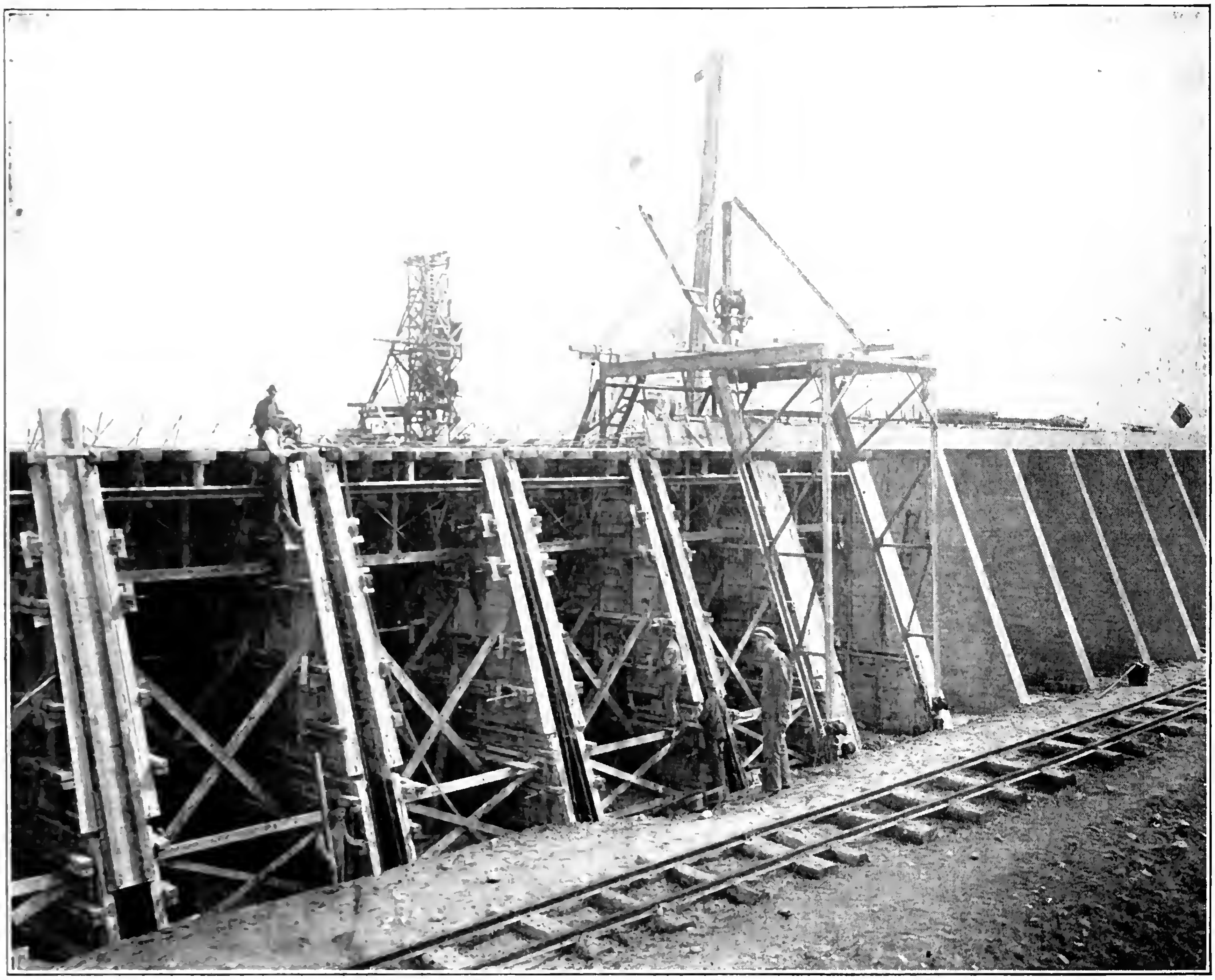
BUTTRESSED WALLS NECESSITATED COMPLEX FORM CONSTRUCTION

cement house ran the batch track to the traveling mixing plant. All batches were proportioned at the service bins and cement house in side dump cars holding each a batch.

Batch cars run to the mixing plant, which was mounted on a 16 x 22-ft. steel frame with a two-wheel truck at each corner and a wheel gage of 15 ft. From the platform rose a hoist tower, with a boom for supporting chutes. The tower bucket was charged from two 1-yd. mixers, which in turn were charged by an elevating skip into which the batch cars dumped. A 50-hp. boiler supplied steam to two hoist engines and to the mixer engines, all mounted on the steel frame.

The concrete was proportioned 1 : 2 : 4. At the beginning, empty batch cars returning from the mixer passed the cement house and there received their supplies of cement. Thence they passed under the service bins and received sand and gravel. With this method of loading, the cement stuck to the car bottom and gave trouble in dumping. To avoid this, a change was made by which the cement was added last. Trouble was then experienced from the cement blowing off the car in transit. The final change was to load first the sand, then the cement and finally the gravel. An inspector controlled the proportioning, from an elevated seat under the service bins. The measuring hoppers at the bins were like those described in *Engineering News-Record* of June 27, 1918, p. 1221. As originally planned, sand and gravel were dropped into the car simultaneously by one lever movement. When the order of loading was changed to sand first, then cement and then gravel, the hoppers had to be operated by separate levers. This was the only change found essential in the plant or the methods of handling raw materials.

The construction of the reservoir structure began with the concreting of the partition wall. First the footing was poured by direct chuting from the mixing plant running on a track parallel to the wall. When the footing was finished the mixing plant retraced its course and poured the wall proper. After the partition wall and a section of the connecting side wall at one end were completed, the mixer track was moved over a distance equal to three bays of the reservoir parallel to its first position. It was planned to complete the reservoir by repetitions of this operation. One condition which prompted this plan was that the specifications restricted chuting of concrete to a distance not exceeding 50 ft. The procedure in concreting



ROOF FORMS COLLAPSED, CARRIED AND ERECTED BY TRAVELERS

the first three bays was about as follows: The inverted groined arch floor three bays wide was poured for several days, by which time the forms for a group of columns had been erected. The mixing plant then backed up and poured the columns. It then moved ahead and resumed pouring the floor until the roof forms were in place on the columns first poured, when it ran back and poured the roof arches and such other columns as were ready. Shuttling ahead and back, the mixer proceeded until three bays across the east end of the reservoir were completed.

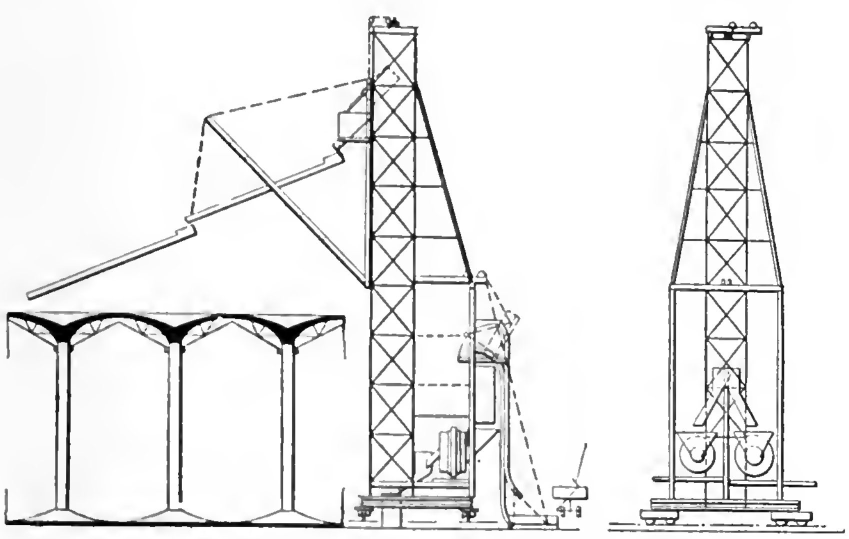
During the operations just described the contractor had been working with the material and labor market rising. A change of plan was necessary to equalize the wage and price increase. While this change was being planned, the mixer was set to concreting the wall footings all around the reservoir, and it had completed this work when cold weather set in.

Too frequent shifts of the traveling mixing plant to place a small yardage of concrete was the fault of the first plan of operation. Not only did the plant have to go ahead and back up several times to concrete the floor, columns and roof for a three-bay zone, but it had to be shifted sidewise, track and all, every 48 ft. During the winter the contractor sought by careful cost analysis a means of overcoming the fault. The outcome was a decision to place a permanent mixer track just west of the north and south middle line of the reservoir, and from this track to complete both halves of the concrete structure, spouting the middle 50-ft. zone and handling the concrete in buggies from mixer to forms for the remainder of the area. This plan was put into operation when work was resumed in the spring.

The procedure by the new plan was to concrete first the east half and then the west half of the reservoir. In detail, the operations were: The mixer, standing at the south end of the north and south track, poured, two rows at a time, nine rows of footings from the track east to the east wall of the reservoir. Concrete was spouted directly into the footings nearest the mixer and was wheeled in buggies on runways to the footing farther away. By the time nine rows of footings had been concreted, column forms had been erected on the two rows first poured. The mixer backed up and poured these two rows of columns, the buggy runways being supported on the column forms. Then the mixer ran ahead and poured two more rows of footings (rows 10 and 11). The form erectors then had ready roof forms on the two rows of columns first poured and also two more rows of column forms. The mixer then backed up and poured two rows of roof arches and two rows

of columns, and ran forward and poured two more rows of footings. These operations were repeated until the east half of the reservoir was concreted. Precisely the same procedure was followed in concreting the west half. By the sequence of operations followed, the concrete poured in each operation had time to set, the form erection was kept ahead of the concrete, and the mixing plant was continuously in operation. The time required to pour 24 footings was six hours; 24 columns three hours, and 24 roof arches 5½ hours. The maximum yardage poured in one day was 330 cubic yards.

The cost of placing concrete by the original method was $1.43 per cubic yard. Then the average yardage of the plant was 25 cu.yd. per day. In 1918 the plant averaged 155 cu.yd. a day. The cost is not available, but it can be stated that it has been considerably less than in 1917, notwithstanding the increased wages.



Sectional Elevation Front Elevation

TRUCK-MOUNTED MIXING PLANT FACILITATED ZONE CONCRETING

When work was started in 1917 wages were on a 25c. per hour basis. In 1918 work began with an increase to 30c., then to 35c. and finally to 40c. Labor difficulties were not lacking. During the height of operations 175 men were required, but a two weeks' payroll had 527 names entered.

Form handling by means of travelers was employed whenever practicable. In building the partition wall timber sections 12 ft. long and the full height of the wall, 21 to 23 ft., were supported and moved by steel frame travelers which straddled the wall. Forms were set up for a 50-ft. wall section at a time, and a 50-ft. section of 150 cu.yd. was poured in six hours. This did not include footing, which was concreted in a separate operation at the rate of 25 cu.yd. per hour, or a 50-ft. section in eight hours. Side walls were concreted in step with the floor, roof and column construction previously described, except the footing slab, which was completed ahead of the other work. Chief interest in the side-wall concreting lies in the use of traveling forms for a complex wall design. The forms and traveler are shown by the drawings and picture. All of the forms were designed with care to economize in lumber by repeated use. Groined arch roof forms were like the wall forms handled by travelers.

The contract for the work was held by the George J. Grant Construction Co., St. Paul, Minn., which completed the concrete work Aug. 5, 1918, and the reservoir Oct. 1. The City of St. Paul furnished f.o.b. cars at the contractor's plant all cement, reinforcing steel, pipe and castings.

Fine Screens and Chlorine Meet Daytona Conditions

Ample Dilution—Chlorine Removes 80% of Bacteria — Imhoff Tanks Elsewhere More Efficient Than Screens at Daytona

By GEORGE W. SIMONS, JR.,
Sanitary Engineer, State Board of Health, Jacksonville, Fla.

PERFORMANCE studies of the Reinsch-Wurl sewage screens installed by the City of Daytona, Fla., in 1916, made by the State Board of Health, show that although the percentage of removal of suspended matter is only 7, yet fine screening, followed by chlorination, gives results at low operating cost which meet local requirements of discharge into the Halifax River. The percentage removal of solids would be higher if pumping and storage did not break up the sewage considerably.

Daytona sewage is almost wholly of domestic origin. Originally strong, it is highly diluted by ground water on its way to the screens. Ejectors at seven stations lift the sewage from half the area of the city over a ridge to the screening, disinfecting and main pumping station within the corporate limits of the city. For efficiency of pump operation, the sewage is stored in 560 ft. of 24-in. trunk sewers and in nearby laterals for some five hours, and is then fed to the screens and at the maximum capacity of the pump in operation at the time. Regulation is effected by passing the sewage through a small slot, the size of which is automatically controlled by a float designed by G. A. Main, superintendent. As the most remote sewer connection is less than 7000 ft. from the sewage-works, the sewage would be comparatively fresh were it not for the storage just mentioned. The septic action, combined with the previous agitation of the ejectors and the subsequent passagé of sewage through the regulating slot, comminutes the original solid matter to such an extent that much of it passes the screen in a finely suspended or colloidal state, as is shown by the analytical data and also by tests with Imhoff conical settling glasses.

The raw sewage, as delivered to the screen, shows

TABLE I.—VOLUMES OF SEWAGE PASSING REINSCH-WURL SCREENS AND AMOUNTS OF CHLORINE USED AT DAYTONA

Date, 1917	Start of Pump	Length of Run, Hr.	Pumpage in Gallons Per Run	Pumpage in Gallons Per Day	Chlorine Used, Lb.
Dec. 1	7:00 a.m.	1.75	146,000	......	1.5
	3:00 p.m.	2.00	166,000	......	1.0
	9:00 p.m.	1.50	125,000	437,000	1.5
Dec. 2	5:15 a.m.	1.75	146,000	......	1.0
	11:30 a.m.	1.00	83,000	......	0.5
	5:45 p.m.	1.50	125,000	......	1.5
	11:30 p.m.	1.00	83,000	437,000	1.0
Dec. 3	6:00 a.m.	1.00	83,000	......	1.0
	11:10 a.m.	2.00	166,000	......	1.0
	4:30 p.m.	1.50	125,000	......	1.5
	11:45 p.m.	1.50	125,000	499,000	1.5
Dec. 4	6:20 a.m.	1.10	97,000	......	0.5
	12:30 p.m.	2.00	166,000	......	1.5
	5:00 p.m.	1.00	83,000	......	1.0
	11:45 p.m.	1.10	97,000	433,000	1.0
Dec. 5	6:00 a.m.	1.50	125,000	......	0.5
	2:55 p.m.	2.30	195,000	......	1.5
	11:20 p.m.	2.50	208,000	528,000	2.5

upon evaporation (filter paper, etc., method) an average of 95.7 p.p.m. of suspended solids (800 lb. per 1,000,000 gal.) and 620 p.p.m. of dissolved solids—or 87% of the total solids content appears as dissolved solids or volatile matter. The same sewage showed 15 p.p.m. of nitrogen as free ammonia, 31 parts of total organic nitrogen and 142 parts of chlorine.

Sewage flow for 24 hours on May 23-24, 1917, with 335 house connections, was 280,000 gal., or 835 gal. per connection. Daily totals for Dec. 1-5, 1917, are shown by Table I. The average for these five days was 470,000 gal., or 1030 gal. a day for each of the 456 connections then in use. Some idea of the relative rates of flow during the 24 hours may be got from the records of intermittent pumping given in the table. On Dec. 6-7, when the pump was operated continuously for 24 hours, the maximum daily rate of flow was about 860,000 gal. and the minimum night rate was about 500,000 gal. All these records fall outside the winter tourist season and in comparatively dry weather, although there was rain on Dec. 5-6 and again on Dec. 6-7. The ordinary night flow is apparently ground water, at a rate of 100,000 gal. or more a day. This dilution increases the volume of sewage to be pumped and treated, and it affects the operation of the screen.

The Screen and What it Accomplishes

The sewage screen is of the usual Reinsch-Wurl overhung type, 8 ft. in diameter, with 5/64 x 2-in. tapered rectangular slots. The screen is driven by a belt at a rate of approximately 0.5 r.p.m. The rotating brushes move around the vertical axis of the brush shaft at a speed of 7.5 r.p.m. and revolve around their own axis at a speed of 37.5 r.p.m. The screen is placed in a pit at the pump station, receiving the gravity flow from the trunk sewer.

According to the specifications, "the screen will be required to remove from the sewage all solids sedimentable and nonsedimentable above 0.10 in. in diameter." The screen does this, but for reasons already stated a large part of this suspended matter passes the screen, the average suspended solids content of the screened sewage being 88.6 p.p.m., or 740 lb. per 1000 gal. On Dec. 6, 1917, an increase appeared in the composite samples representing the sewage flow from 5 to 11 p.m., sample collections being made every 15 min. Increases are not of regular occurrence, as decided reductions have also been made, as on Dec. 5, 1917. At this time composite samples representing the flow from 2:55 to 5:15 p.m., collected at 5-min. intervals, indicated a decided reduction.

The removal of screenings is the one real criterion by which to measure screen performance. During the pumping period, 2:55-5:16 p.m. Dec. 5, 3.67 cu.ft. of wet screenings were collected from 195,000 gal. of sewage, representing a removal of 18.8 cu.ft. or approximately 1080 lb. per 1,000,000 gal. From the pumpage started at 11:20 p.m. on Dec. 5 and continuing for 2.5 hours and again resumed at 6 a.m. Dec. 6 and continuing for an hour, 15.3 cu.ft. of wet screenings were collected per 1,000,000 gal. of sewage, representing the night flow. During these two periods a total of 291,000 gal. of sewage were pumped; 208,000 gal. from 11:20 p.m. to 1:50 a.m. following a heavy downpour of rain, and 83,000 gal. between 6 and 7 a.m. The influence of the rainfall can here be noted. The combined removal of wet screenings during the two periods representing the night flow was considerably less than during the period preceding, when there was no rainfall. The reduction of screenings following a heavy rain is made still more apparent in the following paragraph.

TABLE II.—COMPARISON OF SUSPENDED MATTER REMOVED BY IMHOFF TANKS AND R-W SCREENS

Raw Sewage, p.p.m.	Treated Sewage, p.p.m.	Percentage Removal	Place	Method
170.0	48.0	72	Eustis	Tanks
116.0	35.0	70	Mulberry	Tanks
201.0	85.0	58	Tampa	Tanks
95.7	88.6	7	Daytona	Screen

To get results with the screen operating continuously, a 24-hour test was instituted 11:36 a.m., Dec. 6, 1917. All sewage passing the screen was carefully gaged and samples were collected at frequent intervals. During this 24-hour run a heavy rain occurred which affected the flow curve decidedly, and 446,000 gal. of sewage passed the screen. From this total sewage flow only 4.7 cu.ft. of wet screenings were collected, representing about 10 cu.ft. per 1,000,000 gal. These wet screenings weighed 271 lb., or 608 lb. per 1,000,000 gal. of sewage. Unfortunately, no apparatus was available for making moisture determinations of the screenings. The screened sewage showed an average of 88.6 p.p.m. suspended solids, or 740 lb. per 1,000,000 gal. of dry matter.

As the sewage flows upon the screen the degree of comminution is easily noticeable, and the finely divided appearance of the screenings gives additional evidence of the disintegrating action. The sewage after screening is very turbid, high in suspended solids, but free of large particles which would have a tendency to float, despoiling banks and flats, and of a quality suitable for disposal into ample dilution water.

The wet screenings, which average 14.5 cu.ft. (2½ cans) a week are removed from the screen station to a dumping ground a mile west of the city limit by a negro who is paid 37½c. a can for this work.

Chlorination to Protect Oyster Beds

Chlorine is used to protect the oyster beds in the vicinity of the sewer outfall into the Halifax River. When the plant was first started the chlorine was supplied to the sewage, previous to the screening, at a rate of 20 lb. per 1,000,000 gal. of sewage treated. During the spring of 1917 the point of chlorine application was changed so that the greater part of the disinfectant was admitted to the chamber under the screen, a small portion still being admitted to the upper side of the screen. Bacteriological determinations made under the original plan (chlorine applied previous to screening) indicated a 75% reduction of all bacteria and a 90% removal of the colon type. At the present time, with the chlorine cut down to 5 lb. per 1,000,000 gal., there is an 80% removal of all bacteria.

For the year 1917 the cost of screen operation, including labor for removing and burying screenings and for other purposes and slight repairs, but with no allowance for power consumed, was $370. The sterilization cost for the year was $679.

Much has been said of late as to the relative merits of fine-screen and Imhoff-tank treatment. That there is a definite place for screen installations and a future

for fine screens is unquestionable, but screens will hardly replace tank treatment where refined results are necessary. Out of curiosity the writer has collected a few suspended-matter removals from Imhoff tanks in Florida, in plants treating sewage closely resembling that at Daytona. These results are shown in Table II. (See preceding page.)

With the usual Florida conditions—where fresh sewage is to be handled, quantities are small, flow is regular and ample supplies of dilution waters are available—the screen is more to be preferred than the tank because a refined treatment is not essential.

In conducting investigations at Daytona the writer has received heartiest coöperation and assistance from George A. Main, superintendent of the sewerage department.

Characteristics of War-Time Highway Work in Great Britain and the United States

War Conditions Have Been Injurious to Roads in Both Countries, and Immediate Maintenance Is Necessary—Each Has Recognized the Importance of Better Systems, Nationally Organized

This article has been prepared by an engineer who has seen the work of the United States Highway Council at close range and has also been in touch with highway work and highway control in Great Britain. A brief comment on this article will be found in the editorial pages—EDITOR.

NOW that peace is assured, it is apparent that one class of public works in need of immediate attention in this country and Great Britain is the public highway. In both countries it has been subjected to such excessive wear and inadequate maintenance, the investment in roads is already so great that the loss due to further neglect will be a serious economic matter, and it has been demonstrated that the utility of the roads during war times has so national an aspect that there, as well as here, a national system of highways is receiving serious study. Until the war laid its heavy hand on road work, the nationally economic value of main roads was looked upon in many quarters as theoretical rather than actual. The purpose of these notes is to point out how the war has nationalized road work on both sides of the Atlantic among English-speaking peoples.

Pre-War British Road Work

Before the war Great Britain had made a small step toward national roads by the creation of the Road Board. This was formed in 1910 for the purpose of assisting financially desirable improvements in the highways of the United Kingdom. The influence of this board was directed toward the widening of narrow roads, the improvement of road intersections, the strengthening of bridges and the betterment of the pavements forming the roadway. The actual amount of money granted by the board has not been large, but its influence has been marked.

When the war broke out there were 150,000 miles of roads and streets in England and Wales, of which 33,600 miles were in cities and 23,800 miles were main rural highways. The funds for the road work were provided by taxes levied by the local authorities, by loans which required the sanction of the Local Government Board and which were equivalent to American bond issues, and, to a small extent, by funds supplied by the Road Board. The funds supplied by local taxation formed most of the appropriation for road building, and were not directly subject to national control.

In Scotland there were 24,900 miles of roads and streets. Here the financial management is more local, for there is no national board to control the making of loans for road work. The Road Board exercises practically all the national influence there is upon the highways of the kingdom; it is mainly advisory and coöperative.

In Ireland there were 58,300 miles of roads and streets, under a sort of dual control by both county and district councils. Here there is a Local Government Board which must give its consent to all loans for public works, so that the local financing of road work, not carried on by direct taxation, is under central control.

British War-Time Road Control

The financial features of road work in Great Britain during the war have been little understood in the United States, and as a consequence many erroneous statements have been made. It has been frequently stated that the British expenditures for road work have greatly increased; actually, however, the total funds made available for road and street work have remained practically stationary, despite the fact that large appropriations were made by the War Department and other agencies for roads having heavy motor traffic. The local authorities have continued to raise for road work sums which would be ample for their usual programs under normal conditions, but these sums have rarely been used up, and there are considerable accumulations available for work when conditions become normal. Practically no money has been raised for road work by loans, the Local Government Board stopping such bond issues, and the funds of the Road Board have been greatly reduced.

As soon as the war began, British road building received its most severe setback by the call for experienced road engineers and road builders for service in France. Just as some of the British railways had their rolling stock, rails and ties shifted to France almost overnight, so every highway resource in men and materials was sent across the Channel to maintain the roads which it was recognized at once were essential for military success. The first call was by no means the last, and the reports of the local authorities are practically unanimous in declaring that lack of skilled labor at any price has been one of the most serious difficulties in British road work since 1914.

This is a more serious matter in Great Britain than

here, because the normal road program is based on wages for experienced road men which are extremely low from our viewpoint. This is shown by a recent report from the authorities of Derbyshire, complaining that the minimum wages have been advanced to 20s. (about $5.00) a week, and there were 157 workmen receiving 25 to 30s. Even wages so high as to be unprecedented have failed to obtain needed men, and the following quotation from the latest report of the county surveyor of Worcestershire is typical of many such statements: "While there are considerable stocks of material in certain parts of the county, they are more or less concentrated on a few roads on which it was impossible to provide the labor. In some cases the material has been deposited on the side of the road for upwards of three years, and it is unfortunate to be compelled to watch a road seriously deteriorating while material is ready at hand."

A few attempts have been made to work German prisoners on the roads, but the results do not seem to have been satisfactory. The county surveyor of the eastern part of Suffolk recently reported that he had some prisoners on road work being done at the request of the military authorities. They were paid about 1½d. an hour; some were good workers and some were slackers. The results depended to some extent upon the man in charge of them, for they were not obedient to civilian superiors, and more attention had to be paid to their oversight than was the case with free labor.

By the end of 1916 it was apparent that the war demands for stone and gravel were so great that some method of rationing such materials was needed. Accordingly, the Road Stone Control Committee, composed mainly of experienced engineers, was organized to have supervision of their production and transport. It obtained from the local authorities statements of their requirements and from the quarry and pit owners of their facilities for production, also information regarding transportation facilities. Then the material needed for essential war-time road work was allocated, and the remaining needs were met in what seemed to the committee the most fair manner.

Complaints Against Restrictions

There has been some complaint about the restrictions placed upon local officials, but such complaints arise in times of peace as well as under the stress of war. One of the chief complaints has been that the committee forced some authorities to employ local stone, inferior to that previously used and brought from a distance, but the war-time demands for the superior stone and the limited transportation facilities in Great Britain during the war are held to justify such rulings. When the committee first exercised its authority producers of these materials were quite generally able to supply large quantities of them, and there was much criticism that prohibition of shipment was in some cases an unwarranted and arbitrary exercise of power. As time went by, it was discovered that such shipments would have been useless, because the labor for using the materials was not available, and those accumulating in stock were used elsewhere to immediate advantage. In other words, the comprehensive knowledge of the needs of the country which the committee possessed enabled it to foresee conditions better than the local authorities could.

The supply of tar for road work was also curtailed in 1917. In September, the Minister of Munitions directed that no crude or dehydrated tar should be used for the purpose, without a permit. The Explosives Department of the Ministry of Munitions allocated 52,000,000 Imp.gal. for 1918 road work, and entrusted its distribution to the Road Board. This quantity was later reduced to 47,000,000 Imp.gal., and the specifications were changed to allow a somewhat greater percentage of oils in the tar. This material has been used only on roads of national importance. As a matter of fact, the scarcity of labor in some districts has been so great that even had more tar been available it could not have been used satisfactorily. Attempts have been made to use women in tarring roads, but with only fair success.

War-Time Road Work Under Direct Control of Road Board

Strictly war-time road work has been under the control of the Road Board, to which the Army Council early delegated the following duties: (a) Arranging and supervising the construction and maintenance of new roads, and the improvement of certain private roads in several districts for military purposes; (b) arranging with local authorities for improvements on public roads, mainly at the cost of the Army Council, required for military purposes; (c) settlement with the local authorities for the Army Council of damages due to extraordinary traffic for military purposes; (d) similar duties for the Admiralty, the Ministry of Munitions, the Timber Supply Department of the Board of Trade, and for the Air Ministry. About $22,000,000 have been spent on such work since the beginning of the war; about three-fourths of this sum has been spent for the War Department.

The common belief in the United States that the British Government repairs all damage it does to roads, or pays for such repairs, is entirely wrong. The principle on which payment is made can be stated by quoting as follows from a recent report of the county surveyor of Nottinghamshire: "The damage done to the roads by the timber traffic has been considerable. Up to the present no satisfactory scheme has been inaugurated whereby the liability for the damage can be fixed on the responsible parties. Ninety-five per cent. of the timber is for national purposes, but the Treasury has so far declined to accept the responsibility for making good damaged roads, except those damaged by conveying timber on behalf of a direct Government department, it being left for highway authorities to take proceedings on the ground of extraordinary traffic against the person by or in consequence of whose order the traffic has been carried on." As such proceedings are very expensive, the local authorities are reluctant to begin them, for even if they are successful, the cost of obtaining an award will be so great that the net return is likely to be inconsiderable.

On account of the shortage of materials and labor during the war, most of the work done on the roads of Great Britain has been performed on main routes. The

impetus given to reconstruction and effective maintenance by the Road Board for a number of years prior to 1914 put the highways generally in good condition for any ordinary service. The county surveyor of Nottinghamshire reported a few months ago that the main roads under his care were in a very satisfactory condition, considering the general condition of public works.

In Aberdeenshire, where only one-third of the normal number of men can be obtained, the official report for the last fiscal year calls the road conditions very fair. In Essex, the roads have of late been kept in fair condition with the greatest difficulty only. There "efficient labor has been greatly reduced, whilst team labor in the ordinary sense has almost ceased to exist." In Kent and Worcestershire, the main roads have been maintained in fair condition, but they will soon need reconstruction. In Northamptonshire, a recent report states, the shortage of labor and materials has made maintenance very difficult, and extensive reconstruction necessary as soon as possible. In Gloucestershire, the conditions of labor, materials and traffic were such that it has been impracticable even to maintain some of the main roads, and highway conditions there are very poor.

If the occasion demanded, it would be possible to give many similar comments from comparatively recent reports of local engineering officials, regarding the British situation. It is unnecessary to do so, however, for these conditions have been summed up by the Road Board substantially as follows:

There is an urgent demand for the reconstruction of important roads to fit them for modern traffic. When the war is over a great number of motor trucks will be released for business uses. Roads must be built for the legitimate use of such trucks, but it should be stated here that there is the same complaint in Great Britain as in the United States about the reckless use of heavy trucks by military drivers. One county surveyor recently commented bitterly on the "unnecessary damage to road surfaces through the excessive speed at which Army motor lorries are driven, both empty and loaded." Another stated lately that where excessive damage has resulted from military and timber traffic, it has been almost entirely due to driving heavy vehicles in the same tracks without endeavoring to break wheel gage. There are strong indications that while heavy truck traffic will be planned for in Great Britain, the regulation of this traffic will be strict, and the taxpayers will have their investment in roads protected against the needless destruction caused by high speed and careless operation of vehicles.

Many Roads Must Be Reconstructed

It has been estimated by the board that about 15,000 miles of English and Welsh roads must be reconstructed for the traffic they will have to carry shortly. It is out of the question for local authorities to raise the money needed for this work and also for the other public improvements which are essential. The cost is estimated by the board at about $150,000,000. It is justified, the board states, by the fact that unless the main roads referred to are reconstructed to carry heavy traffic, as they become worn out, the annual cost of their repair and maintenance, as now built, will be greater than the total annual cost of suitable highways. This reconstruction of main roads is by no means all of the necessary expense at an early date in order to repair war-time neglect and place the roads in suitable condition for the traffic. About $6,500,000 must be spent on new roads and on widening old highways, and about $35,000,000 must be spent on bridge work in order to make the roads useful for the heavy vehicles which present structures are unable to carry. The total expenditure needed in Scotland is estimated at about $15,000,000. The same need of providing large sums for road improvements does not exist in Ireland, according to the Road Board, because the large volume of heavy traffic which has caused such destruction in Great Britain has not existed in Ireland.

American War-Time Road Work

It will not be possible to give any good summary of the effect of the war on roads in the United States until the state and municipal authorities make public the information concerning the work they would certainly have undertaken if not stopped by one cause or another incident to the war conditions. In a general way, however, anybody who has kept in touch with the road work here and in Great Britain has seen for some time one great similarity—namely, that the local officials agreed that the severe restrictions placed on their activities by the national authorities were marked by an excessive zeal in opposing local improvements. Probably this is perfectly natural, for the persons ordered to check construction in specified lines must inevitably be unpopular with those whose activities are hindered, no matter how carefully they may endeavor to minimize the hardships of the regulations.

The first war-time trouble in road building in this country was due to car shortage, just as it was in Great Britain. The difficulty was much greater here than there, however, because so much more road material is moved by cars here, and our coal situation was so much more acute than that in Great Britain. When the Government Commissioner of Priorities issued his order forbidding the shipment of road materials in open-top cars, except under special conditions, the bottom was knocked out of road work until arrangements were made for hauling such materials when empty cars were moving in the direction of the mines. This was a material help. A little later the demands for fuel oil became so great, and the prospect of still heavier demands was so good, that the Fuel Administration put its ban on the use of bituminous road materials. By this time it was apparent that some step had to be taken to enable important road work to proceed and to distribute the available road materials where most needed and where transportation could be provided. Accordingly, the late L. W. Page, director of the Bureau of Public Roads, suggested the formation of a committee representing all the Government agencies interested in any way in road materials and transportation, for the purpose of unifying all regulatory supervision of road and street construction and maintenance. The Secretary of Agriculture approved this plan and invited the Railroad Administration, the Fuel Administration, the War Industries Board, and the War Department to join with the Department of Agriculture

in the formation of a committee which would practically control road and street work through the control exercised by the departments and agencies named. The United States Highways Council formed in this way later had the coöperation of the Department of Labor and the Capital Issues Committee, and, as a consequence, was able to assist materially in overcoming situations similar to those which had previously led to the drastic orders of the Railroad Administration and the Fuel Administration, to which reference has already been made. If the work of the council has seemed oppressive at times, the conditions prior to its formation should be the criterion and not pre-war conditions.

Coöperation Given by State Highway Departments

The work of the United States Highways Council was only made possible by the coöperation of many of the state highway departments. All requests for materials had to be approved by the highway departments of the states concerned before they were considered by the council. Some of the state departments exercised great care in examining applications, and their recommendations were of the greatest help, it is understood. Even in such cases, however, war-time demands for materials or transportation made it impossible for some of the departments and agencies to furnish the assistance desired, and the applications had to be denied. Other state departments did not have the facilities for making such complete investigations, and as it was physically and financially impracticable for the council to investigate every application through the resources at its command, many of the applications were doubtless delayed seriously by the correspondence necessary to establish the facts.

The outstanding facts concerning the work of the council seem to be these: Before it was established, road construction and maintenance were in a fair way to be stopped. As soon as it was established, the conditions under which road materials and transportation could be furnished were explained, and the state highway departments were not only notified, but were asked to coöperate by passing upon all projects in the light of the conditions outlined by the council. This was in line with the action of the Road Stone Control Committee in Great Britain. In both countries the central authority apparently desired to utilize the knowledge and resources of the local authorities to the utmost. The coöperative idea was carried much farther here than in Great Britain, however, and it is believed that, when the extent of the countries, the mileage of roads and streets and the quantities of materials are taken into account, the results here are at least as good as those in Great Britain.

No data concerning the operations of the council have been given out by that body, but in a general way it is known that of the materials approved by the state highway departments the council was also to supply about 85% of the bituminous materials, over half of the cement, about the same proportion of brick, about three-fourths of the crushed stone and about two-thirds of the gravel. Steel was practically beyond the reach of the council, for the other war committees required all of it for war purposes.

The reasons for declining to furnish materials approved by the state departments have been quite varied. In the Southeastern states the transportation situation has been so difficult that it was necessary, speaking generally, to restrict the quantities of materials brought into that section to a minimum, and to stop all freight movements not essential. The fuel shortage operated to restrict the output of cement and brick below the quantities which the producers were able and willing to supply, if permitted to do so. The threatened shortage in fuel oil made it necessary to exercise, over some grades of bituminous road materials, control which would otherwise have been unnecessary. Transportation difficulties existed in some of the Central states which interfered somewhat, in all probability, with the delivery of materials allocated by the council, although the Railroad Administration did all it could to furnish transportation, for road materials, granted by the council. That body has stated the reasons for its actions in individual cases without any attempt at concealment, but it could not lay down detailed rules governing the allocation of materials, because the conditions varied from time to time and from place to place. All it could do was to give every possible help to essential road projects approved by the state highway departments, at the time these applications were received.

The roads of the country have suffered from lack of maintenance, but that is a chronic condition in the United States. It is open to debate whether maintenance would have been done any better throughout the country, as a whole, if there had been no war conditions. The most serious result has been the ruin of many miles of roads by heavy military trucks, just as in Great Britain. Neither country has produced any effective measure of diminishing such destruction by control of speed and careless driving, and very little attention has been paid to overloading.

Selection of National Highways

In this country, as in Great Britain, the war has shown that some roads are a military necessity—which is synonymous with national necessity. It has shown that where railways are congested and good highways are available the latter are a decided help in moving freight, particularly fast freight. But it is apparent in both countries that the cost of building roads for heavy trucks operated at high speed is so great that no balance sheet of the cost of motor trucking which does not include an item for roadbed—just as the cost sheet of railway transportation includes such an item—is complete, and it may be so incomplete as to be misleading. The experience in this country indicates that one of the most difficult things to define is a "road of national importance," and while there is an evident tendency in both countries toward national highways, the war has done little to help along the determination of those roads whose construction and maintenance are so widely useful that they are plainly of national rather than state importance. The war over there and its influence over here have shown that railways, waterways and highways form a complete transportation system that can only be successfully studied in a broad way, free from economic errors, when studied collectively, before its parts are taken for detailed investigation.

Earthquake Wave-Action in Guatemala

WAVE action of the earthquakes in Guatemala last winter is shown effectively by the effects on an old masonary aqueduct near Guatemala City, according to Lee F. Whitbeck, chief engineer of the International Railways of Central America, who has sent the accompanying view.

He states that at a high arch, illustrated in *Engineering News-Record* of Oct. 3, p. 624, the fallen keystone-shaped block of heavy masonry lies directly under its

WAVE ACTION OF EARTHQUAKE RUPTURES COVERED AQUEDUCT AT REGULAR INTERVALS

former position in the arch, indicating that the wave distance coincided very nearly with the distance between the pillars. Under the wave action the spandrel walls evidently puled apart, allowing the central block of masonry to fall, and then closed. This occurred in a succession of arch spans. The wave distance is clearly marked in the accompanying view of the covered aqueduct, where this action caused the arched roof to "pop out" at regular intervals.

How Soldiers Were Quartered and Fed in the Spruce Production Camps

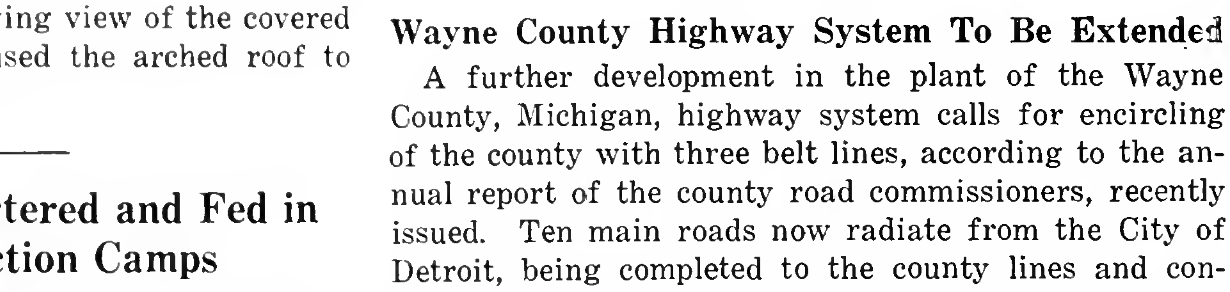
ALTHOUGH there were many phases of the soldier's life in the Northwest woods, under the direction of the Spruce Production Division, which were unlike that at military encampments, yet the camp sanitary regulations were on a strictly military basis and were rigidly enforced. A great contrast to the usual woods camp was presented by the appearance of those camps in which soldier labor was quartered. Typical of these was Camp I-H at Raymond, Wash., the layout of which is shown in the accompanying drawing. The plan shown was the standard arrangement for camps of 100 men. While the men were in fact "under canvas," yet all the tents had wooden floors and wooden wainscoting 3 ft. high, with a wood frame structure over which the tent was stretched. A striking feature of the camp was the scrupulously clean condition of all quarters inside and out, and the strict regulations concerning all sanitary measures. In the mess hall the boards in the table tops and bench seats were loose and were removed and scrubbed daily. Hot and cold water was always available in the bath tent, a feature of the camp that was very popular. The quarters were kept clean and in order by the men themselves. The beds were made, floors swept, clothes hung up, Army shoes shined, blankets aired twice per week, and the sides of tents raised or furled when the weather permitted. The sleeping quarters were inspected daily by both the commander and the doctor of the company.

The regulations of the Food Administration were strictly observed, and meals were served by the contractor on a cost-plus-10% basis. The quality seemed to be very satisfactory to the men. The quantity of foodstuffs and the actual costs of meals served in several of the camps, during August, 1918, are given in the following table:

AMOUNT AND COST OF FOOD SERVED AT THE ARMY LABOR CAMPS OF THE SPRUCE PRODUCTION DIVISION

Camp	Sugar Per 90 Meals (Standard 6 Lb.), Lb.	White Flour Per 90 Meals (Standard 23 Lb.), Lb.	Total Food per Meal (Standard 2.2 Lb.), Lb.	Number of Meals	Cost per Meal
I-A	4.00	7.03	1.404	14,526	$0.24
I-CH	10.76	14.34	2.984	7,690	.485
I-D	6.18	11.88	2.191	8,514	.374
I-E	6.01	11.33	2.047	3,549	.3374
I-F	3.05	14.00	2.086	5,994	.413
I-G	4.03	15.00	1.820	9,642	.339
Averages,	5.67	12.26	2.088	49,915(total)	$0.3647

These figures were supplied by G. W. Gauntlett, district supervisor for the Warren Spruce Co., at Raymond, Wash., in which district these camps were located.



TYPICAL LAYOUT FOR SOLDIER-LABOR CAMP FOR 100 MEN

Wayne County Highway System To Be Extended

A further development in the plant of the Wayne County, Michigan, highway system calls for encircling of the county with three belt lines, according to the annual report of the county road commissioners, recently issued. Ten main roads now radiate from the City of Detroit, being completed to the county lines and connected up to most of the villages and cities. The outer belt will be finished this fall, and a start has been made on both the middle and inner belts. These belts will enable traffic to get out of Detroit on any main road and return by any other main road, as desired.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

How Raise Status and Pay of Engineers?

Sir—In engineering magazines there is much discussion as to the status and pay of engineers. Not very long ago, while reading a scholarly article along these lines by an engineer of prominence, the writer could not dismiss from his thoughts an experience with the organization of which this same engineer was the chief engineer, in which his indisputable rights received no consideration. This article strengthened the opinion—which had gradually grown to be a conviction—that the average engineer working for a salary has the employer-engineer and those in the higher positions to thank for most of his blessings in the shape of remuneration and resultant standing in the community in which he lives.

The employer-engineer fixes the salary, and to a certain extent controls living conditions. No complaint has ever been heard that he fixes the salary too high, or makes conditions too livable. His main idea seems to be to make low cost records. On large projects no other item contributes so little to the total cost as engineering. Still, in these times, when skilled and unskilled labor is getting two or three times its normal pay, we find some lines of engineering working on practically the same basis as in pre-war times.

Evidently, there will be no relief from this state of affairs until we have an association to look after our own interests. Whether it will be necessary to form a new one or reshape an existing one is the question. Such an association could adopt a minimum scale of salaries for all grades; that is, in civil engineering for rodmen, instrument men, assistant engineers, etc., in the various branches; for city engineers in cities of various sizes, etc., and similarly in other lines of engineering. The engineer or employer who violated this scale could be blacklisted. In a short time the rank and file of engineers, seeing the advantages of such an association, would come into the fold. This may smack too much of unionism to some engineers, but through such an association only, in my opinion, can results be obtained.

Some months ago, in a small city, the seven physicians by mutual agreement doubled all of their fees. Suppose the engineers of that city had done the same, what would have been the result? They probably would have starved, for the services of others from outside could undoubtedly have been obtained at the old rates. Not so with the physicians. Another would not think of coming in and cutting under the new scale established.

Did the physicians' standing in this community suffer? Not that the writer is aware of. The prosperity of a person has much to do with his standing in the community in which he lives. In all probability—other things being equal—the physician with the smallest practice in a big city has a better standing than the city engineer who, acting singly, probably could not get a penny's increase in salary.

These observations are made by an engineer who for twenty years has been of the opinion that hard, earnest work is the all-important thing, and that salary, conditions, etc., will take care of themselves. Twenty years' experience has made him "a sadder but wiser man," and has led him to the conclusion that only through an organization similar to the one suggested above can the rank and file of engineers get results.

SUBSCRIBER.

Sir—"Questioner," in your issue of Dec. 5, p. 1042, states that "following the signing of the armistice he lost a position paying $350 a month." On the same page there is also a letter from V. S. Lawrence on the wage question.

While perhaps but little consolation to these writers, an article in the Sunday papers entitled "Grindstone Jennie," by Christine McKenzie, is *apropos*. The gist of the article is this: Mrs. Hanch is a pretty widow, 24 years old and she has one child. A few months ago she was earning $2 a day as checker in the Submarine Boat Corporation shipyard's (Newark Bay) commissary. She was transferred to a machine shop and her pay jumped from $2 to $8 a day. It took her about two hours to master her new job, earning $48 per week.

This is in striking contrast to $35 a month received by a leveler on a line now owned by the Baltimore & Ohio R.R., with $15 added for board; and $65 a month paid the resident engineers on a line now controlled by the New York Central R.R. Many other instances can be given which would place the engineering profession in very unfavorable light.

I have read Dr. Charles R. Mann's report very carefully, and, in the vernacular of the day, "What's the idea?"—spending years in a college to imbibe knowledge which will yield but a small remuneration, when two hours' practice in a shipyard will bring in $8 per day?

I have been a member of the American Society of Civil Engineers for 30 years, and my membership has never been a financial advantage to me. As you plainly say on page 1057 of your issue of Dec. 12, the main object of engineering societies is "the reading of voluminous papers." I recall one of 350 or more pages that could be compressed into 35. E. N. GINEER.

"No Place."

Proposes National System of Trails

Sir—The pedestrian has been driven from our roads by motor traffic, but, as he is still on earth, he is entitled to some consideration.

The tendency in locating and relocating roads is to take care of a heavy commercial traffic, so that roads begin to assume more and more the utilitarian aspect of the railroads. The problem, even in scenic areas, of locating a road that combines utility and scenery is almost hopeless. It has, however, been done in a few places, such as the Columbia River Highway.

The writer, as the locating engineer for the state highway through the Snoqualmie Pass in 1913 (Cascade Mountains, State of Washington), gave this phase of

the locating problem special study, but with only moderate success; the prettiest places were not touched by the road. Construction of trails through the country and mountains will accomplish this end. These trails should follow certain uniform lines. The right-of-way should be 30 ft. wide. In the matter of grade and curvature, there should be anything up to 10% grades, and curves with a maximum radius of 60 feet.

In the United States, as in all countries, the wealthy have acquired the best places both in the mountains and along the coast, so that an American cannot see his own country except by permission of private property owners. Now, although a man can rightly object to having his estate cut up by a road, he could not make the same objection to the construction of a trail. On the trails, no motor-propelled vehicle or motor cycle should be allowed, and no livestock should be driven over it. The surfaced portion of the trail should be 10 ft. wide—this will enable troops to march in column of squads. These trails would have a great value in the training and maneuvering of infantry, and would be used by the Boy Scouts on their hikes. Trails would run through all the cities and towns.

Every state highway department should have a trail department, so that the work of location, construction and maintenance could be kept separate from that of the roads. It is probable that county engineers would separate their work into road and trail work. By designating a project, for instance as the "Sunset Trail," it would be easy to distinguish between it and the "Sunset Highway," although in naming trails duplication of names should be avoided.

The question of bridges would call for a large variety of treatment. The conditions, as between the mountains and the seashore, would be too variable to permit of the laying down of hard and fast rules. It would add to the military value of a trail situated in a strategic area if all structures were designed to carry a 10-ton road roller.

"See America First" is a good slogan for all Americans, but America cannot be seen until we have built at least 100,000 miles of trails.

Renton, Wash. FRANK W. HARRIS,
Captain, Civil Engineer, United States Army.

Concrete-Base Track For Bridges

Sir—Your editorial of Dec. 12 on concrete-base track and the illustrated article on a 2000-ft. stretch of permanent way of this character on the Northern Pacific R.R., as well as the article on waterproofed floors for railroad crossings over streets, by H. T. Welty, recall testimony given by me in 1917 on behalf of the City of Elizabeth before the Board of Public Utility Commissioners of New Jersey, advocating the use of such concrete-base track for bridges, referring to the low maintenance costs in the subways and elsewhere for such permanent way, and giving also some new designs for concrete bridge floors and other trough sections for ballasted floors.

I introduced here four types of thin floor construction, keeping to about 3 ft. thickness from the underclearance line to the top of the rail (my records are in New York), designed in connection with the problems of eliminating grade crossings on the Central R.R. of New Jersey, where headroom over city streets was very limited, and in new alignment and changes for six tracks of the Pennsylvania Railroad through Elizabeth. The crossing of 12 tracks at two levels over Broad St. made a very interesting problem, one street approach being on sharp curve and at a grade of over 7%, dipping under the intersection of the two railroads to a sinkhole which could not be drained by gravity. The upper railroad was at its summit, with falling grades in both directions.

In making these designs to meet such requirements for thin floors, I began with the old Thompson trough floor which my chief installed on the Park Avenue viaduct in the early nineties, when I was assistant engineer on this work, and followed other practice of record and in evidence within my experience about New York. Mr. Welty has the benefit of all the experience in better designs used on the New York Central R.R. since then, and gives valuable information concerning his several types which may be adapted to the various requirements of the railroad engineer.

In the testimony we brought out at the grade-crossing elimination proceedings to which reference has been made, it was shown that waterproofing materials generally used were not flexible or sufficiently elastic, especially, as Mr. Welty says, at the junction with main girders and attachments of least deflection, and a good type of waterproof thin floor was not in evidence.

Philadelphia, Penn. R. W. CREUZBAUR,
Emergency Fleet Corporation.

Discussion Has Failed to Reach Bottom of Highway-Truck Problem

Sir—In the many discussions of the "motor truck vs. highway" problem that have appeared in print during the past few months, there has been, I believe, an almost unanimous failure to get far enough back into the economics of the proposition. The question that is now vexing highway engineers the country over is, like all other questions, based on certain propositions that have been either firmly established or long recognized as axioms. Starting from these basic propositions, one should be able, by logical steps, to answer beyond the shadow of a doubt two very important questions: First, "Has the motor truck an economic right to exist?" and, second, "Is there a definite relation between the capacity of the truck and the cost of the road and has this relation, in common with other relations, one point that is economically to be preferred?"

Considerable compilation and collaboration will be necessary to answer finally the questions stated above, but the logic that is involved in the answering may be outlined. The questions are of such broad import that there is neither justice nor wisdom in putting the whole thing up to the highway engineer. They are questions for the whole engineering profession to solve, and that solution must be found soon. But let us state the facts that have been overlooked, apparently, in the discussions to date.

As an opening statement on which all can agree, we can reënunciate the old statement—long established but often disregarded through oversight or design—that

"it is the ultimate consumer that pays the bill." This expression has been bandied about until it has become almost if not quite hackneyed, and yet it is deliberately ignored in even the most elaborate estimates of the cost of motor transportation. In the most reliable of the estimates—those based on actual performance—we shall find entering into the ton-mile costs all items relating to the truck itself—interest, depreciation, repairs, taxes, insurance and operation. In how many of them shall we find the fact recognized that money spent on roads for interest, depreciation or repairs should also enter into the estimate? What would happen to the privately owned railroad if it forgot, when fixing its freight rate, to include the cost of building and maintaining its roadbed, bridges and tracks?

When a merchant receives a consignment of goods by freight, he pays for such transportation service a definite amount—an amount which includes the whole cost of bringing the goods to him. This amount he adds to his other costs, in fixing the price to be paid him by the consumer for the goods. If the goods are transported by motor truck instead of by rail, the cost of part of the transportation service—building and maintaining the road, the track on which the truck operates—is not included in the price paid by the consumer for the goods. This cost is paid, however, by the consumer in the shape of a state or Federal tax for highway purposes. Because of our more or less invisible system of taxation, it is impossible to attack the problem from this end—that is, we cannot determine the actual cost to the consumer of any article in which such an item as a road tax enters. The true cost of transporting goods by trucks can be established, however, but before proceeding to outline the procedure let us point out once more that "the consumer pays the bill" either as a higher rate to the railroad or as a tax to the state.

In order to establish the true transportation charge on material carried by trucks, we must include part of the cost of building and maintaining the road. Here begins the argument between the highway builder and the truck manufacturer. What part of this cost shall be included? Opinions, more or less biased, may be uncovered, varying all the way from all to none. A position at either extreme of the discussion is untenable.

Disregarding the truck, roads are still of prime importance and still cost money. It is comparatively a simple matter to determine what a road will cost, both for building and for maintaining, to meet successfully any class or concentration of traffic. It is possible to build a road over which we could transport the Rockies, a mountain at a time, and such a road would be not a question of skill but merely of money. We can therefore determine the difference in cost of building and maintaining a road designed for any class of traffic, and a road designed for any other class of traffic. The calculations may be complicated, but they can be made. With these differences in cost, we are in a position to determine the true transportation charge over a road per ton-mile by trucks of various sizes.

As long as this ton-mile cost is lower than the corresponding freight rate, the truck is an economic factor in life and has a right to consideration, and the truck that would make this figure a minimum is the truck to use, whether its capacity be a hundredweight or a hundred tons. With highways designed for such a truck, it remains for legislation to provide for the proper use of the highways.

It may be objected that the solution is easy to point out but hard to find. That is true, but it is not a problem for one man or for one group of men to solve. We all know the story of the bird that, having found a hole in the roof of a deserted house, tried to fill the house with acorns—how he worked and worked and finally gave it up with the idea that it could not be done. It could have been done, nevertheless, but not by one poor little bird. Just so this proposition calls for the united experience of truck makers and users the country over, even involving the value of different designs in truck construction. It calls for the clearest thought of engineers and financiers and, since it touches the pocket book of every person that pays taxes—and who of us does not?—it is a legitimate subject for Governmental consideration.

W. EARL WELLER,
City Engineer.
Binghamton, N. Y.

Lehigh Valley Dredging Chart Used As Standard for Records

Sir—Referring to the graphic dredging chart shown in your issue of Dec. 12, p. 1070, furnished by G. T. Hand, chief engineer of the Lehigh Valley R.R.: I was allowed to make a few suggestions in this scheme for showing at a glance performances and hold-backs in the work of this suction dredge, operating for the Emergency Fleet Corporation.

Last spring the Fleet Corporation was seriously in need of a third dredge to clean up the turning basin at the Newark Bay shipyard. Partly for patriotic reasons an unnamed 20-in. hydraulic dredge, which we called the "Lehigh," was put to work for the Fleet Corporation on a low flat rental basis. It gave, as partly shown in this chart, an output as high as 970 cu.ft. per hour on a 3200-ft. discharge. This was generally light material, silt, including some shell and hard material.

The work of this dredge was frequently interrupted by the breaking of the line across the Port Newark channel, where we had made an arrangement with the quartermaster's department for quick opening, but in spite of this device the percentage of channel openings ran from 20% to 28% of the total time, increasing costs; notwithstanding this, the clean-up was entirely satisfactory as to cost.

On getting this diagram from Mr. Hand last spring I took the liberty of using it as standard for dredging records in the several shipyards coming under my control.

R. W. CREUZBAUR,
Emergency Fleet Corporation.
Philadelphia, Penn.

Air Currents or Lorelei?

Sir—A queer sort of phenomenon has been occurring at Huntington Lake, the reservoir for the power houses of the Southern California Edison Co., at Big Creek, Cal. This takes the form of a shrill sound which travels, quite regularly, from one end of the lake to the other, very rapidly, and at an altitude of about 200 ft., apparently, above the surface of the water.

Huntington Lake is in the heart of the San Joaquin high Sierras, about 75 miles northeast of Fresno. The lake is about 4½ miles long and one-half to three-quarters of a mile wide, and extends northeast and southwest. The water in the lake is impounded by three large arched concrete dams, the tops of which are at El. 6950 ft. above sea level. These dams were raised from El. 6915 during the summer of 1917.

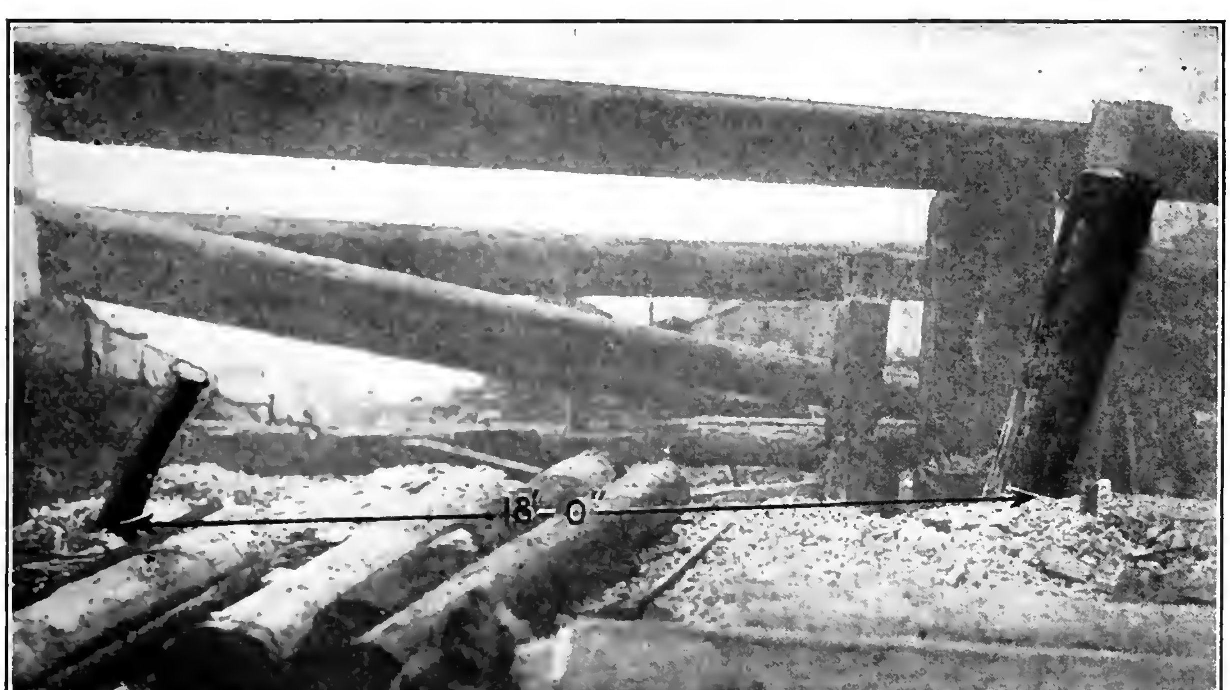
The sound in question was never heard before the spring and summer of the past year, 1918, and it is wondered whether or not the raising of the dams would so affect the action of air currents as to produce a noise which resembles the whir of the propeller of an airplane. The sound occurred regularly during the spring and summer months at 10 a.m. daily, starting in at the south end and traveling to the other end and back in 10 sec. Since the colder weather began in October the visitations have become irregular and less frequent, although they still occur at 10 a.m.

There is no construction work in progress that would produce an echo, and the only explanation advanced so far is that conflicting air currents may produce the sound. Some of the readers of *Engineering News-Record* may be able to corroborate this or offer another explanation. D. H. Redinger.

Big Creek, Cal.

Driven Pile Point Comes Out of Ground

Sir—In driving a wood pile at Pearl Harbor, Hawaii, some time ago, the shaft took a most curious path. As shown in the accompanying view, the point came up vertically through the ground some distance away from where it was driven. At the time the pile was being driven it was noticed that it was not driving straight, but driving was continued, with the result shown.



PILE 52 FEET LONG COMES UP OUT OF GROUND 18 FEET AWAY

The pile was 52 ft. long, of green douglas fir, and it was driven in a hydraulic back-fill of coral, overlying a rock excavation. The distance from the center of the butt, projecting 6 ft. above the ground, to the center of the point, projecting 4 feet, was 18 feet.

James T. Reside.

Washington, D. C.

A Gift and an Appreciation

Sir—One of the most insistent demands to be met by a working engineering library is that for bound volumes of technical periodicals. It has been found that in the library of the Bureau of Yards and Docks the call for previous issues of *Engineering News* and *Engineering Record* is especially urgent. Up to a recent date, the bureau's file was far from complete, and some difficulty was being experienced in obtaining one or two volumes of comparatively late issue.

Henry B. Seaman, who has been connected with the Navy Shipyard Plants section of the bureau during the war period, happened to learn of this situation. Mr. Seaman, who was formerly chief engineer of the New York Public Service Commission, First District, bridge engineer for the Erie R.R., etc., has been a subscriber to the *News* and *Record* during a long professional career and up to a very recent date had kept an unbroken series of the bound volumes on his shelves. It was therefore with every indication of deep chagrin that he informed the writer that, owing to the hazards of moving from place to place, he had found it necessary to consign his entire collection only a week previously to a second-hand dealer in Brooklyn. The writer's regret, as may be imagined, became acute as the tale progressed. Mr. Seaman, however, was not disposed to let the matter rest. He held that the books ought to give the greatest service to the greatest number, regardless of his pecuniary interests in the transaction.

He accordingly got in touch with his dealer, found that the volumes had not been uncrated, and directed that the whole shipment, consisting of three heavy cases, be forwarded to this bureau at once by express, all expenses, save actual rail charges, to be met by him personally. In due time the consignment was delivered to this library, all volumes in good condition, complete with indexes, and excellently bound. Numbers were found to supply the recent deficiencies, and the previous volumes were "tied on" to the bureau's series—so that today, owing principally to Mr. Seaman's generosity, the Bureau of Yards and Docks possesses an unbroken file of *Enginering News* from 1887 to date, and of *Engineering Record* from 1890 to date—a collection practically invaluable for the bureau's purposes.

Over the gentleman's protest, this letter is being written as evidence of the unselfish public spirit and genuine human coöperation which seem to form a salient part of the first-class engineering character.

T. J. Mosley,

Librarian, Bureau of Yards and Docks, Navy Department.

Washington, D. C.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Contentious Contractors Shunned by Engineers

AN OLD contractor who was gossiping away an idle hour with the editor remarked: "One accomplishment which I may claim, and which few contractors can claim, is that in 30 years' contracting I have never had a lawsuit. Sometimes I have lost money by refusing to go to law, but I have gained a more valuable asset, which is the reputation of not being quarrelsome. That reputation has helped me to secure many contracts." Submission is a practice not free from risk. Occasionally, at least, the reputation of being able and willing to hit back is the best guarantee of peace. Nevertheless, it is true that the engineer having contracts to award shuns as one shuns pestilence a contentious contractor. That contractor may have the reputation of doing work quickly and well, of working to specifications in every detail, but, if he is known to be contentious, he is passed by for a contractor who is perhaps less capable but is certainly more amiable. A contractor's appeals to the law courts should be rare, and only when all other resorts have failed. A reputation among engineers of being "easy to work with" is an asset which a contractor should not lightly risk.

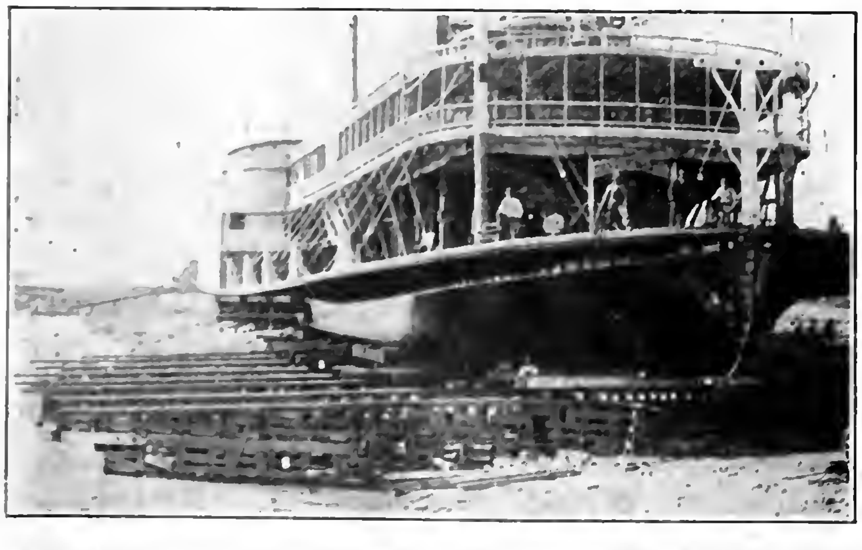
C. S. H.

Stranded River Boat Moved and Relaunched on Rollers

By Emil Dauenhauer
Pittsburgh, Penn.

STRANDED by high water 250 ft. from and 30 ft. above the river edge, a 1000-ton steamboat was moved by jacks and rollers and side-launched without injury to any part, and a few days after the launching the boat resumed her regular schedule. Ordinary house-moving procedures were followed, and the operations, begun Aug. 13, were completed Oct. 7, 1918.

As shown by the view, the vessel was a typical steel-hull stern-wheel river steamer. The steel hull had a beam of 40 ft., but 16-ft. guards in the sides increased the overall width to 72 ft. The length was 248 ft., the draft at the stern 3½ ft., and the weight approximately 1000 tons. As stranded, the boat lay parallel to the river.



STRANDED RIVER BOAT MOVED TO RIVER EDGE PREPARATORY TO RELAUNCHING

Using 200 jackscrews, the boat was raised sufficiently to place it on runways consisting of 11 lines of 6 x 8-in. oak timbers laid to a grade of 1 on 12. Skids were placed under the hull, one over each line of runway timbers, and 8-in. wood rollers inserted between the skids and the runways; 225 rollers were used. When mounted, the boat was pulled to the river edge by six sets of block and tackle reaved three and three. At the river edge it was necessary to grade down the bank and carry the runways down to an elevation about 4 ft. above water level. Jackscrews eased the vessel down the steeper grade. From the ends of the runways 11 lines of launching ways were extended down into the water to a depth greater than the draft of the vessel. These launching ways were 13 x 15-in. timbers, thoroughly blocked and braced. The grade was 1¼ on 12. The boat was slid down the launching ways on skids and rollers.

The contractors for the moving and launching were the John Eichleay, Jr., Co., Pittsburgh, Penn. The writer was in charge of the work. The boat was the "Kate Adams," owned by the Memphis, Helena & Rosedale Packet Company.

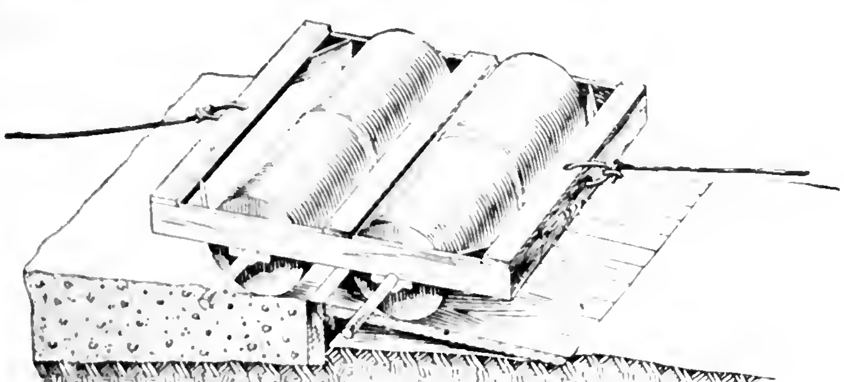
Double Roller and Long Board Float Give Superior Road Finish

By Samuel P. Baird
Columbus, Ohio

EXCEPTIONALLY good finish on a concrete road built at Camp Sherman, Ohio, was secured by using a double roller and long board float. The roller and the float were built on the job.

At Camp Sherman the warehouse street has two 30-ft. pavements separated by a 10-ft. utility space for pipes and poles. The pavements have no crown, but for proper drainage received transverse grades of 6 in. in 70 ft. to 17 in. in 70 ft. The slabs were built in lengths of a day's run, the longest being about 135 ft. The side forms were 2 x 6 in. x 16-ft. Southern pine planks. As the forms were left in place to protect the edge of the slab, their construction was unusual. To insure exact elevation, the side planks were supported on 2 x 4 x 12-in. blocks set 3 ft. apart and tamped to solid bearing in the ground. Thin wedges on the blocks adjusted the plank to exact elevation, and stakes held it upright. To hold the planks close to the slab edge when the stakes were removed, ¼-in. wire ties 3 ft. long were inserted 3 ft. apart along the edge of the slab.

After the concrete had been struck off with an extra heavy strikeboard it was compacted by the double roller shown by the drawing. Four 28 x 18-in. rollers were made of No. 18-gage galvanized iron shaped in a bend-



DOUBLE ROLLER FINISHES CONCRETE PAVEMENT

ing roll. Each roller had a 1$\frac{3}{4}$-in. solid head in each end, made of two $\frac{7}{8}$-in. boards that were placed with the grain crossed.

There were also intermediate heads $\frac{7}{8}$ in. thick. These heads were sawed out on a band-saw. The center hole was a loose fit on a 1-in. pipe. Between the rolls and between the rolls and the frame were placed $\frac{7}{8}$-in. wood washers. The pipe axles were rigid in the frame and extended beyond the frame, for use as convenient handles. All the frame material was $\frac{7}{8}$ in. x 4 in. cypress. When completed the roller weighed 105 pounds.

The location of this work was so restricted by warehouse platforms on one side and a very busy street on the other, that the use of a roller with a handle was out of the question; also, a single roller hauled by ropes did not give satisfaction, so the double roller was designed.

The split feature was the result of an afterthought; we could not find a bending roll to handle anything wider than 28 in., nor could we get the material, No. 18-gage, any wider than the standard sheets.

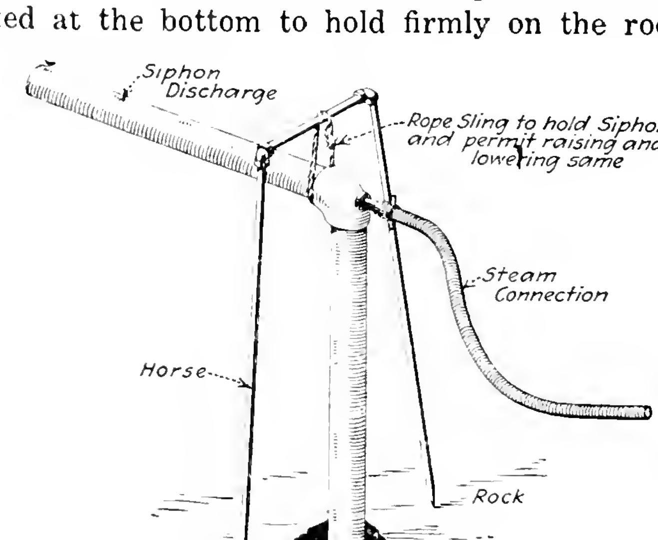
To get best results, there should be placed at each side of the road temporary strips outside the side forms, as shown by the sketch, so that the front roller can be readily pulled over the side forms. In this way any water which is ahead of the second roller can be forced over the forms.

Removal of the water is one of the objects of rolling concrete. Another good result is the crowding down of the coarse aggregate slightly below the surface, thus permitting the ready use of a float 2 ft. longer than the road is wide, and made of some light wood from $\frac{1}{2}$ to $\frac{3}{4}$ in. thick and 8 to 10 in. wide. The results are more satisfactory than those given by a belt. At Camp Sherman the float used was a cypress board $\frac{1}{2}$ x 6 in. and 32 ft. long, composed of two 16-ft. pieces spliced on top. The split-roller idea is of no practical use in my opinion, as the roller—whether pulled by ropes, as in the case in question, or by a handle—is not easily controlled as to direction of movement, and any rolling close to the expansion joints tends to get them more or less out of line.

Simple Horse To Support Steam Siphon

By G. W. McAlpin
Point Pleasant, W. Va.

For holding steam siphons on rock foundations the horse shown in the accompanying sketch has been successfully used. It is made of two pieces of 1$\frac{1}{2}$-in. pipe pointed at the bottom to hold firmly on the rock, and

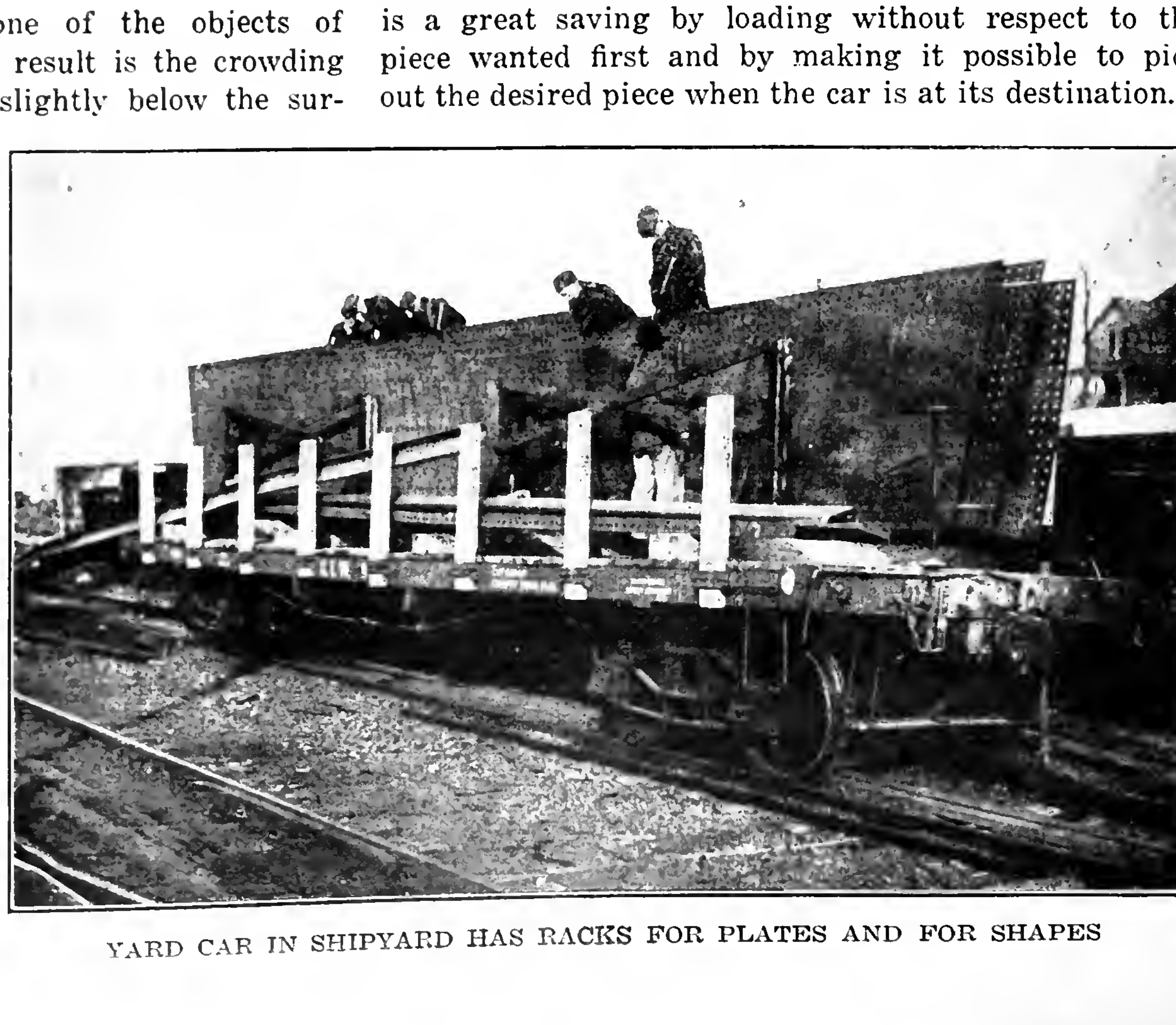


SIMPLE SUPPORT FOR STEAM SIPHON

connected at the top by elbows and an 8-in. nipple. The siphon is suspended between the legs of the horse by a rope passing over the nipple. This permits the raising or the lowering of the siphon, as desired. By resting the discharge pipe of the siphon on a discharge chute, or other convenient rest, balance is obtained.

Shipyard Has Cars With Plate Racks

To facilitate loading and to reduce dangerous overloading, the Groton Iron Works, in the shipyard at Groton, Conn., introduced racks on the yard cars. One such car is shown in the view. This car has plate racks in the middle and shape racks on the side. A greater weight can be carried in this way, and there is a great saving by loading without respect to the piece wanted first and by making it possible to pick out the desired piece when the car is at its destination.



YARD CAR IN SHIPYARD HAS RACKS FOR PLATES AND FOR SHAPES

NEWS OF THE WEEK

New York, January 9, 1919

City Drops 300 Engineers on Half Day's Notice

ew York Rapid-Transit Work Crippled By Cut in Appropriation—Many Contracts Will Be Affected

A New Year's surprise came to over 00 engineers of the Public Service ommission, New York City, in the hape of abrupt discharge from their ositions. The Board of Estimate of he city resolved upon this action at a ieeting held Dec. 30, and advised the 'ublic Service Commission of the acion on the following day. As the iatter involved was the administrative ppropriation for the first quarter of 919, the engineers affected were given otice of the termination of their emloyment on the evening of Dec. 31.

Application made by the commission or the sum of $559,000 for adminisrative expenses during the first quarer was submitted a month ago, but was ot acted upon until Dec. 30. The Board of Estimate cut the amount sked for to $291,000, and required that his amount be expended in accordance vith a schedule of positions prescribed y it. This list, as compared with the xisting organization of the rapid-tranit work, represented a reduction of 76 men (out of 1004), of whom 334 re engineers (out of 812).

Board of Estimate of City Has Final Authority

Prior to the present year, it was ossible for the Public Service Comnission to appeal to the Supreme Court in urgent cases, but under a new aw of 1918 it is considered that final uthority as to all appropriations and ther administrative matters involving ther departments of the city is lodged vith the Board of Estimate. The Pubic Service Commission has therefore pplied to the board for a supplemental ppropriation to restore its staff to roper number.

Sverre Dahm, deputy chief engineer, nd George S. Rice, division engineer, re two of the men whose positions vere abolished by the appropriation chedule. All designing engineers but ne were discharged, and the designing orce cut from about 130 to 41—this n spite of the fact that new contracts re in course of preparation for letting luring the current year, among them hose for the Nassau Street line, the extension of the Steinway tunnel, and new elevated extensions and yards. The vork in hand was sufficient to tax the esources of the designing division as t was organized, and cannot be accomplished in the necessary time by the educed force. In the field, correspondng conditions prevail. In a typical intance, the division engineer and the assistant division engineer are dropped the senior assistant is retained, the section engineer and one inspector and four junior engineers are dropped; this section has lost seven men, out of a staff of eleven. It happens to be one of the sections on which work was being rushed in order to complete the line of which it is a closing link, so as to permit starting of operation of traffic. A number of other sections show similar figures, and in general it is a typical instance of how the situation affects the field work of the commission.

Supervision of field construction is one of the important daily functions of the engineering organization of the Public Service Commission, especially as, under the contract, the commission must furnish all engineering data to the contractors, including lines and grades for all construction. The contractor is dependent wholly on the engineer for field information on the location and the character of the work, for approval of finished work, and for estimates for payment. In work of particular difficulty, as the river tunnels, the engineering service is continuous, and the proper progress of the work essentially dependent upon it. As it will be impossible to perform these varied functions with the depleted staff, the acting chief engineer of the commission, Robert Ridgway, is temporarily making such adjustments and exchanges of men as will permit operations to be carried on in normal manner at the most vital points. The commission's contracts at present include about 20 active sections of rapid-transit lines, exclusive of many contracts for track construction, station finish, equipment, and cases of final estimate.

Engineers Volunteer Services

In order to maintain the organization and allow work to continue, in the anticipation that better counsel will soon prevail and the organization be restored to working condition, a number of the discharged engineers voluntarily continued in their regular duties, giving notice to the commission that this continuance in service is at their own risk, subject to future provision for it by the Board of Estimate, and that the commission is not liable to any claim against it for these voluntary services.

The present crippling of the commission's organization follows a long period of sharp political controversy between members of the commission and officials of the city Government (the commission is a state body, though dependent upon the city authorities for its appropriations and for ap-

(Concluded on page 114)

Commerce Commission For Return of Railroads

Sentiment Favors Return Within 21-Month Period Rather Than Five-Year Control Plan

At the Senate Interstate Commerce Committee's hearing on proposed railroad legislation, Commissioner Edgar E. Clark presented the first alternative yet proposed to Director General McAdoo's plan for a five-year extension of Government control. The Interstate Commerce Commission considers that the 21-month period intervening between the signing of the peace treaty and the return to private ownership affords sufficient opportunity for readjustment before the roads are turned back by the Government. Commissioner Clark said:

"Considering and weighing as best we can all of the arguments for and against the different plans, we are led to the conviction that with the adoption of appropriate provisions and safeguards for regulation under private ownership it would not be wise or best at this time to assume Government ownership or operation of the railways of the country."

He also stated that it seemed obvious that no plan of private ownership should be considered unless it be under broadened, extended and amplified Government regulation. He said that comparatively few contracts for compensation had been perfected between the transportation companies and the Government. Return to private ownership and operation should, therefore, not be understood as meaning precipitous return. A reasonable period of readjustment or preparation should be afforded, and reasonable notice given that upon a given date the properties would be restored to their owners.

Commissioner Woolley dissented from part of the report and gave a number of reasons why he favored the extension plan proposed by Mr. McAdoo, saying that the good accomplished far outweighed the shortcomings and was a promise of better things for the future, and that the proposal to return the railroads to private control had not yet been productive of any concrete plan which would carry the undertaking safely over the breakers obviously ahead.

The commission reiterated its recommendations, made last year, that the Presidential power to merge lines during war or peace should be continued, that railway construction should be limited to works of necessity, and that inland waterways should be developed and coördinated with the railways.

Says France Will Do Her Own Rebuilding

At the meeting of War Service Committee chairmen in New York City, Jan 3, W. H. Manss, until recently chairman of the War Service Executive Committee of the United States Chamber of Commerce, stated that investigations of which he had knowledge had disclosed the fact that France intended to do her own rebuilding. He told the maunfacturers' representatives present that they could not expect much French business in materials. He strongly urged the initiation of an extensive public works program, particularly in highways, emphasizing the point several times. Mr. Manss' words bear out the statements made by *Engineering News-Record* of Jan. 2, that American engineers and contractors—at present, at least—are not wanted in France.

Professional Division U. S. Employment Service Opens Office

The Professional Division of the United States Employment Service has opened a New York office at 16 East 42nd St. Its registrations of experienced professional men are increasing. University graduates in mechanical, electrical, and civil engineering, and in chemistry, and other technical men with several years of practical experience are now registered. The record of each man is carefully investigated before registration is permitted.

Employers seeking men of professional experience are asked to inform the division of the precise nature of the positions which they wish to fill. Only men who are well qualified for such positions are referred to employers.

Zionist Engineers Organize to Rebuild Palestine

The first annual conference of the Zionist Society of Engineers, which was organized at a National Zionist convention in Baltimore in June, 1917, was held Dec. 28-30 in New York City, for the purpose of instituting plans for undertaking engineering development in Palestine, in connection with the expected immigration.

The opening session of the meeting was addressed by Judge Julian Mack, president of the Zionist Organization of America, Jacob de Haas, secretary of the organization, and Dr. Benzion Mossinsohn, director of the Hebrew Secondary School, Jaffa, Palestine. Pledges made by the allied nations with respect to Palestine were reiterated. A resolution was adopted that the society immediately embark upon the preparation of plans and estimates for the agricultural and industrial projects which will be made necessary by the expected immigration. To carry out the resolution, studies of the national resources, topography, etc., of the Holy Land will be made, and a commission will be sent as soon as conditions warrant such a step.

Colonel Roosevelt's Part in Panama Canal and Reclamation Work

Tributes to the Former President by

GENERAL GOETHALS *and* Dr. NEWELL

FOLLOWING receipt of news of the death of Colonel Roosevelt, "Engineering News-Record" asked Maj.-Gen. George W. Goethals, former chief engineer of the Panama Canal, and Dr. F. H. Newell, former director of the United States Reclamation Service, for brief appreciations of the part the former President played in the great works with which they were connected. Their replies follow:

GENERAL GOETHALS—"American engineers especially should honor the memory of Theodore Roosevelt. It was due him that they were given the opportunity to show what American engineering science, skill and initiative could do in the greatest undertaking of peace in the history of the world—namely, the building of the Panama Canal.

"Theodore Roosevelt's name must be forever linked with the building of the canal. He boldly went in opposition to the Board of International Engineers which had decided upon what they believed to be the best type of canal, and whenever and wherever American engineers are gathered they should bear in mind that the confidence that Theodore Roosevelt had in them and in their work gave them the opportunity to serve in linking the nations and in making a highway among them which will forever serve the cause of Humanity and Justice."

DR. NEWELL—"Roosevelt's interest in the irrigation of the arid lands, the preservation and use of the national forests and allied engineering matters of broad national importance was not only deep-seated but effectively shown. That interest came primarily from an enthusiasm for out-of-door things, matured by his experience as a Western frontiersman and student of natural phenomena.

"As Governor of New York he came in contact with the forestry and water supply problems of his state. Almost his first action on arriving in Washington as President was to confer with the experts on these subjects in order to lay out with them his first message to Congress and to develop needed legislation. The resulting Reclamation Act, signed by him June 17, 1902, was made possible by his influence. He gave personal direction to many of the larger reclamation problems, cutting them free from entanglements of red tape and hampering precedents. His guiding principle was that the work, if necessary for the public benefit, should be carried out in spite of opposing precedents unless clearly prevented by existing law.

"We, as engineers, owe a debt of gratitude to Roosevelt not only because of his breadth of vision, embracing in its wide scope the public benefits conferred by engineers, but for his sympathetic attitude and effective co-operation in encouraging and securing methods that lead to economy and efficiency."

Engineers Honor Hoover

Almost coincident with the news that to Herbert C. Hoover has been given the huge responsibility of directing the distribution of food supplies to the neutral and enemy peoples of Europe comes the announcement that American engineers have recognized the great services rendered to humanity by their fellow engineer, by making him the first recipient of the Washington Award.

Two years ago, John W. Alvord of Chicago made a gift of $1000 to the Western Society of Engineers, to establish a prize which is to be given annually to some engineer, "on account of accomplishments which have preëminently promoted the happiness, comfort and well-being of humanity."

©Underwood & Underwood
HERBERT C. HOOVER

The award of this prize is made by a board of 17 engineers, of whom nine are chosen by the Western Society of Engineers and two by each of the four national societies. The award, therefore is representative of the American engineering profession at large.

As Mr. Alvord remarked in his letter giving the fund to establish the award, "almost all engineers serve the public, directly or indirectly, and it is one of the most important duties of engineering societies to point out to their membership and to the public such instances of engineering and administrative skill as seem to have unusual merit, in order that honor may be properly accorded where it is due."

The story of how Mr. Hoover organized the work of feeding the millions of people in Belgium and Northern France during the early years of the war, and how he organized food production and conservation in the United States, is fresh in the memory of everyone.

Now comes a task far surpassing in magnitude and difficulty either of the foregoing; and all agree that upon its accomplishment with some measure of success depends the chances of checking the flood of Bolshevism and anarchy now rolling westward.

Mr. Hoover has been in Europe for several weeks coöperating with the officials of the allied nations in an investigation of European food supplies and needs. On Jan. 3 it was announced at Paris that the allied governments had requested the United States to take a predominating part in the organization of relief measures in all enemy and neutral countries, and that President Wilson had named Mr. Hoover to be director general of the international commission which is to carry on this work. There are 250,000,000 persons with whose food necessities this commission will have to deal.

The story has been told, but will bear retelling, of Mr. Hoover's notable engineering career. That story is of a boy born on an Iowa farm, working his way through Leland Stanford University, being graduated with high honors in 1895 and tackling at once the hard work of mining engineering, first in New Mexico and California and then in West Australia. In his two years spent in the latter country, his rise was so rapid that in 1898 he was made chief engineer of the Chinese Government's Bureau of Mines. The Boxer rebellion of 1900 put an end to this work; and while it was going on he helped organize the defense of Tientsin. When the rebellion was over he found work for a few months in rebuilding Chinese railway and harbor works.

In 1901 he went to London, and as a partner in the firm of Bewick, Moreing & Co., mine operators, he became at once a prominent figure in the organization of mining industry, especially in the East Indies, China and Burmah. The engineering treatises which he somehow found time to write, "Economics of Mining," published in 1906, and "Principles of Mining," published in 1908, are standard textbooks for the profession.

It was characteristic of Hoover that he threw himself in 1914 heart and soul into the work of a hastily organized American committee which undertook the task of rescuing the 100,000 or so Americans who were caught unaware by the war's outbreak and were panic-stricken over the difficulties of getting home.

In the American colony in London, Hoover's great ability and public spirit were so well known that when the huge task of organizing relief for the Belgians was presented the late Ambassador Page was in no doubt where to turn to find a man equal to the need. From that time to the present Mr. Hoover has been been devoting his time and ability to carrying on a work of public service without a precedent in the world's history, and without compensation other than the consciousness of duty that was well performed.

City Drops 300 Engineers

(Concluded from page 112)

proval of contracts and certain other acts). Governor Smith indicated his intention, even prior to taking office on Jan. 1, of reshaping the entire Public Service Commission, and in his message to the legislature recommended division of the functions of construction and regulation, each to be entrusted to a single-headed commission. Under these conditions the action of the Board of Estimate is regarded as merely an item in political warfare, having no regard to the efficiency or services of the engineering organization. No information has been obtainable to show whether the Board of Estimate considered in taking its action the delay and interruption to contract construction work and the probability that contract claims for delay will result therefrom.

War Service Council Approves National Highway Plan

Acting as an industrial advisory council to the War Service Executive Committee of the United States Chamber of Commerce, the chairmen of the War Service Committees at a meeting in New York Jan. 3 adopted a resolution advocating the construction of a national system of highways, the creation of a national highway commission, and the extension of the Federal-aid plan as applied to highways. The resolution was identical with that adopted by the Highway Congress in Chicago in December.

Resolutions favoring a national highway policy were adopted at several of the related-group sessions at the recent Atlantic City Reconstruction Conference, but did not get through the Clearance Committee. The latter body referred them for consideration to the War Service Committee chairmen acting as the Industrial Advisory Council.

Mechanical Engineers Take Over "Engineering Index"

The "Engineering Index," published for 25 years in *Engineering Magazine* and its successor, *Industrial Management*, and the standard index to engineering periodical literature, has been acquired by the American Society of Mechanical Engineers, and hereafter will be compiled and published by the society. The first issue of the index under its new management appears in the January number of the society's *Journal*. The index will be regularly issued in three forms: (1) As a part of the *Journal;* (2) as a separate monthly publication for libraries or individuals desiring to clip the items for indexing purposes; (3) as an annual volume in which all the items for the year are collected.

The "Engineering Index" originated with Professor J. B. Johnson of Washington University, St. Louis, Mo., in 1883, and for 12 years was prepared

under his direction and published by the Association of Engineering Societies. The following classifications give an idea of the scope of the "Engineering Index," as it will be carried in the *Journal:* Mechanical engineering, 31 subheads; electrical engineering, 11 subheads; civil engineering, nine subheads; mining engineering, 14 subheads; metallurgy, seven subheads; aëronautics, 19 subheads; marine engineering, four subheads; organization and management, 13 subheads; industrial technology; railroad engineering, 15 subheads; munitions and military engineering; general science, three subheads.

First Filter Plant Bids Received Since War's End Are Low

Bids received for a filter plant at Wyandotte, Mich., Dec. 30, one of the first municipal jobs of this kind to be advertised for since the armistice was signed, indicate that prices are apparently somewhat lower than those of last spring. For concrete masonry walls, beams and columns, the bids of the six firms represented ranged from $17 to $25. The low bid on filter boxes was $19 a yard. Cast-iron pipe prices ranged from $75 to $90, with specials ranging from $160 to $185. Flanged specials were listed from $185 to $250. The Pitt Construction Co. was the low bidder at $211,235. The figures given were received from R. Winthrop Pratt, civil and sanitary engineer, Cleveland, Ohio.

Angus Sinclair

The death of Angus Sinclair at the advanced age of 78 years removes a notable pioneer in American engineering journalism. It was 35 years ago that he left a job as roundhouse foreman on the Burlington, Cedar Rapids & Northern Ry. and came to New York City to be an assistant editor on the *American Machinist.* His experience previous to that time has been chiefly in the railway field. While holding the job named he managed to attend classes in chemistry at Iowa State University, and was made chemist for the railway company, a job at that time deemed of so little importance, however, that it was combined with the place of roundhouse foreman.

It was at this time that Mr. Sinclair began writing for the technical and railway journals. One of his early writings was a treatise on "Locomotive Running and Management" which has passed through 26 editions.

In 1883 he came to New York to take up work on the editorial staff of the *American Machinist.* A few years later the late John A. Hill also left a locomotive on a Western railway to go to the same journal, and the two men formed a friendship which resulted in a business partnership for the publication of a journal devoted to locomotive engineering. This made a rapid and spectacular success, which in a few years enabled the partners to purchase the *American Machinist,* on the staff of which they had started their work in journalism.

It was then decided to dissolve the partnership and Mr. Sinclair took the journal with whose field he was personally familiar.

He was a member of the American Railway Master Mechanics' Association for 46 years. He served as its secretary from 1887 to 1896, and was its treasurer from 1900 until his death. In 1908 Purdue University conferred on him the degree of Doctor of Engineering.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 West 39th St., New York City; Jan. 15-16, New York.

AMERICAN WOOD PRESERVERS' ASSOCIATION; F. J. Angier, Mt. Royal Station, Baltimore, Md.; Jan. 28-29, St. Louis.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

NATIONAL RIVERS AND HARBORS CONGRESS; 824 Colorado Bldg., Washington, D. C.; Feb. 5-7, Washington, D. C.

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Feb. 17-20, New York.

The following state societies will hold their annual meetings as listed below:

Ohio Engineering Society, Columbus, Jan. 14-16.

Michigan Engineering Society, Flint, Jan. 21-23.

Indiana Engineering Society, Indianapolis, Jan. 23-25.

Illinois Society of Engineers, Bloomington, Jan. 29-30.

Minnesota Surveyors and Engineers' Society, St. Paul, Feb. 12-14.

Iowa Engineering Society, Muscatine, Feb. 19-20.

Engineering Society of Wisconsin, Madison, Feb. 21-22.

The Engineers' Club of Philadelphia will be addressed by Col. James B. Curtis, president of the American Manganese Bronze Co., on "The Legal Engineer," at the weekly luncheon Jan. 14.

The Duluth Engineers' Club, at a meeting Dec. 23 passed a resolution favoring immediate efforts toward the organization of the engineering profession in an effective form to render full public service and to obtain adequate recognition of the work of its members. A committee of five, to be appointed by the president, W. G. Swart, will communicate with other engineering organizations, in order to obtain coöperation and concerted action for calling a general engineering congress, in the name of and by the authority of all the coöperating societies. The Duluth committee will make a report of progress every two weeks. Another resolution relative to the street railways of Duluth was adopted; it suggested that a thorough engineering investigation be made and a plan prepared to provide additional trackage in the center of the city, to relieve present congestion.

The Boston Society of Civil Engineers has made the following nominations for office, through the nominating committee: For president, Leonard Metcalf; for vice-president, Robert Spurr Weston; for secretary, S. Everett Tinkham; for treasurer, Frank O. Whitney. The election will take place Mar. 19.

The Chicago Chapter of the American Association of Engineers was addressed Jan. 3 by Capt. Charles E. Merriam, on "Italy's Part in the War." Captain Merriam, who is a candidate for mayor, represented the Committee on Public Information in Italy.

The Brooklyn Engineers' Club will be addressed tonight by James C. Meem on "Metropolitan Subway Construction." Mr. Meem's paper will deal with the diversion of sewers during construction, the underpinning of buildings and overhead structures, provision for the care of surface structures, the excavation and disposal of material, and methods of tunneling.

The Rochester Engineering Society, Rochester, N. Y., was addressed Jan. 6 by Prof. Victor J. Chamber, University of Rochester, on "The Development of a Research; Synthetic Indigo." The regular monthly meeting of the society will be held tomorrow; C. E. Drayer, secretary of the American Association of Engineers, will read a paper on "Local and National Societies Coördinated."

The Technology Club of Syracuse, N. Y., will be addressed Jan. 13 by Secretary of Commerce William C. Redfield and Dr. S. W. Stratton, director of the United States Bureau of Standards. Secretary Redfield will speak on the various phases of the work of his department, with perticular reference to the Government's reconstruction plans for industry and the extension of foreign commerce. Dr. Stratton is expected to discuss important chemical discoveries not made public heretofore.

The Engineers' Subdivision of the Chicago Association of Commerce was addressed Dec. 30 by George Bayard Jones, who explained the recent report on the proposed rebuilding of various Federal buildings in Washington. He advanced arguments for the removal of the capital to a more central location. T. E. Tallmadge described a layout prepared for a model capital on Lake Michigan, north of Chicago. A committee to follow up the project was named.

Personal Notes

Readers who are returning to civil life from military, naval or other Government service are strongly urged to send in items about themselves and about their friends who are in similar situation. Items should give former position, describe character of military or other service and state the civil work to which the engineer or contractor in question is going. In the case of those with service abroad, information regarding the activities of the units to which they were assigned is especially desired.

HENRY W. CLAUSEN, first assistant city engineer of Chicago, and formerly engineer of water-works construction, has resigned to enter the glove manufacturing business. Mr. Clausen's chief work in Chicago was the construction by force-account of the Wilson Ave. water-works tunnel, intake and Mayfair pumping station.

J. HAROLD RAPP and John J. Dunkel have become associated as the firm of Rapp & Dunkel, structural engineers, Fulton Building, Pittsburgh, Penn.

HOWARD B. KEASBEY has been appointed county engineer of Salem County, New Jersey.

H. STRINGFELLOW, district engineer, Southern Ry., with headquarters at Lexington, Ky., has been appointed district engineer at Charlotte, N. C., succeeding F. Furlow, appointed engineer of surveys, with headquarters in Washington, D. C., as noted elsewhere.

C. R. SEABROOK, who until last September was structural engineer, Chile Exploration Co., Chuquicamata, Chile, has become structural engineer for H. M. Lane Co., industrial engineers, Detroit. More recently he has been engaged in the Air Nitrates Division of the Ordnance Department.

H. Z. OSBORNE, JR., has resigned from the office of engineer of the Los Angeles street planning department to become chief engineer, board of public utilities. Mr. Osborne has been connected with the Los Angeles city engineer's office for 22 years. Last year he was elected president of the Engineers and Architects' Association of Southern California.

F. FURLOW, district engineer, Southern Ry., at Charlotte, N. C., has been appointed engineer of surveys, Southern Ry. Lines and Associated Railroads, with headquarters in Washington, D. C.

MAJ. H. W. LOCKETT, U. S. A., has obtained his discharge from the service and will become associated with Fred. S. James & Co., to take charge of engineering and inspection work. For the past year and a half Major Lockett has served as a building section chief in the Construction Division. Previously he was with the Chicago office of Fred S. James & Co. for 18 years.

IRA E. TAYLOR, previously county engineer, Pottawatomie County, Kansas, has been appointed assistant engineer, extension division, Kansas State Agricultural College, and will specialize in farm drainage.

FRANKLIN D. HOWELL, formerly chief engineer of the Board of Public Utilities, Los Angeles, Cal., has become general manager of the California Highway Transportation Company.

LIEUT. COL. EDWARD BARTOW, Sanitary Corps, U. S. A., was incorrectly mentioned in these columns Dec. 26 as Maj. Edward Bostow, due to a typographical error. He was in charge of water analysis laboratories for the American Expeditionary Forces, and has recently been promoted to the rank of lieutenant colonel. He was formerly director of the Illinois Water Survey.

KARL R. KENNISON, supervising plant engineer, Emergency Fleet Corporation, stationed at the recently completed concrete shipyard in Mobile, has been transferred to the office of the district plant engineer, Middle Atlantic District, Baltimore.

MAJ. CHARLES H. HIGGINS, Ordnance Department, U. S. A., has received his discharge from the service and returned to the firm of Delano & Aldrich and Charles H. Higgins, architects and engineers, New York City.

A. YAPPEN has been appointed assistant engineer in charge of bridge maintenance, inspection and operation, Chicago, Milwaukee & St. Paul Ry., succeeding C. N. Bainbridge, promoted to be engineer of design, as mentioned in *Engineering News-Record* of Dec. 12, p. 1102.

J. C. HILL has been appointed division engineer, St. Louis District, Missouri, Kansas & Texas Lines, with office at Sedalia, Mo., succeeding B. E. Wilbur, resigned.

CAPT. ARTHUR C. POOLE, Corps of Engineers, U. S. A., has returned from Camp A. A. Humphreys to his duties as city engineer of Rochester, N. Y.

L. S. HULBURD, senior assistant engineer, New York State Barge Canal, has been appointed division engineer of the western division of the canal, succeeding F. P. Williams, appointed special deputy state engineer, as mentioned in *Engineering News-Record* of Dec. 26, p. 1203.

W. L. WINTERS has withdrawn from the firm of Winters & Dove, civil and hydraulic engineers, Forth Smith, Ark., and is engaged in practice under his own name in the Merchants' National Bank Building, Fort Smith.

Obituary

DR. ROSSITER W. RAYMOND, mining engineer and author, previously editor of *Engineering and Mining Journal*, published by the McGraw-Hill Co., Inc., died at his home in Brooklyn, N. Y., Dec. 31, at the age of 78. He was graduated from the Polytechnic Institute of Brooklyn, and later studied at the University of Heidelberg, the Royal Polytechnic School, Munich, and the Saxon Mining Academy of Freiburg. He served in the Union Army from 1861 to 1864, after which he began practice as a mining engineer and metallurgist. Four years later he was appointed United States Commissioner of Mining Statistics, and in 1870 became lecturer on economic geology at Lafayette College. He was one of the United States commissioners to the Vienna World's Fair in 1873. He was appointed New York State commissioner of electrical subways for Brooklyn in 1885. For many years, beginning in 1866, Dr. Raymond was editor of the *American Journal of Mining*, which afterwards became the *Engineering and Mining Journal*.

WILLIAM J. GALBRAITH, civil engineer, Montreal, Canada, died in that city Dec. 21. He was 32 years of age, and was graduated from McGill University in 1909. A year afterward he became associated with the Geological Survey in the Rocky Mountains. Later he entered the firm of M. P. & J. T. Davis as assistant engineer on caisson work for the Quebec bridge. Recently he became associated with the Foundation Co. of New York City as a superintendent of construction of shipways on the North Pacific Coast. He was a member of the British Institute of Civil Engineers.

CAPT. GRANDVILLE REYNARD JONES, Sanitary Corps, U. S. A., previously associate professor of civil engineering, Johns Hopkins University, Baltimore, died of influenza at Camp Benning, Columbus, Ga., Dec. 22. Captain Jones was graduated from Ohio State University in 1904 and from the Massachusetts Institute of Technology in sanitary engineering in 1907. His principal professional work was with the filtration plant, Washington, D. C. At Johns Hopkins University he designed and built the Hydraulic Laboratory and the Laboratory of Sanitary Research. He developed several courses in sanitary engineering for the senior classes in civil engineering at Johns Hopkins. Early in November of last year Professor Jones was commissioned in the Sanitary Corps, with the rank of captain, and was ordered to Camp Greenleaf, Georgia, for a brief period of training, at the end of which he was sent to Camp Benning as camp sanitary engineer.

Last Year's Coal Production More Than in 1917 by 36,000,000 Tons

Although the year 1917 was in itself a record year in bituminous coal production, that of 1918 exceeded this by 36,000,000 tons, according to official figures of the United States Geological Survey. The total production for the year just closed was almost 600,000,000 tons. This record was made under the spur of war-time necessity, with fewer men generally in the coal mines of the country than during 1917. Patriotism, increased efficiency, and the desire of the employees to support to the utmost, the Government in its various undertakings, and a better railroad car supply and movement are believed to be chiefly responsible for this increase in production. It is believed that the country at present has a sufficient bituminous coal supply to meet its requirements.

Gage of Argentine Railroads

The gage of the Argentine railways, as given on p. 1204 of the Dec. 26 issue of *Engineering News-Record*, should have been 5½ ft. for the first, 4 ft. 8½ in. for the second, and 3 ft. 3⅜ in. for the third, instead of 6 ft. 5 in., 4 ft. 9½ in., and 3 ft. 4 in., respectively.

Labor Ample, But Materials Still High in Central West

A report from the Central West indicates that an ample labor supply has become available within the past few days. All big munition plants have ended their war work, and employers of labor report more applications than they can handle. A contracting company having large drainage projects on hand in all sections from Minnesota to Louisiana reports a plentiful supply. This company suspended all operations last September on account of labor shortage, but is now going ahead with everything and even starting new projects. Another contracting company which specialized in cantonment and war plants reports labor plentiful at 40c. an hour in all cities where it is operating, whereas 10 weeks ago it could not get labor at 65c. No further shortage is anticipated, the company says.

Regardless of the disappearance of labor difficulties, however, building construction is still delayed on account of the high cost of materials, as was shown in recent bids for steel work.

A bid of almost $120 a ton on structural steel to be used in a proposed building in Chicago indicates that the steel price is still high, especially since this same class of work was quoted two years ago at half that amount. It is reported that architects who have work on hand are recommending that owners hold off until a price of $80 is allowed, and a report is current that a reduction will be made about Mar. 1.

Crushed Stone in 1917 Half the Total Stone Quarried

Crushed stone represented 48% of the quantity and 35% of the value of all the stone quarried in the United States in 1917, according to a bulletin of the United States Geological Survey. The total sales of crushed stone in the United States in 1917 amounted to over 40,000,000 short tons, valued at about $29,000,000, and the average value per short ton at the crusher was 72c., 11c. more than in 1916. Of the crushed stone produced, 66% was limestone, 20% traprock, nearly 8% granite, nearly 4% sandstone and a little over 2% miscellaneous rock, classed as trap.

New Machinery Association to Be Formed

Manufacturers of material-handling machinery will form an association similar to other national associations of manufacturers. Representatives will meet at the Hotel McAlpin in New York City Jan. 15 to hear a report of the temporary committee appointed last fall to consider the matter.

It is expected that the association will afford means for the coöperation of all manufacturers of material-handling machinery with the United States Shipping Board, the Port and Harbor Commission, the Railroad Commission, and other boards interested in the handling of material; also to extend the acquaintance and coöperation of manufacturers. It will also afford means for the concentration in a general bureau of statistical information, to cover the present methods of mechanical handling as now practiced in this country and abroad, the dissemination among the members of information collected and developed by the association, as well as educational campaigns and the collection of information on foreign trade.

A luncheon is announced at which the Hon. William C. Redfield, secretary of commerce, and Edward F. Carry, chairman of the Port and Harbor Facilities Commission of the United States Shipping Board, will speak. The announcement requests all manufacturers of material-handling machinery who desire to join the proposed association to sign an application and send it to J. A. Shepard, temporary chairman, care of the Shepard Electric Crane & Hoist Co., 30 Church St., New York City.

Chlorine Price Cut in Half

A contract for liquid chlorine for water treatment has been awarded by the City of Chicago on a bid of 8c. per pound, while market prices until recently have been 14 to 16c. The contract, given to the Hooker Electro-Chemical Co., Cleveland, Ohio, is for 400,000 lb. for the 1919 supply, delivery to be made as required by the city.

Business Notes

Charles H. McCullough, Jr., was elected president of the Lackawanna Steel Co. at a recent meeting of the board of directors. Mr. McCullough has been vice-president and general manager of the company, and succeeds Edward A. S. Clarke, who resigned a week ago.

S. M. Williams, president of the Highway Industries Association, and for the past four years sales manager of the Garford Motor Truck Co., has been relieved of his duties as sales manager to take charge of the new department of highway development which has been established by the company.

Walter N. Polakov, consulting engineer, 31 Nassau St., New York, announces the founding of Walter N. Polakov & Co., Inc., consultants in power-production methods, industrial investigations, labor problems, scientific record systems and production accounting.

The Brown Hoisting Machinery Co., Cleveland, Ohio, announces the following changes in its organization: Harvey H. Brown, chairman of the board of directors; Alexander C. Brown, president; Melvin Pattison, vice-president, general manager and director.

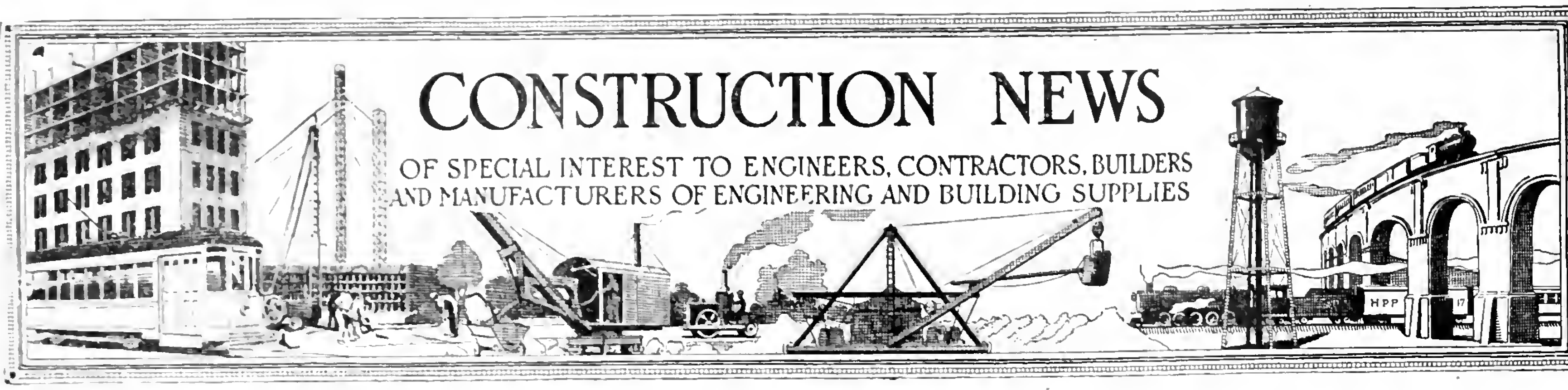
Trade Publications

The American Zinc Institute has issued its 1918 bulletin. It is a 5-p. folder outlining the aims of the institute and the reasons for its formation. Other information of interest to zinc users is given.

The American Manganese Steel Co., Chicago, Ill., has issued a new catalog on sand and gravel pumps, which they announce is for distribution among those interested in pump installations. It is a 6 x 9-in. pamphlet of 22 pages, punched for filing in a loose-leaf binder.

"Home Building with Metal Lath and Stucco for Permanence and Safety" is the title of a 7 x 9½-in., 20-p. catalogue issued by the Associated Metal Lath Manufacturers, Woodward Building, Washington, D. C. It illustrates and describes residences and buildings in which their product is used.

The Denver Rock Drill Manufacturing Co., Denver, Colo., has issued a leaflet describing its model 110 Waugh drill steel punching machine which, the company states, is one of its latest products.



PROPOSALS

For Proposals Advertised See Pages 54 and 55

WATER-WORKS

Bids Close		See Eng. News-Record
Jan. 10	Pembroke, Ont.	Jan. 9
Jan. 14	Detroit, Mich.	Jan. 9
Jan. 15	Kansas City, Mo.	Jan. 2
Jan. 31	Poteau, Okla.	Dec. 26
	Adv. Dec. 19 and 26.	

SEWERS

Jan. 15	Long Island City, N. Y.	Jan. 9

BRIDGES

Jan. 13	Eureka, Cal.	Jan. 9
Jan. 13	Los Angeles, Cal.	Jan. 9
Jan. 22	Ft. Smith, Ark.	Jan. 2
	Adv. Jan. 2 and 9.	
Jan. 27	Fallon, Nev.	Jan. 9
Jan. 27	Winneucca, Nev.	Jan. 9
Feb. 3	Charlotte Harbor, Fla.	Jan. 2
	Adv. Dec. 19, 26, Jan. 2 and 9.	

STREETS AND ROADS

Jan. 13	California	Jan. 9
Jan. 13	Brownwood, Tex.	Jan. 9
Jan. 14	Bay City, Tex.	Dec. 26
Jan. 15	Blytheville, Ark.	Dec. 5
Jan. 15	Indiana	Jan. 9
Jan. 16	New York, N. Y.	Jan. 9
Jan. 20	Oswego, Kan.	Jan. 2
Jan. 21	Charleston, S. C.	Jan. 9
	Adv. Jan. 2 and 9.	
Jan. 24	Topeka, Kan.	Jan. 2
Jan. 27	Nevada	Jan. 9
Feb. 3	Wichita, Kan.	Jan. 9
Feb. 5	Indiana	Jan. 9

EXCAVATION AND DREDGING

Jan. 13	Delta, Utah	Jan. 9
Jan. 14	Albany, N. Y.	Dec. 26
	Adv. Dec. 19, 26, and Jan. 2.	
Jan. 15	New Ulm, Minn.	Dec. 26
Jan. 15	Carnesville, Ga.	Jan. 9
Jan. 15	York, S. C.	Dec. 26
Jan. 21	El Centro, Cal.	Jan. 9
Jan. 27	Madison, S. D.	Jan. 9
Feb. 3	Madisonville, Ky.	Dec. 12
	Adv. Dec. 5, 12 and 19.	

BUILDINGS

Jan. 14	Cherokee, Ia.	Dec. 19
Jan. 15	Norfolk, Va.	Jan. 9
Jan. 20	Hartford, Conn.	Jan. 9
Jan. 25	Asbury Park, N. J.	Jan. 9
Jan. 30	Phoenix, Ariz.	Jan. 2
Feb. 3	Melbourne, Fla.	Jan. 9
Feb. 3	St. Paul, Minn.	Oct. 31
Mar. 15	Culver, Ind.	Dec. 26

FEDERAL GOVERNMENT WORK

Bids Close		See Eng. News-Record
Jan. 10	Post Office—Vineland, N. J.	Dec. 5
Jan. 10	Altering Lobby—New York, N. Y.—Adv. Dec. 19 and 26.	Dec. 26
Jan. 13	Additional Buildings—Spec. 3611—San Diego, Cal.	Dec. 19
Jan. 13	Post Office—West Point, Ga.	Dec. 5
Jan. 13	Post Office and Custom House—Ft. Fairfield, Me.	Dec. 5
Jan. 13	Post Office and Court House—Globe, Ariz.	Dec. 5
Jan. 13	Altering Post Office and Custom House—Petersburg, Va.	Jan. 2
Jan. 14	Hygienic Laboratory — Washington, D. C.	Jan. 2
Jan. 14	Post Office — Southbridge, Mass.	Dec. 5
Jan. 14	Post Office—Cherokee, Ia.	Dec. 5
Jan. 14	Post Office—McKees Rocks, Pa.	Dec. 5
Jan. 14	Sewers—Wash., D. C.	Jan. 9
Jan. 15	Altering Post Office—Portsmouth, Va.	Dec. 26
Jan. 15	Post Office — Long Island City, N. Y.	Dec. 5
Jan. 15	Post Office—Kenton, O.	Dec. 5
Jan. 15	Post Office — Bellefourche, S. D.	Dec. 5
Jan. 15	Post Office — Winchester, Mass.	Dec. 5
Jan. 16	Post Office—Eldorado, Kan.	Dec. 5
Jan. 16	Post Office—Shawnee, Okla.	Dec. 5
Jan. 17	Post Office—Franklin, Pa.	Dec. 5
Jan. 17	Post Office—Cohoes, N. Y.	Dec. 5
Jan. 17	Post Office—Buffalo, Wyo.	Dec. 5
Jan. 18	Irrigation—Boise, Idaho	Jan. 9
Jan. 20	Gas Holder, Removing System, etc.—Spec. 3594—North Ft. Worth, Tex.	Jan. 9
Jan. 20	Heating System—Spec. 3722—Rockaway, N. Y.	Jan. 9
Jan. 20	Oil Storage Buildings, etc.—Spec. 3714 — Hampton Roads, Va.	Jan. 9
Jan. 20	Post Office — Harrisonville, Mo.	Dec. 5
Jan. 20	Post Office—Owego, N. Y.	Dec. 5
Jan. 20	Post Office—Sunbury, Pa.	Dec. 5
Jan. 20	Post Office—Decatur, Ala.	Dec. 5
Jan. 20	Post Office — Shelbyville, Ind.	Dec. 26
Jan. 23	Post Office—Salem, Va.	Jan. 2
Jan. 23	Post Office — Russellville, Ark. Adv. Jan. 2.	Jan. 2
Jan. 28	Dredging—Key West, Fla. Adv. Jan. 2 and 9.	
Feb. 4	Boilers—Memphis, Tenn. Adv. Jan. 9.	Jan. 9
Feb. 4	Turbine, Pumpset, etc. — Memphis, Tenn. Adv. Jan. 9.	Jan. 9

MISCELLANEOUS

Jan. 13	Dump Cars — Winnipeg, Man. Adv. Jan. 9.	Jan. 9
Jan. 14	Heating, Plumbing, etc. — Sonyea, N. Y. Adv. Jan. 9.	Jan. 9
Jan. 16	Portland Cement, Sand, etc. —New York, N. Y.	Jan. 9
Jan. 24	Sheet Steel Rivets—Los Angeles, Cal.	Jan. 2
Feb. 3	Dam—Los Angeles, Cal.	Jan. 9
Feb. 19	Gantry Crane — Seattle, Wash. Adv. Jan. 2 and 9.	Jan. 2

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Mich., Ferndale (Royal Oak P. O.)—G. Jerome, engr., 1331 Majestic Bldg., Detroit, receives bids about Feb. 1, furnishing and laying water mains for complete water system for village. About $99,000. Noted Dec. 5.

Wis., Oshkosh—City will sell $50,000 bonds Jan. 17, to improve water-works. A. March, comptroller. Noted Dec. 26.

Minn., Fairmont—City receives bids in February or March building 1,000,000 gal. water purification plant. C. H. Currie, Webster City, Ia., engr.

Minn., Minneapolis—Golden Valley Golf Club plans to extend water system at Golden Valley, 5 mi. west of here. About $20,000. E. Von Ende, 651 Plymouth Bldg., secy.

Kan., Eldorado—Black & Veatch, engrs., Interstate Bldg., Kansas City, Mo., making survey of water system and investigating feasibility of building ground water supply and dam for collecting and holding water up river.

N. D., Belfield—City receives bids in spring building water-works system, including rein.-con. pump house, c.i. pipe, mains, rein.-con. reservoir, etc. Former bids rejected. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, Minn., engr. Noted Sept. 12.

Mont., Ft. Benton—City election Jan. 17, to vote on $35,000 bonds to improve water-works system.

Wash., Spokane—City plans to install steel and iron headgates, with operating devices at Upriver pumping plant to replace old timber headgates on masonry dam, cost $30,000; also replacing 6 mi. wooden water pipes with 6 in. steel mains. Will purchase equipment and install same by day labor. A. Lindsay, supt.

Que., Lachine—See "Industrial Works."

Sask., Assiniboia—City plans to complete water-works system. About $20,000. Address J. Nolan.

BIDS DESIRED

Mich., Detroit—Until Jan. 14, by H. S. Starkey, secy. water comn., 232 Jefferson Ave., furnishing 1000 tons 6 in. c.i. pipe and 1000 tons 8 in. c. i. pipe. G. H. Fenkell, 232 Jefferson Ave., engr.

Ont., Pembroke—Until Jan. 10, by town clk., furnishing 1600 lin.ft. 20 in. c. i. pipe, 15 flexible joints, two in. gate valves and 1 screen for water-works intake. W. J. Moore, town engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

Mich., Wyandotte—City received bids Dec. 30, (1) furnishing and laying 1450 ft. submerged intake pipe and elbows equipped with flanges and joints, removal of existing elbow, relocating existing crib, final testing, dredging and backfilling and all labor and material, involving 1450 ft. 24 in. c. i. pipe. Alternate bids on (a) Fenkell joints, (b) Ward joints, (c) Metropolitan joints, (d) Walker flexible joints; (e) according to bidder; (2) building filter plant with 6,000,000 gal. daily capacity, composed of six filter units, 21½ x 24 ft. of 1,000,000 gal. capacity each, 40 x 65 ft. and 37 x 73 ft. brick and steel filter and head houses, 2 coagulation basins, 64 x 94 ft. each, filtered water reservoir having capacity of 850,000 gal., usual equipment of hydraulic valves and controllers and 32 x 50 ft. brick addition to pumping station, (a) using concrete piles with alternate on reservoir; (b) using wood piles with alternate on reservoir, from Amer. Constr. Co., 1552 Rockefeller Bldg., Cleveland, O., (1a) $55,340; (1b) $52,155; (1c) $52,155; (1d) $53,155; J. H. Baer, Penobscot Bldg., Detroit, (1d) $51,750; (1e) $48,632, Class "B" pipe with Walker flexible joints at 72 ft. intervals; Lennane & McIlvenna, 809 Union Trust Bldg., Detroit, (1d) $45,000; Great Lakes Dredge & Dock Co., 1630 Williamson Bldg., Cleveland, O., (1a) $49,300; (1c) $60,900; (1e) $51,475, ordinary B & S pipe Class "B" with Thatcher joints; A. O.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, JANUARY 16, 1919 — Number 3

States Should Attack Reconstruction Problems

RECONSTRUCTION problems have received so little attention at Washington, and Congress seems so unlikely to do anything adequate before adjournment, that the several states must act if danger of great injustice to soldiers and war workers and of serious industrial disturbances is to be averted. Some states have it within their power to provide work through highway and other construction. Many can aid by removing various state restrictions which prevent cities from making needed improvements. All states can and should establish or continue state agencies to deal with reconstruction problems. Such bodies should lose no time in making broad surveys of the field, with a view to determining needs and ways of meeting them and obtaining necessary legislation at the earliest possible moment.

Congress Should Unlock Water Powers

PASSAGE of the Congressional water-power bills now in conference is earnestly to be hoped for before the close of the present session. Every engineer who is familiar with the water-power situation will agree that prompt action is needed. Water-power needs to be unlocked, to conserve fuel and to furnish profitable employment to the men released from military service and munition making. The present Congress has given more attention and study to this vital matter than any previous Congress. Its work should not be lost, especially at this critical time. Even if the bill as finally reported should be more or less of a compromise and defective in many particulars, yet if, without undue sacrifice of vital interests on either side, it opened the way for even a limited development of unused water powers, it would be well worth while as a contribution to the solution of reconstruction problems and to the conservation *and utilization* of our natural resources.

Too Late Is No Better than Never

MORE and more it becomes apparent that public works are the only reservoir which will tide us over the almost inevitable unemployment crisis approaching in the construction field. That reservoir must be made ready immediately, and not delayed, as seems the prospect in most of the proposed projects. In Cleveland, for instance, with great flaunting of headlines it is announced that the mayor is now planning to furnish employment during the reconstruction period, by going right ahead with the $3,500,000 East Side filtration plant. So far the announcement seems hopeful, but one reads farther and sees that it is expected that ground will be broken "the latter part of this year." So far as helping present needs is concerned, such a plan is about as useful as would be a scheme for huge landing places for the transatlantic airplanes which the optimists tell us will be flocking across the ocean within the decade.

Taking State Highway Routes Out of Politics

VARIOUS plans have been devised to keep the designation of the routes to be followed by state trunk highways out of politics, but generally without success. Log-rolling to bring the improvements to locations where they will do the most good to the particular crowd of politicians in power has always been a disorganizing factor, and one which has put peculiar "kinks" in many systems. To eliminate this troublesome interference, the highway officials of Minnesota propose to map out a system and submit the map to vote of the people, as a part of a constitutional amendment (noted in *Engineering News-Record* of Dec. 26, p. 1199) necessary to enable the state to enter upon highway construction. In laying out the roads, tentatively, they have been proportioned to the various parts of the state according to assessed valuation and population, and, if approved, each section will know just what roads it is entitled to. Such a plan has the advantage of fixedness in any event, and if any "fixing" is done in the original layout, the people will be in a position to see the results before voting. The object of the plan—freeing highway routes from log-rolling—is most commendable, but it is a pity if there is no way of doing it short of making the proposed highway routes a part of the state constitution. Such documents should be confined to fundamental principles and not lumbered up with administrative details.

A Daring Adventure In Municipal Ownership

SEATTLE is making a daring adventure in municipal ownership. As noted on p. 163, the city authorities have taken action to buy the local street-railway system. British and some continental European cities set the example long ago. San Francisco has municipalized an important street railway line or two, and Seattle already has a short line of its own. New York, Boston and Philadelphia have put millions into subway construction for private operation, and Cincinnati launched a similar project before we entered the war. Seattle, if it goes forward as rapidly as is expected, will be the

pioneer American city of considerable size to own and operate its entire street-railway system. Whether the present difficulties besetting many of our privately owned street-railway systems will lead to an early extension of municipal ownership is an interesting question. At this critical juncture in local transportation, perhaps it is well that some American city should make a trial of complete municipal street-railway service. Seattle has volunteered.

Philadelphia Again Pays Heavy Penalty

AMONG the good features proposed for insertion in a new charter for Philadelphia under consideration by a voluntary charter committee is one that would authorize long-term contracts for some city services now restricted to yearly contracts. The need for such a reform as to garbage disposal has been pointed out again and again by *Engineering News-Record* and its predecessors. It was recently illustrated anew by a contract award for garbage disposal in 1919 at an advance of $123,636 over the 1918 contract. Earlier last year a bid at a reduced price was received, but for reasons presumably connected with the one-year contract system it became necessary to readvertise the contract twice. As was to be expected, with a new contract beginning Jan. 1, and requiring an extensive plant, there was no competition. The legislature has been asked in vain to authorize long-term garbage contracts for Philadelphia. It gives heed to the interests of contractors and politicians instead of to the pocket books of the citizens of Philadelphia. Possibly this evil, in common with others with which Philadelphia is burdened, may be remedied by a new charter. Unquestionably, they might be if the people would prove by an aroused united effort that Philadelphia is no longer "corrupt and contented." What are the engineers of Philadelphia doing about it?

Look Well to Choice of Camp Cook and Save Money

FOOD waste is characteristic of construction camps, as it is shown by Captain Tharaldsen on p. 146 to be characteristic of lumber camps. Perhaps waste is not so large in construction camps, but the causes are the same. The remedies outlined in the article apply to construction as well as to lumber camps. Camp messes in general fail more because of poor cooks than because of limited variety and poor quality of supplies. This fact makes of prime importance the task of selecting a camp cook. Captain Tharaldsen's remarks on this point deserve emphasis. The position of camp cook is not a menial one which any "pot slinger" can fill even in a small camp. When several hundred men must be kept fed and satisfied, it is a position which only a man having knowledge of foods and menus, and catering generally, can fill and keep the men contented and the costs moderate. No construction employee should be hired with greater care to determine his skill and responsibility than the camp cook. Few workmen can, because of personal inefficiency, directly and indirectly cost the job so much money as its cook. With the higher standards of catering set by war construction as examples, there will be more need than ever for the contractor to look well to the quality of his camp mess.

Motor Trucks Needed To Supplement Not Compete With Railways

THE radical changes in manufacturing industries resulting from the suspension of hostilities and the cancellation of munition contracts are paralleled by the changes in the transportation field. The competition between the railway and the motor truck is entering on a new phase. The motor truck has been an invaluable aid in the munitions industry, especially during railway congestion, because it could give prompt deliveries. Cost of service has been a minor consideration.

That condition has passed. The manufacturers and merchants are looking after their freight bills as sharply as they do to their purchases of goods; and to hold its place the motor truck must show as low a cost, all things considered, as the railway.

During the traffic congestion resulting from the war the railway managers have rather welcomed the diversion of business to motor-truck lines. With the relief of congestion the railways, naturally and properly, are seeking to regain their business, for profits in railway transportation depend directly on the volume of traffic, until the point of congestion and delay is reached.

Certain railway managers are making a careful study of truck transport costs in order to determine the field in which they can expect to regain business. Realizing that one chief advantage of the motor-truck service is prompt delivery, railway managers are making plans for a more rapid and systematic handling of small merchandise shipments over short-distance routes.

As several contributors have pointed out in the columns of this journal recently, the railway and the motor truck ought to supplement each other. Every engineer will heartily approve the recent declaration of Director General McAdoo, "Upon the efficiency of the transportation machine in America depends in great measure the future prosperity of the nation." This efficiency can only be secured by furthering the use of whatever type of transportation that can render the service desired at the lowest cost.

There is an enormous field for the motor truck in reducing the present heavy cost of terminal hauling—using that term in its broadest sense to include short-haul business between cities. It ought to be more generally understood that this is where the need and the opportunity for the motor truck lie and not in competing with the railways for traffic over long-distance routes.

When freight has been loaded into a railway car, made up in a train, and started on its journey, the railway can haul it at a cost per ton-mile which is often not 2% of the cost of hauling by motor truck. The average cost per ton-mile for all freight moved over the Pennsylvania R.R. in the year which ended June 30, 1916, was only 0.43c. This includes, of course, all the expense of handing in railway terminals as well as hauling over the road. Even on railways of very light traffic, the cost of hauling freight over the road seldom exceeds 2c. or 3c. per ton-mile. In contrast with this, the cost of hauling freight by motor truck, even over good roads, is seldom less than 15c. per ton-mile, and often exceeds 25c. This does not include, either, the interest, maintenance and depreciation charge on the road over which the truck runs.

The advantage of the motor truck over the railway lies in its ability to transport goods from the original to the final destination without rehandling. This eliminates the terminal expenses of the shipper and receiver as well as those borne by the railroad itself. These terminal costs on most merchandise shipments are several times the cost of hauling by rail, even when the distance is considerable. It is not at all uncommon to have the cartage charge on a freight shipment at destination equal the railway freight charge on a haul of several hundred miles. The larger the city, the larger, as a rule, are the costs of the terminal handling, both to the railway and to the shipper. The repeated rehandling of goods necessarily is, of course, a large element in these terminal costs, and on certain classes of goods the loss and breakage likely to occur in such rehandling counts very heavily in favor of the motor truck.

This whole matter is not one that interests merely the builders and operators of motor trucks and the railways. Its vital relation to the public welfare is obvious from the quotation from Director General McAdoo, already given. It is not possible to reduce much farther the cost of transportation by railway over long distances, but there are great opportunities for reducing the costs of movement at both ends. The problem here, furthermore, is as much a problem of organization as it is of the proper use of both railway and the motor truck to accomplish the work to which each is best adapted.

Is Interstate Communication Local?

ONLY a week or two ago the War Department reported against giving Federal aid to the construction of a highway tunnel under the Hudson River at New York, on the ground that such an improvement would serve local traffic and benefit local interests. Within the past few days, however, the Government has intervened in a boatmen's strike which stopped communication across the river, and thereby it has acknowledged in unmistakable manner the national importance of this communication.

If the port of New York—physically a unit, but cut in two by the New Jersey-New York state line as regards construction, planning and administration—concerns the nation sufficiently that the Federal Government may take a hand in its intercommunication problems, what shall be said of other places where there is interstate communication? Hitherto the Government has hesitated to approach problems of communication and transportation that are localized at state lines, though these are preëminently problems of interstate commerce. But what has been learned in the past two years about the urgency of transportation questions suggests that the time has come for a change of attitude.

Consider, as an example, the case of the Hudson River, which for 150 miles splits the country in two, without a single road connection and but one railway crossing. In this stretch the Federal Government has spent millions of dollars for facilitating traffic along the river, but not one dollar to help carry traffic *across*. No reason exists for this discrimination except policy founded on an ancient tradition: That rivers are proper subjects for Government appropriations, while bridges and tunnels are not. Shall we continue to let tradition control the allotment of vast sums of public money to works of construction?

Every important river forming a state boundary shows the same conditions existing. As in the case of the Hudson, each instance gives proof that interstate communication is important, and that it has become sunk in general neglect. Local interest, as experience has shown time and again, furnishes no incentive for dealing with the subject broadly, to take care of the whole country's interests.

The national concern in the question, then, is obvious. Interstate communciation is not a local issue. To secure the best adjustment of national, state and local interests in a specific case will not always be an easy problem, but the adjustment will be quite impossible so long as responsible Government departments continue to be guided by tradition rather than by present-day need.

Are Engineering Educators Seizing Their Greatest Opportunity?

ONE of the illuminating statements in the symposium from the deans of various engineering schools upon the effects of their experience with the Students' Army Training Corps (see *Engineering News-Record* of Jan. 2, p. 41, and p. 138 of this issue) is that by Dean Snow, who quotes the popular phrase, "We do not know where we are going, but we are on our way." A review of the replies in answer to the question on future needs and opportunities in engineering education and how they can be met will disclose a discouraging lack of definite ideas, in spite of the fact that the greatest success will come to those educators who best foretell the demands of the future. Do American educators need a reawakening to develop teacher-leaders in applied science? Is it too much to expect a combination of great power of achievement, such as America has shown in the war, with leadership in science? Can we not insist upon a degree of excellence in our schools and colleges such as we have just demanded from industry during the war? Is H. G. Wells right in calling English and American education a "loafer education" as compared with German depth and thoroughness? Have we in the past failed to develop power of sustained mental effort in the graduates of our engineering colleges?

These questions are now receiving the serious consideration of engineering educators, many of whom have been profoundly influenced by their recent experience. For while many colleges are returning to pre-war courses, yet individuals and committees are discussing proposed changes, and studying Dr. Mann's report with its "suggested solutions." Few have made or announced definite changes—some give an impression of being self-satisfied. The majority favor fewer highly specialized courses and a more thorough training in the fundamental core sciences. There is a general agreement that one result of the experience will be a peace issues course, similar in character to the war issues course given in all the S. A. T. C. colleges, to demonstrate the meaning of engineering work in the life of the world. One of the big lessons of the war is the possibility of arousing exceptional effort through the power of a real incentive.

The war experience suggests a solution of the problem of how to provide bread-and-butter training and at the same time meet the need for broadly educated men of limitless possibilities. This solution is a combination course coördinating general with highly specialized courses, using both the spur of discipline and the drawing power of incentive. The latter may be developed by showing the worth of academic effort, by tying it up to actual engineering work. In this combination, which in favorable localities may mean coöperative courses, such as developed by Dean Schneider at Cincinnati, the weakness of both extremes will be overcome—the superficiality and "bluff-it-through" attitude of graduates of general courses on the one hand and the narrow, materialistic results of overspecialization on the other.

The serious question of time limit in a four-year course should be met by using more of the synopsis method and leading the student to read and investigate for himself. This would develop originality and initiative, the necessity for which has been shown, by our war experience, to be so essential. Fewer lectures, refusal to permit teacher-specialists to dominate other departments, new tests for measuring acquired knowledge which will combine the objective tests proposed by Dr. Mann with the usual examination methods, would all tend in the right direction.

Perhaps the greatest need is for teachers with broad vision and practical experience in engineering life. Administrators of technical schools must realize that no price is too great to pay for educators capable of lifting the profession, through their influence on its young men, to new heights of accomplishment.

Government Directors for Railway Corporations

IN THE illuminating discussion of the question of what to do with the railways, by L. C. Fritch, in *Engineering News-Record* of Jan. 2, p. 18, one suggestion in particular is so important and valuable that it ought to be incorporated in any plan involving the return of the railways to company control.

Mr. Fritch urges that in addition to supervision by the Interstate Commerce Commission there should be on the board of directors of each railway company men appointed by the Government to represent the interests of the public. He says: "The policy of selecting able representative business men to act for the Government in such capacity would result in business management of the railways in the interests of the public, and would have a wholesome effect in railway administration."

This, we believe, is one of the most constructive and fruitful suggestions which has been made in the public discussion of the subject. Everyone agrees that there must be established a firm control over railway operations in the public interest, if they are to be returned to the companies. But all regulation by a commission, however constituted, is regulation from outside. What is needed in the public interest, and in many cases in the interest of railway security holders as well, is regulation from inside.

At any previous time it would probably have been impossible to have carried out such a reform successfully, because of the antagonistic attitude which would have been assumed toward such Government regulation. Railway managers and financiers, however, are viewing things through very different eyes from those they used half a dozen years ago, and Government-appointed directors of the right type would not have the uphill fight that would have been their portion a few years ago.

We say, "Government directors of the right type." Of course, if the authority to name directors to represent the public were made use of by the Government to take care of "lame duck" Congressmen and other needy politicians, or to put bureaucratic hacks in a position to exercise authority, the Government directors would be figureheads or worse.

Real and Unreal Progress in Steel Working Stresses

IF THE majority of the structural engineering profession of the country were in accord with the ultra-conservative limitation of column working stresses to 12,000 lb. base, as recommended by the Column Committee of the American Society of Civil Engineers a year ago and now reflected in a few new specifications, there would be reason to fear that engineering judgment is at fault. Structures proportioned for much higher stresses have given satisfactory service for many years, without the least symptom of trouble from excessive column stress. In view of this service efficiency, there is no solid ground to support the claim that steel columns loaded above 12,000 lb. are unsafe; on the contrary, the facts of experience must be taken to prove that a 12,000-lb. limitation will mean a waste of material.

There has been enough criticism of the committee's recommendation to make it probable that practice will be slow to accept it. Individuality of thought is a necessary factor in bridge engineering; committees, however, are often dominated by conservatism or even timidity. It is natural, then, that engineers should protest—as does Dr. Waddell in this issue—against any straitjacketing of structural judgment by the result of such tendencies.

Further tests on columns are surely desirable. But Dr. Waddell suggests a new kind of testing, using a truss or a bridge as a testing machine. The method has attractive aspects, but do we need it? Will it aid progress toward safety and full utilization of material?

The tests conducted for the Civil Engineers' committee, though laid out on a narrow plan and leaving many practical conditions unrepresented, yet produced data that establish a satisfactory basis for judgment on the strength of steel columns. Additional tests, then, should be precise experiments on specific questions of detail. To complicate such tests by introducing the elusive and erratic influence of truss distortions is not likely to meet this requirement.

However, if further testing of heavy members is to be initiated, tension members offer the field of greatest promise. It is true we have ample data on eye-bars. On the other hand, less is known about the strength of the large riveted chords and diagonals of modern bridges than about any type of compression member. It may well be said, therefore, that tensile working stresses are involved in greater uncertainty than column stresses.

Despite this fact, a tendency is distinctly observable toward increase in tensile unit stresses even while—since the report of the Column Committee—the compressive units are being pared down. It is remarkable that this should be the case, in the absence of test knowledge. Manifestly, those who propose to increase stresses aim in the direction of true progress, by way of safety and economy. But we think it may be fairly objected that they secure these objects in divided form—safety in the compression members, economy in the tension members. Is it not necessary, at this stage, to inquire whether test data and sound judgment warrant a raising of tensile stresses to eighteen or twenty thousand pounds and a lowering of column stresses to twelve?

While refinement of analysis and design has been helping us on toward maximum utilization of material, we have adhered to the large margins of ignorance that were established in the early days of the structural art. An increase of working stresses, then, is needed, and if all signs do not fail such increase is sure to come about —at least for those structures which do not involve the perplexing uncertainties of change of railway loading. These stress increases, however, will be based on dependable knowledge of strength, test knowledge, or they cannot be permanent steps of progress. Change such as represented by an indiscriminate increase in the tensile units, while we know nothing whatever concerning the strength of large riveted tension members, is not entitled to rank as true progress.

Electric Drive for Warships

IN THE great superdreadnought "New Mexico," as our readers are well aware, the United States is possessed of the first electrically driven battleship in the world. True enough, we have already had a "trial horse" in the collier "Jupiter," which proved a rather conspicuous success, but the step from a collier to a fighting ship of the highest class is a considerable one, and it is gratifying to know that it has been most successfully taken.

There is nothing mysterious about the general principle involved—that of a high-speed and light-weight generating set furnishing current to variable-speed driving motors. To all intents and purposes, the electrical part of the equipment is a very efficient variable-speed reducing gear. The basic idea behind the electrically driven ship was the intent to take advantage of the great simplicity, compactness, convenience and weight efficiency of the steam turbine, so as to adapt it to marine purposes. No one would have had the least desire to use electrical drive in connection with reciprocating engines.

The steam turbine, of course, in its present stage of development, possesses the qualities just mentioned in an extraordinary degree, and the one thing which stands against it is that these qualities are virtually dependent on the extremely high rotative speed necessary for efficient design, a speed at least ten times greater than can be advantageously used on the propellers of a large ship. To utilize the steam turbine in marine practice implied either an enormous increase in the propeller speed or a great reduction between the turbine and the screw. The former alternative implies, owing to increased friction and slip, a very great loss in the propeller efficiency, so great that it would outweigh, several times over, any conceivable gain by the use of the steam turbine instead of the reciprocating engine. But at its best the steam turbine has such remarkable efficiency from the thermal standpoint that one can readily afford the losses in almost any sort of well-designed reducing gear. As an example of what a turbine can do, it is only necessary to quote the guaranteed performance of a turbine recently installed for land service, which at 14,000-kw. load brought the steam consumption down to 10.45 lb. per kilowatt-hour, equivalent to 0.78 lb. per brake horsepower-hour. Obviously, at this low steam consumption one could well afford considerable loss in a reduction gear while still retaining a fuel consumption of about one pound of coal per horsepower-hour. On the other hand, the losses in trying to use a propeller at the turbine speed would more than nullify the advantages of a turbine.

As between the mechanical gear and the electrical gear as a means of speed reduction, the advantage of cost and weight lies with the former, but that of speed control, subdivision of power in the propellers, and general flexibility, enormously with the latter. In the mechanical sense, too, the electric drive is almost frictionless, the losses being thermal instead of mechanical, and so not expressible in terms of wear. So, whatever success may have been attained with gearing in relatively simple cases for naval use, the electrical gear was a logical recourse. One need not go here into details of the equipment of the "New Mexico," which will undoubtedly be very fully described, now that the war is at its close, in the technical journals specializing in such matters. In brief, she is equipped with two 11,000-kw. turbo-generators which furnish the power to four 7000-hp. driving motors. As the induction motor is essentially a constant-speed machine, the intermediate and lower speeds are obtained by varying the turbine speed, which can be done within moderate limits without too serious effect upon its efficiency. For low speeds one generating set can handle any or all of the motors that may be necessary, and either set can be put upon any motor connection that is necessary.

This arrangement gives a beautifully efficient and flexible drive, and its advantages for naval use are of momentous importance, perhaps not yet fully realized. In fact, it is probably not too much to say that the electric equipment of the "New Mexico" opens a new era in naval architecture. The dimensions of the turbo-generators and of motors are such that they can be kept low in the ship, exceptionally well protected beneath the water line and armor. The motors, too, can be located so as to maintain the best structural relation to the propellers which they drive.

The United States stands committed already to six battleships and five battle-cruisers equipped with electrical drive, and the success of the "New Mexico" is prophecy of the great future that lies before the system. Nor is it likely to be confined to ships of the battle line, for its advantages would be especially valuable in the large, fast cruisers which form the everyday working force of a well ordered navy, ships uniting great radius of action, very economical cruising speed for their long swings about the Seven Seas, and prodigious power when it is necessary to drive them.

Huge Steel Buildings at Ordnance Base Depot in France

Project Includes Both Shops and Warehouses—All Material Supplied from United States—Ten-Mile Transmission Line Built to Supply Electric Power for Machine-Tool Operation

All photographs by "Engineering News-Record"

By Robert K. Tomlin, Jr.
War Correspondent of "Engineering News-Record"

This article was written last summer and delayed in transmission. It is published at this time just as written by Mr. Tomlin, because of the great interest in the work of our engineers in France.—Editor.

Into the construction and equipment of the main Ordnance Base Depot for the American Expeditionary Forces is entering about 60,000 tons of material, practically all of it shipped from the United States. Covering a site of many acres, the 10 big steel structures, now almost completed, represent one of the largest building projects undertaken by United States forces in France. Certainly, it is the largest project involving the exclusive use of structural steel; yet, in spite of the diversity in size and character of the several buildings, standardization has been carried to such a point in the designs prepared for the Ordnance Department by the firm of Stone & Webster that only 148 different kinds of pieces are required for the entire work, this number including not merely main steel members, such as columns, rafters and purlins, but also such small accessories as anchor-bolts, tie-rods, clips and angles.

The buildings already erected (Aug. 15) comprise the following: Two gun-shops, each 245 x 600 ft. in plan; one reamer shop, 182 x 240 ft.; two warehouses, each 240 x 500 ft.; one carriage machine shop, 227 x 500 ft.; one carriage assembly shop, 240 x 500 ft.; one woodworking shop, 200 x 320 ft.; one forge and foundry shop, 160 x 245 ft.; one substation, 40 x 60 ft. This program alone represents steel-frame buildings covering a ground area of 917,000 sq.ft. As future possibilities there are, in addition, two tractor shops, each 245 x 600 ft.; two warehouses, each 240 x 500 ft., duplicating those already built; and a small-arms shop 240 x 500 feet.

All Material Shipped from America—After an investigation of the material markets of France more than a year ago, it was decided to send over from the United States everything needed for building and fitting out the ordnance shops and warehouses. This meant a tremendous amount of advance planning, for provision had to be made not merely for the structural-steel frames, roofing and glazing, but also for a big schedule of machine tools, cranes, electric-lighting fixtures, power equipment and construction plant. The job had to be figured down to the smallest detail, purchases made in America and shipping schedules laid out.

The unusual character of the work, in which the questions of a 3000-mile transatlantic trip for everything entering into the construction, and the probable use of labor entirely unfamiliar with steel erection, were the controlling features, made the preliminaries a subject of prime importance. To have started work in France and then to have discovered that something had been forgotten would have meant not a delay of a few weeks waiting for its arrival, but a setback of months, for material could not be delivered quickly from the United States to France under conditions of shipping existing early in 1918. Foresight in ordering materials has been a big factor in aiding progress.

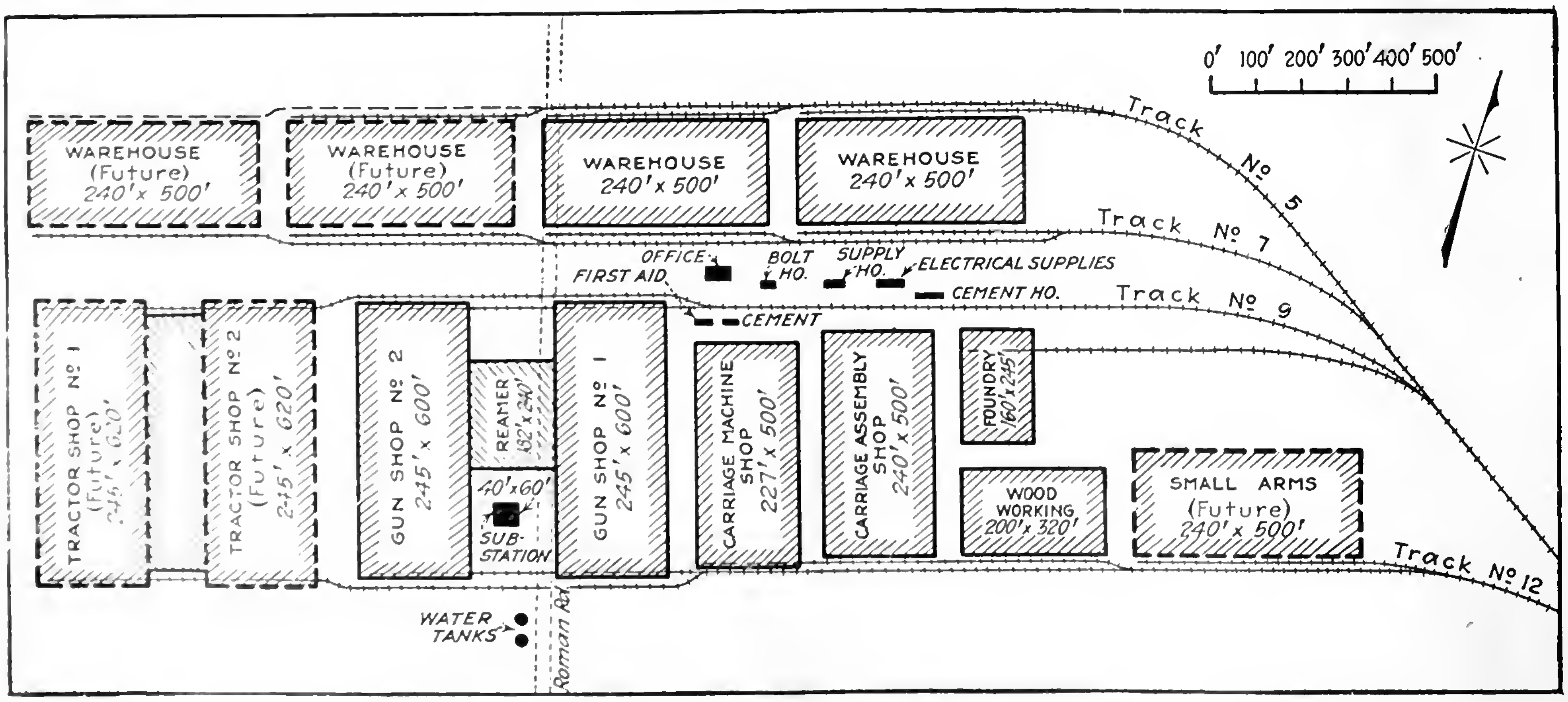


FIG. 1. GROUND PLAN OF THE ORDNANCE BASE DEPOT IN FRANCE SHOWING PRESENT BUILDINGS (JUNE 1918) IN SOLID LINES, AND CONTEMPLATED ADDITIONS IN DOTTED LINES

FIG. 2. DETAIL OF COLUMN FOOTINGS, SHOWING CORRUGATED IRON FORMS FOR CONCRETE

History of the Project—The history of the Ordnance Base Depot in France dates back more than a year, when the contract for the design, purchase of materials, and supervision of construction was awarded to the Stone & Webster organization. The project as originally laid out was described in *Engineering News-Record* of Jan. 3, 1918, p. 13. Many changes, both in the actual layout and the handling of the work, have taken place since those days. It is worth while to present a brief historical outline, for without it no true conception of the project and the working conditions is possible.

Unlike most of the Army engineering work in France, the Ordnance Base Depot has involved the participation of a civilian organization, not only in the design but also in the handling of materials and the supervision of construction. This resulted in the creation of certain special conditions which had their influence on the conduct of operations in the field. To begin with, a civilian organization in the American Army zone of France is not in a position to order things done by military units. There must always be some intermediary. This applies not merely to the actual handling of labor, but to another matter equally as important—transportation of materials. The site of the job is quite a distance from the nearest base port, and, in fact, from the nearest railway station. When railway cars or motor trucks are needed, arrangements for them cannot be made directly; everything must go through military channels.

The status of the civilian representatives was, therefore, somewhat anomalous. As events have turned out, their duties have been largely supervisory. Instead of officially directing the job, and being responsible for its progress, the civilian engineers and superintendents have acted as consultants, rather, giving advice as to the conduct of the work and placing their construction experience at the disposal of such officers as cared to avail themselves of it.

Labor Scarce—One of the earliest difficulties encountered was the matter of labor. The intention was to have the Ordnance Base Depot built by the enlisted personnel of the Ordnance Department, with the Stone & Webster representatives acting as superintendents. The vanguard of the Stone & Webster forces had arrived in France in September, and about the middle of October the Ordnance Department officers who were to have immediate supervision of the project arrived. After some time was spent in examining possible sites for the plant, a definite location was fixed late in October, 1917, and steps were taken to obtain the land from the French. One of the first jobs to be done was the construction of a railroad siding connecting the site with the nearest French railroad line, for material was beginning to arrive in France and means were needed to deliver it to its destination. As all sidings, railroads, camps and other accessories for this project had been assigned to the Army engineer troops for construction, a detachment of engineers was placed on this work and the siding was put in the latter part of January, 1918.

While this was the first step in actual progress, other difficulties were to follow. There were no unloading facilities at the site in those early days and labor was scarce, as a detachment of ordnance troops scheduled to arrive had not reached the job in the numbers expected. Meanwhile, the engineer troops which had put in the railway track began to construct barracks for the working force, and finally began the actual job of putting up the steel buildings for the base depot. In the meantime a detachment of 600 Chinese had appeared on the scene and they were set to work unloading cars and distributing material.

As time went on, however, material still continued to arrive, the labor force began to build up, and the civilian representatives continued in an advisory capacity, assisting in the layout of the work, the routing of materials and the supervision of the steel erection. Ordnance and engineer units in varying numbers came and went, and by the middle of April about 1200 men were on the job. Since then, the force has carried between 1200 and 3000, and on July 1 it numbered about 2500.

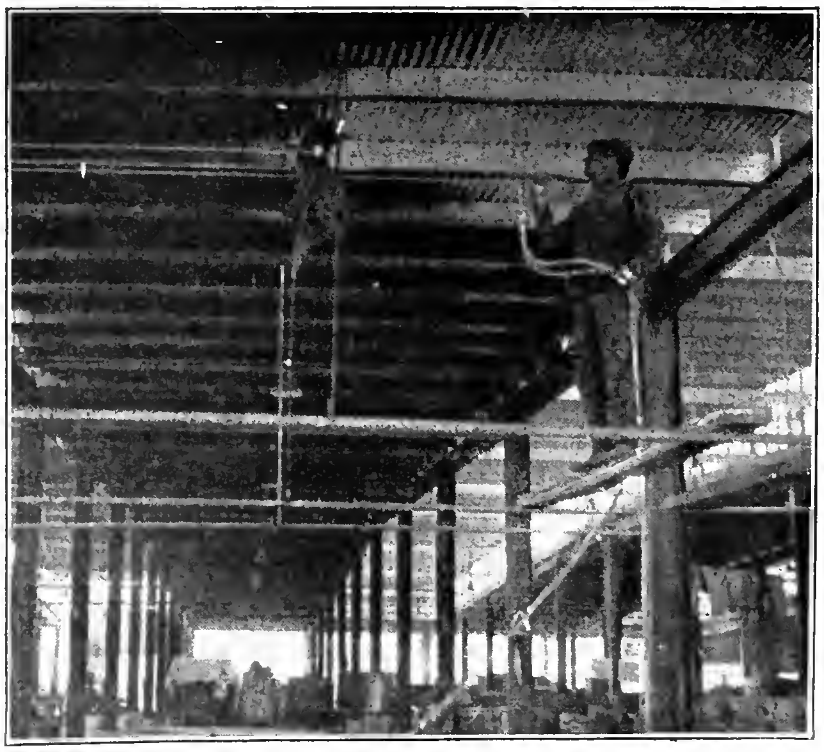


FIG. 3. INTERIORS OF STEEL STRUCTURES ARE PAINTED WITH COMPESSED AIR SPRAYS

The labor force, however, was never constant. In the case of detachments, these would come and go, or, even if they remained, details would often be removed from construction operations and assigned to other duties. The conditions with respect to these troops

are best expressed by one of the officers who, in discussing the difficulties due to the lack of a permanent working force, said that many of the detachments he received "merely filtered through the job." It became necessary, therefore, to train successive batches of men as they arrived, and to lose the benefit of this training when they were removed. The engineer troops, however, remained, and their number was greatly increased by the addition of other units.

FIG. 4. CONCRETE FOR MACHINE TOOL FOUNDATIONS CARRIED IN METAL-BODIED WHEELBARROWS

Between the commanding officer of the engineers and the members of the Stone & Webster organization still on the job there has developed a spirit of cordial coöperation. In fact, during my visit to his headquarters, this engineer officer said to me: "Too much cannot be said for the help which has been rendered by the civilian superintendents and engineers. We are all glad that we have had them here on the job."

Additional engineer battalions arrived at the Ordnance Base Depot site about Mar. 1. In reply to my question as to what he had available for commencing work, Major F—, commanding, replied, "Nothing but snow." He started his men on excavations for the column footings of the big steel buildings and assigned a labor crew of about 500 Chinese to unloading material which was beginning to arrive in large quantities on the newly built sidings connecting with the double-track French railroad.

In the early days of this work everything had to be unloaded by hand, as no locomotive cranes had arrived. It was no easy job to remove some of the steel members from the short French railroad cars, on account of the limited clearance at the ends. With the material out of the cars the problem was by no means solved, because at this time of the year, with the frost leaving the ground, the site was a veritable mud sea—so soft, in fact, that the two-wheel pick-up carts used later for transporting steel columns, rafters and purlins sank in so deep that they could not be moved. At this time all of the steel-work was transported from railway truck to building site in slings carried by Chinese.

There are in the new ordnance depot two general types of building, the warehouse and the shop. The warehouse structures have 10-in. I-section columns spaced 20 ft. on centers, all of the columns being of one length and therefore interchangeable. The roof slope is obtained by varying the elevations of the concrete footings on which the columns rest. The steel frames of the warehouse buildings are sheathed with plain, corrugated, galvanized-iron sheets. A single warehouse structure 240 ft. wide and 500 ft. long involves the erection of 410 tons of steel. Including other accessories, such as corrugated siding, roofing, doors and glass for windows, the total weight of the material entering into a warehouse of the dimensions given above is about 700 tons.

FIG. 5. PACKING CASES SUPPLIED ALL THE WOOD FOR FORMS OF MACHINE-TOOL FOUNDATIONS

While the shop buildings are of the same general type as the warehouses, they differ in certain important details. In the first place, structures such as the big gun-shops will be equipped with traveling cranes in every bay. The column spacing for the shop buildings is 35 ft., as compared with 20 ft. for the warehouses. The columns themselves are heavier, built-up members, in order to carry the crane loads. In the case of the shops, the roof slopes are not obtained by varying the elevations of the column footings, but rather by setting at the proper elevations, by means of a flexible splice, light extensions of the main columns. In other words, the heavy columns are bored with holes for some distance at their tops, and the lighter extension members supporting the roof are bolted to them at the the elevation desired.

FIG. 6. CRANE WHICH HANDLES EXCAVATION FOR GUN-SHRINKING PIT

In the matter of the concrete footings for the columns there is also a difference between the warehouse and the shop structure. In both cases the footings are cylindrical. A plain footing serves for the warehouse, inasmuch as the columns carry only the dead

loads of the roof, but a spread footing is used under the shop columns which support the craneways.

In one other detail also the two types of buildings differ. Warmth in the completed warehouse structures is not a matter of any great importance, and the sheathing, therefore, is of plain, corrugated sheets, galvanized. In the shop structures, however, the force of men will be at work winter and summer, and to conserve heat the sheathing adopted for the sides is asbestos-protected metal.

As indicated in the first paragraph of this article, every effort has been made in the design to standardize the lengths and cross-sections of members and to reduce to the minimum the number of all the different kinds of pieces. All connections are bolted and only two sizes of bolts, $\frac{5}{8}$-in. and $\frac{7}{8}$-in., are employed. The fact that all of the huge structures indicated by solid black lines in Fig. 1 have been erected by labor a large percentage of which had absolutely no previous experience on steel-work is a tribute not only to the engineers who supervised the erection, but also to the men who designed the structures which could be thus handled in the field.

One detail of the spread footings for the shop building columns should be noted. Practically no wood was available for concrete forms, and it will be seen from Fig. 2 that corrugated sheets intended for the siding of the buildings have been bent and employed for concrete forms.

In the early days of the steel erection, which was started Mar. 28, no plant was available, and gin-poles were rigged and used for hoisting the roof members into place. Later, however, auto-cranes of the type shown in Fig. 10 and hoisting engines (see Fig. 9) arrived and greatly expedited steel-erection progress. One rafter was always bolted to a column on the ground, and the two members were raised to place simultaneously.

The original plans contemplated the use of a thin cement layer on top of the corrugated roofing, but on account of the scarcity of cement and sand this feature had to be eliminated. The roofing actually in place consists of a full mop of pitch, two plies of roofing felt and tar, and one ply of finish roofing, the latter being laid in strips with a lap of 6 in. On the buildings thus far erected for the Ordnance Base Depot the roofing item alone involves the covering of an area of nearly 1,000,000 square feet.

The interior of the buildings is painted by sprays (Fig. 3), supplied with air from portable compressors, gasoline-driven. These machines also supplied air for reaming and drilling tools used in connection with the steel erection and electric wiring.

During my visit to the job a large percentage of the glazing had been finished on the shop buildings. Wire-glass is employed for the monitors, while the side-wall sash is fitted with ribbed factory glass. Like everything else entering into the work, the wire-glass was supplied from America. On such a long trip and in the reloading in France, a certain amount of rough handling was inevitable, but even those panels which are cracked are entirely serviceable, as the wire reinforcing holds the plate rigid. Sheets of glass with cracks radiating across their surfaces like spider-webs are set up in the monitors and are performing efficient service. The use of wire-glass has effected a substantial item of saving, because it has rendered unnecessary the replacement of breakage. This is not the case with the plain ribbed glass. At a time when the demand for glass in France has been increased by the bombing and long-range bombardment of cities by German airplanes and guns, it has been possible to use at the Ordnance Base practically all of the wired glazing which we brought over here, rather than go into the French market for it.

The machine tools with which the shops will be equipped include practically everything up to huge gun-barrel lathes 60 ft. long. There is demanded, therefore, a very sizeable yardage of concrete in the foundations for this equipment. The excavation is made by pick and shovel, and for the concrete a number of portable $\frac{5}{8}$-yd. mixers, such as those shown in Figs. 4 and 5, are employed. The delivery of cement and aggregate to the machines and the transporting of the concrete to the forms are handled by metal-body wheelbarrows, of which there are a great number on the job. They are employed not only for the delivery of concrete to machine-tool foundations (Fig. 5) and column footings, but also for distributing the earth fill for the floors.

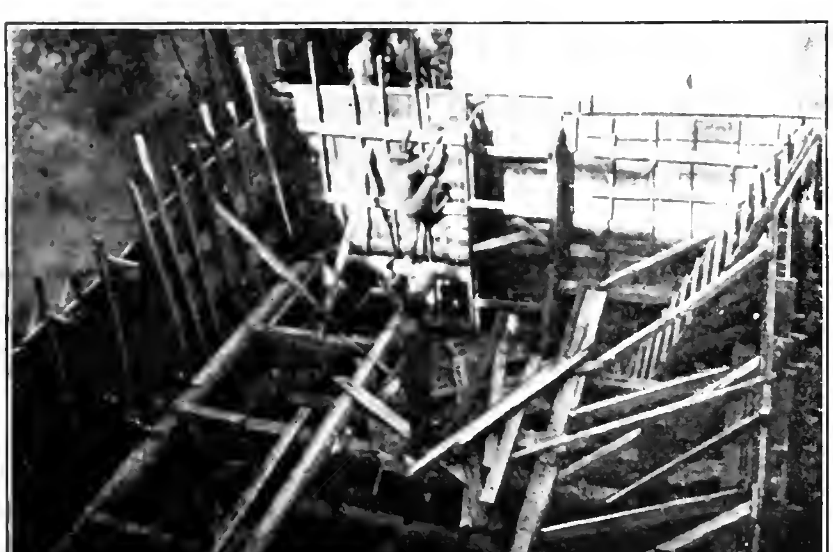


FIG. 7. WOODEN FORMS IN PLACE FOR CONCRETE LINING OF GUN-SHRINKING PIT

FIG. 8. CORRUGATED IRON SHEETS FORM INCLINED CHUTES FOR LINING GUN-SHRINKING PIT

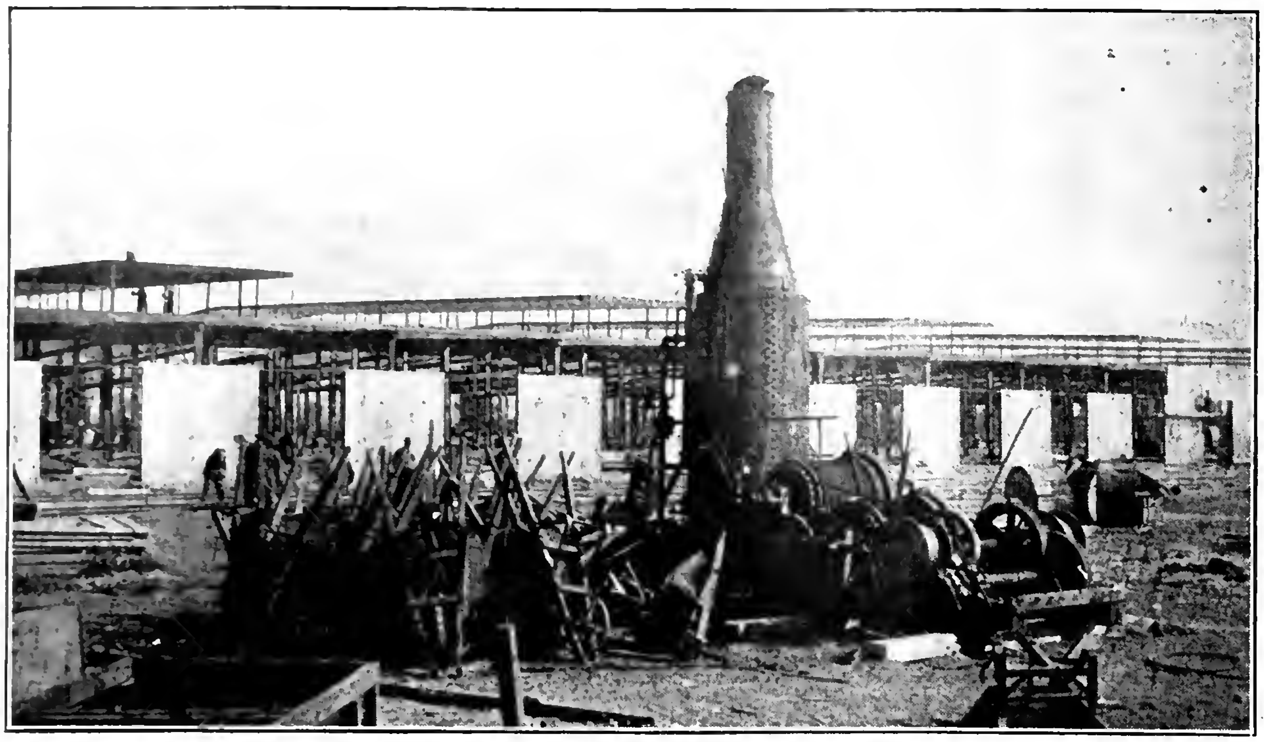


FIG. 9. IN BACKGROUND, STEEL WAREHOUSE STRUCTURE PARTIALLY SHEATHED; IN FOREGROUND, HOISTING ENGINE USED IN STEEL ERECTION

Wood is at a premium on the Ordnance Base job, and the sight of packing-cases broken up and used for concrete forms is such an old one in France now as hardly to attract attention. Practically all of the forms for the machine-tool beds are made of packing-case lumber. Another place in which this lumber is serving is in the gun-shrinking pit at one end of the gunshop. Here a rectangular excavation 20 x 35 ft. in plan and 25 ft. deep was taken out with the aid of a clamshell bucket and a crane, as shown in Fig. 6. This pit is being lined with concrete, mixed in a paving mixer. An interesting detail of the work of placing the concrete is the improvised inclined chutes shown in Fig. 8. These are merely the regular corrugated sheets used for the siding of the warehouses, and bent into the form of a trough.

The patchwork character of the framework in the shrinking-pit, due to the scarcity of lumber, is also plainly indicated in Fig. 7. The concreting of the floor of the pit was rendered difficult by a flow of underground water amounting to 600 gal. per minute. Pumps had to be installed before the concreting work could proceed. While on the subject of concreting, it is well to mention the difficulty of obtaining cement, sand and coarse aggregate. One of the superintendents told me that the job has been out of concreting materials for 10 days at a time.

Shipping Details Systematized—With the tremendous number of crates reaching France it is important, to insure prompt delivery at the right destination, that all packages be properly marked. To this matter the shipping end of the Stone & Webster organizations in the United States and in France gave particular attention. Every crate intended for the Ordnance Base Depot carries on its side a triangle and the initials "S. W." painted in black, together with a complete description of its contents.

The explicit marking aids in the routing of the crate to its proper place on the job. Initials O. B. D. in the triangle identify the crate at once as intended for the Ordnance Base Depot. The serial and package numbers aid in checking invoices; the plant and building numbers leave no doubt as to where the machine is to be installed.

For the handling and routing of Ordnance Depot material arriving in France men were stationed at every base port. Shipments leaving the United States may arrive at any one of several ports—no one knows in advance the point of landing. The method followed in checking up was substantially as follows: On receipt of a ship's manifest at a base port the representative at that place would at once communicate with his headquarters office and receive instructions as to routing of the material, for half a dozen of the ordnance buildings were set up at other sites than the main depot. The record of the material received was made in the form of a quadruplicate report. One copy of this report went to the administrative headquarters in France, two copies were sent to the job, and the fourth was retained by the checker at the docks. The two copies reaching the job were checked up against material actually delivered, one copy was retained for the job files, and the other was sent to administrative headquarters as a receipt of the shipment. On Aug. 15, 2400 carloads of material had been delivered to the base depot and 48 carloads were en route.

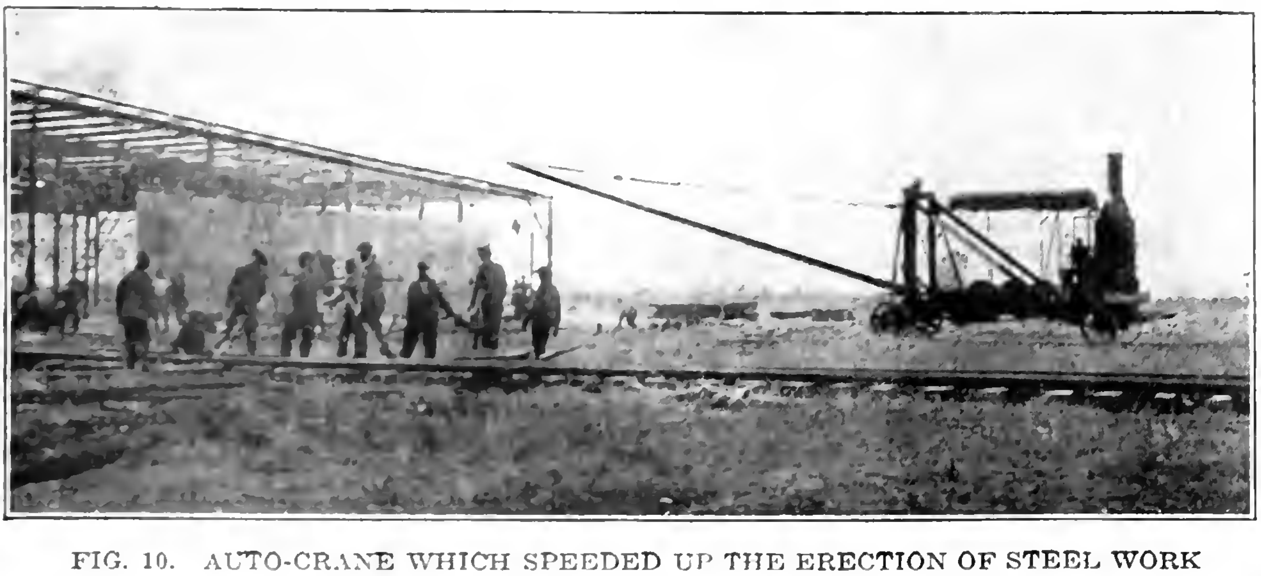


FIG. 10. AUTO-CRANE WHICH SPEEDED UP THE ERECTION OF STEEL WORK

Construction Plant—While construction plant did not arrive in time to aid in the first stages of the job, notably in building the railroad siding, and in unloading the first shipments of material, a considerable number of machines of various types was delivered later and have been responsible in large measure for the progress made. "We didn't even havea track jack when we began the railroad work," said a captain of engineers,

in telling me of the early difficulties encountered. "Mud was one of our chief enemies early last spring, and the use of wheeled vehicles for distributing material around the job was simply out of the question. Why, in walking across the site of the gun-shops the mud would build up on a fellow's boots in a broad, flat cake, so that after he had been going awhile he looked as if he had snowshoes on his feet."

The following table lists some of the more important construction plant used in building the Ordnance Base Depot:

Type of Machine	Number	Kind of Work Done
Locomotive cranes	2	Handling steel and crates
Steam shovels (¾-yd.)	2	Railway excavation
Hoisting engines	6	Steel erection and miscellaneous
Auto-cranes	2	Steel erection
Traction crane and bucket	1	Excavation of shrinking pit
Portable air compressors	4	Drilling, el work, reaming and spray painting
Stiffleg derricks (10-ton)	4	Not yet set up
Road roller	1	Rolling floors
Wheelbarrows	Several hundred	Concreting and earth moving
Concrete mixers		Concreting column footings
Pavers	4	Machine tool foundations, and lining shrinking pit
Portable (¼-yd.)	12	
Locomotives	3	Handling cars

There is an abundance of concrete mixers on the job. Those in use are serving the column footings, the machine-tool foundations and the shrinking-pit lining. The change in plans whereby concrete flooring for all of the shop and warehouse structures has been eliminated has left many of the mixers idle, and they will probably be shipped to other points in France where there is a demand for them.

For the Army all construction work at the big base depot is under the immediate direction of Major F—, commanding the 501st Engineers, which consists of four companies of about 250 men each. One of these companies, however, has been assigned to duties connected with the handling of a railroad yard some miles away. In addition, there are detachments of ordnance units, several hundred Chinese, negro labor battalions and a so-called detachment of Spanish labor. Referring to the last unit, Major F— told me that shortly after the men had arrived on the job his interpreter came into the commanding officer's barracks looking absolutely fagged out.

"Did you get things all straightened out with that Spanish outfit?" inquired the major.

"Spanish!" sputtered the interpreter; "I've checked them over, and there are fourteen different nationalities represented in that bunch. Anybody that wants my interpreter's job can have it right now."

Wages for Foreign Labor—The Spanish labor is paid from 8 to 12 francs per day and board. Chinese labor is cheaper. The Orientals receive a minimum wage of four francs daily, plus food and lodging, and in addition there is a payment of 1.50 francs per man per day made to the French for the privilege of using this labor. The Chinese are good on simple jobs involving repetition of operations. For example, in connection with some of the roof work, 50,000 pieces of wire had to be cut to a certain length and twisted to a certain form. One of these pieces was made up as a sample and turned over to a detachment of Chinese. The remaining 49,999 pieces turned out by the Chinese did not vary a hair's breadth from the original model. "They copy a thing of this sort so perfectly," said Major F—, "that you would think the job was handled by a machine."

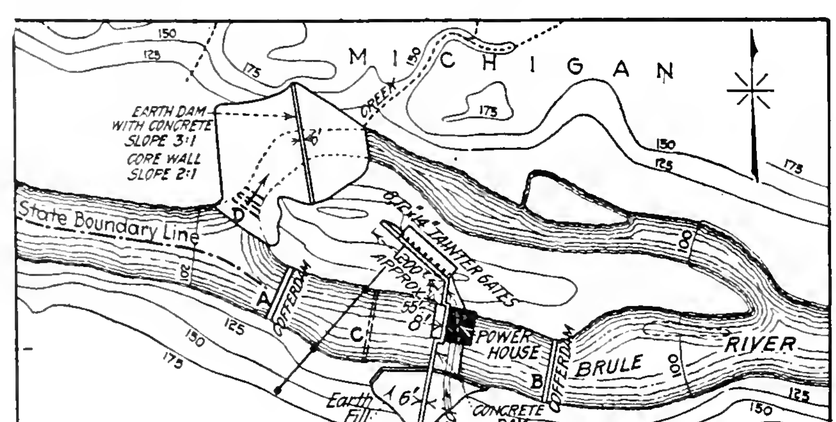
What the advent of mechanical plant on the Ordnance Base construction has meant in speeding up the job is indicated by one illustration. The steel-work for the first warehouse, 240 x 500 ft. in plan, took about three weeks. For the second, after the auto-cranes, hoists and other plant were available, the time of steel erection was about 4½ days.

Closure of Concrete Dam Completed Behind Needle Dam

Two Channels Formed by Island Simplify Problem of River Control by Cofferdams in Water-Power Plant Construction

EXCEPTIONAL use of cofferdams solved the problem of stream control in constructing the new Brule River plant of the Peninsular Power Co., in Wisconsin. Besides dams for diverting the stream and inclosing the construction operations in the stream beds, an ingenious combination of needle and flap-gate cofferdam was devised for backing up the water while making the closure of the concrete portion of the dam left open to pass the flow during construction.

Where the new power plant dams the Brule River, high banks inclose the stream and an island divides it into two channels, as shown by the map. The power



FLOW OF STREAM DIVERTED ALTERNATELY TO NORTH AND SOUTH CHANNELS

house and a short section of concrete dam close the south channel. The north channel is closed by an earth dam with a concrete core wall. On the low part of the island is a second short concrete dam and a spillway of Tainter gates.

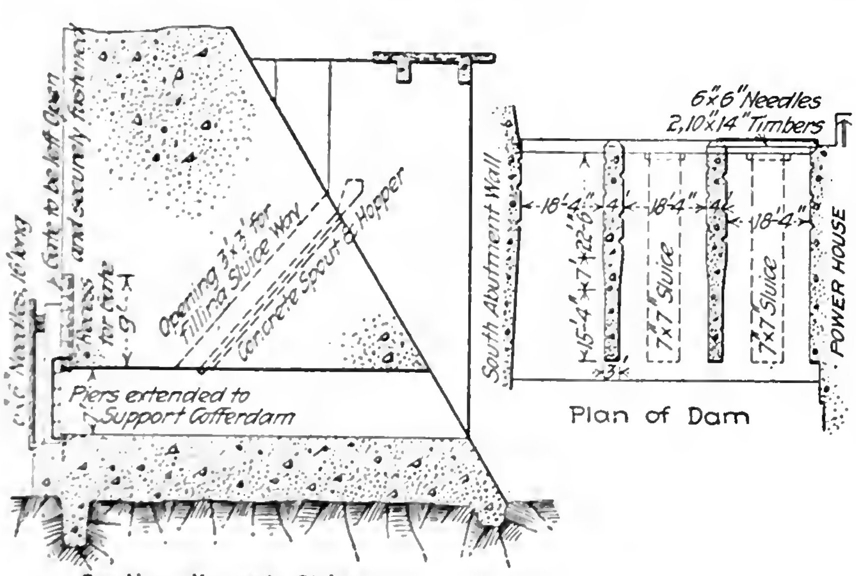
Construction was begun in June, 1917, and will be completed in 1919. In general, the plan of procedure has been: First, diversion of the stream through the north channel, and construction, to above water level, of concrete structures in the south channel; second, rediversion of the stream through the south channel, and construction of the earth dam in the north channel; third, the backing up of the south channel flow and completion of the closure of the south channel dam. Operations 1 and 2 have proceeded simultaneously, in some measure.

Work began on the south channel structures. Near the head of the island a cofferdam, A, was carried across the channel. Here the water had a maximum depth of

5 ft., and the stream bed consisted of gravel and boulders overlying bedrock. A rock-filled timber-crib dam was constructed and sheeted on the upstream side with 2-in. tongue-and-groove planks. This dam diverted the stream through the north channel. To protect the lower end of the works from back flow a second cofferdam, B, was constructed. Water here was only 2 ft. deep, and a dam of A-frames, sheeted on the downstream side with 2-in. tongue-and-groove planks, met the requirements. Dams A and B inclosed the south stream bed operations.

Seepage through the upper dam A was small, but to reduce pumping as much as possible a secondary earth-fill dam, C, was constructed about 200 ft. downstream. A fall of about 2 ft. between the upper and the lower main dams permitted a sluice, located along the south edge of the island, to carry the water ponded by the secondary dam to a discharge below dam, B. Two 4-in. diaphragm pumps then unwatered and kept dry the stream bed needed for construction.

Under the power house and south dam, bedrock lay only about a foot below stream bed. Excavation to get to sound rock was a hand-loading and dump-cart operation. Construction of the power house and of the two wings of the concrete dam followed. For the south wing of the dam only the foundations and the south abutment were completed; the dam section proper, as shown by the drawings, was left open except for two narrow diaphragms, of the section of the dam, which were built up like two piers and which divided the opening into three 18-ft. sluices for passing the stream until closure. The power house and the north wing of the dam were constructed complete. After completion of the south channel structures, as described, a cofferdam,



NEEDLE COFFERDAMS BACK UP WATER FOR FINAL CLOSURE OF THE DAM

D, was built across the north channel and the stream rediverted through the south channel and the sluices in the south wing of the concrete dam.

Excavation was next begun for the core wall of the earth-fill dam across the north channel. The core-wall trench was carried down 18 ft. below the stream bed. After the core wall was concreted, as described later, the earth fill was begun. A ¾-cu.yd. steam shovel loaded the earth in 1½-cu.yd. dump cars which traveled to and dumped into the fill.

The concrete construction included the south channel dam shown in section by the drawing; the foundations, forebay and wheel pits of the power house; the foundations and piers for the Tainter gates, the core walls and the necessary dam abutments.

All the concrete was mixed at and distributed from a plant on the south bank of the river. Here the mixers were set at an elevation about 4 ft. above the dam top. Two steam-driven mixers of 12- and 16-cu.ft. capacity, and one electrically driven, 16-cu.ft. mixer constituted the plant. Only one mixer was operated, the two others being spare units. Storage bins for gravel were constructed above the mixers and a cement house alongside them. Gravel was excavated from a bank about ½ mile from the mixing plant, and was hauled in dump wagons to an elevated road above the bins, and thence dumped into the bins. Cement from a railway at Florence, Wis., was hauled by wagons to the same elevated road, and thence chuted into the cement house.

The concrete for the lower portions of the work was chuted to a hopper at the foot of the bank. As the work progressed, the hopper was raised. Distribution from the hopper was by two-wheeled carts. Even the concrete for the core wall of the north channel dam was hauled by carts over the power-house site, dams and spillways. For winter work the concrete materials were heated by means of perforated steam pipes in the bins.

Closure of the south wing of the concrete dam was to be accomplished by backing up the water. As shown by the drawing, one of the 18-ft. openings will be closed by 6 x 6-in. needles. Behind this needle dam the gap will be filled with concrete, except for a 7 x 7-ft. sluice, which will be fitted with a wood flap-gate. The second and third gaps will be closed by similar methods, except that the third gap will be completely closed. Until the final raising of the water the two 7 x 7-ft. sluices will remain open. At that time the gates will be closed, and the sluices will be filled with concrete by means of the spout indicated on the drawing.

J. R. McDonald, Black River Falls, Wis., is general contractor for this work on a cost-plus-fixed-sum basis. Daniel W. Mead and Charles V. Seastone, Madison, Wis., are the chief engineers, the entire work being done under their supervision. They are represented on the work by A. M. Trester. O. C. Davidson, Iron Mountain, Mich., is the president of the power company, and F. E. Turneaure, Madison, Wis., is the secretary-treasurer.

Work at Head Office of Highway Department

That the routine work in the main office of a state highway department is large is shown by the report of H. Eltinge Breed, first deputy highway commissioner of New York State. This report, recently issued, covered the year 1917. Some of the work reported consisted of the following: Making 31,689 blueprints and 4643 white prints, of which 4178 were on cloth; 335 sets of highway plans on cloth, averaging 12 sheets each, 609 sets highway plans on paper, averaging 13 sheets each; 5385 prints of 500-ft. scale maps; 3000 cross-section prints; 2700 right-of-way prints; 5500 maintenance and repair prints; 6500 miscellaneous prints of forms, etc. A total of 149,504 sq.ft. of paper and cloth was used for this purpose.

Developments in the Practice of Laying and Manufacturing Paving Materials

War-time restrictions have had a marked effect upon progress in the field of pavement construction. Output has been cut to a minimum, by both Government regulations and by uncommon economic disturbances. However, the following statements, obtained at the solicitation of "Engineering News-Record" from representatives of manufacturers of various materials, indicate that there has been considerable advance in the adoption of methods heretofore considered experimental, and that economies have been fostered or forced by the abnormal conditions. It is shown that much greater attention is being paid to proper drainage, smoothness and other details of construction, and that maintenance methods are being more closely studied. Mortar-bed or other rigid construction has become practically established for all types of block pavements, superseding the old sand-cushion design. Interesting adaptations of paving materials to war purposes are also recorded.—EDITOR.

Asphalt Block Adapted to War Purposes

By Edwin J. Morrison
President, National Association of Asphalt Block Manufacturers

NOTHING notable was added during 1918 to the accepted practice in the building of streets and roads with asphalt blocks. Many Governmental restrictions confined construction to essential improvements of heavy-traffic roads where asphalt blocks were specified because of their demonstrated ability to carry heavy motor-vehicle traffic. The most interesting developments of the year were along the lines of working out labor-saving methods, in order to minimize the effects of extreme labor shortage and high wages. These efforts resulted in far-reaching improvements in methods of handling blocks, so that from the plant to the place of use, practically all hand labor has been eliminated, and mechanical devices have been designed.

A notable development of the year has been the demands of war and war industries upon the industry and the adaptation of the blocks to many military and essential war uses. Their utilization in war business has amounted to over 85% of the year's output for the company which the writer represents. The Navy Department has made extensive use of asphalt block at the New York, Boston, Philadelphia and Washington yards in flooring for storehouses, machine shops, etc., and at the great Brooklyn Navy supply base, where alone about 45,000 sq.yd. were used in flooring for storehouses, paving of loading platforms and streets around the plant, and paving connecting roadways between the buildings and the water front. These installations involved a very careful study of service conditions, in order to adapt the manufacturing formula to the production of blocks of requisite hardness, softness or malleability for special traffic and temperature conditions.

One unique problem urgently submitted to us was to produce an acid-resisting block for use in the flooring of a large submarine-battery storage building. This problem was successfully solved by the manufacture of a special block composed entirely of traprock, crushed to an unusual degree of fineness, and combined under high pressure with a processed cementing material. These blocks passed the severe tests of the Navy Department when subjected to a 25% sulphuric-acid solution.

In addition to many installations in ordnance and munition plants, the War Department selected asphalt block for extensive use in one of its most important plants—the South Brooklyn Army supply base—where more than 100,000 sq.yd. are being used in the flooring for the four piers, 1300 ft. long by 150 ft. wide; also for bridges, tunnels, loading platforms and traffic aisles.

The developments for the near future will probably be in the direction of the improvement of paving material and the design and construction of highways to carry the vastly increased motor-vehicle loads which recent military use has shown to be beyond the power of many existing highways to withstand.

A Negligible Year in Asphalt Paving

(From interviews with asphalt manufacturers)

GLOOMY prospects for new paving of every description marked the opening of the year 1918, on account of war conditions. Aside from any other features, the railroad situation was such that it seemed hopeless to figure on shipping paving materials with any degree of success at that time. Labor was extremely scarce, very high in price and in most cases inefficient; but the particular feature which affected the asphalt situation was the shortage of tank and other steamers to carry the crude asphalt from Mexico and South America and the impossibility of land transportation from other sources.

A large number of steamers carrying supplies for the American Expeditionary Forces were equipped to burn fuel oil, and it was especially desired that they should do so, owing to scarcity of coal. A great many Pacific Coast steamers which were fuel-oil burners were diverted to the European traffic, and all such steamers had to rely upon the Mexican oil for power. Consequently, the demands for oil were so great that it was necessary to make this the paramount feature in connection with the importation of Mexican asphaltic maltha.

In addition to there being a shortage of tank equipment, the importation of asphalts from South America was also greatly restricted by the action of the War Trade Board, which cut down the importation of these asphalts on account of the shortage of cargo steamers. These outstanding features, combined with the labor problem, made it a very negligible year in the construction and maintenance of asphalt pavements.

Maintenance has been the principal paving use to which asphalt has been put, and surface treatments have been used to some extent. Considerable patching has been done by "cold-patch" methods, using asphalt.

The fact that the maintenance of so many streets and roads had to be neglected, and the widespread and insistent demand for new roads and streets, would portend that the year 1919 may be a very busy one.

Status of Paving Brick in Manufacture and Use During Past Year

By Will P. Blair
Vice-President, National Paving Brick Manufacturers' Association

No DISTINCTIVE advance in the manufacture of paving brick has developed during the year. Progress is always in the mind of the manufacturer, covering two essential phases of the business: (1) Economy of production; (2) betterment of quality.

Generally considered, manufacturers do not hope for any special development which will increase the quality of paving brick. They do, however, bear in mind that care and skill must be constantly exercised, or quality will depreciate. The best known methods must be skillfully applied in each step of manufacture—preparation of the raw material, its formation, its drying and its burning—or, properly speaking, its vitrification.

In the economical phases of production, considerable hope is felt that some special saving may be achieved. Economy in fuel is a large question, to which many engineers are devoting much time. It is most important in the manufacture of paving brick, because the great proportion of expense is for the large amount of fuel consumed.

Economical handling, in both the processes of manufacture and of loading for shipment, is open to improvement. Special skill and devices, many of which have been patented, embracing almost numberless designs—all of more or less merit—have been brought into existence; but neither a particular method of fuel consumption nor any of handling has attained general approval.

In the use of paving brick throughout the year but few really new methods have been suggested. West of the Mississippi River the use of a bituminous filler is adhered to almost universally.

Throughout the Central states, the use of the sand cushion underneath the brick in connection with the use of cement filler has been almost wholly abandoned. In its place the method known as "the green-concrete-foundation method," which consists in laying the brick in the wet concrete, is extensively used. South of the Ohio River, particularly in the Gulf Coast section, also, this method is becoming popular.

Both in the Central and Eastern parts of the country there is frequently employed the type of construction known as the "sand-cement superfoundation," which consists of mixing the cement with the sand in a dry state and laying the brick thereon, after which the sand and cement is thoroughly dampened.

There has been a suggestion—in theory meeting the approval of a number of students of construction—to lay the brick upon a bituminous base or foundation. However, this method has not been tried out sufficiently.

During the past year the subject of drainage (always of frequent mention, but seldom seriously undertaken) has gained in importance. F. R. Williams, paving engineer, Cleveland, reports an interesting experience the past year. Improvement of Woodhill Road was designed for the monolithic or green-concrete-foundation type of brick pavement. The road skirts the foothills throughout the greater part of its length, so that the fall of water through the plastic soil has been the source of much trouble. Drains were laid outside of either curb and at sufficient depth to carry the water into the manholes. Cross drains discharging into these were laid under the entire base of the pavement, with sufficient fall to remove the water quickly from the subgrade. It was immediately observed, following severe downpours of rain, that the subgrade was quickly relieved of water, and the contractor was able to resume work with little loss of time due to weather.

Such advantage in construction economy was established by this drainage that contractors have installed it without cost to the city even where their specifications did not call for it. This experience not only established a construction economy, but clearly demonstrated that such a complete drainage system insured a continuous dry subgrade, and thereby the durability of the road.

Sees Development in Maintenance and Repair by Tar Products

By John S. Crandell
Consulting Engineer, General Tarvia Department, The Barrett Company

EXPERIENCE during the past year has emphasized the necessity for careful laboratory control and strict adherence to standardized methods, in the manufacture and use of paving materials. Especially has this been true of tar products. Control at the plant has been insisted on more than ever before, with the result that the output has been satisfactorily uniform. In the actual road work it has been necessary to try new methods, for the shortage of labor and its high cost have made economy obligatory. Furthermore, the restrictions placed on the highway builders by the Highways Council have caused the former to repair and maintain many miles of road that, under former conditions, would have been rebuilt. In consequence of this, patching and maintenance materials have been used to a greater extent than materials of construction.

For the repair of bituminous roads, cold patching has assumed a leading place. Tarvia-KP has been used in quantity by the various state and town highway officials. It has shown what can be done to keep roads in good condition at slight expense. Concrete roads have been repaired and kept in service by the use of Tarvia-XC; this is the material recommended by the Association of Portland Cement Manufacturers for patching and for mending cracks in concrete roads.

In actual road construction a new method has been standardized. This is the cold-penetration method, using Tarvia-B to take the place of water in the water-bound road. The results appear to have fully justified the slight increased cost of tar over water-bound macadam. The roads built by this method in Camp Douglas, Wisconsin, have carried heavy camp traffic. Enough roads of this type have been built to standardize the method of construction.

What may have been the established practice for many years in one locality may be a novelty in another. Surface treatments with Tarvia-B have been standard practice in many regions for years, but in others this past year has been the first in which they have been tried. With the increase of heavy truck and swiftly moving pleasure-car traffic, and with the scarcity of labor, the necessity of preserving existing macadam and gravel roads has been placed upon the entire country.

The greatest development looked for in the near future is the return to the tar-bound base. A number of articles have been written during the past few months on this subject, which show plainly that engineers are interested. The undisputed success of this type of foundation in many widely scattered cities points to its possibilities and offers interested engineers an opportunity to investigate. Specifications covering the materials and method of construction have been prepared and published in periodicals. The tar-bound base has been used under sheet-asphalt and block pavements.

Another development looked for is the patching of brick and the mending of the cracks in grouted brick pavements with Tarvia-XC in the same manner in which cement concrete pavements are now repaired. Many of the brick pavements that have failed could have been saved, probably, for some time, if the cracks and holes caused by local disintegration had been filled with Tarvia-XC at the time of their appearance, and before the adjacent pavement began to shatter.

Another future development expected is the treatment of wood-block pavements that bulge and heave, due to absorption of moisture. If these dried out blocks receive a treatment with a light tar, they become waterproof.

Highway Engineers Perfect Details of Concrete Road Construction

By A. N. Johnson

Consulting Highway Engineer, Portland Cement Association

Experience during the past year with heavy war traffic has demonstrated the necessity of thoroughly substantial pavements, so that thicker roads will be more generally designed and built. Concrete roads should be not less than 6 in. thick at the side and about 8 in. in the center for widths up to 20 ft. On main traveled ways, a thickness of 8 in. at the side and 10 in. at the center should be laid.

With the greatly increased use of concrete for roads, highway engineers are giving more and more attention to perfecting details of construction. There is probably no single development in the manufacture of concrete of more significance than a proper water content. An appreciation of this fact has been made possible chiefly through the exhaustive investigations carried on under the direction of Prof. D. A. Abrams of Lewis Institute, Chicago, made in coöperation with the Portland Cement Association. By controlling the water content, the strength of the concrete can be increased from 50 to 100 per cent.

It was formerly the practice to specify 1½ in. as the limiting size for the largest aggregate. It is now generally recognized that the largest aggregate may well be 2 in., and many engineers are using aggregate as large as 2½ in. It is of more importance to have clean aggregates than it is that particles of aggregate shall be of the hardest and toughest variety. In fact, it has been shown by the service rendered on many concrete roads that aggregate which is too soft for use in macadam roads does make a concrete road that will withstand without appreciable wear the heaviest motor traffic.

The importance of testing aggregates, particularly the fine aggregates, for organic impurities has received prominence in recent practice. The colorimetric test devised for this purpose can be readily made in the field, as only the most simple apparatus is required. The test is made with a 3% solution of sodium hydroxide in which the fine aggregate is shaken, the organic impurities being readily detected by the dark color of the liquid after settling. Light yellow or amber color indicates freedom from organic impurities that will injure the concrete, while a pronounced tan or light brown color indicates an amount which should not be allowed in aggregate for concrete road work.

Thoroughly mixed concrete is recognized more and more as essential to the best results, so that now practically all state specifications require not less than 1 min. of thorough mixing of all materials. The most common mix is 1:2:3, but some engineers require 1:1½:3.

Special attention has been given to the development of as perfect a surface as possible for concrete roads. Of first importance to secure this result are accurately placed and substantially built side forms, which should be rigidly held to the grade line. The roller-and-belt method of finishing has made it possible to secure a better surface than with the hand-float method. During the past year no less than 85% of various sections of concrete road work have been finished by this method, which is prescribed in many state specifications.

An improvement upon this method, and one that gives a remarkably true surface, is made by the use of a finishing machine so constructed that it automatically shapes and tamps the concrete. The machine can be reversed so that it is possible to go over the surface a number of times. This is of the highest importance, if the greatest density and strongest concrete are to result. Also, a much smaller quantity of water may be used in the mix, when finishing is done by this device, and this insures a stronger and better concrete.

Paint-Coat Method Becomes Standard Construction for Wood Block

By Walter Buehler

Chairman, Committee on Wood-Block Paving, American Wood Preservers' Association

During the past year the greatest advance made in the construction of creosoted wood block pavements has been the general adoption as a standard of the pitch paint coat method.

In January, 1918, the American Wood Preservers' Association's Committee on Wood-Block Paving submitted, as information, a specification for the laying of wood blocks directly on a smooth concrete base painted with a thin paint coat of pitch. At that time there were only a few examples of this form of construction. During 1918 more than 1,000,000 sq.yd. were laid in this way.

The principal precautions necessary to assure success, aside from the treatment of blocks, are: (1) Proper

proportioning of the concrete; (2) careful application of the paint coat; (3) proper application of the filler.

Concrete for this work should consist of aggregates so graded and proportioned as to assure a sufficient mortar content to permit of proper finishing. A mixture consisting of one part of cement, 2½ parts of sand and 5 parts of gravel or crushed stone, the gravel or crushed stone all passing a 1½-in. mesh and retained on a ¼ in., and with no intermediate sizes removed, will give satisfactory results.

A number of ways of finishing concrete have been developed. The simplest is by the use of a long handled float. The standard concrete roller-and-belt methods have also been used. E. R. Dutton, engineer of paving of Minneapolis, Minn., has developed a method which he asserts is working out successfully. It consists of a small pipe roller of about 3 in. diameter and about 15 ft. long. This roller is operated crosswise of the street on templets, consisting of 1 in. boards on edge, cut to crown of street and held vertically by specially prepared iron stakes driven into the subgrade. Whatever method is used, the important result is an even surface, but it is not necessary that it have a sidewalk finish.

Application of the pitch paint coat requires no special skill. It is important that the pitch be heated to at least 250° F. and that it be spread over the surface of the concrete in a very thin layer, not exceeding ⅛ in. thickness. The blocks should be laid after the paint coat has hardened. If possible, all paint-coated concrete should be covered with blocks each night.

To assure success, it is important that the blocks be properly filled. The pitch must be heated to a temperature of not less than 250° F. and not more than 325° F. It should be poured on the surface of thoroughly cleaned blocks and squeegeed rapidly in one direction only and should not be mopped back and forth. The ideal condition is a clean surface, with pitch filling about one-third of each joint.

Granite Block Laid on Mortar Bed and Adapted to Trunk Highways

By A. T. Rhodes
Field Engineer, Granite Paving Block Manufacturers' Association

There are several developments, both in manufacture and laying of granite blocks, which deserve the consideration of engineers and commissioners of public works—such as standardization of sizes, adoption of the mortar bed, and the recent adaptation of the blocks to trunk-line highway construction.

If any practicable method could be devised whereby paving block could be machine made, economically, this method would be adopted. When it is realized, however, that the subdivision is made from blocks as large as 1 cu.yd., and a block containing eight standard sized pavers is reduced to finished units in 90 sec., it can be seen that a skillful mechanic can make these blocks by hand much faster and more economically than could any present mechanical device requiring shifting of the blocks into various positions.

There is another condition in manufacture which would be very much improved if engineers would realize that they gain no particular advantage by sticking to their "pet" size of blocks. If blocks were standardized the producer could more readily hold a large stock of material, having confidence in the ultimate sale of any standard style. As there are schedules of sizes under which paving cutters sign annual agreements, and as any deviation from these sizes in the way of specials calls for an increased charge, a standardization of sizes to not more than three or four would give confidence to these producers and effect an economic saving.

From a construction standpoint, 3½-in. granite blocks are coming rapidly to the front as resurfacing for worn-out pavements of various types. Where these were constructed originally with good concrete bases, sufficiently low for laying, this method is proving satisfactory.

Probably the greatest change from the original construction methods, during the past few years, is the elimination of the use of peastone to hold the blocks while ramming. It is probable that more failures occur in granite paving through the use of peastone than are occasioned in any other way.

Cement-grout filler of 1 : 1 mix is unquestionably the best. In connection with this, it is found better to eliminate pargeting, or plastering, of the rails of street-railway tracks, and allow the grout to run in against the rail itself. The grout makes a much better bond with the rail, is a more substantial mixture and has been—in one instance, at least—the support of the railway iron for three years after the ties were rotted out. Where grout filler is used, a bituminous expansion joint along the curb is coming into practice.

Another change in practice is toward the mortar bed instead of the old sand cushion under the blocks. This bed should be a 1 : 3 mix, in the writer's opinion. It is laid dry and is wet down after the blocks are rammed, so as to give it a set and a bond with the cement filler.

The use of the bituminous mastic filler is more or less in its infancy, superseding the old peastone and pitch type of joint filler. It cannot be expected that it will show the durability of cement grout filler, but circumstances, such as opening the street immediately to traffic, instead of waiting six days, and giving a better footing for horses and facilitating the making of pavement cuts, make its use advisable in many cases. To obtain the best results, it must have a quality of extreme fluidity (so that it will flow readily to the bottom of the joint), a high melting point (so that it will not bleed in the hot weather) and have strong adhesiveness. This, to my mind, could be obtained best by a mixture of tar and asphalt, but producers are opposed to supplying a mixed product. The proper proportion of sand for this mastic filler is from 35 to 50 per cent. It is difficult to use a greater amount of sand without extreme care.

One of the newest developments in the matter of granite-block paving is its entrance into the field of trunk-line highway construction. With the increased cost of all other paving material, it has been found that by slight changes in the type of construction granite-block can compete for this work with most of the more permanent paving materials. The concrete base is omitted and a cement-sand bed, as described above, 1½ in. deep after ramming, is spread directly upon the prepared subgrade. The blocks are then laid and grouted. This gives a monolithic pavement which compares favorably in cost and in wearing quality with others of equal thickness.

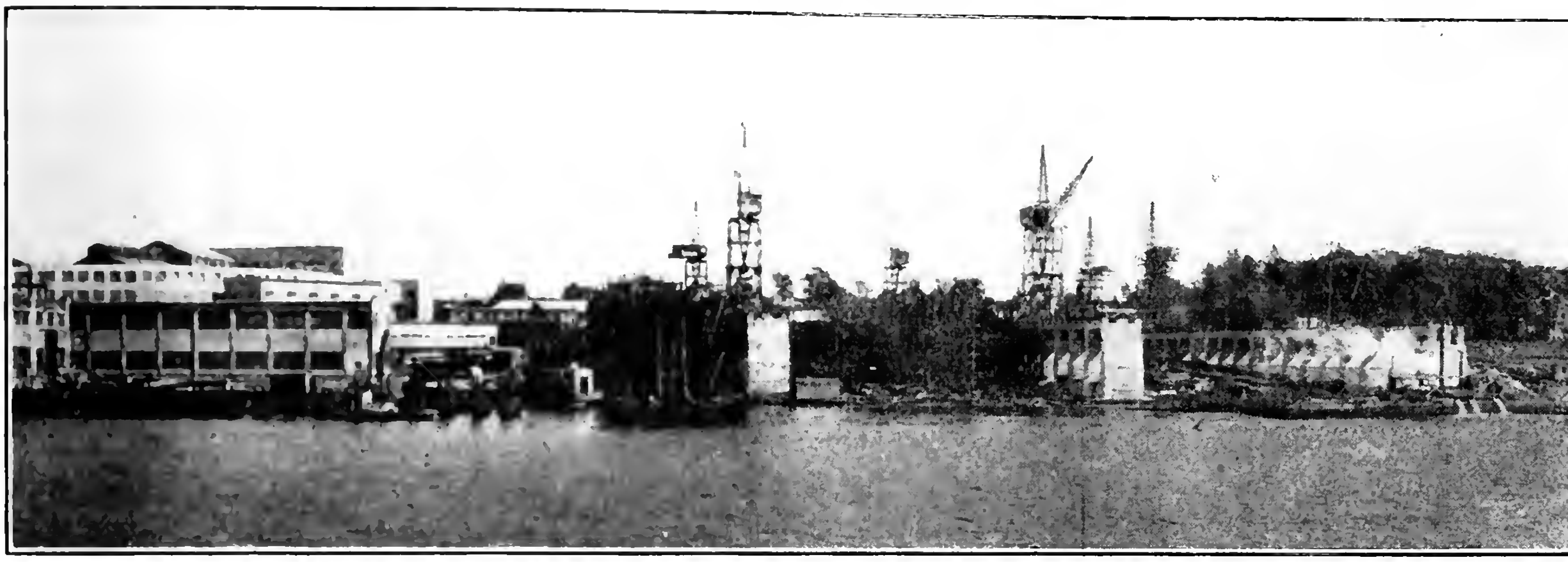
Groton Shipyard Built on Sloping Limestone Ledge

Fabricating and Storage Yards Level with Rails on Concrete Crane Ways and 22 Feet Above Concrete Shipways Set Into Rock

SIDE-HILL topography, unusual in shipyard layout, has been utilized successfully in the new yard of the Groton Iron Works at Groton, Conn., on the east shore of New London harbor. Advantage has been taken of the high land inshore to develop a two-level yard in which the material is fabricated and stored on the level of the rails of the crane runways, which themselves are some distance above the shipways. Concrete has been used extensively in the craneway and shipway construction, blacksmith shop, machine shop and fitting-out dock, though, on account of the speed necessary in erection last summer, many of the buildings have wood-frame members.

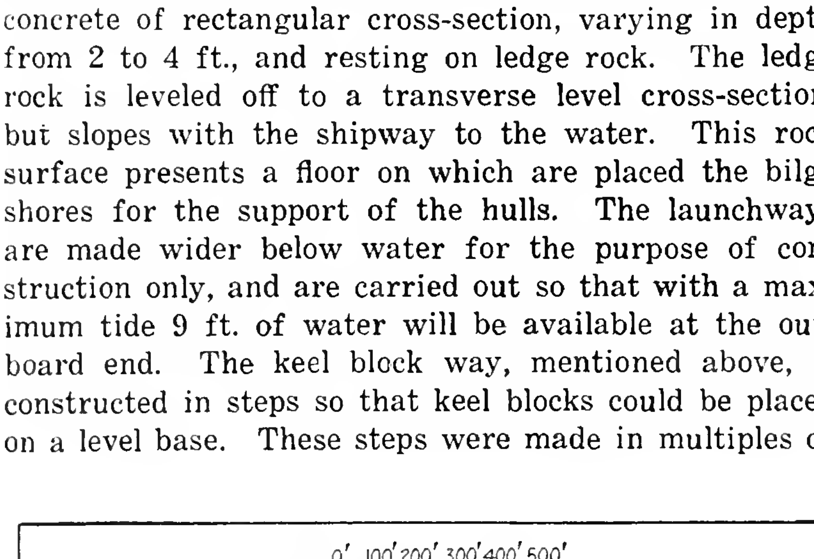
When the company took over the site in the spring of 1918, it was a country estate, similar to many of those lining the shores of New London harbor, a grassy slope underlain very close to the surface with a granite ledge sloping on a grade of about 1 in 15 down to the water. The site embraced 20 acres between the water and a main highway, and is traversed at the north end by the old main line of the New York, New Haven & Hartford R.R., which in the days before the Thames River was bridged had a ferry at this point running over to New London. The layout of the yard is shown on the accompanying drawing. Six end-launching ways were located at the south third of the yard. The northern two-thirds was left essentially on its original slope, so far as rock excavation was concerned. The tracks and buildings were laid out to accommodate themselves to the varying topography. During the construction of the yard, there was excavated approximately 15,000 yd. of ledge rock.

The ship ways are divided into three groups of two. Each group is controlled by a centrally located concrete trestle which supports two traveling cranes and a central standard-gage track for the purpose of supplying material to be placed in ships. The ways themselves slope on a grade of $\frac{5}{8}$ in. to the foot from an elevation of 24 ft. at the head of the way to $2\frac{1}{2}$ ft. at the low-water line. The grade at the top of the craneway and the assembly yard at the east of the craneway, as well as at the fabricating shop and storage yard at the north, is 42 ft. The supply tracks and the craneway tracks are placed at the above elevation. As shown on the cross-section of one of the sets of ways, a rubble-stone and concrete retaining wall, located at the head of the ways, separates the upper level from the lower level.

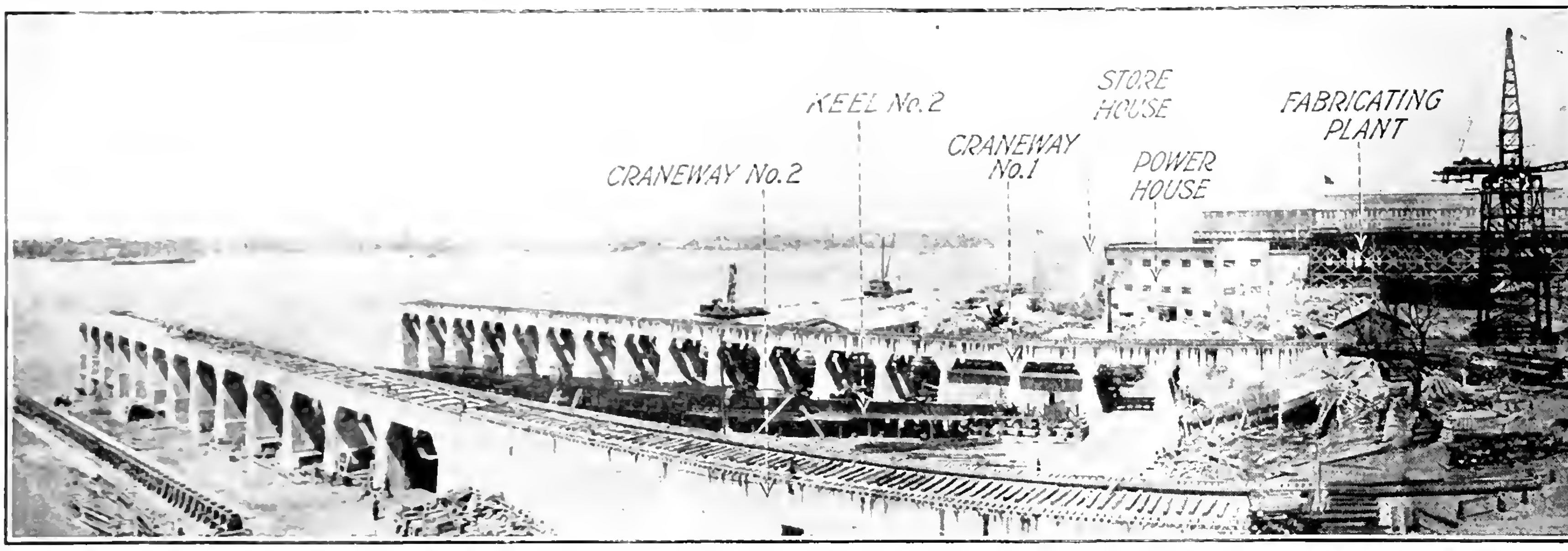


NEW SHIPYARD AT GROTON, CONN., IN OPERATION LATE LAST FALL

Each shipway consists of a central keel blockway, and two parallel launchways. All three ways are of concrete of rectangular cross-section, varying in depth from 2 to 4 ft., and resting on ledge rock. The ledge rock is leveled off to a transverse level cross-section, but slopes with the shipway to the water. This rock surface presents a floor on which are placed the bilge shores for the support of the hulls. The launchways are made wider below water for the purpose of construction only, and are carried out so that with a maximum tide 9 ft. of water will be available at the outboard end. The keel block way, mentioned above, is constructed in steps so that keel blocks could be placed on a level base. These steps were made in multiples of



GROTON IRON WORKS SHIPYARD BUILT AROUND A TWO-LEVEL LAYOUT



HIGH-LEVEL CONCRETE CRANE RUNWAYS AT CROTON YARD IN EARLY STAGE OF WORK

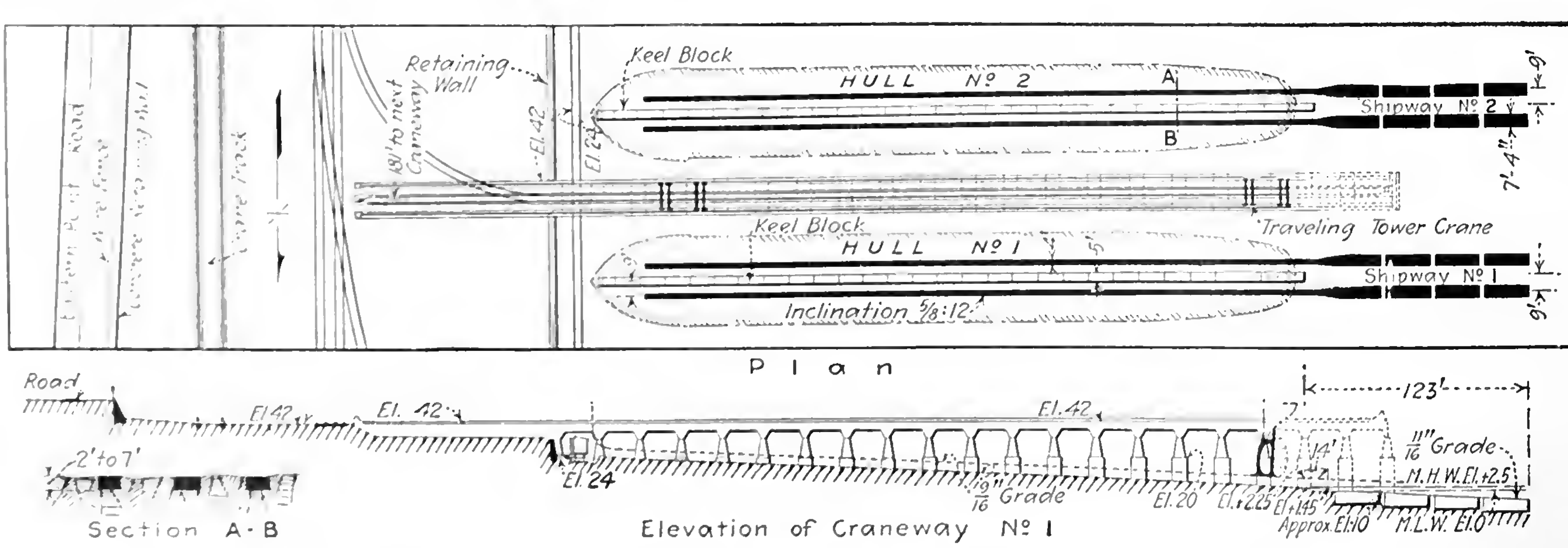
4 ft., as keel blocking is placed on 4 ft. centers. The keel block way extends but a short distance below high tide—in fact, just far enough to provide a foundation for stern post struts. The average amount of concrete in the six shipways is approximately 1200 cu.yd. In this concrete no reinforcing steel has been used, excepting as anchors, etc.

The craneways are of pier-and-girder construction, as shown in detail. The piers for the craneways are built of rubble concrete without steel, except for quill rods, etc. In some cases, rubble masonry was laid around the perimeter for the first section of the pier, and the interior filled with concrete. In all cases the piers were designed on the assumption that at least 50% of the volume could be constructed without cost over and above the cost of excessive formwork, as the great amount of granite excavation left available a ready supply of stone for this purpose. The girders, two for the crane rails and one for the central supply track, were reinforced and designed as simple beams, with the joint over the center of each support. Each of the three craneways contains approximately 3500 cu.yd. of concrete.

The traveling cranes are of Terry & Tench manufacture, and are designed for a working load of five tons at 87½ ft. and 12½ tons at 52 ft. The weight of the crane, consisting of steel frame, counterweight, machinery, etc., is approximately 107 tons. The cranes are operated by a direct current, 220-volt, 65-hp. motor for hoisting, a 25-hp. motor for swinging, and a 65-hp. motor for transit. The power is transmitted by means of two 50-lb. steel rail conductors by means of collector shoes. These conductors are carried on special framework, insulated and protected between the girders of the trestle. The eastern 100 ft. or more of each craneway is constructed on concrete walls carried down to rock—that is, where the height of the trestle was not sufficient to warrant the construction of piers and girders.

The movement of material through the yard is readily understood from the drawings. Practically everything comes in on the railroad at the north end of the yard, and is carried on standard-gage tracks, and stored in racks near the entrance. These racks are so constructed with concrete bases and steel uprights that the unfabricated material may be placed in storage, according to size and thickness, and on edge so that it can be removed with a minimum of labor when any particular section is required. Material requiring shopwork then proceeds on standard-gage tracks to the fabricating shop, where it is fabricated and sent to the storage yard in the rear of the craneways, or diverted to the machine shop, blacksmith shop, pipe shop, or fitting-out dock, as the case may require.

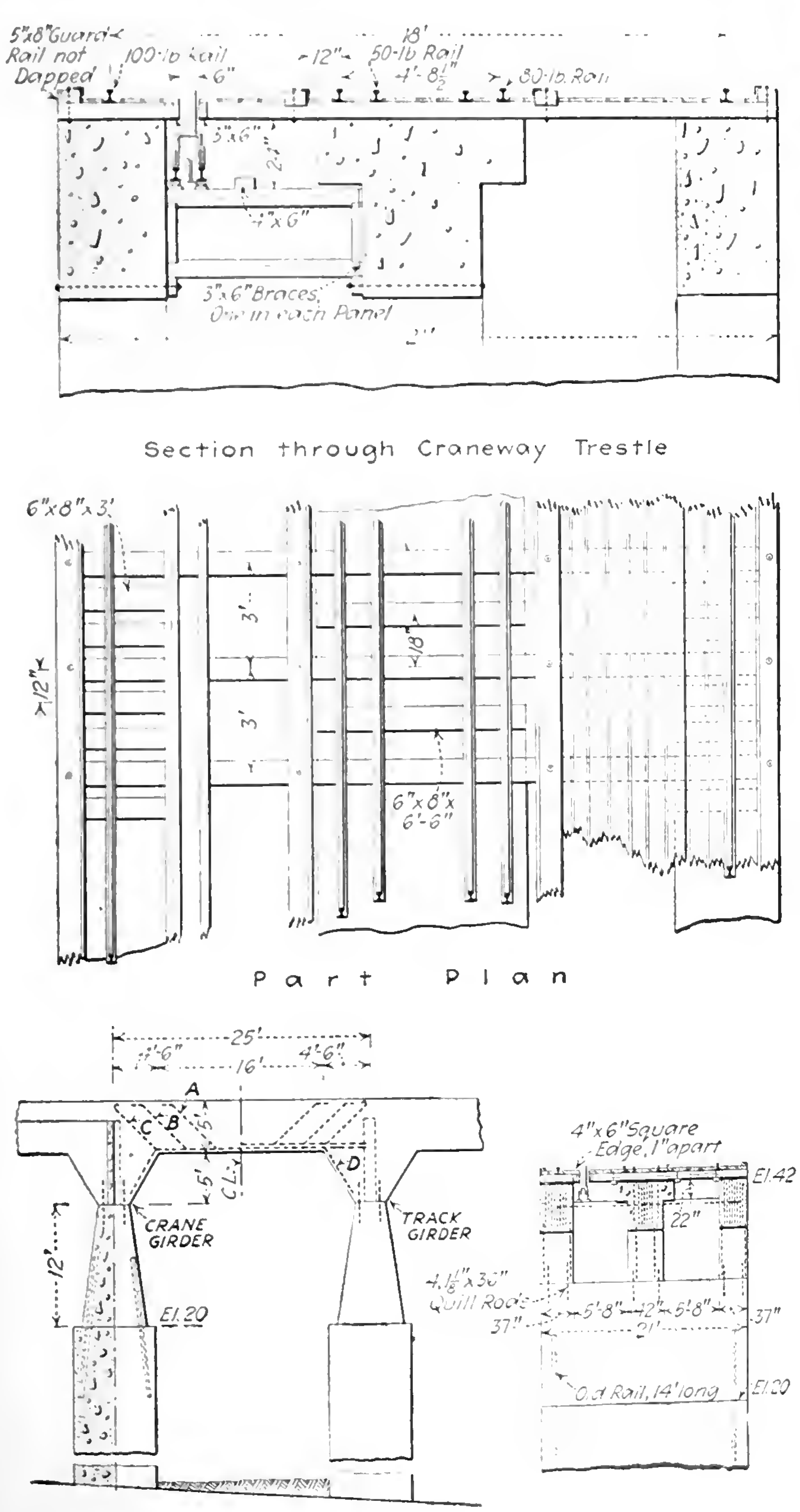
A large part of the assembling of structural parts is carried on in the inter-track space, adjoining the south side of the fabricating shop and east of the craneways, which is called the "assembly yard." It has been found to be more economical to assemble boilers, engines, condensers, channel foundations, shaft channels, bulk-



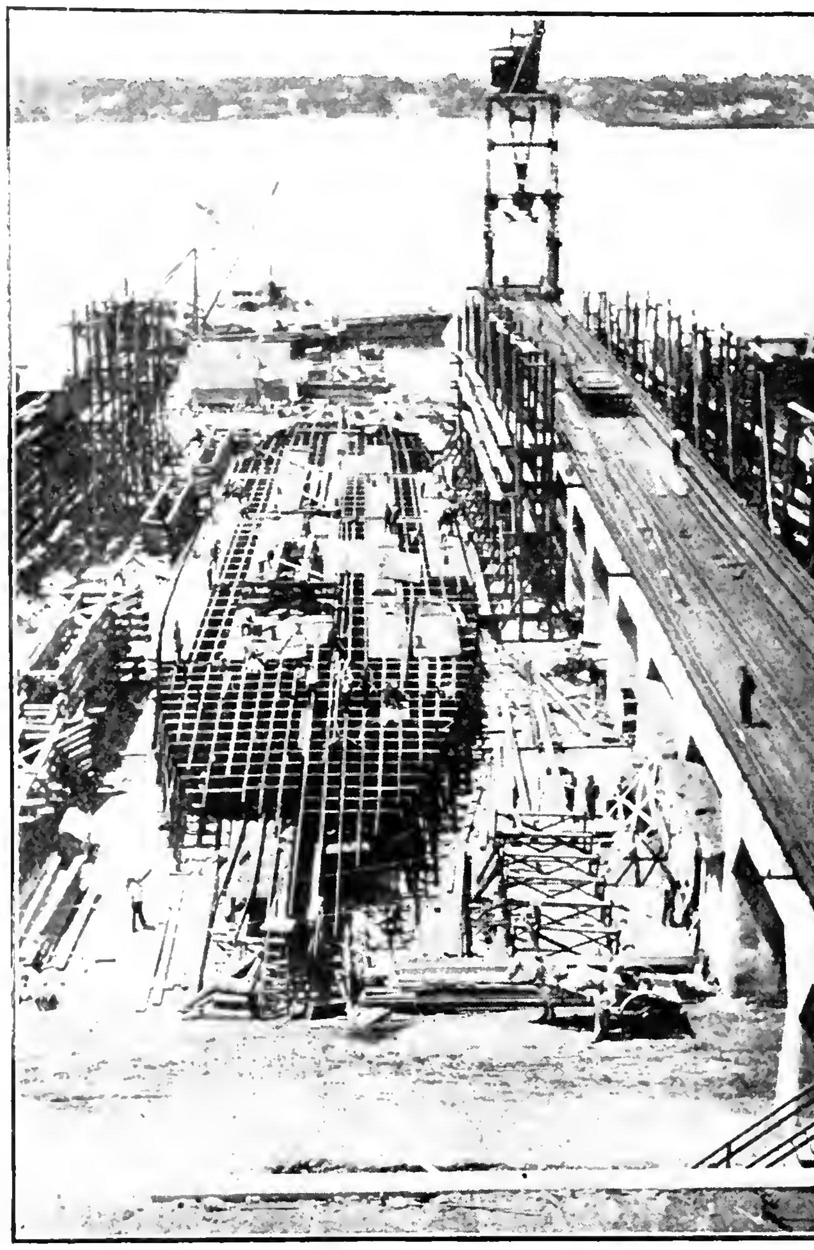
CONCRETE SHIPWAYS SET IN LEDGE ROCK AND CONCRETE CRANE RUNWAYS AT HIGH LEVEL

heads, funnels, uptakes, skylights, fantails, deck houses, floors, girders, pillars, brackets, etc., in this assembly yard, and transport them within reach of the traveling cranes by locomotive cranes. There, by means of an equalizing bar, structural units weighing upward of 20 tons have been placed by two traveling cranes. In the assembly yard, there is being constructed a craneway for a Terry & Tench crane similar in design to those mentioned. This will be used exclusively for assorting and assembling all the structural units mentioned above.

Operating in the yard, on the standard-gage tracks, are four locomotive cranes, one 35-ton crane, and three 20-ton cranes. These cranes are used in all parts of the yard, primarily for the purpose of unloading steel from cars and placing it in the plate racks, also coöperating with the traveling cranes in placing fabricated material in the hulls. The traveling cranes are so designed that material on cars can be pushed out onto the craneways under them; and, also, the locomotive cranes mentioned above can, when the case requires, be operated on the craneway in conjunction with the traveling cranes.



DETAILS OF CONCRETE TRESTLE AT SHIPYARD OF GROTON IRON WORKS


LEVEL ROCK WAY PERMITS STORAGE OF MATERIAL ALONGSIDE HULL

The main entrance track extends the entire length of the yard, east of the store house and power house, and east of the craneways. A turnout taken off near the north entrance extends to the west of the store house and power house and under the craneways at an elevation of approximately 21. From this track a turnout to the left extends north, and leads to the machine shop, carpenter shop, and fitting-out dock by means of sidings. The above track, extending west of the power house and under the craneways, is of great value for the purpose of transporting material from the machine shop, blacksmith shop, or carpenter shop to the ships before launching. This does not interfere in any way with the work in the fabricating shop or assembly yard. This track is paralleled by a roadway for the use of motor trucks, to accommodate the relatively small amount of material received in this manner.

In addition to the railroad entrance to the yard, there is a fitting-out dock, with a deep-water approach, over which material may be brought in by water. Roads have been built throughout the yard to facilitate motor-truck delivery, both from the main highway and from the dock. Keels have been laid on each of the six ways, and construction is going forward on each hull.

E. A. Morse is president of the Groton Iron Works, and E. O. Cutler vice-president and manager. The layout arrangement and equipment of the yard have

been personally directed by Mr. Cutler. The construction work has been done during the past 16 months, partly by contract, and partly on force account. The F. T. Ley Co., Springfield, Mass., constructed a section of the fabricating shop and one craneway. The Raymond Concrete Pile Co., New York, constructed the outboard launch ways. The T. A. Scott Co., New London, constructed the fitting-out dock. The remainder of the work was done by force account. G. L. Bilderbeck has been the construction engineer in charge of the structural design from the beginning of the plant construction. Arthur Jackson has been superintendent of construction in charge of the greater part of the force-account work.

Engineering Educators' Opinions Reflect Past and Predict Future Conditions

This is the second installment (the first appeared in "Engineering News-Record" of Jan. 2, p. 41) of replies to the following questions:

1. What was the influence of the Students' Army Training Corps upon the engineering colleges? Did the experience affect the educator's viewpoint, and if so, how?

2. Will the return to peace mean a return to pre-war courses without essential modification? If not, just what changes are contemplated? What considerations determined these changes?

3. Have you embodied in your plans for after-war courses any of the suggested solutions brought out by Dr. Mann in his "Study of Engineering Education"? (See "Engineering News-Record" of Oct. 24, p. 782). If so, just how are they to be applied?

4. What is your estimate of the new needs and opportunities in engineering education developed as a result of the war? How can they best be met?

Cornell Believes in Military Training, in Spite of S. A. T. C.

By E. E. Haskell

Dean of the College of Civil Engineering, Cornell University, Ithaca, N. Y.

The experience with the S. A. T. C. at Cornell was rendered unsatisfactory by the actions of younger officers, and the fact that orders to the military instructors and to academic authorities were not in duplicate, resulting in confusion and conflicts in student hours. The general feeling in regard to the work of the corps was expressed when the faculty voted unanimously to refuse the opportunity for continuing the training to the end of the present year. Nevertheless, there is still a strong feeling that military training, properly coördinated with academic work as it has been administered here for freshmen and sophomores ever since the University was established as a land-grant state institution, is a very essential part of the young men's training. Indeed, President Schurman hopes to see at Cornell University regular military and athletic training for all students for a period of not less than one hour for five afternoons of the week, with intra-mural competition between class and class, college and college, and other existing units.

The Navy unit, about 350 men, was administered successfully, but the Army unit, about 1200 men, accomplished relatively little academic work. Study facilities were inadequate, and officers monopolized the time in the evenings which should have been devoted to preparation for class work. In reply to the four specific questions which you submit I would say:

1. In view of the unsatisfactory nature of the experience with the S. A. T. C., there has apparently been no definite influence on the engineering college here.

2. We are returning to our pre-war courses on Dec. 30, and are planning to extend the third term into the summer, probably for a period of eight weeks beginning July 1. A faculty committee is considering changes already debated before the war, but no definite lessons from the war experience have yet been discussed. Last spring the trustees of the university decided in favor of the principle of consolidation of the several existing engineering departments into one department of engineering education.

3. Dr. Mann's report is being used, with other sources, for determining modifications of the present courses. Professor Jacoby is strongly in favor of the idea of making the academic work relate itself closely to practical engineering. In fact, he has for years used in his classroom work a specific problem method, with topics written out on cards. This method was extended recently to include definite questions for classroom discussion, also stated on cards. Since the co-operative courses are impracticable, it is contemplated to have students use the summer vacations for work in the fields in which they are most interested. He urges the selection of teachers who have had practical experience, and also the necessity for providing them with courses in educational psychology. The simultaneous use of both objective tests and examinations is favored. It is hoped to reduce the differentiation between courses in the freshman year, and a line may be drawn

between the sophomore and the junior years in order to insure the success in their specialties of those students who continue. A course designed to show the relation of engineering to industrial organization is contemplated. The courses in physics, mechanics and mathematics should be given by teachers who know engineering.

Stevens Institute Going Back to Pre-War Conditions

By Alexander C. Humphreys
President, Stevens Institute of Technology, Hoboken, N. J.

REPLYING to your letter of inquiry, the situation has not yet so cleared up as to enable me to express *final* opinions as to the workings and influence of the S. A. T. C. on the educational life of the United States.

1. We have to recognize that the S. A. T. C. was not given full opportunity to demonstrate its positive influence for good.

2. As far as Stevens Institute of Technology is concerned, I see no reason for not returning as rapidly and completely as possible to our pre-war conditions.

3. I am unable to find in Dr. Mann's survey anything that would be of particular value to *us*. Here we have to bear in mind that our course of instruction is a fairly harmonious blend of theory and practice. With us "the proof of the pudding is in the eating."

4. The war has emphasized the value of engineering education, as indicated in my answer to the third question.

In general, the S. A. T. C., as exemplified in the Army section, was sadly handicapped by Washington red tape. For this the Army officers assigned to Stevens were in no way responsible. The operations of the Navy unit were, by comparison, free from this disorganizing red tape influence. I give my views based upon the operations and results as they *now* appear to me.

I was and am in favor of a certain amount of military training for engineer students. I regret that the Army section of the S. A. T. C. has not helped to confirm me in this belief.

Need for Broader Training Seen as Result of War Experience

By William G. Raymond
Dean of the College of Applied Science, University of Iowa, Iowa City, Iowa

I AM very sorry that the S. A. T. C. was discontinued, for while it was a dismal failure while it lasted, it was improving and under modified administration I believe would have been tremendously successful. Answering your questions as best I can with the limited time available for their consideration, I would say:

1. The S. A. T. C. tremendously increased attendance in engineering colleges, but with a temporary increase, much of which will be lost with the close of the organization. I am not sure that the experience affected the educator's viewpoint at all. I find it difficult here to disassociate the effect of the S. A. T. C. and the general effect of the war, which, it seems to me, did affect the educator's viewpoint in that the necessity for a broader training in economics, sociology, accounting, etc., was made manifest.

2. I think this question is answered under No. 1. In our institution we shall get back to pre-war courses with some modifications, the nature of which cannot be definitely determined now, but which will be in line with the suggestion in the answer to question 1.

3. I have not studied sufficiently Dr. Mann's report to say just what effect it will have. We shall not make any attempt to adopt the so-called Cincinnati plan, the good points of which we recognize, but which does not appeal to us as at all desirable for universal application.

4. I think the first part of this question is answered under No. 1; the second part, I suspect, remains to be answered. My own judgment is that professional engineering courses should be based on courses in arts; that the engineeer of tomorrow must have a breadth of education at least equivalent to that of the lawyer or physician.

Columbia University Returning to Former Six-Year Course

By George B. Pegram
Dean of the School of Mines, Engineering and Chemistry, Columbia University, New York

I REPLY as follows on the points suggested in your questionnaire:

1. No useful comment can be made on the influence of the S. A. T. C. on engineering schools without distinguishing between the conception on the one hand and the execution on the other hand. The conception was good, and in a similar emergency we should gladly see it adopted again without any notable change. In actual execution, the S. A. T. C. began by greatly demoralizing the work of our engineering students, but thereafter improved steadily until a fairly satisfactory condition prevailed. The military administration could not suddenly furnish an organization to handle efficiently its side of the educational undertaking. Yet the war has afforded a great object lesson in the astonishing rate at which students can learn under a compelling incentive and inspiration.

Our university committee on admissions made good use of the opportunity presented by the excess of student applicants over accommodations, to make its selections partly on the basis of special tests of mental alertness and of ratings on outstanding personal qualities. The mental alertness tests were prepared by Prof. A. H. Thorndyke on the lines of his tests as applied to Army aviation candidates. The work of the men admitted indicates that these tests were valuable. In this matter of admission requirements it is quite probable that the S. A. T. C. experience will change somewhat our educational viewpoint.

2. We are now returning to pre-war courses without essential changes. Prior to the war we had established three-year professional courses based on admission requirements equivalent to three years of college work, to include mathematics, physics and chemistry, besides the usual college courses in the humanities. This brings these schools into line with our other professional schools of law and medicine. We believe that the emphasis, so evident in the selection of men in the war, on the adaptability that comes from breadth of fundamental training, as contrasted with mere technical expertness, will lead an increasing number of the more able and ambitious students to take up the study of

engineering on the foundation of a sound general and scientific education.

3. We shall find the interesting and suggestive report of Professor Mann a definite stimulus to research in engineering education. At present we are partly in agreement and partly in disagreement with his interpretations.

4. The immediate new needs and opportunities appear to be at the two ends of the scale of technical education. Vocational education should receive a great stimulus. That ship riveters can be trained in two weeks and that bent-shouldered tailors can rapidly become blacksmiths of marked skill, means broader prospects for workers in general, and with the development of schools this vocational education will lead into the elementary types of engineering. The middle ground is well covered by our present engineering schools. Beyond this there is sure to be, on account of the wider outlook of our industries, an increased demand for young men of broader training than the engineering graduate now has. We are trying at Columbia in one way to produce these men, other schools are going about it in other ways, but the product must be had if we are to develop the possibilities of our future in productive achievement.

California Experience Unsatisfactory

By C. Derleth, Jr.
Dean of the College of Civil Engineering, University of California, Berkeley, Cal.

IN MY judgment the influence of the S. A. T. C. upon the engineering colleges was unsatisfactory. Had the war continued the students would have suffered so far as purely engineering instruction is concerned. I believe that the aims of a military school are distinct from those of a civilian engineering institution; the two cannot effectively blend unless one is made decidedly subordinate. The best way to train doctors, engineers and technical chemists for Government service in time of war consists in first educating properly qualified men solely for these respective professions. In each case the course should not be less than three and preferably four years.

When these men have satisfactorily completed a course in medicine, engineering or chemistry, they should then become candidates for Army or Navy service. From these graduate groups men should be selected for military and naval training, but the amount of war training should be a minimum.

In the S. A. T. C. program it was intended to give intensive instruction whereby engineering students in two years would receive the fundamentals that heretofore had comprised a course extending over four years. It is my judgment that such intensive training mixed with military instruction and drill cannot be made effective. There is a limit beyond which the student cannot be driven. Sound growth is always slow growth.

I hope that with the return of peace engineering schools will revert largely to pre-war courses, with only a minimum of modification. Changes are necessary in our engineering curricula to meet new conditions, but these changes must be gradually and judiciously introduced. We must experiment to decide to what extent such subjects as physics and mathematics may be combined effectively with engineering applications, so that the student may study physical and mathematical principles at the same time that he is applying these principles to engineering problems. I think it would be a mistake to carry the combination to an extreme. In the beginning the student must study fundamental principles alone; the complex applications can only be attacked after the student has reached a considerable maturity.

During the past decade engineering schools have been unduly differentiating engineering courses. Too many special curricula confuse the student and tempt him to narrow his fundamental training. I hope that during the next few years our schools will limit the number of different courses offered.

Johns Hopkins University Plans Closer Relation to Practice

By C. J. Tilden
Professor of Civil Engineering, Johns Hopkins University, Baltimore, Md.

THAT at heart America is not a militaristic nation has been rather clearly shown by the experience with the S. A. T. C. During the two and a half months of the S. A. T. C. there was a great deal of friction between the military and the academic authorities in carrying out the requirements issued by the War Department. Educators, realizing the importance of the task under existing war conditions, adapted themselves and their courses to the needs of the Government, only to find that they were materially hampered by the large number of none-too-willing students and by the self-importance and officiousness of half-trained immature youngsters who had been commissioned second lieutenants. A large part of the student body was not of the usual college caliber, and found difficulty in keeping up with the many things demanded of them.

Conditions at the Johns Hopkins University were better than at many other institutions. The question of attendance on classes was settled early by an order of the military authority that the academic work was an essential part of the military training, and that purely military functions must not be allowed to interfere with it. With the chance of fighting in France taken from them, however, there is the almost universal desire on the part of the students to get out of uniform and drop the military training.

The S. A. T. C. of itself will probably have little permanent influence upon the engineering curriculum. The courses in engineering were greatly modified and made more intensive during the emergency, the program put out by the Education Committee of the War Department having been adopted practically in its entirety. This is not at all satisfactory, however, as a permanent basis, and will be relegated to the scrap heap just as rapidly as the transition can be made.

Nevertheless, many modifications of the pre-war courses are being seriously considered and will probably be adopted. In view of General Black's strong emphasis on the need for more training in descriptive geometry, the number of hours devoted to this subject will be increased, with more attention to practical

applications. The study of Spanish instead of German will be encouraged, in order to meet the demand of growing opportunities in South America. Coöperative courses, such as those offered at the University of Cincinnati, are being planned by the mechanical engineering department, and the idea receives a favorable response from industries in Baltimore. There is a new and vital need for trained organizers, and courses must be worked out to develop men to meet the practical requirements for quantity production, which will be paramount in the next few years.

Dr. Mann has given valuable suggestions in his "Study of Engineering Education." One result of the study of this report is that more emphasis will probably be put on the "project" system in teaching. It is hoped to develop this idea along the lines of the architectural problem in design or construction, with its carefully worked out schedule or program of requirements. In some ways this method is, of course, similar to the "case" system which has proved so successful in law schools.

Many Consider Experience as Disastrous

By Anson Marston
Dean of Engineering, Iowa State College, Ames, Iowa.

As I HAVE just returned from continuous service as lieutenant colonel of engineers in the Army since July, 1917, I have had no direct experience with the S. A. T. C. However, I have had opportunity to obtain personally the views of a considerable number of representatives of the principal engineering schools of the country, as well as to observe the situation at this institution. I would answer your questions as follows:

1. The experience with the S. A. T. C. at the engineering colleges has been little short of disastrous. Its effect has been to arouse—for the moment, at least—intense opposition to everything military. This feeling is so widespread among the patrons of the colleges as well as the college authorities that I fear it may have a disastrous effect upon the decision of the country as to the adoption of universal military training, which I personally favor.

2. The return to peace conditions will not mean a probable return to pre-war courses without modification. The effect of the war has been to disrupt the colleges completely. The authorities propose to take advantage of this situation to make desirable improvements, many of which they have been debating for years previous to the war. Changes will be decided upon between now and the opening of the next college year.

3. As to the "suggested solutions" by Dr. Mann in his report, they are under consideration, with other possible improvements, but nothing is finally decided as yet.

4. Post-war conditions will call for much bigger and broader engineers. This country is now a world power, and must extend her manufacturing, shipping, and financial interests all over the world. This will demand engineers of the biggest caliber and broadest training. Nevertheless, I feel that general engineering education, in meeting the new conditions, will be simplified rather than made more complex. It is so manifestly impossible to train every engineer in a predetermined specialty which will meet the demands upon him in his professional work that it seems to me probable that we must give the engineer a very thorough and broad training, and provide special schools of high technical character to which practicing engineers may come back for special training after they have determined their specialty by actual experience.

Princeton May Return to Four-Year Course

By F. H. Constant
Head of the Civil Engineering Department, Princeton University, Princeton, N. J.

IT IS rather early to answer your four searching questions upon engineering education, but we are giving the subject careful consideration.

1. Academically, the influence of the S. A. T. C. was negative. It is too early to learn what permanent influence military discipline has had upon the student mind, but it has at least been shown that the student is capable of much more intensive effort than he was encouraged to make in the past. The colleges, on the other hand, are awakened to a new conception of service. There is no reason why any man should not be permitted to pursue courses in college for which he is prepared, whether they lead to a degree or not.

2. We shall continue the three-year course for sophomores and juniors, including a nine weeks' term next summer. We may return to the four-year course for the present freshman and subsequent classes.

3. We are making a careful study of Dr. Mann's report, and may embody some of his suggested solutions in our plans. In particular, should we return to the four-year course it will be with the expectation that some system of coöperation with the engineering industries during the vacations can be put into effect. This would be the most potent reason for returning to the four-year course.

4. The war has developed a greater appreciation of the value of an engineering education. The engineering schools will undoubtedly have more students than ever before. It is the duty of these schools to keep in closest touch with the new needs created by the after-war conditions, in order that they may fulfill their highest service at this time.

Experience at Northwestern Emphasized Value of Discipline

By John F. Hayford
Director of the College of Engineering, Northwestern University, Evanston, Ill.

THE short experience of the colleges of engineering of the United States with the S. A. T. C. was an incomplete experiment, conducted under circumstances extremely unfavorable to educational success, and brought to an untimely end by the abject surrender of the Germans.

That experiment has started new lines of thought in the minds of engineeering educators, and has greatly increased the vigor with which all suggestions for improvement are studied. It has furnished suggestions only, not solutions—and some of the suggestions are clearly negative, indicating methods to be avoided.

The experiment, and to a much greater extent the whole war experience, have put forward two old ideas so strongly and clearly that improvement is reasonably sure to follow. The ideas are (1) that strong motivation leads to rapid and permanent progress on the part of the learner, and (2) that discipline leads to better performance of the whole man, including his brain.

The embryo officer in a training camp, with a clear picture in his mind of the part which it might become possible for him to take in the greatest single piece of work civilized people have yet undertaken, was so motivated that he learned at a rate that was astonishing, and later performed accordingly if the opportunity came to him. How can we secure some considerable fraction of such a motivation in our students of engineering? It must be secured, if that is possible. Can it be secured in part by showing the student early in his college career what engineering is, how essential it is to our present civilization, and how the apparently abstract parts of his early studies—in mathematics and physics, for example—are related to his possible success as an engineer?

Discipline which leads each man to coöperate with every other man in the group in such a way as to secure the maximum effectiveness of the group in accomplishing the purposes which are common to all also leads to development of the individual, including his brain, and even that indefinable part of him which gives courage, initiative and automatic habits which make hm a better man. Discipline is objectively most highly developed in the military form, and its direct effects are most obvious.

The war has emphasized the need of more and better engineering education rather than of a radically different engineering education.

It is too soon to expect the conclusions of the Mann report to be embodied in action. But, just as the valuable, permanent effects of the war on the methods of engineering education are still in the future, but sure to come, so also are the similar effects from the Mann report.

No Definite Changes Yet Decided Upon at New York University

By Charles H. Snow

Dean of the School of Applied Science, New York University, New York City

IT SHOULD be remembered that the S. A. T. C. is made up of two parts: Sections A and B, otherwise known as the academics and the vocationals. It seems to me that when commenting unfavorably, as many do, upon the work of the S. A. T. C. the tendency is to forget the participation of Section B. We regarded the work of the New York University Section B as very successful.

1. There was no constructive influence exerted by Section A upon the work of the School of Applied Science of New York University. The experience with Section B has intensified the feeling of many that certain men may not learn at all readily from books, and yet learn with surprising readiness "by doing."

2. I do not think that the return to peace will mean a return to pre-war courses without essential modifications, but I cannot yet tell what the changes here will be. Thus far it is a case of "we don't know where we are going, but we are on the way."

3. We have not yet embodied in our plans any of the suggested solutions brought out by Dr. Mann in his admirable paper. The experience is too recent; the matter is too important for quick action. We shall conclude this year on last year's program, save that the spring term will continue over into the summer. Changes will be announced for next autumn.

4. The importance of the engineer and his education has been greatly increased by the war. To say the least, this importance will not be diminished by the reconstruction period. The field suggested by your question is very large. At this writing, I can make no other direct reply than to say that the new needs and opportunities in engineering and engineering education developed as a result of the war will be very great indeed; I cannot detail.

Minnesota to Modify Surveying Course

By John R. Allen

Dean of the College of Engineering and Architecture, University of Minnesota, Minneapolis, Minn.

ANSWERING your questionnaire in regard to the effect of the S. A. T. C. at the University of Minnesota, I would say:

1. In the collegiate section of the S. A. T. C., we conducted our surveying classes all day long from 9:30 a.m. to 4:30 p.m., the students eating their luncheons in the field. This method we found very effective and satisfactory, and we shall probably continue it, although we have never done it before. This is the only class in the college which was better conducted during the S. A. T. C. than in the ordinary period.

2. There will be no substantial changes in the courses taught our students, as engineering is just the same now as it was before the war.

3. Dr. Mann's suggestions in his report were in most cases not new, and had already been considered in most engineering schools. We are making some changes in the teaching of mathematics, as we have added laboratory hours to these courses. We are also making some changes in the teaching of mechanics and physics. These changes were contemplated, however, before the publication of Dr. Mann's report.

4. I believe the opportunities for engineering education and for the engineer will be greater than before the war, due to the prominence that has been given to engineering during the war. I do not believe the needs in the engineering profession will be substantially different after the war than they were before.

Harvard Sees Need for Fundamentals

By H. J. Hughes

Professor of Civil Engineering, Harvard University Engineering School, Cambridge, Mass.

YOUR questionnaire has been referred to me for reply. The absence of many of our staff makes it impossible to give you anything but a personal opinion, which follows:

1. I am convinced of the folly of attempting to make students do the impossible, and the importance of suitable methods of selecting men for certain duties was

forcibly shown here. I have long believed that the entrance requirements now in vogue are defective, yet the recent experience has demonstrated their merits. Students in the S. A. T. C. showed distinctly less ability than our average, in spite of the fact that much of the work was less academic than usual. The best thing about the S. A. T. C. was the fine enthusiasm shown by many of the boys for any work whatever when they thought it brought them nearer active service in the war.

2. A return to peace will probably not mean a reversion to pre-war courses without essential modification, but the changes are likely to be gradual. The S. A. T. C. did not last long enough to upset traditions, and in framing its engineering programs a great opportunity to discourage needless differentiation was lost. It seems likely that certain methods of intensive training used successfully in the officers' training camps will be continued. More emphasis will probably be placed upon fundamental subjects, less upon temporary standard practices.

3. This school is being reorganized as the result of a court decision to the effect that a coöperative agreement made with the Massachusetts Institute of Technology is illegal (see *Engineering News-Record* of Dec. 26, 1918, p. 1198). The present year will be chiefly devoted to meeting the varied needs of students returning from service. Dr. Mann's report is of particular interest to us, but it is too early to say what solutions suggested by him will be embodied in our courses. Our students will have opportunities to take courses in the college, in the business school, and in other departments of science. We mean to plan for specific coöperation with the industries at some time and in some way over a considerable part of our programs. We expect to study the Cincinnati plan as an outstanding, successful experiment.

4. The new needs appear to arise from increasing demands for young engineers who are thoroughly grounded in science and capable of solving new problems at first-hand. The importance of training in fundamentals has been emphasized for years, and yet some of the most glaring defects in engineering education continue to be perpetuated. Most engineers realize that the fourth year and often the third are padded with so-called professional subjects, superficial in themselves, and valuable chiefly as advertising matter. Now the schools have an opportunity to face the facts honestly, to break with old habits and prejudices, and to provide the kind of training we know to be needed.

Unusual Features in Willamette River Bridge at Salem, Oregon

Timber Floor With Asphalt Wearing Surface—Pony Truss Span Supported by Cantilever—Arched Struts Used

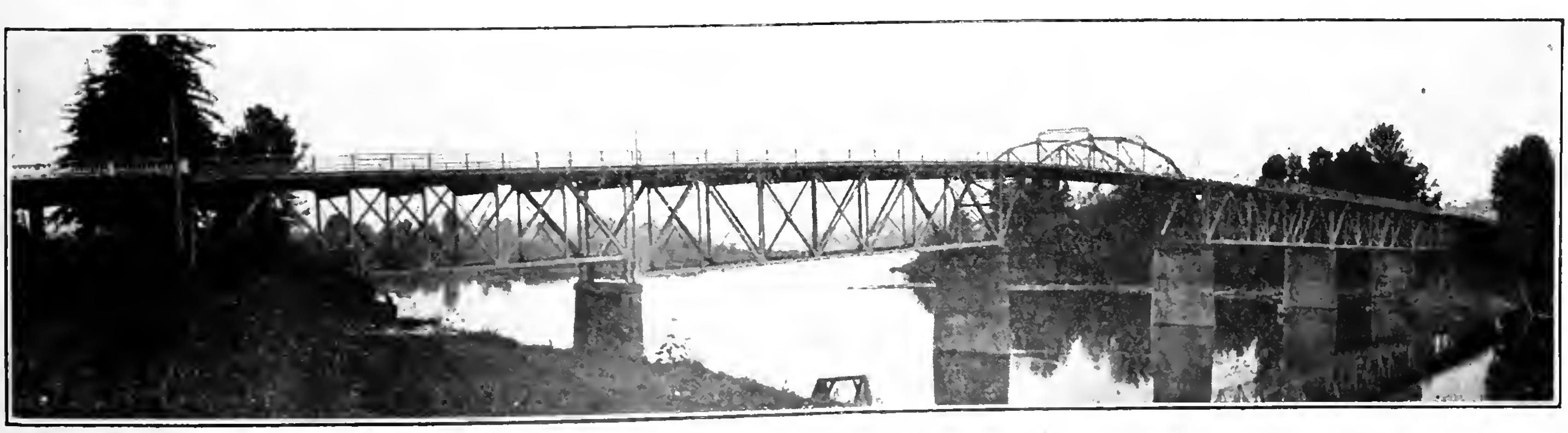
By Lewis W. Metzger
Designing Engineer, Oregon State Highway Commission

PROBABLY the longest highway bridge built recently is that over the Willamette River at Salem, Ore. It replaced two 360-ft. steel spans, erected in 1890, which were too light for the heavy modern traffic recently developed on this main highway through the Northwest. Several special features distinguish the design of this bridge, a composite structure with a reinforced-concrete approach on one side, a timber trestle approach on the other, and deck steel truss spans with a pony truss span 123 ft. long supported on cantilever arms to give the requisite clearance requirements. Curved latticed struts connect the trusses of the pony span. The floor throughout is built up solid of 3 x 7 fir members on edge, carried by steel stringers and by the top chords of the deck trusses, with a wearing surface of asphalt 3½ in. thick.

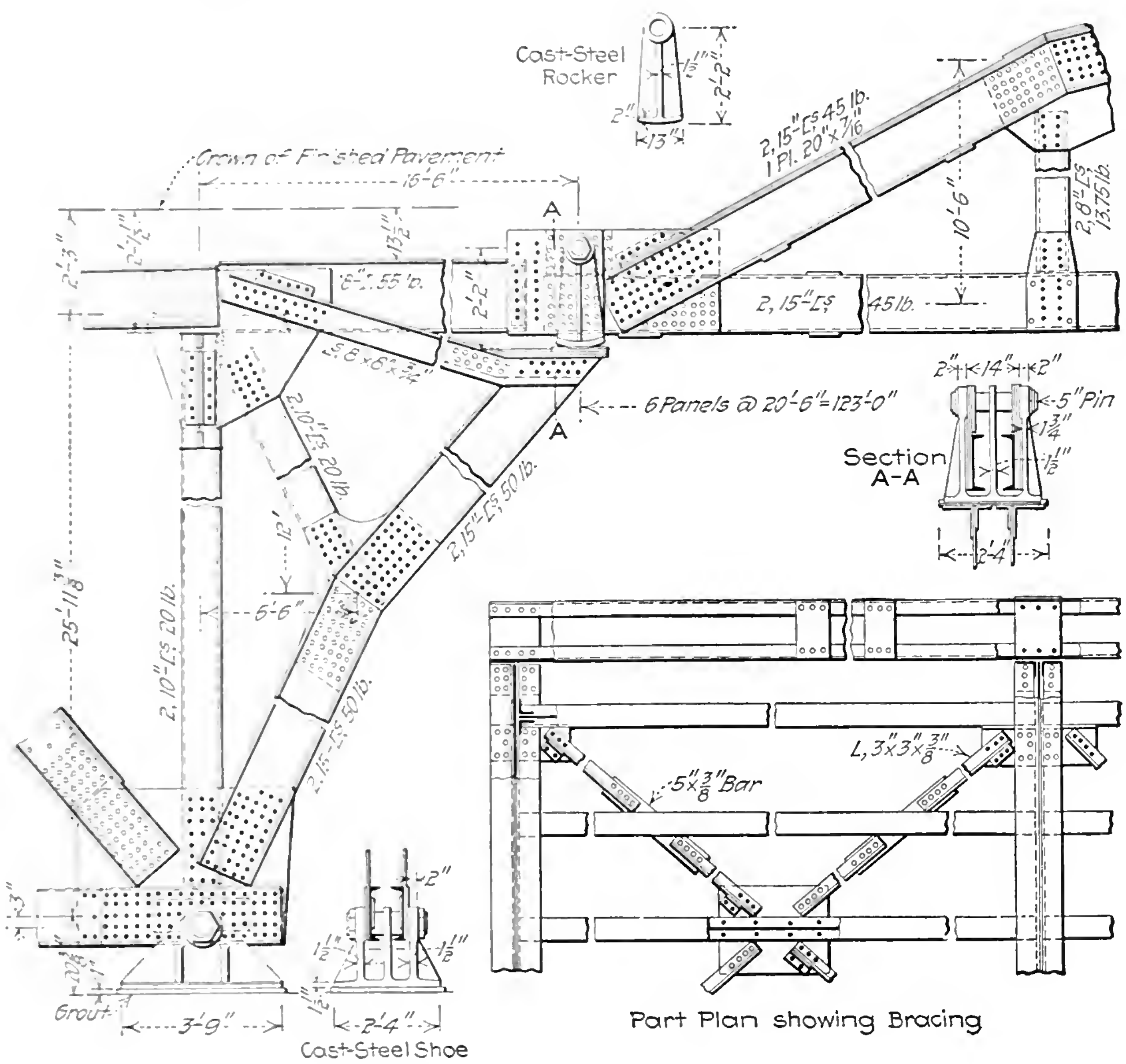
This design is the same as that described in *Engineering News-Record* of Nov. 8, 1917, p. 876, and was originally outlined by Joseph Weare, assistant state engineer. It consists of a pile trestle approach 780 ft. long on the Polk County side, four steel spans of the same length (152 ft. 3 in.) a single pony truss span 123 ft. long carried on cantilever supports from the adjacent spans, one shorter steel span (111 ft. long) and a reinforced-concrete approach 352 ft. long on the Marion County side. As the Willamette River is navigable at this point, United States engineers required a minimum horizontal clearance of 120 ft. and a vertical clearance of 66 ft. By the pony truss and cantilever design a clear opening of 145 ft. was provided.

The west approach follows a modern design of timber pile trestle type. The fir piling was treated in an open vat with carbolineum at a temperature of about 220 degrees Fahrenheit.

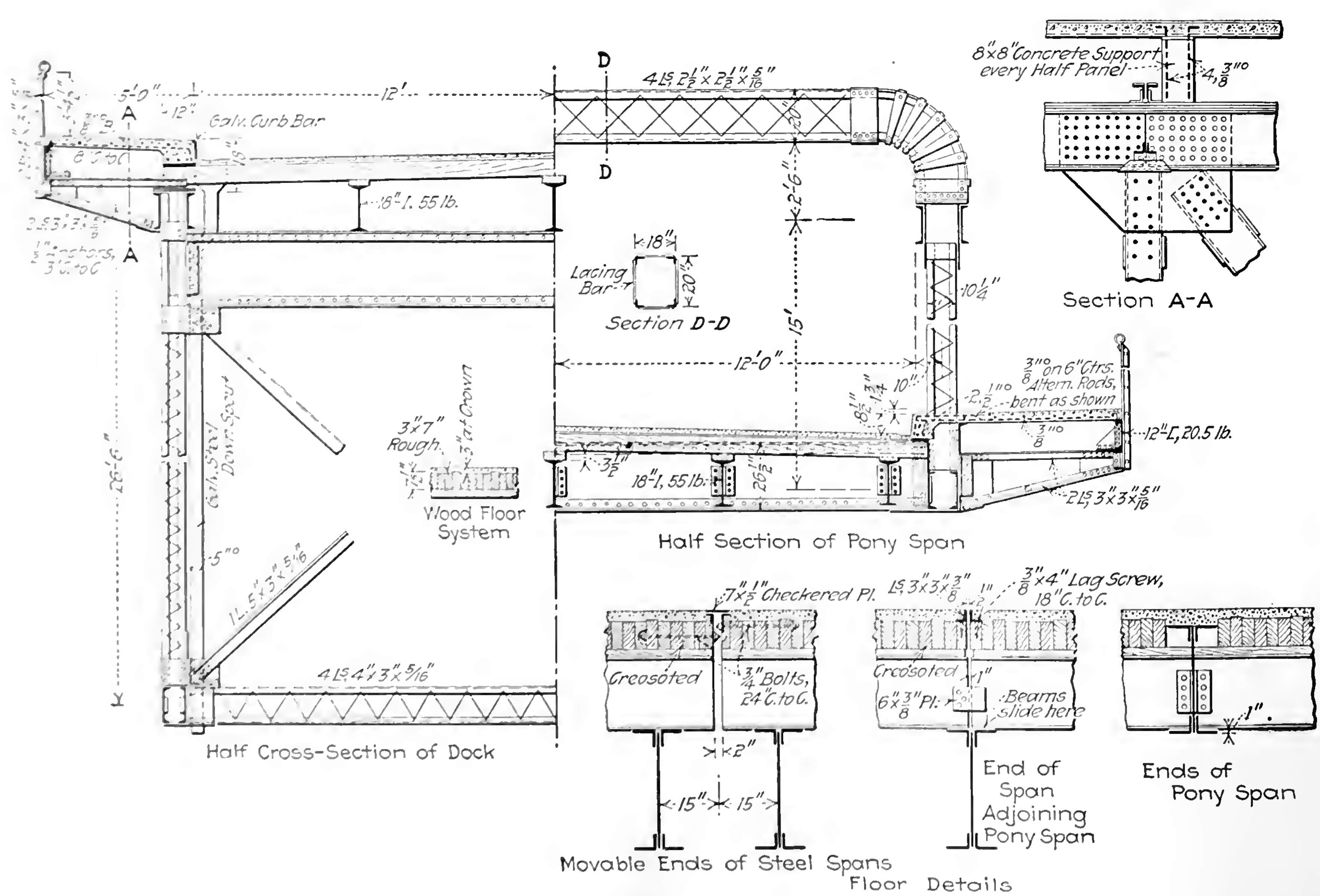
Lumber being comparatively cheap, the entire roadway deck of the bridge and wooden approach is com-



WILLAMETTE RIVER BRIDGE AT SALEM HAS PONY TRUSS SPAN SUPPORTED BY CANTILEVERS



posed of 3 x 7 in. x 26 ft. fir laid on edge, spiked together, and thus projecting 1 ft. on either side of the 24-ft. roadway. An asphaltic wearing surface 3½ in. thick effectively waterproofs the wood, and the small interstices between the pieces will allow sufficient circulation of air to preclude any possibility of attack by dry rot. The ends of the floor members were painted with hot carbolineum, as were also the wooden members contiguous to openings in the floor caused by expansion joints between the spans. The steel span adjacent to the east approach is not so deep as the adjoining one, and the difference in height is made up by means of a rocker which, of course, also serves the purpose of movable shoes. The channel span of the pony-truss type rests on cast-steel rockers on one end, each of which are carried by a shelf on the cantilever panel, projecting from the adjacent steel deck truss



UPPER—DETAILS AT EXPANSION END OF PONY SPAN. LOWER—TYPICAL CROSS-SECTIONS OF STEEL SPANS—FLOOR DETAILS AT EXPANSION JOINTS

span. The details of the movable end of this span are shown in one of the accompanying drawings. The other end of the span was pin-connected to a built-up shoe.

For the sake of economy it was decided to design the upper chords of the deck spans to serve as outside floor stringers, thus taking bending as well as direct compression. Wooden sleepers were bolted at intervals to the top chords, to facilitate the attaching of the wooden flooring. The typical cross-sections shown in one of the accompanying drawings indicate the nature of the details connecting the floor system with the steel trusses of both the deck and pony types.

The two 5-ft. concrete sidewalks are carried on brackets beyond the trusses, the curbs serving as reinforced-concrete beams. Small concrete struts extend up from the top of the top chords at the panel and mid-panel points. Between the bottom of the curb and the top of the wooden floor is a $\frac{3}{4}$-in. cushion of "Sarco." Owing to the grade of the bridge, it was necessary to precast this in sheets the width of the curb. When the material hardened it was rolled up in convenient lengths and placed.

It will be possible to renew the wooden floor with comparatively little difficulty, although it is believed that the wooden floor base, protected as it is, should last at least 50 years.

The final coat of battleship gray paint applied to the steel work has evoked favorable comment, being an innovation and a change from the black commonly used.

The cost of the crossing complete was about $250,000. The engineering cost was remarkably low. Including the surveys, borings, inspection of cement and steel fabrication, the resident engineer's salary, the cost of design, blueprints and supplies, and stenographic work, it amounted to $4600, or about 1.8% of the total cost.

The bridge was built by the Coast Bridge Co. and Robert Wakefield of Portland, Ore.; Charles McDonald was superintendent. The engineering work was done by the Oregon State Highway Commission. Herbert Nunn is state highway engineer. The writer was designing engineer.

Conserving City Water-Supplies in Southeastern Kansas

Recent Dry Seasons Resulted in Draining Natural Pools and, for More Permanent Results, in Formation of Reservoirs

By F. M. Veatch, Engineer, State Board of Health AND Professor F. N. Raymond, University of Kansas

THE severe drought in southeastern Kansas during the past two seasons has caused the working out of a fairly definite plan for conserving the water-supplies of the towns in that district. The city officials and the consulting engineers who have had most to do with these water-works plants, together with the state engineering departments, have been working not only to relieve present shortages, but also to safeguard the future and at the same time help toward a better use of the water resources of the whole district. These notes will describe the measures taken to increase and utilize stream storage.

Southeastern Kansas is not especially dry as compared with other parts of the prairie states, its mean annual rainfall, as calculated by the United States Weather Bureau, being above 35 in. The population is fairly numerous, however, and the people are largely engaged in mining and in oil and gas producing and attendant industries. There are some 50 towns of from 1000 to 20,000 population. Most of these have water-works systems that in ordinary times are very satisfactory. But these systems have usually been built in the first place mainly for fire protection, and the demands of communities growing both in population and the varied uses to which water is put have made the supplies more and more inadequate.

The recent drought was the severest on record. In the 20 months from January, 1917, to August, 1918, the rainfall was a little more than 60% of what is normally to be expected in these months. The water-supply ran low in the summer of 1917, but no great suffering was caused; the situation improved during the winter, but by June, 1918, many of the streams quit running, and the approach of the annual dry season caused much anxiety. In July service had to be restricted to domestic use in some towns, in order to prevent actual suffering. Railway supplies at city plants had to be cut off, and the shipping of cattle out of the country began. The trouble increased steadily until the latter part of August, when the rains began.

The surface water-supply for this district comes from the catchment areas of the Marais des Cygnes, Neosho, and Verdigris Rivers and some minor streams. The run-off varies from 0 to 13, and averages 0.4 to 0.5 sec.-ft. per square mile. The engineering problem, practically, is to provide storage reservoirs for water enough to last through a possible two years of drought.

Plenty of water is always to be found in the pools of the rock-bottomed Neosho for the small towns along the lower part of that stream. In other places, however, as along the Verdigris and the Marmaton, where the stream beds are soft, alluvial material, the natural pools cannot be depended upon. Generally, too, the flat country and the shallow channels of the streams do not afford good sites for large reservoirs.

The means for combatting the drought have heretofore depended almost altogether upon the conditions at each place at the time of shortage. At Cherryvale, for example, where the water is taken from the Verdigris River, ditches were cut from pool to pool in the river bed, and the contents of the pools all drained down to the reservoir at the city plant. But these ditches destroyed the storage value of the pools for the future. At Independence and Coffeyville, the largest towns in the district, similar ditching was done with similar results, also at other places.

In case pumps or siphons are used to convey water from pool to pool, the cost of obtaining and operating the extra equipment is often excessive—in fact, in some cases the cost of the work for a single dry spell has wiped out the profits of the plant for a year or more.

The logical development of the plan has been, therefore, to build dams at the points where the rock out-

croppings forming the pools occur. Such dams have valves so located that the water stored in the pools above them may be made available at will. Usually, a series of small dams is better than one large dam, for the small dams cause less trouble in case of flood.

The following cities have built or are building dams on this plan: Fort Scott, Neodesha, Eureka, Cherryvale, Independence, Coffeyville, Lyndon, Ottawa, Garnett and Cedarvale. The Verdigris (including its tributary, the Fall River) will be almost a continuous series of these storage reservoirs for many miles.

From the studies necessary in these cases, data are being gathered to supplement the general survey of surface-water resources in the district.

Balanced Rations and Good Cooks Cut Cost of Camp Messes

Investigation of Spruce Production Board Engineers Show 30 Per Cent. of Avoidable Food Wastes—Simple Meals Satisfy Workmen

BALANCED rations and good cooks will reduce food wastage in construction camps. This conclusion is arrived at by an analysis of mess practice in the lumbering industry, made by Capt. Thorfinn Tharaldsen, Spruce Production Board, Bureau of Aircraft Production, United States Army. Four principal kinds of waste exist: In buying, in storage, at table and at plate. Unbalanced rations, extravagant menus, improper storage and poor accounting are the causes of these wastes. They amount in the lumbering industry of the Northwest to from 20% to 30% of the total of foodstuffs purchased.

TABLE WASTES LARGEST ITEM OF FOOD WASTES

Too great a variety and too large quantities of food are prepared for each meal. Using the mess as an indirect method of attracting labor is often the reason for this extravagance. The remedy is the adoption of a standard ration list and a simple menu. A suggested ration list is given in the accompanying table. No more than one meat and one dessert should be served at any one meal. Further specification of menus is impracticable, since proficiency of the cooks, tastes of the men, accessibility to markets, season, market conditions, etc., determine the bills of fare at different times and places. Adoption of a system of monthly or bimonthly reports will aid in regulating the rations. A proper report form will show at a glance whether or not too much food is being used, which kinds are being used to excess, and whether the ration is well balanced.

Single meat and dessert menus are the solution of the problem of table waste. Meat and vegetables should be prepared only in such quantities as will probably be consumed at one meal. Meats, when placed on platters for serving, if cut into smaller pieces will permit the man to take as many portions as he may wish, but will not encourage him to take more than he can eat. Waste of leftover food can be reduced by skillful cooking which permits reservice in appetizing forms, as mentioned later.

Plate waste is due to men placing more food on their

SUGGESTED DAILY RATION LIST FOR CONSTRUCTION CAMP MESSES

	Pounds per Man per Day	Pounds per Man per 90 Meals
Meats, fish	1.25	37.50
Eggs	0.156	4.68
Lard, etc	0.08	2.4
Butter and substitutes	0.15	7.5
Cheese	0.05	1.5
Milk, canned	0.25	7.5
Milk, fresh	1.00	30.00
Beans	0.125	3.75
Potatoes	1.00	30.00
Peas	0.10	3.00
Corn	0.10	3.00
Tomatoes	0.10	3.00
Onions, carrots, parsnips, etc	0.125	3.75
String beans, asparagus, etc	0.062	1.86
Sugar (all purposes, baking, cooking, table, etc.)	0.20	6.00
Syrup and molasses	0.25	7.50
Jams and jellies	0 031	0.93
Flour (all kinds)	0.90	27.00
Oatmeal	0.10	3.00
Cornmeal	0.02	0.60
Cornstarch	0.02	0.60
Rice and barley	0.02	0.60
Dried and canned fruits	0.25	7.50
Fresh fruits, etc	0.25	7.50
Teas	0.01	0.30
Coffee	0.071	2.13
Total	6.670	203.10

plates than they can possibly eat. This is generally due to one of four causes: Too large portions placed on the serving platters; natural hoggishness of men with keen appetites; food sabotage, and unpalatability. The greatest waste is due to the first cause.

Plate waste can be largely eliminated by serving smaller portions and repeating the servings as the men ask for more. Instead of shortening the meals by "no talking" rules, encourage the men to lengthen the meal time. A personal appeal to the men not to waste food is effective if reduction of waste is accompanied by an immediate and corresponding reduction in the price of board. Food sabotage can be corrected only by punishment; observation shows very little malicious and intentional destruction of food in camp messes. A fourth remedy is to insist upon palatable food; this is a matter of getting good cooking, as is discussed later.

STORAGE AND BUYING WASTES EASILY CORRECTED

Buying foodstuffs is often put into the hands of someone who has little skill in balancing rations and in forecasting conditions. Often food is bought ahead for a gang of 50 men, when in the following month the gang may be reduced to 35 men; or a surplus of one kind of food is bought and not enough of another kind. Divided authority to purchase is another fault causing duplication of purchases, one by the camp cook and another by someone at headquarters. The remedy is to centralize buying authority and to educate the buyers in scientific catering.

Waste in storage is due chiefly to lack of cold-storage facilities. Some form of cold-storage apparatus in every camp of 50 or more men is a profitable investment. Another cause of storage waste is inadequate protection from destruction by rats, mice and other vermin.

A good, practical camp cook is the most valuable man in the camp, and his services should be properly recognized. Such a cook can save many times his wages in foodstuffs, and he is also a very important factor in the labor situation at his camp. It is a universal rule that men well fed will endure great hardships without grumbling. An incompetent cook will invariably mean

a full garbage bucket. He will waste many times his wages in food destroyed. Even the best quality of foodstuffs loses its value if improperly prepared by an incompetent cook. Such cooks are directly responsible for no small part of the wastage in the camp mess.

A good camp cook is cheap at almost any price, and an incompetent one is expensive, no matter how small his wage. A camp cook works long hours. From 4:30 a.m. to 8:30 p.m., seven days in the week, is a fair average. When his legs give out, he is accused of having "gone stale on the job," and his services are dispensed with "for the good of the service." It would seem wise to arrange to give each cook a short vacation, on full pay, at stated intervals.

Meat and potatoes should be served in different styles and varied in kind from day to day. Men have an inborn antipathy for "hash." Leftover meats should be re-served in form of stews, "mulligan," meat pie, etc., preferably with the addition of suitable quantities of fresh meats. Leftover meats and vegetables should be re-served in some form within 24 hours. Special care must be taken to see that no tainted meats or soured vegetables are used as an ingredient in any stew, meat pie, etc. No foodstuffs whose quality is questionable should be served under any circumstances. The meats should be properly washed and trimmed before they are prepared.

Frequent changes make all food more appetizing, and special attention must be given to the rotation of the different foods of the same kind. For instance, potatoes served mashed at every meal become tiresome, while if served baked, fried, boiled and mashed in rotation they are very palatable. A steady beef diet loses its attraction in a short time, while if the meat diet is made up of beef, pork, mutton, fish, etc., in rotation, with beef preponderating, this will not occur.

The success or failure of any meal depends largely on the manner in which it is served. Careless, sloppy service will ruin the best prepared meals. Everything should be neat and clean; meals must be served promptly, and dirty dishes removed quickly and quietly. Sloppy service will upset a camp as quickly as it will a hotel. Complaints should be made privately to the person in charge and not to cooks or waiters, and prompt investigation and adjustment of the matter should follow.

What Part the Engineer Played in Government Housing

Report of Chief Engineer of the United States Housing Corporation Outlines Work of His Division

ENGINEERS in general are not too conversant with the part they can play in housing developments. For their information there is printed below a large part of the report of John W. Alvord, the Chicago consulting engineer who was chief engineer of the United States Housing Corporation. Mr. Alvord's report outlines the work of his division in the construction of the many housing projects undertaken by the Department of Labor under a $60,000,000 appropriation. The signing of the armistice cut off the completion of most of the projects of this bureau, but the engineering work made up a large portion of the preliminary operations.

Mr. Alvord's report follows:

The Engineering Division of the United States Housing Corporation was early formed because the proposed Government housing is principally conducted in cities, or closely adjacent thereto, and it became necessary to obtain the aid and advice of engineers familiar with municipal and public utility work to plan and supervise these improvements and make the necessary arrangements with the municipalities in which they were operating, and also to contract with utility companies whose service was needed.

Extent of Housing Undertaken

The work has included the planning and negotiation for the extension of municipal improvements, such as drainage, sewerage, water-supply, electric light, fire-alarm systems, fire protection, gas, sidewalks, gutters, street paving, street lighting, sewage-treatment plants, pumping stations and other municipal improvements.

In connection with the housing bureau program, 60 or more developments projected in various parts of the country have reached the stage of engineering planning. These range all the way from 25 to 3000 families per development, and there have been necessarily planned for this work in the aggregate the following municipal improvements:

180 miles of sewer, costing about $2,852,700.
160 miles of water pipe, costing about $2,672,600.
11 independent pumping stations for water-supply.
83 miles of gas lines, costing about $637,700.
145 miles of eletcric transmission systems, at $775,000.
135 miles of street paving, curbs and gutters, costing $3,060,300.
260 miles of sidewalks, $1,234,300.
2877 street lights.
6 sewage-pumping plants.
13 sewage-treatment plants.

The total cost of all contemplated municipal area utility improvements will approximate $13,060,000.

The necessity for working in coöperation with the municipality in which the development is situated has necessitated negotiation with over 60 mayors, city councils and city engineers as to the inter-relations of the bureau with the municipality. In each case it has been urged upon the city that it is their privilege and duty to assist the bureau, as far as possible, by doing for the Government at least what would usually be done for a private individual making a similar investment. In many cases more than this amount of aid has been sought, and in some cases generously extended.

In some cases the inter-relations with municipalities have necessitated loans; in other cases complex special assessment relations; often aid to the city in urging permission for the issue of securities by the Capital Issues Committee; and, nearly always, obtaining priority orders for material and negotiating regulations made by the War Industries Board for emergency exclusion of expensive materials, difficult to obtain in the view of other war demands, and the adaptation instead of local materials.

For this purpose the Engineering Division has, of necessity, been largely composed of municipal engineers, especially skilled in municipal work, assessment law, city regulations, precedents and practices. The Engineering Division, through its negotiations, has obtained aid

from municipalities to the extent of \$3,103,000 or 24% of the total cost of the total utility and municipal work contemplated.

The Engineering Division has further been entrusted with the negotiations with private utility companies for the necessary service for the bureau developments of gas, electric lights, water-supply, and, in some few cases, of heating facilities and telephone service as well.

In all some 250 negotiations have been conducted, a large portion of which have been brought to a successful termination. In many instances it has been necessary to come to the assistance of utility companies which were financially embarrassed, yet whose continued service was essential to the development and the Government in adjacent war industry. In these cases, a financial adviser, skilled in utility securities and banking, has reported carefully upon the financial ability of the company, and its ability to furnish necessary collateral. Where good banking loans could be had, the utility has been financed through approval of the Capital Issues Committee. In cases where good banking loans are not available, utilities have at times been financed by the bureau direct, making the loan upon such collateral as was available.

In every case, it has been urged upon utility companies that they ought to accord the bureau the same service, if not more service, than they would accord a private investment under similar circumstances. The necessity of the situation has required contract relations or negotiations with 48 gas companies, 67 electric companies, and 40 water companies, or about 150 utility companies in all.

The Engineering Division, through its negotiations and efforts, has obtained aid and financial investment from utility companies for United States housing to the extent of \$1,600,000, or 12.3% of the total cost of utility investment. The total amount raised by suggestion and negotiation of the Engineering Division from municipalities and utility companies for United States housing requirements has been \$4,702,700, or 36.2% of the total requirements of \$13,040,134, estimated utility expenditure. Of the \$4,702,700 raised from municipalities and utility companies, about one-half, or \$2,216,900, has been financed by the municipalities and utility companies, and the remainder loaned them by the bureau, to be repaid to the Government in the near future.

Preliminary Investigations

The Engineering Division has been employed in making preliminary investigations for the bureau in connection with the selection of local sites for housing developments. This matter, almost always difficult to determine, has been handled by a committee consisting of an engineer, an architect, a realtor and town planner, and in each case all sites offered or suggested have been carefully canvassed, their development cost estimated, and the selection made on the basis of actual desirability regardless of all private interests.

The Engineering Division at the central bureau consists of a chief engineer, an engineering secretary to the chief, a chief assistant, 10 district engineers (each of whom has conducted the individual details of a group of projects), two utility engineers, one road engineer (lent by the Bureau of Roads and Rural Engineering), one fire-protection engineer (lent by the National Board of Fire Underwriters), two electrical engineers, an attorney on contract relations, and an engineer in charge of engineering contracts, bills and accounts, and four stenographers—about 25 in all.

Organization of Engineering Division

The duties of the central staff have been:

1. To prepare a manual of standard directions for local project engineering designers, and
2. Standard instructions, drawings and specifications and directions.
3. To act as adviser to other divisions on engineering questions.
4. To report on all unusual or difficult engineering problems, such as constantly arise.
5. To select, appoint and contract with all local project engineers and their assistants.
6. To guide and direct the local project engineers.
7. To revise the budget allowance in accordance with the policy of the bureau.
8. To initiate and conduct all contract relations with city and utility companies.
9. To approve all detailed plans, estimates and specifications of such local project engineers and control their operations.
10. To check the bills of material.
11. To advise the town-planning and construction divisions on all engineering questions.

In the field some 60 local project engineers have been appointed who have been either persons or firms having locally efficient office, organization, acquaintance, equipment and financial ability in addition to specialized training in municipal problems, and who could do rush work on short notice in the preparation of plans, conducting negotiations and the supervision and construction of local development projects. Contracts with the local project engineers have been on a uniform contract form prepared by the Engineering Division, and based on a scale of fees less than ordinarily earned but thought to be sufficient, in which all contracting engineers have been uniformly treated alike. The fees and overhead expenses have been on a sliding scale, reducing in cost per house with the increase of the development, and prepared on the basis that the municipal improvements would vary approximately with the number of houses in each development. The average of fees and overhead allowance has been but 1% on the cost of utilities involved, amounting to about \$2500 on a 200-house development, and increasing to about \$4500 on a 1000-house development, in addition to which the project engineer received actual cost for his assistants, the traveling expenses and such obvious expense as could be readily checked by the fiscal division.

Oil Production Gains Three Per Cent Over 1917

A gain of 3% over the record production of petroleum in 1917 is indicated in the preliminary estimate for 1918. An estimate of nearly 350,000,000 barrels, as against the record for 1917 of over 335,000,000 barrels, is made. The reserve of crude oil held by all producers and pipe-line companies in the United States at the end of 1918 is estimated at 123,000,000 barrels, as compared with 150,000,000 barrels at the end of 1917.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Flow of Water in Open Channels

REVIEWED BY ROBERT E. HORTON
Consulting Hydraulic Engineer, Albany, N. Y.

CALCULATION OF FLOW IN OPEN CHANNELS—By Ivan E. Houk, Assoc. M. Am. Soc. C. E. Technical Reports, Part IV. The Miami Conservancy District. Dayton, Ohio: The District. Paper; 6 x 9 in.; pp. 283; illustrated. 75c.

More perhaps than any other branch of engineering, hydraulic science has received numerous contributions during recent years, in the form of elaborate technical reports. Dating back to the monumental United States Deep Waterways Report of 1898, and running through the series of reports on the New York water-supply, the New York Barge Canal, and others, later, resembling these prototypes, there has probably been none which contained so much in the way of definite contributions to hydraulic theory and practice as the series issued by the Miami Conservancy District, of which the work under review is one.

Apparently, the title might better have been "Formulas for Flow in Open Channels," as the book is devoted almost entirely to a discussion of numerous formulas for flow in open channels and the presentation of experimental data to test the accuracy of these formulas. There is a great deal of technic to the calculation of flow in open channels that is quite apart from the formulas used and is not gone into in this book, except as it is involved incidentally in the computation of experiments here recorded.

By way of clearing the ground of minor criticisms, it might be noted that formulas in which the exponents of the hydraulic radius r or the slope s have values other than one-half as in the Chezy formula are here referred to as "exponential formulas." The term "exponential formula" has a definite meaning in mathematics, and refers to an expression where the exponent is a variable. That is not true with regard to these formulas. Furthermore, the Chezy formula is as much an exponential formula in the sense of the term used in this book as any of the others. It is true that this loose terminology has been used before. What is meant is that the exponent of r or s or both is not one-half as in the Chezy formula. The various formulas referred to are all special cases of a general nth-power formula.

The formula devised by the Swiss engineers, Ganguillet and Kutter, is often referred to here, as it is elsewhere, as Kutter's formula. Failure to give Ganguillet equal participation in the credit appears unjustified even on the plea of abbreviation, but the practice is probably too well established to be easily changed.

The book contains calculations of maximum discharges in the flood of 1913 in the Miami Valley, using Ganguillet and Kutter's formula with coefficients of roughness checked by special experiments on reaches of the same or similar streams. This part of the book affords convincing proof that reasonably reliable and satisfactory determinations of flood discharge can be obtained in this way, and the manner in which the work was done and is described in the book is worthy of commendation. Incidentally, a method of calculating discharge from the drop in the water level during floods in passing through contracted bridge openings is described. Such methods are often needed, and the one presented here will probably find useful applications.

To most hydraulic engineers Chapter IV, containing the results of some 84 experiments for the determination of the coefficient of roughness in natural river channels, will be of great interest and value. Details of the experiments are given in full, with descriptions of the character of each river reach on which experiments were performed. These descriptions are accompanied, in several instances, by photographs which convey some idea of the roughness and channel conditions involved in the experiments. On the theory that these photographs will be useful to engineers generally who desire to apply the results of these experiments, it would seem that a much larger number of such photographs would have further increased the value of the data presented.

Abstracts and translations of original papers are included in the book, showing clearly the development of various slope formulas and the antecedents of such formulas, especially those of Ganguillet and Kutter, and Bazin. Many formulas less generally known are discussed, including the German and Austrian formulas of Siedek, Hessle, Christen, Hermanek, Biel, Matakiewitz and Lindboe. The author concludes—and without doubt correctly—that not one of these formulas is of much practical value. They are mostly based on considerations of an ideal channel, and like much German literature on kindred subjects in hydraulics and hydrology, they are stronger in the speculative than in the practical aspects of the subject. However, they are interesting if only as museum specimens, and may afford useful suggestions. Other recent formulas, including those of Schmeer and Barnes, are discussed but the general conclusion is reached that "although the Kutter formula is not ideal it is the best equation available at the present time."

Confirming its general use and utility, a brief list is given of some recent important hydraulic works on which the Ganguillet and Kuttler formula was used. In this list should have been included the New York State Barge Canal, probably the most important example of all in this respect, in that it involved over 400 miles of large natural and artificial channels, the hydraulic features of which were determined by the Ganguillet and Kutter formula. The substantial accuracy of these determinations has been verified by subsequent experience.

Criticisms frequently made of the Ganguillet and Kutter formula are cited. These are of two classes: (1) Criticisms, often sweeping, which are in effect only a confession of ignorance on the part of the critics; (2) specific criticism of the inclusion of a slope factor

in the formula, or of its accuracy when applied to very flat slopes. The slope factor was included in the original formula to adapt it to Humphreys and Abbott's gagings of the Mississippi River, and to answer this question recent gagings of the lower Mississippi are used. The evidence presented is not so convincing, one way or the other, that the reader may not interpret it differently from the author.

There is some discussion of Manning's formulas. The conclusion is reached that in most ordinary cases they give results practically identical with the Ganguillet and Kutter formula, with the same coefficient of roughness.

For very flat slopes and large channels, the author prefers the Ganguillet and Kutter formula with the slope correction factor (omitted from the Manning formulas). For such conditions the Manning and the Ganguillet and Kutter formulas do not agree with the same value of n and a question arises as to which is nearer the truth. The author states (p. 243): "The average error of the results calculated by the Manning formula for the gagings of Humphrey and Abbott was 19.8 per cent., while the average of those calculated by Kutter's formula was only 4 per cent." For very flat slopes the Ganguillet and Kutter formula gives the higher velocities. If, therefore, the reported velocities in the Humphreys and Abbott experiments are, say 8 per cent. too high, as elsewhere concluded, the showing would be changed to an error from the truth probably about equal for the two formulas.

King's "Handbook of Hydraulics" appeared about the time when Houk's book went to press, and is not cited by Houk. King's book contains a much more elaborate and thorough discussion of the relation of the Manning and the Ganguillet and Kutter formulas, and the conclusions of Houk on this subject should be read in conjunction with King's discussion.

It will probably appear to many that, except perhaps for very flat slopes on large streams, the Manning formula has the great advantage of simplicity, and yet one trained in the selection of values of n for one formula can in general apply these directly to the other, with assurance that in most cases the results will be nearly identical.

It seems also proper to add to the author's discussion that for very flat slopes, where the velocity in an appreciable portion of the cross-section is below the critical velocity, further exploration is needed. Here there is good physical reason for a slope correction, or else the use of a formula involving terms both for v and v^2, as in earlier formulas of Prony and Eytewein. The general comparison of slope formulas in Houk's book supplements and brings down to date a similar comparison contained in Humphreys and Abbott's classical monograph, in the added light of later experience. The book is a welcome and timely addition to the literature of hydraulics.

Shutting Water Out of Cased Wells

METHODS OF SHUTTING OFF WATER IN OIL AND GAS WELLS—By F. B. Tough. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 122; illustrated. 30c. from Superintendent of Documents.

Although written for oil and gas men, this excellent monograph contains much information equally useful for water-supply engineers and contractors. In oil- and gas-well practice it may be necessary to shut out water from either the bottom or the sides of the well. In water wells, the shutting out is usually from the sides, and reliance is often placed upon the casing—which may sooner or later prove inefficient—or it may be considered cheaper to use a thin casing, backed with cement grout. Most of this bulletin is devoted to the subject of stopping water inflow by cement, but attention is also given to the use of hydraulic lime and mud fluid. Equipment for cementing and also for mudding is described. There is also a section on calculating the thickness of casing needed for various depths.

A Current Compendium on Concrete

AMERICAN CONCRETE INSTITUTE: Proceedings of the Fourteenth Annual Convention, Atlantic City, N. J., June 27-29, 1918. Chicago, Ill.: The Institute. Cloth, 6 x 9 in.; pp. 581; illustrated.

Annual reports of societies, containing the papers presented at their meetings, are, as a rule, merely listed in this section, but the great specialization of the papers presented before the American Concrete Institute makes it worth while to give more than ordinary notice to the volume of "Proceedings" recently issued. While most of the papers are up to the usual average, there are three special features of the 1918 "Proceedings" to which concrete engineers should give great attention. The first is the paper by Prof. D. A. Abrams of the Structural Materials Laboratory, Chicago, entitled "Effect of Time of Mixing on the Strength and Wear of Concrete." The second is the report of the Committee on Concrete Roads and Pavements; and the third is the group of papers on concrete ships.

Professor Abrams' paper takes 70 pages of the "Proceedings." It is an exposition of an elaborate series of tests on various kinds of concrete, and embraces very much more than its title would indicate. For instance, the amount of water, the effect of consistency, the relative value of materials, grading, etc., all are discussed by the author. As it stands, it is the most complete résumé of concrete tests since that issued some years ago by the United States Bureau of Standards. The Committee on Roads and Pavements makes its report almost entirely of a 60-p. document entitled "Recommended Practice for Concrete Roads," by far the most recent and advanced statement of concrete-road technic that has yet been published. It contains drawings and photographs descriptive of recent concrete-road practice, as well as analyses of contractors' organizations and estimates of costs. The concrete-ship papers are noteworthy, and, with the present interest in that art, should receive considerable attention.

An Engineer in Action at the Front

FIGHTING THE BOCHE UNDERGROUND—By H. D. Trounce, Formerly of the Royal British Engineers; now Captain of Engineers, U. S. A. New York: Charles Scribner's Sons. Cloth; 5 x 8 in.; pp. 231; illustrated. $1.50.

Born in England and having spent most of his life there, the author went to Canada on coming of age, then attended the Colorado School of Mines, and in 1910 settled in California, where he practiced as a mining engineer and became an American citizen. In the latter part of 1915 he went to England, obtained a lieutenancy in the Royal Engineers, and for 18 months was at the front, engaged mostly in sapping and mining

operations. In the middle of 1917 he returned to California, and in October was commissioned as captain in the Engineer Officers' Reserve Corps. Meanwhile, at the solicitation of friends, this book was written.

The volume is a straightforward account of the author's experiences, largely in explosive mine tunnel work, at Vimy Ridge, on the Aisne, at Arras and on the Hindenburg line. Concluding chapters deal interestingly and informingly with "The Psychology of Fear" and "Some Principles of Mining," the latter being illustrated with sketches and a folding map. The volume has both general and technical interest.

Useful Notes on Rural Roads

THE LOCATION, CONSTRUCTION AND MAINTENANCE OF ROADS—By John M. Goodell. Reprinted from "Good Roads Year Book" 1917. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 207; illustrated. $1.

Discussion of rural road problems without the confusion inherent in a combined work on both urban and rural highway improvements is a feature of this work. In its preparation Mr. Goodell had the coöperation of over 50 leading highway engineers of America.

Location, general design and plans are first treated. Following this the various types of road ordinarily used in rural districts are taken up, separately, and are discussed as to the approved practice for specifications, construction and maintenance. Interspersed with these are special chapters on cement, petroleum and residuums, asphalt, tar and tar products, with specifications for each.

Following these constructional and maintenance features are general chapters covering highway bonds, the tractive resistance of various types of roads, and tables showing the mileage and improved condition of roads throughout the United States. The book closes with a chapter setting forth the general arguments to be used in promoting good-roads sentiment.

An Engineer's Forecast

THE ENGINEERING PROFESSION FIFTY YEARS HENCE—By Dr. J. A. L. Waddell, D. Sc., D. E., LL. D., Consulting Engineer; Reprinted from *The Scientific Monthly*, Vol. VI, No. 6, June, 1918, and Vol. VII, Nos. 1 and 2, July and August, 1918. Kansas City, Mo.: The Author. Paper; 7 x 10 in.; pp. 54.

First delivered before various engineering schools and societies, this lecture consists of a "Prelude"—treating of present conditions "affecting the welfare of the engineering profession, the long-continued attempt to establish an American Academy of Engineers, and what can best be done to take advantage of existing possibilities for the advancement of engineering in the United States"—and a "Retrospect." The latter is "intended to indicate what is practicable of accomplishment for the profession in the next half century, although it must be confessed that occasionally there is inserted in lighter vein a suggestion which might properly be termed imaginative."

The author's object in putting the lecture in print is to give engineers in general some topics to consider that are essentially different in type from those which they encounter in their daily routine of work—in the hope that, ultimately, at least a few of the innovations suggested may be materialized. The "Retrospect," which occupies most of the space, is supposed to have been delivered in 1968, by J. A. L. Waddell, 2nd. In the flights of his imagination the author sees many if not most of the pet projects of himself and his more intimate friends brought to a happy conclusion—thanks largely to the academies of engineers, economics and law and the Society for the Promotion of Engineering Education.

Studies for Railway Projects in India

RULES FOR THE PREPARATION OF RAILWAY PROJECTS, 1918: With Notes by G. Richards, M. Inst. C. E., Chief Engineer with the Railway Board, India. Simla, India: Railway Board. Paper; 8 x 13 in.; pp. 55; illustrated by typical plan and profile.

Instructions as to estimates of traffic earnings and operating expenses are a prominent feature of this book of rules, which is a revision of earlier editions.

General instructions are given in regard to preliminary survey or proper location, made by compass traverse; also for location survey by instruments. The instructions for fieldwork are based on the use of the 100-ft. chain. Compensation for grade is specified for both easy and sharp curves, the prescribed rate being 0.04% per degree of curvature on the 5½-ft. gage, 0.03% for meter gage, 0.02% for 30-in. gage and 0.015% for 24-in. gage, all these various widths of gage being included in the railway system of India. Transition curves are required and are to be spirals based on the cubic parabola. Other rules relate to the prescribed proceedings and forms for plans, profiles, estimates and reports; specimens of these are given.

Notes on Stadia Surveying

TOPOGRAPHIC STADIA SURVEYING: A Manual with Reduction Tables and a New Type of Reduction Diagram—By C. E. Grunsky, Eng. D., Mem. Am. Soc. C. E. New York: D. Van Nostrand Co. Flexible Cloth; 5 x 7 in.; pp. 95; illustrated (with pocket containing stadia reduction diagram.) $2.

The author of this little handbook, a well-known consulting engineer of San Francisco, presents these notes on stadia surveying, and a useful stadia reduction diagram which he has prepared as a result of many years' practical experience in such work. He plunges into technical definitions without any preliminary introduction, and describes the Porro telescope and other special terms. The theoretical formulas and descriptions of a satisfactory type of stadia rod are clearly presented, and are followed by a concise description of stadia surveying methods, with practical suggestions. In the chapter on the latter subject, he lists six departures from ordinary methods, relating to (1) the type of rod; (2) the elimination from the notes of the height of the telescope above a station plug; (3) the liberal use of the magnetic needle; (4) the method of keeping field notes; (5) the use of approximation formulas, and (6) the use of convenient stadia reduction diagrams.

The correction tables included and the satisfactory samples of notes should be helpful, also the hints on plotting stadia notes. C. G. Anderson's tables for reduction of stadia, used by the United States Geological Survey, are reproduced, and a complete explanation of the author's special stadia diagram is given.

British Engineering Standards

The British Engineering Standards Association (28 Victoria St., London, S.W., England), announces that as soon as necessary arrangements can be made its 87

publications, with a few exceptions, will be issued in French, Italian, Spanish and Russian, and that both these and the corresponding English texts will be sold at 1s. apiece, plus postage—generally 2d. The association was founded in 1901, as the Engineering Standards Committee, by five British technical societies—the Institutions of (1) Civil (2) Mechanical and (3) Electrical Engineers and (4) Naval Architects and (5) the Iron and Steel Institute. Among the subjects covered by the specifications thus far published are: Rolled structural sections; rails; portland cement; steel for bridges and buildings; cast-iron pipe, separately for (1) water, gas and sewage, (2) hydraulic power, (3) soil pipe, (4) waste and ventilating pipe; salt-glazed sewer pipe; tar, pitches, bitumens and asphalts for road purchases. A new report, just at hand, deals with fine screw-threads.

Progress Report on Run-Off

Pending the completion of its investigations and report, the Boston Society of Civil Engineers' Committee on Run-off has published a progress report consisting of a glossary of run-off terms, and five papers. The latter are as follows: "The 0.2 and 0.8' Method in Power Canals," and "Precipitation, Evaporation and Run-Off," by Arthur T. Safford, chairman of the committee; "Use of the Current Meter in Stream Gagings;" "Effect of Ice on River Discharge" and "Methods to Use in Compilation of Data," by C. H. Pierce, secretary. These papers, with a prefatory note by Mr. Safford, fill 35 pages of the *Journal* of the Boston Society of Civil Engineers for November, 1918 (Tremont Temple, Boston; 50c.).

Spanish-English Specifications

To facilitate foreign trade, the United States Bureau of Foreign and Domestic Commerce and the United States Bureau of Standards are coöperating in translating for circulation abroad "standards for materials of various kinds, commercially acceptable and representing good American practice." Thus far four specifications of the American Society for Testing Materials have been translated into Spanish and printed in that language and in English, on facing pages. The latest of these (Nos. 3 and 4), translated by Antonio Lano, cover (No. 3) open-hearth steel girder and high-tee rails and (No. 4) low-carbon steel splice bars (5c. each, from Superintendent of Documents, Washington, D. C.). No. 1 covered portland cement and No. 2 dealt with carbon-steel rails.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

BUILDINGS AND EQUIPMENT FOR SCHOOLS AND CLASSES IN TRADE AND INDUSTRIAL SUBJECTS: Trade and Industrial Series No. 4—Washington, D. C.: Federal Board for Vocational Education. Paper; 6 x 9 in.; pp. 72; illustrated.

BUREAU OF STANDARDS, ANNUAL REPORT OF THE DIRECTOR TO THE SECRETARY OF COMMERCE: June 30, 1918—Washington, D. C.: Bureau of Standards. Paper; 6 x 9 in.; pp. 206.

The number and variety of services rendered by the Bureau of Standards, as disclosed by this report, is far beyond what those not familiar with the work of the bureau would suppose. The pamphlet deserves wide circulation in order that the work of the bureau may be better known and a wider opportunity thus be given for utilizing its services.

COUNCIL OF NATIONAL DEFENSE: Second Annual Report, June 30, 1918—Washington, D. C.: The Council. Paper; 6 x 9 in.; pp. 275.

DIRECTOR OF THE BUREAU OF MINES: Annual Report to the Secretary of the Interior, June 30, 1918—Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 118. 10c. from Superintendent of Documents.

FERRO-CONCRETE IN INDIA—By G. Richards, M. Inst. C. E., Chief Engineer with the Railway Board. Simla, India: The Author. Paper; 9 x 12 in.; pp. 85; illustrated.

The use of concrete is not confined to the United States and to Europe, as this document shows. For some time the Railway Board of India has been issuing technical papers through its chief engineer's office. A number of those relating to reinforced concrete have been gathered together and are now published under one cover. The pamphlet contains details of structures, paragraphs of specifications, results of tests, contract provisions, etc., all of which might be useful to American concrete engineers who wish to be fully informed on the progress of their art.

GRAPHICAL AND MECHANICAL COMPUTATION—By Joseph Lipka, Ph.D., Assistant Professor of Mathematics in the Massachusetts Institute of Technology. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 264; illustrated. $4.

HIGHWAY MAINTENANCE: Devoted Especially to Patrol Maintenance on the State Trunk Highway System—Compiled by J. T. Donaghey, Maintenance Engineer. Madison, Wis.: Highway Commission. Paper; 6 x 9 in.; pp. 69; illustrated.

Contains instructions for those in charge of highway maintenance, including patrolmen, maintenance foremen, and county highway commissioners. Sets forth the proper methods to be used in each kind of work, the best time of year for each kind of road, the best weather conditions for each kind of work, and the kind of machinery to use and how to use it.

INTERNATIONAL HEALTH BOARD: Fourth Annual Report, Jan. 1, 1917-Dec. 31, 1917—New York: The Rockefeller Foundation. Paper; 6 x 9 in.; pp. 147; illustrated.

INVESTMENTS IN LATIN AMERICA AND THE BRITISH WEST INDIES—By Frederic M. Halsey, Special Agent, Washington, D. C.: Bureau of Foreign and Domestic Commerce. Paper; 6 x 9 in.; pp. 544; illustrated. 50c. from Superintendent of Documents.

JOHNSON'S MATERIALS OF CONSTRUCTION: Rewritten by M. O. Withey, Associate Professor of Mechanics in the University of Wisconsin, and James Aston, Metallurgist with the A. M. Byers Co. of Pittsburgh. Edited by F. E. Turneaure, Dean of the College of Engineering of the University of Wisconsin. Fifth Edition. New York.: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 829; illustrated. $6.

OXWELDING AND CUTTING: Manual of Instruction—Newark, N. J.: Oxweld Acetylene Co. Paper; 5 x 8 in.; pp. 124; illustrated. 50c. Without Charge to Users of Oxweld Acetylene Apparatus.

REPORT OF THE COMMISSION APPOINTED TO DELIMIT THE BOUNDARY BETWEEN THE PROVINCES OF ALBERTA AND BRITISH COLUMBIA: Part I, 1913-16. Commissioners, R. W. Cautley, D.L.S., A.L.S., J. N. Wallace, D.L.S., A. O. Wheeler, B.C.L.S. Ottawa, Can.: Office of the Surveyor General. Cloth; 7 x 10 in.; pp. 189; illustrated. Atlas; 19 x 15 in. pp. 27

RETAINING WALLS: Based Entirely on the Theory of Friction —By Pedro J. Dozal, C. E., Escuela Nacional de Ingenieros de Mexico. Done into English by R. T. Mulleady, B.Sc. Eng. (Birmingham.) Buenos Aires: The Author. Cloth; 7 x 10 in.; pp. 155; illustrated.

SOME COMPRESSION TESTS OF PORTLAND CEMENT MORTARS AND CONCRETE CONTAINING VARIOUS PERCENTAGES OF SILT—By Arthur C. Alvarez and James R. Shields. Berkeley, Cal.: University of California. Paper; 7 x 11 in.; pp. 13; illustrated.

STORING: Its Economic Aspects and Proper Methods—By H. B. Twyford, Otis Elevator Co., Author of "Purchasing: Its Economic Aspects and Proper Methods." New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 196; illustrated. $3.50.

SURFACE WATER SUPPLY OF THE UNITED STATES—Nathan C. Grover, Chief Hydraulic Engineer. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; illustrated. No. 432: 1916. Part II. South Atlantic and Eastern Gulf of Mexico Basins; Guy C. Stevens and Warren E. Hall, District Engineers. Pp. 53. No. 435: 1916. Part V. Hudson Bay and Upper Mississippi River Basins; W. G. Hoyt and A. H. Horton, District Engineers. Prepared in coöperation with the States of Minnesota, Wisconsin, Iowa and Illinois. Pp. 204. No. 441: Part XI. Pacific Slope Basins in California, H. D. McGlashan and F. F. Henshaw, District Engineers. Prepared in coöperation with the State of California. Pp. 330. No. 465: Hawaii, July 1, 1916, to June 30, 1917; G. K. Larrison, District Engineer. Prepared in coöperation with the Territory of Hawaii. Pp. 184. No. 428: Artesian Waters in the Vicinity of the Black Hills, South Dakota; by N. H. Darton. Pp. 62.

THE UNITED STATES GEOLOGICAL SURVEY: Report of the Director to the Secretary of the Interior, June 30, 1918—Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 154; illustrated.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

"Service Bureau" Established by San Francisco Societies

In San Francisco there has recently been established an "Engineers' Service Bureau" which is intended to serve as a clearing house through which engineers in search of employment may get in touch with prospective employers and through which employers may find technical men promptly, as they are needed. This bureau is being conducted at the San Francisco Engineers' Club through the Joint Council of the San Francisco engineering societies. In this organization are represented the local sections of the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Society of Mining Engineers and the American Chemical Society.

The bureau is to be provided with as complete a list of engineering vacancies as it is possible to compile, and endeavor will be made to keep this list up to date. Applicants are to state their qualifications and experience on blank forms which are to be sent in by mail. As these applications come in they will be compared with the "Engineers Wanted" list. If a call is found for a man with the qualifications given, the applicant will be notified at once. Otherwise, his application will be filed without acknowledgment, awaiting a call. The bureau is to give information only by mail or telephone; no applicants are to be received in person.

Notice of the establishment of the bureau has been sent to more than a thousand engineers on the mailing lists of the several local sections, and every effort is being made to encourage the support of the individual members. It is felt that if the general coöperation of the members is secured in the matter of reporting vacancies, the bureau will be able to handle applicants effectively, and the plan can be made permanent. Positions to be included within the field of the bureau's activities are such as "could be filled by civil, mechanical, electrical, mining or chemical engineers, inspectors, construction superintendents, assayers, surveyors, draftsmen, or, in general, men with technical training and experience in the fields of the five societies represented."

Minnesota's Inclusive State Society Nearing Organization

Following the Engineering Council's suggestions—for greater coöperative activity—as sent out to the various engineering societies and brought to many organizations in person by the secretary, A. D. Flinn, the Engineers' Society of St. Paul, Minn., has had a special organization committee working on a plan for a state society. It wanted one that could function more surely and serve the engineers and engineering societies in a better way than has the Minnesota Joint Engineering Board, if possible, although that body has probably done more effective work than any similar organization in the country. Note was made of the original move in this column, Dec. 19, 1918, p. 1141, but a later *Bulletin* of the affiliated Engineering Societies of Minnesota indicates changes from the original tentative proposal.

It is felt that the name Minnesota State Polytechnic is not so good as Minnesota United Engineering Society, for the word "Engineering" should not be omitted. Eight sections are proposed: Electrical, mechanical, mining, structural, highway, drainage, municipal and railroads. Each member shall be enrolled in one or more sections, but vote in but one. Societies would become associated with the state organization, and the members would become, automatically, members of the larger body. In addition, any engineer with the necessary qualifications residing or practicing in the state may become a member. A somewhat complicated system of government of the affairs of the society is proposed, but with the idea of representation according to the different branches of engineering, and not in any respect according to local societies.

An annual convention is to be held at which any one or more sections may have separate meetings for technical papers and transact business pertaining to the section.

A business meeting of elected delegates is to take place, and a general program is to be provided by the board. Delegates are to be elected as follows: Each section shall elect a member of the Minnesota United Engineering Board, which member shall be one of the delegates of that section at the annual business meeting. Each section shall also elect one delegate-at-large to the annual meeting.

Each associated society shall elect one delegate-at-large to the annual business meeting for each 50 of its membership, provided it shall be entitled to one delegate if it have but 30 members.

The officers of the Minnesota United Engineering Board shall be the corresponding officers of the Minnesota United Engineering Society, and with the other members of the Minnesota United Engineering Board shall constitute the board of directors of the Minnesota United Engineering Society.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Drainage of Irrigated Land

Sir—In connection with the article on the Imperial Valley seepage case, on p. 237 of the issue of Aug. 1, 1918, and your editorial on the same subject in the issue of Aug. 8, I desire to call attention to another phase of the problem.

It is a well known fact that, in time, portions of nearly all irrigated lands will become water-logged and alkalied to such an extent as to preclude the possibility of profitable farming on the affected areas. It is

conceded that, in general, this water-logging is due to the rise of the ground water. All waters going into the ground beyond those used by plants or evaporated from the soil tend to raise the ground-water level in the low places. These waters may include seepage losses from reservoirs, transmission losses in main canals, laterals and farmers' ditches, deep percolation losses from irrigated fields and waste water allowed to run into sink holes and low places, from which it slowly seeps away into the ground water. As a rule, deep percolation losses from irrigated fields constitute the largest factor in water-logging soils.

Thus it is evident that, in a majority of cases, it is impossible to ascribe the damage to any particular one of these parts of the irrigation system. As a matter of fact, all, or nearly all, of these sources are usually present, and it can be said truthfully that the damage is done by the whole irrigation community, including those using reservoirs, canals, laterals, higher lands and lower lands alike.

When any considerable area of land in a district has become water-logged, two courses are open to the owners. They may abandon them either partly (by devoting them to pasture) or wholly, or they may drain them. In each case these owners may shoulder the whole burden or it may be distributed. In the first case they may suffer the loss with as good grace as possible, or they may attempt to reimburse themselves for their loss by suing the owners of higher lands or canals, as in the Imperial Valley case. This is always expensive and the results are doubtful, to say the least.

In the second case the drainage may be done by the owners of wet lands, either singly or through some organization which includes only owners of wet lands, or it may be accomplished by the organization of a drainage district taking in not only the wet lands but the higher contributing lands, including the canals.

Several of the Western states have made provision through the enactment of suitable drainage district laws for the formation and administration of such districts. The Idaho law provides that higher lands and canals may be assessed for part of the cost of constructing drainage systems in proportion to their responsibility for the damage. This provision has been upheld by the state supreme court, both as to higher irrigated lands and as to canals. (Burt vs. Farmers' Coöperative Irrigation Co., 30 Idaho, 752). There are similar provisions in the laws of Montana, Oregon and Washington.

The tendency in Idaho is toward assessing the costs, in districts where all the wet lands have become so as a result of irrigation, at a flat rate per acre over the whole district. Such a flat rate for drainage costs in an irrigation district was recently upheld by Judge Isaac F. Smith in the seventh judicial district of Idaho.

The method of solving the seepage problem by draining the wet land and apportioning the cost over all the lands contributing to its water-logged condition has a number of advantages. It restores the land to a condition permitting a high state of cultivation, instead of allowing it to become mosquito-breeding marsh or an alkali-covered waste. It prevents the loss of home and improvements by the unfortunate owner of lower-lying lands. It divides the cost of reclamation among all those who have contributed to the damage, instead of making the owner of the low land pay the total cost of reclamation in addition to the loss of the use of the land during the interval, often long, between the time when the land becomes water-logged or alkalied and the time when it is reclaimed by drainage.

With the provision that such districts must not be constructed unless the enhanced value which will accrue to the lands of the district will exceed the cost of drainage, including organization and construction, there seems to be no danger that this solution of the problem will retard or cripple the irrigation development of the West. In fact, it should help that development, as it provides a feasible and equitable way of restoring the fertility of water-logged lands.

M. R. LEWIS,
Irrigation Engineer.
Boise, Idaho.

Problems Before American Society of Civil Engineers

Sir—Referring to the discussion of the problems before national engineering societies: I am summing up here the recent arguments I have heard. There is some uncertainty as to whether or not the governments of the national engineering societies are now supported by majorities such as are generally presumed to determine policies and carry them into effect. It has yet to be proved that any society can live indefinitely when its nourishment is limited to things technical.

By "society" we may mean (1) the collective body of persons forming a community, or the aggregate of such communities; (2) any body of persons connected by acquaintance, friendship or neighborhood, or associated for a common object; (3) the more favored class or classes or the fashionable portion of a community; the term "society" is then often used attributively; and (4) association in social relationship, fellowship, or companionship.

Our national engineering societies were doubtless organized under the theory set forth in definition 2—that is, "persons associated for a common object." The pioneer members of the society felt the need for an organization which would permit them to exchange ideas relating to engineering theory, design and construction. In their time, scientific research and investigation were sorely needed. The necessity for great activity in this kind of work on the part of the society has decreased as other agencies, better organized and better qualified to assume leadership, have come into being. The "common object" has remained practically unchanged, regardless of altered conditions.

The society has become more institutionalized, while its management is said to be less democratic, than during the earlier years of its history. The engineer has not given much study to the meaning of the words "civil engineer." The engineer who has tried to frame a registration law for civil engineers appreciates how difficult it is to define these words clearly. Yet we have all the machinery that any organization has evolved for its business management. That we lack something that pervades the atmosphere of the American Medical Association, and even of the American Bar Association, is clear to the engineer who has studied the activities of those two societies.

The technical field of the civil engineer is so broad that it is difficult to arouse a general interest among the members of the society in the study or discussion of a paper of great merit, as it generally concerns an isolated branch of theory or practice. Able critics hold that the society has already lost its place as a leader in the technical field, and that it has fallen under the influence of an element that may be indexed under the third definition of "society." If a change has taken place, let it be hoped that it is of a kind to encourage evolution in the right direction. If the change tends toward a condition that may be described under definition 4, we have cause for a feeling of optimism.

The engineer is too ready to provide machinery and to set it going, and then to leave it, assuming that the plant will produce desired results. His societies are inclined to be technical and impersonal. He is, speaking generally, an individualist of a somewhat extreme type. He is seldom the first to suggest coöperation. His time is largely occupied by investigations of a technical nature. His study and his leisure reading are not likely to direct his attention to "society" in its broad sense. While he is presumed to live in an atmosphere that is saturated with the sentiment of democracy, his organizations have been inclined to become more autocratic in government.

Recently the officers of the national engineering societies—some twenty to thirty men—committed the entire membership of thirty thousand in support of legislation before Congress, without giving the rank and file an opportunity to express individual views. This does not smack of democracy. The engineer is to achieve greatness through service. Opportunities for maximum service may be somewhat clouded when the element that largely dominates the policies of organizations (presumed to be representative) centers at the financial and industrial metropolis of the country. If these governmental defects are common to the four Founder societies, each should clean house before the average member will take much interest in any plan which contemplates their amalgamation.

The growth of local chapters, or associations, of the American Society of Civil Engineers suggests a longing for personal contact among its members. While some of these local associations will doubtless indulge in technical discussion for a time, in imitation of the parent body, the members will ultimately discover, I believe, that another cause leads them to assemble at a local headquarters where men of common interests may become mutually helpful through social intercourse. If these local associations do not recognize the motive which prompts their organization, I predict that they will be short-lived.

It is evident that the local associations are ultimately to dictate the policies of the national society. All centers of population will provide opportunity for such associations, and when the number multiplies to the point where a majority of the members are identified with one of the smaller organizations, the parent society must step aside and submit to the commands of these groups. The business of the national society will then be transacted through representatives of the local associations—and New York, instead of being the national headquarters, will simply support a local association of its own and will cease to use the facilities of the society for the benefit of a local club, as it is now presumed to do by many who simply stand and wait.

An organization which manifests but little interest in human problems is not likely to enjoy the permanent, sympathetic support of its members. The civil engineer may argue that he performs his greatest service to society when he perfects the technical machinery of his own profession. This kind of argument appeals to the man who is content to be recorded as a technician, pure and simple. Such a man manifests no sympathy for his associates in the engineering field; he has no concern regarding the welfare of his neighbors; public interests never disturb him, and the word "altruism" is not to be found in his dictionary. A society made up of men of this type must be a drab affair. That such a society must slowly disintegrate as its members begin to obtain a vision of opportunity for higher service is apparent.

The prominent engineer of the near future must exhibit as much interest in the welfare of his associates as in his own business or technical success. Engineering will have a place among the real professions when engineers accept these broader responsibilities.

CLARENCE T. JOHNSTON,
Professor of Surveying, University of Michigan.
Ann Arbor, Mich.

Are Bridge Engineers Losing Their Heads On Unit Stresses?

Sir—The report of the Committee on Column Tests of the American Society of Civil Engineers appears to have caused some fright among bridge designers; for I notice that the Engineering Institute of Canada has lately published a "General Specification for Steel Railway Bridges" in which the unit stress for columns is given by the formula,

$$p = 12{,}000 - 0.3(l/r)^2$$

in which l = the unsupported length of the column in inches and r = its least radius of gyration in inches.

This is quite a sudden jump from the old standard formula,

$$p = 16{,}000 - 60l/r$$

The change indicates one of two things: Either that hitherto we have been overstressing compression members from 15 to 25%, or that there is going to be wasted a vast quantity of metal in the future.

Moreover, in making such a sweeping change in the compression formula the writers of the Canadian specifications were not consistent, because in Clause 47 they allow for the compression flanges of beams an intensity of

$$16{,}000 - 200l/b$$

In the case of railway stringers l/b is generally in the neighborhood of 10; hence the intensity of working stress is about 14,000 lb. As b is equal to about $4.5r$, for $l/b = 10$ we shall have $l/r = 45$. Substituting this in the Canadian column formula gives

$$p = 12{,}000 - 0.3(45)^2 = 11{,}400 \text{ lb.}$$

In the case of one compression member of a bridge, it appears to be legitimate to stress the metal up to 14,000 lb. per square inch, and in another up to only 11,400 lb. per square inch, a difference of 23 per cent. And

there is no valid reason for stressing differently a strut which forms a part of the top chord of a truss and a strut which forms a part of the top flange of a beam. "Consistency, thou art a jewel!"

If the correctness of the formula for compression flanges of beams be conceded—a formula which, for a dozen years or more, has been one of the clauses of the American Railway Engineering Association's standard bridge-specifications, and which the Engineering Istitute of Canada has appropriated without change—and if it be granted that b is generally equal to about $4.5r$—why should not the equivalent formula,

$$p = 16{,}000 - 44l/r,$$

apply in general to struts with fixed ends? Be it noticed that this formula gives higher results than does my old formula,

$$p = 16{,}000 - 60l/r.$$

The American Railway Engineering Association is getting ready to trim down materially its old intensities for steel struts, although not to the extent that the Engineering Institute of Canada has done.

What aggravates the effect of this proposed decrease of compression intensities is that, simultaneously therewith, the American Railway Engineering Association is contemplating increasing its tensile intensity of working stress from 16,000 lb. to 18,000 lb.; and other specification writers are advising that it be made as high as 20,000 lb. To an outsider it must look as if the bridge engineers of this country were losing their heads!

The compression tests that started the present wave of apprehension did not have governing conditions corresponding properly to those of actual truss-members; hence I would suggest that, before the bridge engineers of America take the drastic step of assuming steel in compression to be only 60 or 70% as strong as the same material in tension, some really practical tests of struts be made under conditions corresponding to those in actual structures. Such a series of tests would cost considerable money; but, if the Bureau of Standards at Washington were to indorse the suggestion to make them, it ought not to be at all difficult to obtain from Congress an ample appropriation for the purpose.

The method of conducting these tests that I have in mind is this:

Let there be built a five-panel riveted-truss bridge of about 100 ft. span; let the middle panel-lengths of the top chords thereof be made decidedly weaker than all the other portions of the structure; and let a uniformly distributed live load be applied at the panel-points by hydraulic pistons. All portions of the structure, including the two weak members, should be scientifically detailed, so that failure will inevitably take place in the main portions of the weak struts and not in the details thereof, and so that the bridge can be used for a long series of tests to destruction of the said mid-panel lengths of the top chords. The weak members should be attached to the connecting plates with an ample number of rivets to develop the full strength of the test pieces; and these rivets should be removed carefully after each test to destruction is completed.

Of course, it would be entirely practicable to vary the value of l/r in the different tests, provided that the attachment of the test-strut be not made eccentric.

There should be a supporting platform beneath the span to prevent its falling any material distance when failure occurs.

By adopting a weak vertical post instead of a weak panel-length of top chord, and by loading (at the elevation of the latter) three panel-points only, a series of tests could be made on vertical posts. A similar series could be carried out on the inclined end posts.

A cheaper method than that just described, but not quite as satisfactory, would be to build a single truss, instead of the complete span, and steady it laterally but not vertically, and then to apply the test loadings directly above the top chord at the panel-points. A great advantage of the span tests as compared with the truss tests is that duplicate tests could be made simultaneously on similar members. Moreover, the span tests would be in practically exact accord with actual conditions of loading, while the truss tests would not.

By removing occasionally the test loading, the elastic limits of the struts could be ascertained through noting the absence or otherwise of permanent set.

Experiments similar to those described could be made on a pin-connected span or a pin-connected truss so as to determine the strength of struts with hinged ends.

In view of the immense amount of bridge manufacture and construction that is likely to be done in the United States within the next five or ten years, the making of this proposed series of tests is worthy of being considered a matter of national importance.

J. A. L. WADDELL,
Kansas City, Mo. Consulting Engineer.

International Language for Modern Engineers

Sir—Some years ago, during a voyage across the Pacific Ocean, I became acquainted with an English naturalist who jokingly defined the American engineer as a "most migratory species of mammalia." No wonder that among the engineers one may find many who know or study foreign languages—Spanish, German, French, even Chinese or Japanese—and not a few who can read, write and speak in Esperanto.

I never will forget my surprise when, in 1915, during the world exposition at San Francisco, I approached a group of gentlemen talking Esperanto, and found that more than half of them were engineers; as far as I recollect, among that group were H. Babcock, of the Southern Pacific Co.; F. G. Cottrell, mining engineer now at Washington, D. C., occupying an important post in the Bureau of Mines; a civil engineer with a difficult Slavonic name, and Professor Languel, mechanical engineer and professor of mechanics at the University of California.

No doubt readers of *Engineering News-Record* use or know this international language and might be interested in the only technical journal published in Esperanto, edited by Dr. R. Saussure, grandson of the renowned scientist H. Saussure who made the famous exploration of Mont Blanc in 1787. The name of this monthly is *La Teknika Revuo* (10 Hotel Glasse, Berne, Switzerland; annual subscription 5 francs, less than a dollar). The first number was published in July, 1918. The reading matter is subdivided into the following sections: Editorial; science; industry and commerce;

international associations, and technical dictionaries. It also includes a list of the 20 periodicals published at present in Esperanto in different countries. Among them we find Amerika Esperanto, West Lynn, Boston, Mass.

Knowing from my own experience how Esperanto is useful during travel and for obtaining first-hand technical information in foreign lands, I sincerely believe that any engineer who is too busy to learn several foreign languages will be benefited immensely by familiarizing himself with Esperanto, which he can acquire in his spare minutes of relaxation from routine professional work. At the same time Esperanto will enable him to come in contact with any foreign country, through the agencies or Esperanto delegates whose names are printed regularly in the Esperanto Year Book. Further information may be obtained from the Esperanto Association of North America, West Newton, Mass.

CIVIL ENGINEER.

Washington, D. C.

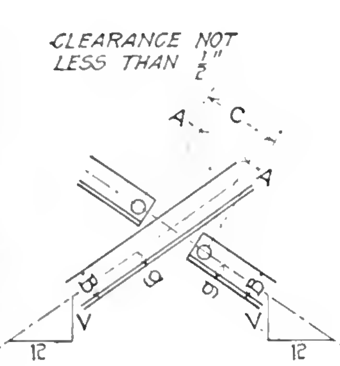
Spacing of Rivets in Lateral Bracing

Sir—The accompanying tables show the spacing of rivet holes for lateral bracing angles, giving a clearance of ½ in. between angles or between angles and chord.

These tables, while very simple, are not found in handbooks, and greatly facilitate the design of lateral systems.

VALUES OF C
A = 1¼"

LEG-B		2	2½	3	3½	4	5
GAGE-g		1⅛	1⅜	1½	1¾	2	2½
BEVEL - V	3	13⅝	15⅝	16¾	18⅝	20⅝	24⅝
	3½	12⅛	13⅞	14⅝	16⅜	18⅛	21½
	4	10⅞	12⅜	13⅛	14⅝	16¼	19⅛
	4½	10	11⅞	12	13⅜	14⅝	17⅜
	5	9¼	10½	11⅛	12⅜	13½	15⅞
	5½	9	9⅞	10⅜	11½	12⅝	14¾
	6	8¼	9¼	9¾	10¾	11¾	13¾
	6½	7⅞	8¾	9¼	10⅜	11⅛	12⅞
	7	7½	8⅜	8⅞	9⅝	10½	12¼
	7½	7¼	8	8⅜	9¼	10	11⅝
	8	7	7⅝	8⅛	8⅞	9⅝	11⅛
	8½	6¾	7½	7¾	8½	9¼	10⅝
	9	6½	7¼	7½	8¼	8⅞	10¼
	9½	6⅜	7	7⅜	8	8⅝	9¾
	10	6⅛	6⅞	7⅛	7¾	8⅜	9½
	10½	6⅛	6⅝	7	7½	8⅛	9¼
	11	6	6½	6¾	7¼	7⅞	9
	11½	5⅞	6⅜	6⅝	7⅛	7⅝	8¾
	12	5¾	6¼	6½	7	7½	8½

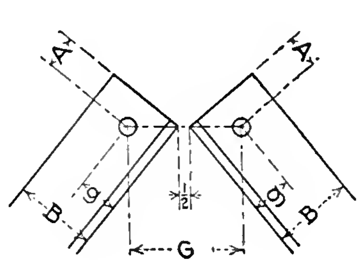


VALUES OF C
A = 1½"

LEG-B		2	2½	3	3½	4	5
GAGE-g		1⅛	1⅜	1½	1¾	2	2½
BEVEL - V	3	14⅛	16⅛	17⅛	19⅛	21⅛	25⅛
	3½	12⅝	14⅜	15⅛	16⅞	18⅝	22
	4	11⅜	12⅞	13⅝	15⅛	16¾	19⅝
	4½	10½	11⅞	12½	13⅞	15⅛	17⅞
	5	9¾	11	11⅝	12⅞	14	16½
	5½	9½	10⅜	10⅞	12	13⅛	15¼
	6	8¾	9¾	10¼	11¼	12¼	14¼
	6½	8⅜	9¼	9¾	10⅝	11⅝	13⅜
	7	8	8⅞	9⅜	10⅛	11	12¾
	7½	7¾	8½	8⅞	9¾	10½	12⅛
	8	7½	8⅛	8⅝	9⅜	10⅛	11⅝
	8½	7¼	8	8¼	9	9¾	11⅛
	9	7	7¾	8	8¾	9⅜	10¾
	9½	6⅞	7½	7⅞	8½	9⅛	10¼
	10	6⅝	7⅜	7⅝	8¼	8⅞	10
	10½	6⅝	7⅛	7½	8	8⅝	9¾
	11	6½	7	7¼	7¾	8⅜	9½
	11½	6⅜	6⅞	7⅛	7⅝	8⅛	9¼
	12	6¼	6¾	7	7½	8	9

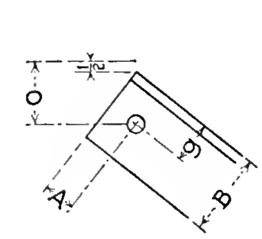
VALUES OF G

LEG	GAGE	A=1¼	A=1½
B	g	G	G
2	1⅛	3⅞	4¼
2½	1⅜	4¼	4½
3	1½	4⅜	4¾
3½	1¾	4¾	5⅛
4	2	5¼	5½
5	2½	6⅛	6⅜



VALUES OF O

LEG	GAGE	A=1¼	A=1½
B	g	O	O
2	1⅛	2 3/16	2⅜
2½	1⅜	2⅜	2½
3	1½	2 7/16	2⅝
3½	1¾	2⅝	2 13/16
4	2	2⅞	3
5	2½	3 5/16	3 7/16



SPACING OF RIVET HOLES FOR LATERAL BRACING ANGLES TO GIVE ½-INCH CLEARANCE

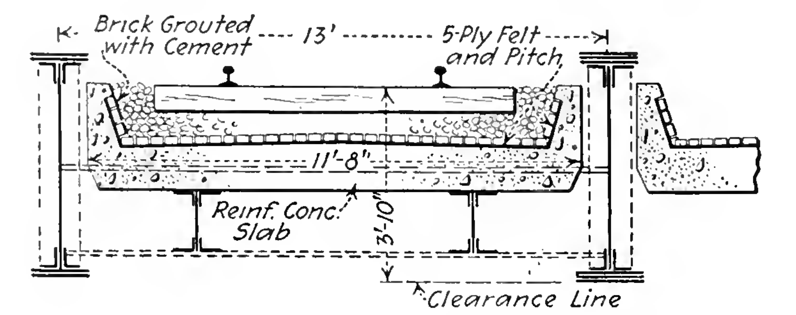
Thinking they may be of interest to designers, I have taken the liberty to forward them for publication, knowing that thus they would obtain wide circulation.

Dayton, Ohio. EDMUND FELDMAN.

Concrete Trough-Slab Floor Construction for Railway Bridges

Sir—In the discussion of waterproofed railroad bridge floors by H. T. Welty, in your issue of Dec. 12, p. 1081, a type worthy of note is not mentioned. This is the construction, shown by the accompanying sketch, in which the track is carried in a reinforced-concrete trough which is separate from the girder. The trough is supported by longitudinal beams under the rails. The vertical distance required from underneath the clearance line of the girder to the base of the rail is 3 ft. 10 in., or about the same as is required for the more recent designs of those described by Mr. Welty.

My observation has been that where concrete floors are finished against the girder the most careful applica-



REINFORCED-CONCRETE BRIDGE TROUGH NOT FINISHED AGAINST THE GIRDERS

tion of waterproofing material and the most careful attention to details will not insure complete success. In a series of bridges, some will be altogether tight, and others will show a slight discoloration on the under side, usually at columns. These defects do not pass water through in any appreciable amount, and are of no disadvantage from the point of view of the users of the street under the bridge. But they are serious in that a slight percolation of water to the fabric of the bridge endangers the structure, and means that the chief function of the waterproofing, to protect the steel, has not been accomplished. An unpleasant feature of this situation is that no information can be had as to whether the bridge is safe or unsafe, covered as it is by concrete.

In the design shown by the sketch the bridge members are all exposed and are protected by paint. There is no difficulty about the waterproofing. In fact, the brick and felt protection shown could in many cases be omitted.

JERVIS VAIL,
Assistant Engineer, Pennsylvania Railroad.

Rahway, N. J.

Heavy Road Traffic in Colorado

By a census taken under the auspices of the Colorado State Highway Department, the Santa Fé Trail is shown to have carried a traffic of 24,900,000 ton-miles. The next heaviest section in the state, the roads between Pueblo and Colorado Springs, carried 17,300,000 ton-miles.

Hints for the Contractor

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

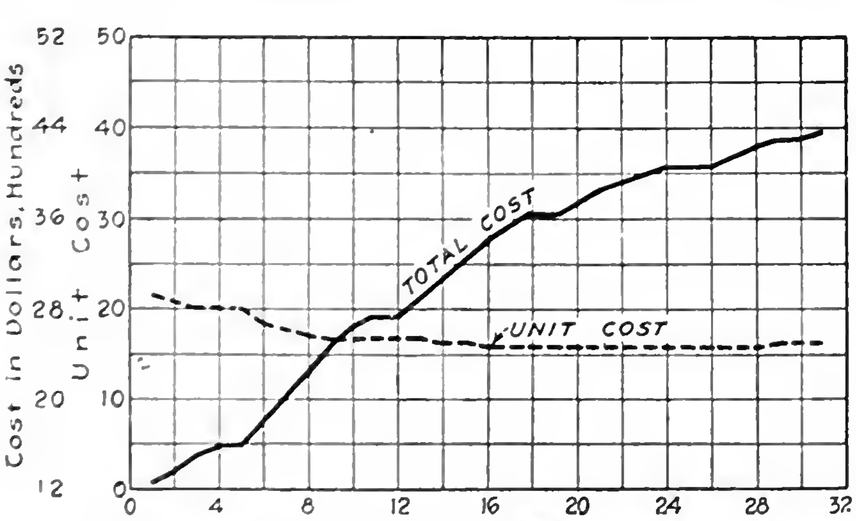
Only Completed Work Counts in Monthly Estimates

THE mixer was operating at possibly quarter capacity on a certain construction job. Only a part of the regular crew had reported for work that day. Such occurrences were not unusual last summer, when war industries were clamoring for workmen, and contractors had to be prepared to make the best of them. In this particular instance the contractor could have shut down the mixer and sent the men home. He could, if there had been opportunity, have transferred the men to other gangs. He could have put the men at work trimming stock piles or cleaning around the mixer, or otherwise marking time.

He did none of these things. Instead, he put the men at work operating the mixer and placing concrete at such speed as they were able. Obviously, the plant was not working economically. The contractor knew this. But he pointed out that, on the other hand, work which was being done was work which would count as money when the monthly estimate was made up. The incident is not very important in itself, but it exemplifies an important truth: Volume of construction completed is the only thing that counts in the contractor's monthly estimate. C. S. H.

Simple Chart Provides Complete Labor Cost Analysis

TWO curves record labor costs for construction performed by the Detroit Edison Co., as shown by the sample chart reproduced herewith. By a series of simple computations, using data read from the curves, a dozen facts of direct utility in checking construction costs and in estimating the cost of prospective work



LABOR COSTS FOR CONSTRUCTION SHOWN BY CHART

may be deduced. In fact, states William M. Ferguson of the Detroit Edison Co., in the *Synchroscope*, the curves furnish on a few sheets facts which reflect conditions of the work which would not be noticed in a lengthy report nor be seen by looking the work over in the field.

From the total cost curve can be read directly the total cost of the job at any time during the progress of the work. The second curve shows at any date the cost per unit of material placed—as, for example, the cost per cubic yard of concrete or per thousand of brick. It is obtained by dividing the total cost to date by the volume of material placed to date. The values for platting both curves are obtained from the time tickets each day, the backs of these tickets being used for reporting the amount of material used during the day's work.

Besides giving the total and unit costs at any date by direct reading, computation determines: (1) Total quantity of material, by dividing the total cost at any date by the unit cost as of the same date; (2) the cost for any day or the quantity of material placed for any day, by subtracting the total to date on the day previous from the total to date on that day; (3) the days of lost time, by counting the number of days that the total cost line extends horizontally; (4) the percentage, complete to date, by dividing the total quantity by the total estimated quantity multiplied by 100; (5) the percentage of work done from one date to another, by subtracting the totals at the two dates, dividing the remainder by the total for the whole job, and multiplying by 100; (6) the percentage of appropriation used, by dividing the total cost to date by the total estimated labor cost, and multiplying by 100. The unit time, or man-hours per unit of material placed, is another unit which may be obtained by dividing the unit cost by the rate per man per hour.

On the Detroit Edison Co. work the charts are kept by jobs, which are subdivisions of construction work orders; that is, each work order is divided into jobs according to the kind of material to be placed or the kind of work to be done.

Place Gravel Well Strainers in Shell

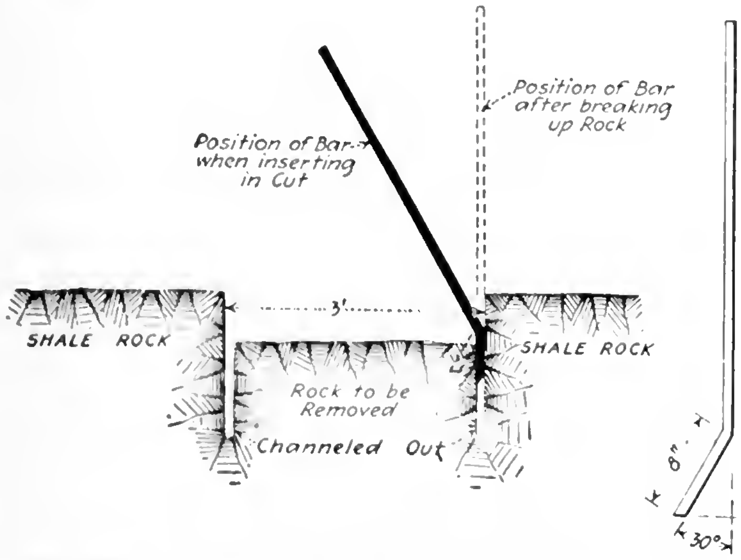
WATER for Camp Dodge, near Des Moines, Iowa, came largely from a 50-ft. circular open well 31 ft. deep, with the shell built of concrete, in which 30 strainers were inserted to permit water to enter from the sides as well as from the bottom. L. P. Wolff, in describing the engineering features of the camp in the *Bulletin* of the Affiliated Engineering Societies of Minnesota, states that the open well was constructed by building up the walls in sections above the water line, and then sinking them by excavating from the inside with a clamshell bucket operated by a derrick and hoisting engine. The bottom of the well was left about 5 ft. above the level of the blue clay. The strainers consist of openings in the wall filled with graded, screened gravel held in place with perforated cast-iron plates. Before being sunk, the screens were covered on the

outside with $\frac{3}{16}$-in. steel plates to prevent the entrance of the fine top soil, a cable being attached to each plate for the purpose of withdrawing it after the excavation was completed.

Bent Crowbar Easily Removes Shale Rock

BY G. W. MCALPIN
Point Pleasant, W. Va.

AN ORDINARY crowbar, bent back at the bottom for about 7 or 8 in. of its length to an angle of about 30 deg., proved a very useful tool in removing shale rock from a channeled key. As the key was narrow



ORDINARY CROWBAR, BENT, REMOVES ROCK

the rock was removed by hand, in preference to shooting. The bar was inserted in the channel cut and then pulled back. Thus the shale was torn up and its removal with shovels made possible.

Weed- and Root-Grubbing Implement Useful on Highway Maintenance

BY E. EARL GLASS
Monrovia, Cal.

A HOME-MADE combination hoe and hook has been used with excellent results in Los Angeles County, California, in clearing the weeds, sod and roots from the shoulders of the county highways. Combining two of the tools ordinarily used for this work, it not only

COMBINATION TOOL LOOSENS ROOTS, WEEDS AND SOD ON HIGHWAY SHOULDERS

reduces the number of pieces to be carted about the job but also saves considerable time which formerly had been consumed in changing from one tool to the other.

To make the implement, get a 16-in. piece of $\frac{3}{8}$ x $\frac{3}{4}$-in. steel and sharpen it at both ends. Then heat the steel to redness, bend it around the eye of a stout hoe and rivet it securely, as indicated in the illustration, which shows the tool in use on highway maintenance.

In operation, the tines formed by the bent steel serve to loosen gravelly soil, and are useful in removing tough weeds and roots and in hooking the loosened sod from the shoulders. A mattock, similarly fitted, has proved valuable for heavier work.

Home-Made Truck Supports Welding Outfit

BY E. EARL GLASS
Monrovia, California

TO FACILITATE the handling of a welding outfit, the small truck to support the apparatus, as shown in the illustration, was constructed from scrap by the shop men of the Los Angeles County Road Department. This addition to the welding outfit makes one-man operation and conveyance possible.

WELDING OUTFIT ON HOME-MADE TRUCK

To make the truck, parts were secured from several machines. The frame was obtained from an old steel bicycle rack, the wheels came from a discarded lawnmower and these were combined with the base and pipe handle to make a well-braced truck which proved very handy and useful as a support for the gas tanks.

Submerged Dividers Used on Concrete Walks

Submerged steel division plates were used on one-course concrete sidewalks constructed by the roller method at Donora, Penn. This method was described by W. M. Kinney, of the Universal Portland Cement Co., in *Engineering News-Record,* of June 20, p. 1196. The work was being done for the American Steel & Wire Co. on an extensive concrete housing development, requiring 25,000 sq.ft. of 5-ft. walk. The steel plates were $\frac{3}{16}$ in. thick, 5 ft. long and of a depth that would not project above the finished surface when in position. Where wooden forms were used, the plates were held in position by steel pins; where steel forms were used the plates had a special hook at the end which fitted into a prepared slot in the form. The concrete was filled to a depth of $\frac{1}{2}$ in. above the top of the plates and thoroughly rolled longitudinally, with the concrete roller. When it had stiffened sufficiently, the plates were removed by means of hooks, and the surface over the division line was grooved in the usual manner. A $\frac{1}{2}$-in. prepared bituminous expansion joint was placed every 50 feet.

NEWS OF THE WEEK

New York, January 16, 1919

F. S. Curtis, President of American Society

Engineer and Railroad President Elected at Annual Meeting In New York

Fayette Samuel Curtis, president of the Old Colony R.R., and previously vice president and chief engineer of the New York, New Haven & Hartford R.R., was elected president of the American Society of Civil Engineers at the annual meeting in New York this week. His experience in civil engineering in a period of over 40 years has been almost entirely in railroad work.

Mr. Curtis was born Dec. 16, 1843, at Owego, N. Y., and received his early education at the public and private schools of Owego, after which he took a course in civil engineering at Owego Academy. He began his engineering work in the summer of 1863, when he was employed by the Albany & Susquehanna R.R. Co. in the location and construction of a line between Binghamton and Albany. In 1866 he was engaged by the Southern Central R.R. Co. in railroad location and construction between Oswego and Auburn, and in 1869 rendered similar service for the Lake Ontario Shore R.R. between Oswego and Rochester. In 1870 he entered the service of the New York & Harlem R.R. as assistant engineer, and was engaged in surveys for the towns of Tremont and Fordham, now included in New York City. In 1871 he represented the Harlem River & Portchester R.R. Co. in the location of lines between New Rochelle and the Harlem River, and in the fall of 1871 was employed by the New York & Harlem R.R. Co. in the location of tracks and yards at the Grand Central Station, after which he was principal assistant engineer in the preparation of plans for and later in the construction of the Fourth Ave. improvement between the Grand Central Station and the Harlem River.

A few years later he was appointed chief engineer of the New York & Harlem River R.R. and superintending engineer of the Fourth Ave. improvement, continuing in the service of the New York & Harlem and New York Central & Hudson River R.Rs. until 1883, when he was appointed chief engineer of the New York, New Haven & Hartford R.R. He served as chief engineer of the New Haven until March, 1910, when he was elected fourth vice-president of the company, in general charge of the engineering department and other matters, with headquarters in Boston. Three years later he was promoted to the second vice presidency, but, owing to the large amount of en-

(Concluded on page 162)

American Society Passes Resolution Favoring Development of Public Works

Annual Meeting Also Indorses Action of Protest Against Dismissal of Engineers of Public Service Commission in New York

Disappointing in the fact that no discussion whatever was started on the report of the Development Committee, the annual meeting of the American Society of Civil Engineers Jan. 15 nevertheless passed two significant resolutions—one on the action of the Engineering Council in calling a hearing of protest in regard to the dismissal of engineers of the Public Service Commission of New York, and the other a strong resolution favoring the active and immediate prosecution of public works for the purpose of furnishing employment, especially to returning soldiers. The work of the National Service Committee in Washington was outlined and members were requested to offer suggestions.

New President of American Society of Civil Engineers

FAYETTE SAMUEL CURTIS

As was the case last year, the annual address by the president was read at this meeting, the summer convention having been omitted on account of war conditions. Pres. A. N. Talbot reviewed the activities of the society for the past year, and called attention to the vital part played by engineers in the war. A total of 1593 members, ranging from major generals and rear admirals down through the ranks, had entered the service. In addition, large numbers of members sacrificed financial and home interests to give their time to Governmental and war activities. In addition to reviewing the details, which will be found in the report of the Board of Direction, noted below, President Talbot stated that the John Fritz medal, awarded to J. Waldo Smith for his services in engineering and his achievement in providing New York with a supply of water, was the second award to a civil engineer, of the total number of 14 awards of this medal made up to this time. He mentioned the work of the American Engineering Standards Committee, and developed in detail many suggestive proposals for the future work of the society. An abstract of this address will appear in a later issue.

The Board of Direction reported a net increase in membership, for the year, of 343, not nearly as large as in some previous years, largely due to the greater number of losses by death, 109. The deaths of men in war service amounted to 18. The total membership on Jan. 1, 1919, was 8933. Three new committees were announced during the year: (1) The Committee on Development, consisting of one member appointed by each of the 22 local associations, and seven members at large appointed by the president; (2) The New York Meetings Committee, with authority to arrange for the second meeting in each month; (3) a committee of the Board of Direction appointed to keep it informed of any Governmental or other programs looking to reconstruction or rehabilitation of the engineering resources of the country after the war.

On Aug. 1 the 57th St. society house was leased to the Ajax Rubber Tire Corporation for 10 years, at a total annual rental of about $22,750. The present mortgage on the building being $200,000, at 6% per annum, the total net revenue will be a little less than $11,000 per year.

The year has been a difficult one financially for the society. If all bills incurred during 1918 had had to be paid by Dec. 31 the books would have shown a deficit of more than $20,000. The present financial condition is the result of several factors. A general estimate of the additional burden due to the unexpected conditions shows a total of $98,000.

The Committee on Award of Prizes reported the following awards: The Norman Medal to L. R. Jorgensen for

his paper, "Multiple-Arch Dams in Rush Creek, California"; the James R. Croes Medal to Israel V. Werbin for his paper, "Tunnel Work on Sections 8, 9, 10 and 11, Broadway-Lexington Ave. Subway, New York City"; the Thomas Fitch Rowland prize to F. W. Scheidenhelm for his paper, "The Reconstruction of the Stony River Dam"; the James Laurie prize to Charles W. Staniford, for his paper, "Unusual Cofferdam for 1000-Ft. Pier, New York City"; and the Collingwood prize for juniors to James B. Hays for his paper, "Designing an Earth Dam Having a Gravel Foundation With the Results Obtained in Tests on a Model."

The Nominating Committee for the coming year was elected as follows: District 1, J. J. Yates; District 3, F. P. Williams; District 5, J. F. Conway; District 6, N. F. Sprague; District 10, F. E. Weymouth; District 11, W. Fay Barnard, and District 13, H. L. Haehl.

The Special Committee on Engineering Education reported that after 12 years of work its final report was ready in the form of Dr. Mann's exhaustive studies, undertaken with the aid of the Carnegie Foundation (see *Engineering News-Record* of Oct. 24, p. 782). After sketching the history of technical education, Desmond FitzGerald moved that the president appoint a committee of three to confer with the committee of other societies to insure careful and general discussion of Dr. Mann's report. This resolution was referred to the Board of Direction and the special committee was discharged with thanks. Reports from other special committees showing the disruption caused by the war and the fact that little progress had been made were received.

The preliminary report of the Commitee on Development, printed in the December *Proceedings*, was accepted without discussion as a progress report.

It was announced that the Board of Direction had passed a resolution on the previous day, stating that it had considered the resolution passed by the Brooklyn Engineers' Club in regard to the summary dismissal of about 350 engineer employees of the Public Service Commission, First District, of New York State, and resolving that the dismissal of these employees was not only eminently unjust and an offense to the engineering profession, but directly opposed to the best interests of the City of New York and therefore to those of the country. It also resolved that the board recognize this to be matter upon which the Engineering Council has properly taken prompt action in calling a hearing of those directly concerned, which took place the same afternoon. It was moved and unanimously carried that the action of the board be approved by the meeting.

The following resolution was then offered by R. S. Buck:

"Whereas, it is vital to the peace and welfare of our country that during the necessary reconstruction period the number of unemployed be reduced; and whereas, the development of transportation, sanitation, power, and public utilities generally is necessary to the development and prosperity of the country; and whereas, the curtailment of needed public works during the period of the war has retarded the development of the country; and whereas, the speediest and most effective means to prevent the suffering, distress and demoralization resulting from unemployment is afforded by public works; and whereas, the public welfare and confidence upon which industry generally depends require that the construction of public works be vigorously prosecuted:

"Therefore, be it resolved that the American Society of Civil Engineers desires to record its profound conviction that public works should be carried forward to the fullest extent consistent with sound judgment, not only for fundamental economic reasons but for humanitarian reasons, to furnish employment for all who are properly entitled thereto, including our returning soldiers; and it is further

"Resolved, that copies of this resolution be forwarded to such Federal, state and municipal authorities as may be able, in the opinion of the Board of Direction, to promote the purposes of the resolution."

Marshall O. Leighton discussed the work of the National Service Committee, recently organized in Washington along the lines of the tentative plan offered by Philip N. Moore in the December *Proceedings*. As chairman of the committee, he asked for help and suggestions from members of the society. The office has been established in a small way in the McLoughlin Building, Washington, and the work is now being financed by the residue of the appropriation made to the Engineering Council last year. A resolution offered by Paul Hansell that it was the sense of the meeting that the four Founder societies should join in asking their members for a subscription of $5 each, to be handled as best seemed fit by the Engineering Council, was laid on the table.

The election of officers was announced, as follows:

President, Fayette Samuel Curtis, Boston; vice-presidents, to serve two years, Herbert Samuel Crocker, Denver, and Leonard Metcalf, Boston; for treasurer, to serve one year, Arthur Smith Tuttle, New York City; for directors, to serve three years, George Hallett Clark, New York City; Jacob Stinman Langthorn, New York City; Charles Clement Elwell, New Haven, Conn.; Willard Beahan, Cleveland; John Watson Alvord, Chicago, and Carl Ewald Grunsky, San Francisco.

At the afternoon meeting Brig.-Gen. R. C. Marshall, Jr., chief of the Construction Division, U. S. A., described in detail the work done in this country during the war.

Labor Department To Study Building Conditions

Division Organized To Collect Data To Be Used In Furthering Construction Campaign

(*Washington Correspondence*)

Preparatory to launching a campaign to encourage the resumption of all kinds of construction, the United States Department of Labor has organized a new bureau, called the Division of Public Works and Construction Development. The division, which is being directed by F. T. Miller under Roger W. Babson, chief of the Education Service, has employed the services of trained political economists and specialists in various fields of business, for the purpose of collecting and compiling definite information for use in furthering the nation-wide campaign for immediate general construction. The research work is being carried on under the general supervision of Dr. E. J. Clapp, professor of economics, New York University, and Dr. M. A. Mikkelson, editor of the *Architectural Record*.

Consulting Board Will Weigh Date

The research work includes the gathering of all data relating to construction, and the information so gathered and classified is to be submitted to a consulting board composed of representative business men with practical experience, who will weigh the facts and decide upon the merits and possibilities of such plans for construction as may be contemplated. The result is then furnished to those interested, through the publicity channels which have been adopted by the division.

The personnel of the Economists and Experts Branch has been carefully chosen to assure each specific field interested in construction being touched upon in the statistical estimates. Aiding Dr. Clapp and Dr. Mikkelson are Dr. Rufus S. Tucker, of Michigan University, and Dr. John Whyte, loaned by the New York University, who are engaged in land values research; Capt. Thomas W. Holden, instructor, Massachusetts School of Technology, investigating materials; Everett Domminick, New York City, in a consulting capacity, reporting on capital; E. L. Keesler, president of the League of Building and Loan Associations, in an advisory capacity; D. Everett Waide, Metropolitan Life Insurance Company, advisory; William M. Garland, president of the National Association of Real Estate Boards; E. J. Russell, director of the St. Louis Chamber of Commerce, estimating the demand for construction; A. P. Norton, statistician, Labor Department, statistics; Miss H. M. Sullivan, Chicago University, in charge of foreign precedent; Miss A. E. Hathaway, legal adviser; William B. King, of the National Federation of Construction Industries, and others who are lending their services to the work.

Specifically, the research branch has been asked to furnish all possible in-

formation as to the available supply of capital, the value of land, the cost of material, the supply of the various materials on hand, as well as the plant capacity for the production of these materials; labor, its supply, its efficiency and its cost; building construction now contemplated and held up during the war, and the demand for various classes of building in various sections of the country.

In connection with these, the economists and experts are amassing such other information as is brought to the notice of the division from time to time and which will aid in furnishing facts for publicity. This publicity will be handled through the newspaper press, the trade journals, correspondence and a speakers' bureau, the latter composed of men who have a thorough knowledge of the construction situation; they will work in coöperation with the chambers of commerce and other organizations.

To Promote Home Building

A poster campaign will be inaugurated to further the "Own-a-Home" campaign. These posters will be distributed throughout the country for display on new buildings, their purpose being to effect a closer feeling between workmen and contractors and to promote the home-building idea generally. The posters will be signed by Secretary of Labor Wilson.

In speaking of the financial plan contemplated by the division, F. T. Miller, in an interview with the Washington representative of *Engineering News-Record*, said that the logical means for bringing the construction campaign to an immediate working basis was through the building and loan associations. Mr. Miller stated that there were 7269 such associations in the United States, with a total membership of 3,838,612. Their total assets, he said, were $1,750,000,000, and their receipts for 1917 were $1,220,000,000. The cost of doing business, he pointed out, was $9,800,000, which amounted to only 0.8 per cent.

"What is necessary," Mr. Miller said, "to make it possible for these associations to aid in the Own-a-Home construction campaign, is to make their assets negotiable. If this can be accomplished—and I see no reason why it cannot—the financial problem has to a great extent been overcome."

Mr. Miller stated that he had no doubt as to the possibility of creating a demand for municipal bonds. These, he said, always have been, and are now, in demand.

The division is now sending out questionnaires to 15,000 contractors who have been compelled to discontinue building operations because of war conditions, requesting that they furnish information as to why the construction is not being completed.

Specific answers are requested relating to the cost of labor and material, and financial plans.

Walker D. Hines Is Made Director General of Railroads

The appointment of Walker D. Hines as Director General of Railroads to succeed W. G. McAdoo, resigned, was announced Jan. 11. Mr. Hines was graduated from Ogden College, and obtained the degree of LL.B. from the University of Virginia. Shortly thereafter he entered the railroad field as assistant attorney for the Louisville & Nashville R.R., at Louisville. He specialized in the study of interstate commerce laws, and in 1900 was appointed first vice president of the road. He left the Louisville & Nashville four years later and formed a law partnership with Alexander Humphrey. In 1906 he went to New York and was made counsel for the Atchison, Topeka & Santa Fé Ry. Soon thereafter he became chairman of the board of directors of the company, and later chairman of the finance committee.

When this country entered the war he resigned his offices with the railroad and went to Washington, where he became Assistant Director General of Railroads. He has been generally regarded by railroad men as Mr. McAdoo's right-hand man. Mr. Hines has definitely announced that he favors the continuation of Federal control of the carriers for a five-year period.

Work of Valuation Bureau Reported by Interstate Commission

Although the war interfered with the prosecution of the work of the Engineering Section of the Bureau of Valuation, the Interstate Commerce Commission reports that it still hopes to complete the field work in 1919. In fact, for the past year—up to Sept. 30, 1918—the road and track parties covered 53,244 miles of main track and 81,470 miles of all track, which is in excess of any previous year's record.

In view of the experience of the current year, the office work probably cannot be finished, as estimated, during 1920. It was more difficult to maintain that force, many more than 25 per cent. of the office employees in a given district changing during a single month.

While the land section has not seriously felt the effect of the war, it cannot produce completed reports until certain information is received from the carriers as to their land; inability to obtain this has limited the progress of this section. It is expected that this section will complete its work within 1920.

The greatest difficulty has been experienced by the Accounting Section in obtaining and retaining competent accountants, owing to demands for this kind of service, both by the Government and by private enterprises. It is difficult to find men competent to put the needed information into the form of completed reports. The field work of this section should be finished in the first part of 1920.

On the whole, it is believed that while the war has seriously affected this work, it will not greatly postpone the period of final completion nor increase the total expense.

Would Appropriate $100,000,000 for Land Reclamation

Expenditure of $100,000,000 by the Secretary of the Interior "for the investigation, irrigation, drainage, and development of swamp, arid, waste, and undeveloped lands," to provide "employment and farms with improvements and equipment for honorably discharged soldiers, sailors, and marines of the United States," is authorized by a bill now before Congress. The lands reclaimed would be so disposed of by the Secretary of the Interior as to reimburse the United States within 40 years from entrance by settlers, with interest at 4%. The money will be available to develop one or more projects in each state, if feasible projects can be found. The scheme is in line with recommendations made by Secretary Lane. Investigations of the kind contemplated are already being made by the United States Reclamation Service.

American Engineer Elected to L'Institut de France

J. A. L. Waddell, consulting engineer of New York and Kansas City, was elected, Dec. 17, to L'Institut de France as a corresponding member in the Académie des Sciences. L'Institut de France is composed of five academies, including the Académie des Sciences, which is restricted to a full membership of 66, all of whom must be citizens of France, and in addition there are 116 corresponding members in other countries. The académie is divided into several sections, including geometry, mechanics, astronomy, geography and navigation, and general physics. Dr. Waddell's election to the mechanical section fills the vacancy created by the death of General Zaboudski of Petrograd.

Fayette S. Curtis

(*Concluded from page* 160)

gineering work being done by the company at that time between New Haven and New York, it was necessary for him to assume personal charge, and in 1904 he moved his headquarters to New Haven. He served as vice president of the New Haven until April, 1907, when he was appointed president of the Old Colony R.R. Co. and the Union Freight R.R. Co. of Boston. Since that time his headquarters have been in Boston.

Some of Mr. Curtis' works, aside from those already mentioned, were the large drawbridge over Fort Point Channel, Boston; the South Terminal Station, Boston, of which he was consulting engineer, and double-tracking and grade-crossing improvement work on many sections of the New Haven.

Railroad Executives Favor a Department of Transportation

At a meeting held in Philadelphia Jan. 5 the Association of Railway Executives unanimously adopted a plan calling for the creation of a Department of Transportation, headed by a Secretary of Transportation, who would be a cabinet officer and to whom would be transferred the administrative functions now performed by the Interstate Commerce Commission. Among other principles for an elaborate revision of existing railroad control legislation, the plan includes the following:

Private ownership, management and operation should, as a matter of national policy, be continued.

The power of regulation, including all rates, state or interstate, should be exclusively in the hands of the national Government, but administered through machinery or agencies responsive to the needs of and convenient to the people of the several states.

The carriers should have the power to initiate rates.

The statute should provide the rule of ratemaking, and should require that rates be not only what has been called reasonable but adequate and sufficient. Rates, whether approved or disapproved by the Secretary of Transportation, may by complaint be brought before the Interstate Commerce Commission, which should have power to pass upon the reasonableness and adequacy thereof.

The Interstate Commerce Commission should have power to prescribe minimum rates as well as maximum rates.

Other provisions are submitted covering in detail the questions of rates and the required modification of the Clayton act, the control of securities and a system of Federal incorporation. Thomas DeWitt Cuyler is chairman of the standing committee of the railroad executives.

Honor Resident Engineer of Army Supply Base at Boston

A dinner was given in honor of George L. Mirick, resident engineer of the Boston Army Supply Base, at Young's Hotel in Boston, Jan. 3, by the engineering staff of Fay, Spofford & Thorndike, consulting engineers, Boston, in recognition of his services on the work. Among those who attended were John Ayer, executive engineer of the supply base; Warren D. Trask, assistant division engineer attached to the field office; Capt. George D. Emerson, Quartermaster Corps, who was in charge of inspection; Carroll A. Farwell, division engineer in charge of substructure design; Bion A. Bowman, division engineer in charge of superstructure design, and Barzillai A. Rich, division engineer in charge of equipment.

The dinner was followed by expressions of appreciation of Mr. Mirick's work as resident engineer.

Engineering Council Holds Hearing on Public Service Engineers' Dismissal

Facts as to Crippling of Rapid-Transit Work Presented—Delegate Protests On Score of Workers' Safety—Mass Meeting Asked

A hearing on the mass dismissal of engineers of the Public Service Commission of New York State, First District, was held Jan. 14 by a committee of the Engineering Council at the Engineering Societies Building, New York. Commissioner Travis H. Whitney, representing the commission, which had been invited to the hearing, stated the situation. More details of how the work of design, construction and supervision is affected were given by Robert Ridgway, acting chief engineer; A. I. Raisman, engineer of design; C. M. Holland, tunnel engineer, and C. F. Smollin, chief clerk. The Board of Estimate, which had also been invited, was not represented.

Figures on the depletion of various branches of the engineering organization were given—the total engineering force of 812 being reduced by 334—and it was stated that in view of the serious responsibilities involved it had been concluded that the only possible course is to concentrate the available men on the contract sections most urgently in need of being carried on. This necessitates stopping work on the other sections. Questions of the committee developed the fact that this procedure will inevitably subject the city to direct losses as well as to contractors' claims of damage for delay. At present contracts amounting to about $80,000,000 are outstanding, on which $60,000,000 has been paid; the latter sum therefore represents capital lying idle in case work is delayed.

Work has had to be stopped on the preparation of designs for a large number of important contracts planned to be let during the coming season, such as the Nassau St. line and the Steinway tunnel extension. Approval of working drawings on present contracts has also been interrupted. The chief design divisions have been cut to one-third or less of their necessary minimum complement.

The committee displayed interest in the statement that the conduct of the river tunnel work and certain other operations represented a grave situation in view of the reduction in engineering force. It then concerned itself particularly with the question whether the cut in appropriation and the fixing of a detailed schedule of positions and salaries had been preceded by hearings, or by conferences between the commission and the board. Commissioner Whitney stated that no hearings or conferences had taken place.

It appeared that the action taken was based on little or no knowledge of the requirements of the rapid-transit work, and that the schedule, which ignores civil service laws and contains many faults and inconsistencies, was prepared by a subordinate of the Board of Estimate of the city and had not been scrutinized by the board.

A strong statement was made by M. McConville, a delegate from the Hoisting Engineers' Union, who asserted that the workers' safety depended on engineering supervision and protested against the reduction of the engineering force by the board.

Resolutions of protest passed by the Brooklyn Engineers' Club, by the American Society of Civil Engineers, and by the Municipal Engineers of New York, were read to the committee by representatives. The General Contractors' Association, the Merchants' Association and the Chamber of Commerce were represented.

J. C. Meem, speaking from the viewpoint of the contractors, forcibly expressed their sympathy with the protest against crippling the engineering supervision of public work.

In opening the hearing, H. W. Buck referred to the development of engineering public opinion in recent years as a new force, and said that the hearing was a step in bringing that opinion to bear on the case in hand.

A plea for more emphatic and representative development of the profession's public opinion was made by E. J. Mehren, editor of *Engineering News-Record*, at the close of the proceedings. He urged the value of a mass meeting of New York engineers, to be called by the council, if the facts developed at the hearing appeared to justify further action.

Seattle To Buy Street Railways

Municipal ownership of the street railways of Seattle, through purchase from the Puget Sound Traction, Light & Power Co. for $15,000,000 of city bonds, is authorized by an ordinance passed by a 5 to 2 vote of the city council Dec. 31. The property includes 203 miles of track and 540 cars, besides carhouses, repair shops and supplies. A referendum vote on the purchase is a possibility but is not expected, for in November last the general plan was approved 4 to 1 on an "advisory" popular ballot. The city and company officials have agreed on a friendly suit to determine the legality of the transaction. It is hoped that the property will be transferred to the city by Mar. 1.

Mining and Electrical Engineers to Hold Joint Meeting

It is planned to hold, at the annual meeting of the American Institute of Mining Engineers, in New York, Feb. 17-20, two joint sessions with the Canadian Mining Institute Feb. 18, and one joint session on the afternoon of Feb. 19 with the American Institute of Electrical Engineers.

Would Give Supply Men More Recognition

Changes in New England Water-Works Association Customs Suggested by President Davis

More recognition of both the younger and the associate members of the New England Water-Works Association was suggested by Carleton E. Davis, retiring president, in his address at the annual meeting of the Association in Boston, Jan. 8. Before reaching this part of his subject Mr. Davis touched on services rendered by water-works during the war and the opportunities for still further service during the reconstruction period. In closing, reference was made to the annual award of the Brackett memorial. A condensation of the address follows:

"Water-works officials may feel legitimate pride that the utilities under their direction responded generally to the public necessities of the war period in a satisfactory way. Probably no other essential to the prosecution of the war suffered fewer breakdowns and caused less concern to the consumer than did the water-works, notwithstanding that they, equally with other public-function activities, were handicapped by the general difficulties of the situation. The period of reconstruction has now come. Out of the present situation will come whatever those who are able to form and direct may desire.

"The association will grow according to the service it renders. There is an opening for a new field of usefulness in the development of the headquarters force, so that any person anywhere desiring information on water-works subjects would think naturally of the New England Water-Works Association as the source to which to apply. Such service would bring returns in increased membership, wider circulation of the *Journal* and greater advertising value for its pages.

Younger Men Should Come to Front

"Perhaps the younger members are not heard from as frequently as desirable. There is a natural gravitation of one age to a like age, and it may be that there has been an undue representation in the management of the association of the members of maturer years who may lack the necessary acquaintance among the younger men to bring out all their possibilities.

"The old-fashioned experience meetings are typical of the spirit of this association. They were good for the soul and good for the mind, and personally I hope it will be found proper to develop an increase in their number. They have been the means of placing at the disposal of the general water-works practitioner a vast fund of invaluable information concerning ways and means, and at the same time they have furnished a wonderful safety valve for pent-up feelings.

"Possibly the future may develop periodical meetings conducted by the associate members—meetings at which the present practice will be reversed and the associates will talk while the members listen. It may be that the associates are now obtaining an undue advantage in listening to the views of the members, pro and con, without being obliged to commit themselves to any line of action. On the other hand, perhaps the members are not availing themselves of an opportunity to hear a frank discussion between the various makers of the articles in everyday use by the water-works operator. Nothing could be more enlightening than a free discussion between makers of competitive goods, and doubtless such discussions could be brought about without detriment to any and with profit to all, apart from the features that may savor of competition. This same principle might be carried further with advantage and membership on committees investigating subjects in which the associates are vitally interested might be given them.

Half of Income from Associates

"One change which has already been effected by the war is open diplomacy and the adoption of perfect frankness and discussion. In following these lines, the association will doubtless reconstruct the present rather indefinite financial status of the associates. From dues and through advertising, the association derives about one-half of its income from the associates, and at the conventions accepts or solicits contributions for entertainments and hospitality. This is not solely a business transaction on either side. The association furnishes a medium through which personal relations are developed, to the mutual advantage of both parties having business to transact with each other. The situation should be frankly recognized and put on a definitely understood basis.

"A notable recognition of the wide range of activities embraced within the membership of this association is the award of the Brackett memorial for a paper devoted to accounting. The water-works operator has been too often classified as a specialist on pumps, pipes, reservoirs or some similar matter, while in fact he is responsible for not only the operation of highly specialized machinery, but he is further charged with the conduct of large business interests. By its own action, the association now lays claim to this larger sphere of operations and asserts the proper standing of its members in the community."

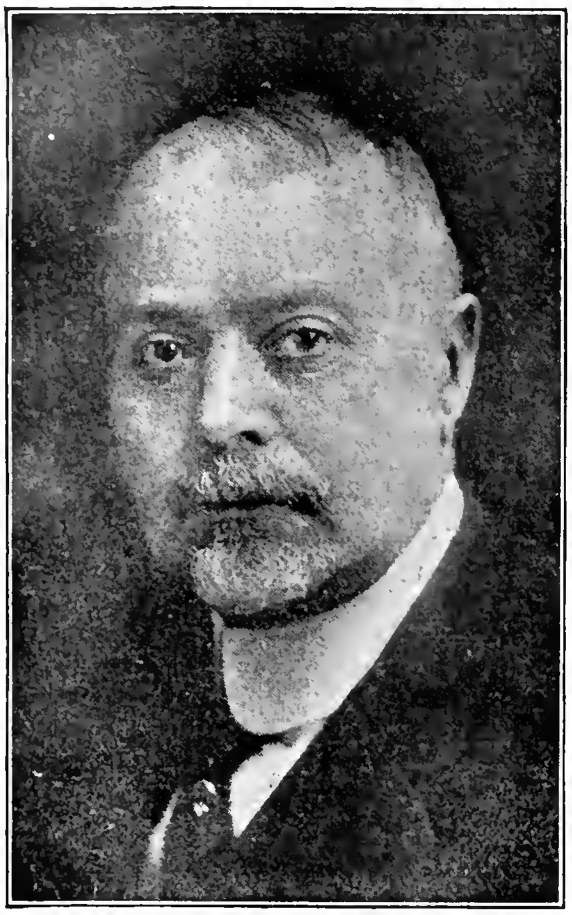
Business Proceedings

The canvass of ballots showed the election as president of Samuel E. Killam, superintendent of pipe lines and reservoirs, Metropolitan Water-Works, Boston, and the reëlection of the following: Secretary, Willard Kent, Narragansett Pier, R. I.; editor, Henry A. Symonds, consulting engineer, 70 Kilby St., Boston; treasurer, L. M. Bancroft, Reading, Mass.

Hermann Laub

Hermann Laub's death from heart failure on Dec. 10 took away an unusually able and versatile engineer. He ranked among the best bridge engineers in the country.

As builder of two important suspension bridges over the Onio River, at East Liverpool, Ohio (1896), and Parkersburg, W. Va. (1916), Mr. Laub had achieved the rank of leading



HERMANN LAUB, 1855-1918

authority on medium-span suspension bridges. Disagreeing with current teachings and practices, he held strong convictions of the merit of the suspension type for heavy street service, and through this conviction accomplished a distinct revival of the medium-span suspension bridge. He showed corresponding independence and vigor of thought in other fields.

Born Apr. 14, 1855, at Durmentingen, Württemberg, of Swiss ancestry, Hermann Laub studied civil engineering at the Stuttgart Polytechnic (1875) and the Munich Technical College (1870) and then removed to the United States. His engineering career in this country began in 1880, on the Denver & Rio Grande. For half a dozen years he was associated with Gustav Lindenthal in engineering practice. In 1890 he established an independent practice in Pittsburgh.

His structures include many notable works. Tasks of exceptional difficulty were often entrusted to him. An example was the salvaging and repair of the 22nd St. bridge over the Monongahela River at Pittsburgh in 1910.

A year or more ago Mr. Laub undertook to set down his views and experiences in the field of suspension bridges. This work remained unfinished at the time of his death.

F. E. S.

Engineer Officers Decorated With Distinguished Service Cross for Services Rendered in This Country

MAJOR GENERAL GEORGE W. GOETHALS

MAJOR GENERAL WILLIAM M. BLACK

BRIGADIER GENERAL HENRY JERVEY

Cleveland Votes to Build New Union Station

By a vote of 31,000 to 20,000 approximately, the City of Cleveland on Jan. 6 adopted the ordinance authorizing the mayor to enter into a contract with the Cleveland Union Terminal Co. providing for the construction, maintenance and operation for the use of steam and electric railways of a union passenger depot adjoining the southwest corner of the Public Square. This contract when signed would, at the option of the railways concerned, serve to abrogate the previously signed contract between the city and the Pennsylvania, New York Central, Cleveland & Pittsburgh and Big Four Railroads for a union station on the lake front. The lake-front station plan was developed subsequent to the adoption of the Cleveland group plan, which provides for a Mall reaching from the lake front south to a point just east of the Public Square and lined on each side with public buildings. This building plan has already been started, and a number of public buildings are in place. The railroad station, however, has never gone beyond the project stage, the contract providing that work should start within six months after the delivery of certain deeds, which real estate deal has never been consummated.

The new union station scheme developed from a project to build a station for the Cleveland & Youngstown R.R., into which were later drawn the Wheeling & Lake Erie, the Erie, the B. & O., and the Nickel Plate, which latter had bought the Cleveland & Youngstown Railroad. The latter station was originally planned as a stub-end terminal lying south and west of the Public Square along the Cuyahoga River valley, and embraced freight terminals farther south along the same valley. When plans for this passenger station were submitted early in 1918 to the United States Railroad Administration it was suggested by the Regional Director that the plan be changed from a stub-end to a through-passenger station, with interurban electric terminal facilities, and that all the railroads entering the city be brought into the scheme. Later in 1918 the various railroads concerned came to an agreement to this end, and a report recommending a grand union station for all the railroads was adopted. This report brought about the introduction of the ordinance which has just been voted upon.

Although most optimistic newspaper reports come out of Cleveland to the effect that the new station will be immediately started, in fact there remain a number of difficulties, partly financial and partly legal, which have to be overcome before actual construction will be started.

A number of technical reports were made on the general feasibility of the new scheme and the desirability of one of the two schemes.

Nominations for American Railway Engineering Association

The nominating committee of the American Railway Engineering Association announces the following nominations of candidates for officers for the ensuing year:

For president, Earl Stimson, general superintendent maintenance of way and structures, Baltimore & Ohio Railroad; for vice president, J. A. Atwood, chief engineer, Pittsbugh & Lake Erie Railroad; for treasurer, George H. Bremner, district engineer, Bureau of Valuation, Interstate Commerce Commission, Chicago; for secretary, E. H. Fritch, Chicago.

Response to Inquiry Indicates Extensive Road Building

Road building will be undertaken on an extensive scale during the coming season, furnishing a large amount of work for returning soldiers, according to information obtained by the Bureau of Public Roads in response to an inquiry sent to the various state highway departments. Of the 38 states replying to the questionnaire, 29 gave definite figures. A summary of their reports shows that they can utilize 11,637 soldiers and sailors, as skilled laborers, and 91,904 as unskilled laborers. The bureau estimates that the total amount of road work in the United States for the coming year will be about $300,000,000.

In making its reports on road conditions to the newly formed Division of Public Works and Construction Development of the Department of Labor, the Department of Agriculture gave detailed reports from 20 states showing that $120,000,000 will be expended on road work which has definitely been decided upon. It is estimated that 50% of this amount will go to labor.

In commenting on these conditions, the Department of Labor urges that public works unquestionably needed should be put under way at once.

Engineering Societies

The Montreal Branch of the Engineering Institute of Canada was addressed Jan. 9 by George H. Greenfield, of the National Fire Protection Association, who spoke on "Fire Prevention."

Calendar

Annual Meetings

AMERICAN WOOD PRESERVERS' ASSOCIATION; F. J. Angier, Mt. Royal Station, Baltimore, Md.; Jan. 28-29, St. Louis.

AMERICAN ROAD BUILDERS' ASSOCIATION: 150 Nassau St., New York City; Feb. 25-28, New York City.

NATIONAL RIVERS AND HARBORS CONGRESS; 824 Colorado Bldg., Washington, D. C.; Feb. 5-7, Washington, D. C.

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Feb. 17-20, New York.

The Indiana Engineering Society, at the annual meeting to be held in Indianapolis, Jan. 23-25, noted in these columns last week, will give prominence to the general subject of the status of the engineer and the organization of engineering societies. Included in the list of subjects and speakers are the following: "The Engineer, His Problems and Opportunities," by W. H. Finley, president of the Chicago & Northwestern Railway Co., and president of the American Association of Engineers; "The Need of Coöperation Among Engineers," by C. E. Drayer, secretary of the American Association of Engineers; "Proposed Bill for Licensing Structural Engineers," by H. O. Garman and W. H. Insley, Indianapolis; "Developments of the Governing Policies for Engineering Societies," by Prof. A. N. Talbot, retiring president of the American Society of Civil Engineers. Highway and railroad problems are included in the topics for discussion.

The Detroit Engineering Society held a meeting Jan. 10 devoted to the subject of "Grade Separation." The meeting was addressed by Prof. Henry E. Riggs, of the civil engineering department, University of Michigan, and John W. Reid, grade-separation engineer for the city of Detroit. The society will hold a meeting Jan. 24, to be devoted to the subject "Artillery in War." The meeting will be addressed by an officer of the Ordnance Department of the Army.

The Engineers' Club of Philadelphia will be addressed by Lieut. Col. E. B. Morden, U. S. A., Constructing Quartermaster, Philadelphia, on "The Construction Division of the Army," at the weekly luncheon of the club, to be held Jan. 21.

The Rochester Engineering Society will hold a meeting Jan. 17, with "Old Surveys of Rochester" as the subject of discussion. This is to be the first in a series of group meetings on the subject of municipal surveys.

The Engineers' Club of St. Louis has elected officers for 1919 as follows: President, Baxter L. Brown; vice-presidents, George R. Wadleigh, W. E. Wolfe and H. W. Eales; treasurer, C. W. Martin; directors, George E. Chamberlin, J. L. Hamilton and W. W. Horner. J. W. Kerr is secretary.

The Engineers' Club of Trenton was addressed, Jan. 9, by Lieut. Col. George A. Johnson, Construction Division, U. S. A., who spoke on "The Operation of Army Camp Utilities by the Construction Division of the Army."

The Florida Engineering Society held its annual meeting at Jacksonville Jan. 6. In presenting the report of the Committee on Harbor Improvements, W. W. Fineren, United States junior engineer, United States Engineer's Office, Jacksonville, emphasized the need of municipalities taking a more active interest in developing the harbor facilities of Florida, and indicated many possibilities for expansion. In the report of the president of the society, emphasis was given to the lack of recognition for engineering service, including a statement that although engineers, by training and experience, are fitted for civic duties, they have in the past been seldom appointed to civic boards and commissions. The following officers were elected: President, B. Johnson, Miami; vice-president, G. B. Hills, Jacksonville, and secretary, J. R. Benton, Gainesville.

The Gas Engineering Section of the Western Society of Engineers was addressed by Prof. S. W. Parr, department of applied chemistry, University of Illinois, on "The Present and Prospective Status of the Gas Industry," at the first meeting of the section since its formation. The meeting was held Jan. 8. This section is one of the few strictly professional gas engineering organizations, and a campaign is being conducted to bring into the society additional membership among gas engineers.

Personal Notes

LEWIS NIXON, consulting engineer, New York City, has been appointed Superintendent of Public Works of New York State. Mr. Nixon was previously consulting engineer and acting commissioner of public works of the Borough of Richmond, New York City, resigning in 1915 to enter private practice. He was graduated from the United States Naval Academy at the head of his class in 1878 and later was sent by the Navy Department to the Royal Naval College, Greenwich, England. He was appointed naval constructor in the United States Navy in 1884. Several years later he withdrew from the Navy to become superintending constructor of the Cramp shipyard, Philadelphia. In more recent years he has been prominently connected with politics in New York State. In 1914 he became consulting engineer and acting commissioner of public works of Richmond.

G. H. DUGGAN, vice president and managing director of the Dominion Bridge Co., Montreal, has been elected president of the company.

MAJ. MYRON B. REYNOLDS, recently released from his command of the 208th Engineer Sappers, 18th Division, Camp Travis, Texas, has been appointed acting assistant city engineer of Chicago, succeeding Henry W. Clausen, who resigned Jan. 1 to enter private business, as mentioned in these columns last week. Major Reynolds was engineer of water-works design in Chicago for four years previous to his entry into Government service in September, 1917. He entered the city engineering department thirteen years ago.

HUGH RODGERS has been appointed to the position of city engineer of Salem, Ore.

RICHARD H. GILLESPIE, formerly chief engineer of the Borough of the Bronx, New York City, has been appointed chief engineer and general manager of the Dewey Cement-Gun Construction Co., with headquarters at Allentown, Penn.

CLARK DILLENBECK, engineer of bridges and buildings, Philadelphia & Reading R.R., has been appointed assistant chief engineer of the Reading, the Central Railroad of New Jersey, the New York & Long Island R.R., the Atlantic City R.R. and the Port Reading Railroad.

HOMER C. BENDER, previously of Berkeley, Cal., has been appointed superintendent of public utilities, Spokane, Wash.

R. A. BURNS has been appointed to the office of city engineer of Lewiston, Idaho.

F. O. DUFOUR, division of construction and engineering, Stone & Webster, has been appointed structural engineer, with headquarters at the main office in Boston.

MAJ. A. CLINTON KNIGHT, Corps of Engineers, U. S. A., who recently returned from overseas, has received his discharge from the service and has been appointed assistant engineer, city highway engineering department, Baltimore.

CHARLES M. WHELAN, hydraulic department, Aluminum Co. of America, Pittsburgh, has been transferred to the sales department of the company at Kansas City, Mo.

P. S. BAKER has been appointed engineer of bridges and buildings, Philadelphia & Reading R.R. and associated lines, succeeding Clark Dillenbeck, who has been appointed assistant chief engineer of the lines, as noted elsewhere in this column.

WAYNE A. PITTS, formerly vice-president of G. W. Ensign, Inc., engineer and contractors, Harrisburg, Penn., has resigned to become plant

engineer for the York Haven Paper Co., York Haven, Penn.

MAJ. D. L. HOUGH, Construction Division, U. S. A., has received his discharge from the service and returned to his office at 17 West 42nd St., New York City. He has spent the greater part of the last seven years in Russia, returning to this country in October, 1917, when he applied for a commission in the Corps of Engineers. He served in the office of General Goethals in Washington until April, 1918, when he was commissioned with the rank of major in the Construction Division, and was later assigned to special duty at the port of embarkation, Hoboken, N. J., as Army representative on the Longshoremen's War Committee.

B. M. ATWOOD has resigned as state engineer of Arizona. It is understood that Mr. Atwood will enter the contracting business, specializing in highway construction.

CAPT. A. D. BUTLER, Corps of Engineers, U. S. A., returned recently to his duties as city engineer of Spokane, Wash. Captain Butler left Spokane in October, and was assigned to the construction of the Army warehouse at Schenectady, N. Y.

C. N. PERRY, assistant chief engineer of the Imperial Irrigation District, El Centro, Cal., has been appointed acting chief engineer and general manager, succeeding C. K. Clarke.

F. M. HAWTHORNE, assistant engineer, Pittsburgh, Cincinnati, Chicago & St. Louis Ry., with office in Terre Haute, Ind., is now assistant division engineer, Pennsylvania R.R., with headquarters in Pittsburgh.

F. L. DORE, chief draftsman, office of chief engineer, Wabash Ry., in St. Louis, is now, by recent appointment, assistant engineer, Pittsburgh & West Virginia Ry. at Pittsburgh.

L. C. HULBURD, whose appointment as division engineer, department of the State Engineer and Surveyor, of New York, at Rochester, was mentioned in these columns last week, has been connected with the state engineering department for the past 13 years. As resident engineer, he was in charge of the construction of the barge canal water-supply reservoir at Rome and several of the canal lock terminals. Previous to entering the state engineering department he was engaged on the St. Lawrence River hydraulic power development at Massena, N. Y., and the Chattachoochee River power developments near Atlanta, Ga.

A. R. DUNN, assistant engineer, Pittsburgh, Cincinnati, Chicago & St. Louis Ry., with office in Richmond, Ind., has been transferred to Terre Haute, succeeding F. M. Hawthorne, appointed assistant division engineer, Pennsylvania R.R., at Pittsburgh, as mentioned elsewhere.

MAJ. HENRY W. WILSON, Corps of Engineers, U. S. A., who received his discharge from the service recently, is now become associated with Young, Corley & Dolan, Inc., New York City. He served for 20 months with the 302nd Engineers, 77th Division, American Expeditionary Forces. Formerly he was representative of the sales department, Barber Asphalt Paving Co., New York City.

A. E. OWEN, chief engineer of the Central R.R. of New Jersey and the New York and Long Branch R.R., has been appointed also chief engineer of the Philadelphia & Reading R.R., the Atlantic City R.R., and the Port Reading R.R., succeeding S. T. Wagner, resigned. Mr. Owen was educated at Rutgers Scientific School, and joined the staff of the engineer of Essex County, New Jersey, in 1896. Two years later he became draftsman for the Central R.R. of New Jersey. He was successively transitman, assistant engineer, and assistant to the chief engineer. In July, 1916, he was appointed principal assistant engineer, and afterwards became chief engineer.

S. E. SHOUP, assistant engineer, Kansas City Southern Ry. at Kansas City, Mo., has been appointed engineering assistant to the general manager.

F. N. HOLMQUIST, consulting engineer, Phoenix, Ariz., has been appointed state engineer of Arizona, succeeding B. M. Atwood, resigned, as mentioned elsewhere. He was graduated from the University of Illinois in 1909, and has spent the greater portion of his time in Arizona. He was city engineer of Phoenix for several years previous to entering private practice in 1914.

CAPT. LAWRENCE D. STODDART, Construction Division, U. S. A., has returned to his duties as city engineer of Trinidad, Colo.

MORTIMER FREUND, who has been in charge of the trench warfare branch, loading section of the explosives and loading division, Ordnance Department, Washington, D. C., recently received his discharge from the service and resumed his work in the firm of Eadie, Freund & Campbell, consulting engineers, New York City.

REVOE C. BRIGGS, previously of the 472nd Engineers, has returned to his former position as assistant engineer, water resources branch, United States Geological Survey, at Pasadena, Cal., following his discharge from the service.

OBITUARY

BROOKS D. HABERMAN, assistant city engineer of Marion, Ohio, died in that city Jan. 4. Previous to his entering the city engineer's office four years ago he was associated with the Marion Steam Shovel Company.

JOHN W. HORTON, for several years assistant city engineer of Sacramento, Cal., died in that city Dec. 24. He was a graduate of the University of California, and was engineer in charge of construction of the Sacramento bypass weir, which was recently completed.

MARVIN W. KINGSLEY, superintendent and chief engineer, city water-works department of Cleveland, died recently at Ripley, N. Y. He was in the service of the water-works department from 1892 to 1901, and the lake intake tunnels were constructed under his supervision. He was born in 1846 and went to Cleveland in 1873.

WILLIAM APPLETON HAVEN, retired civil engineer of Buffalo, died in that city Jan. 6 at the age of eighty-seven. His early engineering experience was in railroad work on the Wisconsin Central and the Burlington. Later he engaged in railroad construction in Vermont and in the double-tracking of the New York Central. He went to Buffalo in 1877 in charge of construction work for the Erie, Lehigh Valley and Buffalo Creek Railroads. In 1885 and 1886 he was associated with Robert Harris in the building of the Northern Pacific Railroad, and later, the Montana Central. He returned to Buffalo in 1890 and became supervising engineer for the Erie Railroad, specializing in grade crossing work. He served in the Civil War as first lieutenant in a New Hampshire volunteer regiment and later became commissary general of a Montana organization. He became a member of the American Society of Civil Engineers in 1873.

DR. WALLACE C. SABINE, professor of mathematics and natural philosophy, Harvard University, and formerly dean of the Lawrence Scientific School of Harvard, died at his home in Boston Jan. 10. He was fifty-six years of age. He was graduated from Harvard with the degree of M. A. in 1888 and became a member of the faculty in the next year. He received the degree of doctor of science from Brown University in 1907 and the same degree from Harvard in 1914. He was a member of the National Academy of Sciences. A large part of his research work was made public in articles in *Engineering Record.*

WALTER V. TURNER, manager of the engineering department, Westinghouse Air-Brake Co., died in Pittsburgh Jan. 9. He was the inventor of the type "K" quick-action air-brake triple valve, which has been a controlling factor in making possible the operation of the long freight trains. He was the inventor of many other railroad appliances. He was born in England in 1866 and received his education at the Textile Technical School, Wakefield, coming to the United States in 1888. He received the Langstreth medal in 1911 and the Elliott Cresson medal in 1912.

Digging and Backfilling With One Machine

Development of the Usual Trencher in Which the Two Operations Are Nearly Simultaneous

A machine that digs and backfills in practically a simultaneous operation has recently been produced. It is a development of the usual trench machine, a dipper bucket having been added. It works in varying material between very loose earth—in which a bucket with shovelers would be necessary—and hardpan and rock, in which blasting is required.

As indicated in the accompanying illustration, it is, in effect, a movable shovel mounted on a separate car and

NEW DIPPER TRENCH MACHINE

operated by an engine placed in a stationary car ahead of the trench. A movable anchor is placed at the opposite end of the trench, and the dipper car is moved back and forth by the same lines that do the holding and digging. With an operating crew, of two men, under ordinary conditions, the earth, dug ahead by the dipper, is carried back and used immediately as backfill. If for any reason the dipper cannot be operated, it is locked up out of the way upon the car.

On a sewer job in Stratford, Conn., during December, this machine was operated on one-half ton of coal per day with but two men; one engineman and one shovelman. During December this machine, operating in soil varying from loose material to hardpan, dug approximately 1250 lin. ft. of trench 4 ft. wide and 11 ft. deep. The contractor stated that in clay he was able to make approximately 100 ft. a day; in coarse gravel and sand, approximately 80 ft. per day, but these figures were reduced to 30 or 40 ft. per day in hardpan. An advantage of this machine, pointed out by the engineers on the job, lies in the fact that it obviates the necessity of placing the excavated material along the edges of the trench, thus reducing the weight on the bank and effecting a saving in handling and sheetpiling in the kind of work to which the machine is best adapted. The machine is manufactured by the Moore Trench Machine Co., Rockaway, N. J.

Italian Government Commission Buys American Lumber

The purchase of 3,500,000 ft. of yellow pine and timber has been made by commissioners representing the Italian Government, according to a report received from the Southern Pine Association. The timber was specified as Southern pine, merchantable grades, for delivery at Gulf ports, to be moved to Italy by ships supplied by the purchaser. The order has been distributed among the Southern pine mills east and west of the Mississippi. The product will be inspected at the mills by the Association of Inspectors and shipped to designated ports to await the cargo steamers.

The association also states that reports are current that France and England will also buy lumber in this country through the various commissions that handled war-time purchases, and the association points out that if the purchasers supply the cargo space the problem of shortage of ships will be very nearly solved for this country.

National Slag Association Elects Officers

The National Slag Association elected officers for the year 1919, and appointed an executive committee, at a meeting held Jan. 10 in Cleveland. The three officers elected are F. A. Sarstedt, C. E. Ireland, and H. J. Love, elected respectively president, vice president and secretary-treasurer, and the executive committee consists of F. A. Sarstedt, L. A. Beeghley, L. H. Hawblitz, E. H. Kuttner and C. L. McKenzie. The executive committee was authorized to act as a contact or coöperation committee with similar committees appointed by the national organizations which are supported by the sand, gravel, and stone interests in the United States.

The report states that in all about 80% of the commercialized blast furnace slag tonnage of the country is represented by this association, whose aim is the ultimate standardization of this product when used as railroad ballast, concrete aggregate, or in macadam highway construction.

French Munitions Department Now Reconstruction Ministry

The Department of Industrial Reconstruction in France has been formed from the armament (munitions) department. M. Loucheur, who has been the minister of armament, will retain the directorship of the new department, according to a recent commerce report. The ministry, it states, will be responsible for the development of industrial production of all kinds, and will distribute among the industries the orders which shall be placed by other Government departments. It will also assist in the preparation of projects relating to the increase of national production, with the object of adapting the munitions factories, created by the French Government and private companies for national defense, to the industrial period now at hand.

Business Notes

The Independent Pneumatic Tool Co., Chicago, Ill., announces the opening of a branch office and service station at 1103 Citizens Building, Cleveland, Ohio.

The Lake Shore Shale Brick Co., Ashtabula, Ohio, has been merged with the Burton Townsend Co., Zanesville, Ohio, and the new company will be known as the Burton Townsend Co. The capital stock, it is said, will be $3,500,000.

P. E. Francis, who has in the past conducted a railroad and industrial equipment business under the name of and in conjunction with Edward Jobbins, has severed his connections with Mr. Jobbins, and his business in the future will be conducted under the name of P. E. Francis & Co., Marquette Building, Chicago, Ill.

The United States Cement Tile Co. is a recently organized corporation, with $100,000 capital. The officers are Matthew Gunton, president; E. F. Norris, secretary and treasury; G. R. Mueller, general manager; W. H. Ault, superintendent.

Trade Publications

Electric tractors and industrial trucks for use in freight houses, warehouses and manufacturing plants are the subject of four 6 x 9-in. bulletins of four and eight pages issued by the Buda Co., Chicago. The tractors have three wheels and are used exclusively to haul trailer trains. The trucks are designed to carry removable platforms which can be set on the floor for loading at any convenient place, and picking up later by the truck.

The Lidgerwood Manufacturing Co. has issued a 9 x 12-in. 32-page catalogue, bulletin of 1918, illustrating and describing its line of steam mine hoists.

A. S. Cameron Steam Pump Works, 11 Broadway, New York, have issued a 12-p. bulletin on pumps for marine service. This bulletin shows sectional and complete views, as well as description and tables, that will be of service to anyone interested in the subject of marine pumps.

The Hunting Davis Co. has issued a 6 x 7½-in. pamphlet illustrating various structures built by the company.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, JANUARY 23, 1919 — Number 4

Sanitary Problems in Burma Solved by American Engineer

TACKLING the sanitary problems of a mining camp in an Indian jungle has recently fallen to the lot of a young American engineer. He tells his own story on p. 172. Mosquito control, water-supply, waste disposal, are some of the problems which he was called upon to solve under unusual conditions, which may fall to the lot of almost any enterprising American engineer in these days.

Irrigation Extension Needed in Russia

IRRIGATION opportunities in Russia, set forth by an experienced engineer on p. 191 of this issue, are large. When order and industry are once more restored in that great country, irrigation will demand a large share of attention. Enough has already been done to point the way, but as yet only a beginning has been made. Besides contributing to the food supply of its own country and the world, the extension of irrigation in Russia would supply needed cotton for Russian spindles —a fact of great economic importance to Russia.

Public Works As Memorial Structures

FROM several quarters comes the suggestion that important public-works engineering structures about to be built might be planned and dedicated as memorials to our soldier dead. It is a bold suggestion, for commonly the works of the architect are alone held to be suitable for memorial use, and age-long custom requires structures of purely monumental character, free from all element of service. Yet there is distinguished precedent for utilitarian structures—not merely memorial fountains, but even a memorial bridge. What structure, indeed, can more truly carry out the mission of holding constantly before the people's thought the spirit of memorial dedication than a great, enduring public work that enters into the daily life of ourselves and our children? Public service and public remembrance may well be joined; service will but grace the memorial and make its message more eloquent.

Research Work Results Should Not Be Scrapped

HEARTACHES have been caused by the abandonment of all sorts of war work without provision for preserving, much less completing, valuable data accumulated or being amassed through various kinds of research work. The heartaches will end, but the data will be forever lost. Can nothing be done to save and utilize this material? Might not much of it be turned over to permanent Government bureaus for completion, where that is needed, for digest and publication? Most Government agencies will prepare histories of their activities. In many cases, though, more is needed, for useful developments have been cut off just as they begin to give high promise. There is an obligation in such cases to the public which paid for the work, to see that it is passed over to some agency, private or public, so that the investment already made will be conserved.

Hammering Forms a Useful Development in Concrete

THE VIBRATION of the forms with an air or electric hammer during the placing of concrete is responsible to a considerable degree for the complete filling of the forms in the new Government concrete ships, and the consequent desirable density of the concrete. There is no reason why this development should not be extended to all kinds of structural concrete work, where somewhat similar form and reinforcement conditions prevail. The tendency to use a dangerously wet mix is due mostly to the desire to insure a concrete which will run around all steel and into the uttermost corners of the form. In the ship concreting it has been found that the constant hammering on the form when concrete is being poured sets up a vibration which with certainty fills the forms and possibly gives a denser mix. Well directed hammering serves every end formerly achieved by slicing or tamping, and in addition leads concrete by no means wet around bends and angles in forms in a manner not possible by any other method. Building and bridge contractors would do well to look into the possibilities of the mechanical hammer for their work. Skill is required in its use. The vibration of concrete already beginning to set is dangerous, and there is the possibility, in joining new concrete to that already some hours old, of pushing out the form and permitting an over-run down the face. But knowledge of such things come with practice. The use of the hammer is undoubtedly a valuable byproduct of our concrete-ship experience.

A Suggested Use of the Army Bases

FREE ports are recommended by the report of the Tariff Commission noted on p. 206. Leaving aside the question of the economic or political desirability of such an innovation, it so happens that physically we are better prepared to attempt the experiment now than we ever were before. At six of our large coast cities—Boston, New York, Newark, Philadelphia, Charleston and New Orleans—the Army is just completing large

port terminals with warehouse and wharf equipment. of a size and coördination unprecedented in this or any other country. Except for an unforeseen calamity, the reason for these immense units will have ceased to exist within the year, and the problem of their utilization will be added to the other burdens of the Government. What better layouts could be found for a free zone or port? Each terminal is Government property, on deep water, readily subjected to that physical control necessary to the free-port idea. Each one is provided with the necessary wharves to and from which material can be handled to ships, and the connected warehouses easily converted into the factories which are a part of a free port. Finally, they have the railroad connections over which may be brought in such domestic products as are needed to complete the manufactured article for re-export. Free zones must necessarily be subject to test before extensive adoption. The experiment may be made most cheaply in one of the new Army bases.

Time Spent in Port Increases Shipping Costs

"I DO not know whether we can build ships as cheaply as they can in Europe, but I do know that if we try we can handle freight more cheaply, and on the proper development of this handling hangs the success or failure of the American merchant marine." Thus spoke Secretary of Commerce Redfield at a meeting of handling-machinery men last week. His words are apt to suffer the neglect common to the obvious, but they are no less forceful for that. Current concern over the future of our merchant marine revolves around the cost of shipbuilding and the wages of seamen, in neither of which is it probable that America can—or, being able, wants to—compete with Europe, with its low-priced labor. But in handling the freight to and from the ship we have a problem peculiarly fitted to our national genius. If American ships are so designed, equipped and operated as to require a turn-around in port half that of foreign vessels, we can laugh at their savings in overhead, for it is not the cost of operating a ship that makes freight rates; it is the cost of its idleness. So, to reduce the time in port requires much more than mere mechanical fitting of wharf and ship. It means a fresh view of the whole transportation problem, a revised design and operation—from the sources of material up to the hold layout of the ship itself—and an education of the men to the advantages they will gain from the rapid turn-around. That engineers in hitherto unthought-of numbers are working on this complex problem indicates a new attitude of mind, which can but result in a successful solution, provided legislators and lay executives have the courage to break the new paths that will be laid out for them.

New Blood in the Shipyards

IN NO one other point is the development of our newly created industry of shipbuilding during the past year of stress more significant with respect to future growth than in the influx of new men into the shipyards. Managers and workmen have been recruited from other walks of life. From the ranks of civil engineering and construction came what we believe to be the most important contribution. But all serve to strengthen the yard spirit; it is the new men that are taking hold best in the shipbuilding work, a yard manager tells us. His explanation is that old-time shipbuilders are one-boat men; their minds are not sufficiently open to the requirements of a new era in the art. It is the prime value of the influx of new hands and brains and ways of thinking that precedent, the mere following of tradition, will have less sway over our shipyard work in the coming development. Though the serious man-power shortage in the shipyards which prevailed and still continues makes a present survey of conditions less definite than could be desired, yet the conclusion is clearly justified that the new men, the new supply of energy, will carry the shipbuilding industry forward to new accomplishments.

Delayed Transit Planning and Growing Problems

RESUMPTION of municipal development after the interruption due to the war finds the problems of transit improvement presenting a changed aspect. While planning was halted and set back, city populations continued to grow, and transit needs became more urgent because of the resulting increase of congestion. The problems put to the engineer have thus been made more immediate, affording less time for study and analysis. They call for earliest possible resumption of transit planning.

Before the war, rapid-transit projects had reached an active stage of development in such cities as Detroit, Cincinnati, Pittsburgh and Cleveland. In a number of others, however, traffic conditions were approaching that point where remedial action must be initiated. These problems of transit shortage still exist, each one having been made measurably more difficult by the lapse of two years. But shortage is not the only factor in the transit situation today, for the conditions that have developed in the street-railway industry present fresh problems to the city and to the engineer. Cities that have heretofore studied rapid transit alone may need to review their work with regard to coördinating surface and rapid-transit transportation. Others, which have not yet outgrown the range of surface carriage, confront new opportunities and new obligations in study of the relations between city development and transit plan.

It is certain, then, that transit study is today a subject of broader scope than before the war, and that it affects the nation's city populations in quite remarkable degree. Moreover, its problems are now exceptionally urgent, and must be accorded a high degree of priority in the scheduling of public works. Further delay in planning is certain to accentuate the seriousness of each problem concerned.

Rapidly increased outward expansion of cities may be expected in the immediate future. During the war the stagnation of building operations hemmed in territorial growth, so that a nation-wide housing shortage developed. There is sure to be a reaction from this restraint. It will mean abnormal spread of the populated areas of cities and, in turn, greater transit needs. With this prospect, we may see even more clearly the imperative need for setting about the study of transit matters at the earliest possible moment.

Progress in Engineering Society Organization in 1918

THERE has been developing for years a healthy dissatisfaction with the organization of engineering societies. The older men have long declared that the engineer should be an influential member of the community; witness, for example, the repeated statement of this view in presidential addresses before the American Society of Civil Engineers. But the older men have been content with statement only. They and the leading engineering societies have apparently lacked the incentive to crystallize their statements into a program and to create machinery for the realization of that which they had so well expressed.

The younger men, however, were not content with high-sounding declarations on state occasions. They expected service from their engineering societies, and, in addition, flexibility and virility. They voiced their impatience, and as a result virile local societies appeared in various sections of the country.

Until the year 1918, however, there was no evidence that the recognized leaders of the profession took seriously the dissatisfaction or were openminded on the proposals for remedying the conditions against which there was complaint. With this year came a change. The fresh thinking stimulated by the war, but even more the constant pounding of those who demanded a new vision, has stirred the conservatives to action, so that even in New York, the rallying ground of the standpatters in engineering society organization, one daily meets former conservatives who advocate more active society organizations. Some few particularly honest ones even state that they have had a change of heart, though most of them try to forget their former league with inaction. The tangible evidence of the new spirit is the very hopeful view generally taken of the prospect for results from the Committee on Development of the American Society of Civil Engineers.

The change in attitude in the conservative East does not mean, of course, that the battle for virility in society work is won. New plans will require new machinery, new machinery will require new men. The victory proceeds so far only to the undertaking of the plans. There must be discussion and agitation, that this planning be well done. Then, when the planning is properly completed there will be needed more agitation and more pressure, that the machinery may be adequate and the men in charge in full sympathy with the plans.

While the ultimate form and aims of engineering society organization cannot be predicted in detail, there has been enough crystallization to show unmistakably the main character of the results. Possibly the most striking bit of evidence of the new aims is afforded by the resolution of the civil engineers' development committee—a resolution, we take it, intended to set the course for the committee's work. It was the sense of the committee, so the resolution declared, that the American Society of Civil Engineers "should adopt the principle of becoming an active national force in economic, industrial and civic affairs." The committee further recommended that the engineering profession establish offices in Washington "charged with the duty of keeping fully advised as to all matters in which the engineering profession should have a voice." Since the resolution was passed the Engineering Council has decided to open an office for just that purpose in Washington.

We are, then, safe in assuming that the engineering society organization of the future will take full account of the engineer's civic obligations. The selfish purpose, voiced now in constitutions of the national engineering societies, has given way to enlightenment.

As to form of organization, we can predict with certainty that it will be democratic. Autocracy in engineering society management is disappearing as surely as the dynasties of Middle Europe, and with its disappearance will go that inflexibility, that indifference to the needs of the individual engineer which has cursed the larger societies and driven many prospective members from them. In this connection we cannot refrain from quoting from an editorial on the American Society of Civil Engineers in *Engineering Record* of Jan. 16, 1915, four years ago.

"Present tendencies in every field" said the editorial, "are toward democratization. The cry against autocrats was louder than the first rumble of the European war. The wise corporation official has changed his motto to read, 'The public be pleased.' Industry's tyranny over the individual has been broken by workmen's compensation acts. Coöperation, fellowship, representative rule, are succeeding the cruder forms that preceded.

"The movement in the American Society of Civil Engineers is of the same order. In a small way it mirrors the large swing of world events and race tendencies. Its ultimate results none can doubt. It behooves those who have placed the society on its present eminence, and have made it financially impregnable, to take hold in the new spirit, that the society may broaden and grow, grasping the larger opportunities which a more complex age is placing before it."

The quotation is indicative of the signs long ago apparent to those who would see.

One further result seems to be foreshadowed, though the signs are still too nebulous to predict either the time or the detailed nature of the result—the heading up of all societies in one widespread clearing house, so that unified professional action may be secured. The Engineering Council, hampered by its form of organization, is nevertheless making headway. The civil engineers' development committee is keeping in touch with similar bodies in other societies, while a number of plans for centralization have come from various sources. All indicate the widespread determination that there shall stand before the public one engineering profession, and not isolated local organizations or bodies of civil, of mechanical and of other specialized engineers.

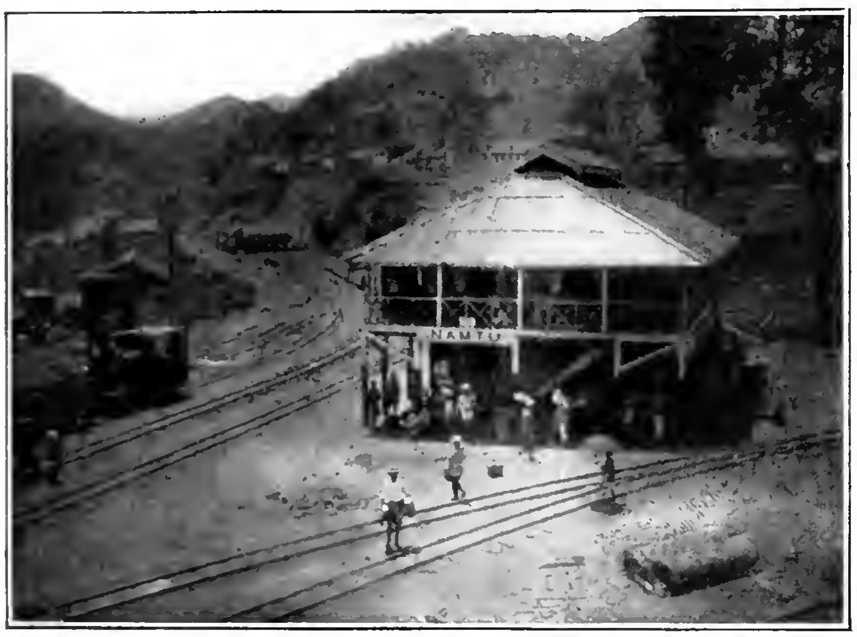
Viewing engineering society organization broadly, then, one can feel satisfied with the year 1918. There has been greater progress—or at least greater visible progress—than in any other year in the memory of living generations. What has developed is but a start, it is true, but a most encouraging one. There is as yet but little result, and since there are still many standpatters and much inertia there can be no relaxing by those with high vision and purpose. The skirmish only is over; the full victory is far from won.

Sanitary Engineers Get Direct Results In East Indian Mining Camp

Experience at Namtu Is Typical of Tropical Sanitation In Rural India—Jungle Cleaning and Drainage Are Successful Measures in Mosquito Suppression—Local Conditions and Habits

By Harry N. Jenks
Sanitary Engineer, Burma Mines, Limited, Namtu, Burma

MOSQUITO control and camp sanitation through the works and follow-up operations of the engineer are effectively preserving the health of Europeans and natives in the jungles of India. Intensive clearing and drainage—utilizing cheap labor rather than oiling on account of the expense of the latter—are the principal methods used by the Burma Mines, Ltd., at the frontier town of Namtu, in the Northern Shan States, Burma. Camp sanitation problems also include water-supply, sewage and refusal disposal (conservancy) and general sanitation. The camp is on the Namtu River, 550 miles from Rangoon, in a region of irregular topography varying from 1755 to 2100 ft. above sea level. Until 1911, when the smelter was moved from Mandalay to Namtu, nothing was done in the way of sanitation beyond the barest necessities. However, with the establishment of the smelting works and refinery, together with the accessory plant and shops, this village was made the center of the company's activities, and the attendant rapid growth of the camp made it necessary to provide a satisfactory water-supply and adopt a system of conservancy. A few house and street sweepers were employed to care for the bungalows and compounds, while a small force was engaged in removing and burying in trenches the night soil from the camp. By this time also the jungle had been cleared of the larger trees, for use as timber and firewood, thus affording relief from the previous almost nightly maraudings of tigers and cheetahs, diminishing greatly the danger from snakes, and making it decidedly more convenient to get from one part of camp to another.



THE RAILWAY STATION COMMANDS A VIEW DOWN THE NAMTU RIVER VALLEY

By 1913 Namtu had grown to be the most important mining camp in the country. Native labor from distant provinces and from China began to appear in great numbers, and, next to Rangoon and Mandalay, Namtu contained the largest group of European residents in Burma. Realizing the importance of greater sanitary vigilance, in view of the increasing population, the company established a sanitary department to work in coöperation with the medical department, in guarding the health of the community.

The personnel of the medical and sanitary staff consists of one European sanitary engineer, two Indian sanitary inspectors, six compounders and dressers, two overseers, one sanitary sweeper, 30 hospital sweepers, eight conservancy sweepers and 20 coolies on jungle cutting and drainage.

Sanitary conditions in this mining camp may be taken as typical of the rural or jungle districts. In general the fight in the Indian municipality is mainly against plague, cholera and smallpox, while in the jungle one is face to face with malaria. By the individual sufferer plague and cholera are more to be dreaded than malaria, but it is questionable whether there is any other single disease in the tropics that causes a greater sum total of misery and human waste than malaria and malarial cachexia. In this respect, malaria is to the resident in the tropics what colds and grippe are to those in America, especially in the New England states. In spite of the drainage afforded by the steep slopes of the hillsides of this region, the inevitable small collection of water in paddy fields and along the banks of the more sluggish streams have always furnished breeding places for mosquitoes. Even in the hills malaria may abound, because the rank growth of jungle impedes the surface run-off and thus allows mosquitoes to breed in every available hollow, as well as in the accumulations of water found in the stalks and among the leaves of the undergrowth. Many coolies coming from the jungle stations along the railway act as malaria carriers, so that in interpreting our malaria statistics a careful distinction must be made between local and imported cases.

Water for the European side of camp is derived from springs in a swampy area. It is collected in open ditches leading to an earth-lined reservoir 30 ft. square, in which it is impounded to a depth of 8 ft. by a concrete dam. The water is carried down the hillside in a 4-in. pipe, passing through two pressure-break reservoirs on the way, and is then distributed throughout the camp by pipes of various sizes. The source of supply is protected naturally by its remoteness from human habitations and by its position near the top of the slope. In this connection it should be noted that typhoid fever is practically unknown in this region.

For conservancy purposes the latrine-trenching method of the disposal of excreta has been adopted. Sanitary practice in India has in general favored the

latrine in its various modifications as a solution of this problem. In justice to a system which in America has been practically abandoned in favor of the water-carriage system, it must be admitted that here in India it serves its purpose surprisingly well. The people are disposed to use the latrines, and a plentiful supply of labor is at hand to attend to them. In Namtu the wet-pail system is used, the night-soil being removed twice daily by bullock carts to the trenching grounds a mile away from camp, and there buried.

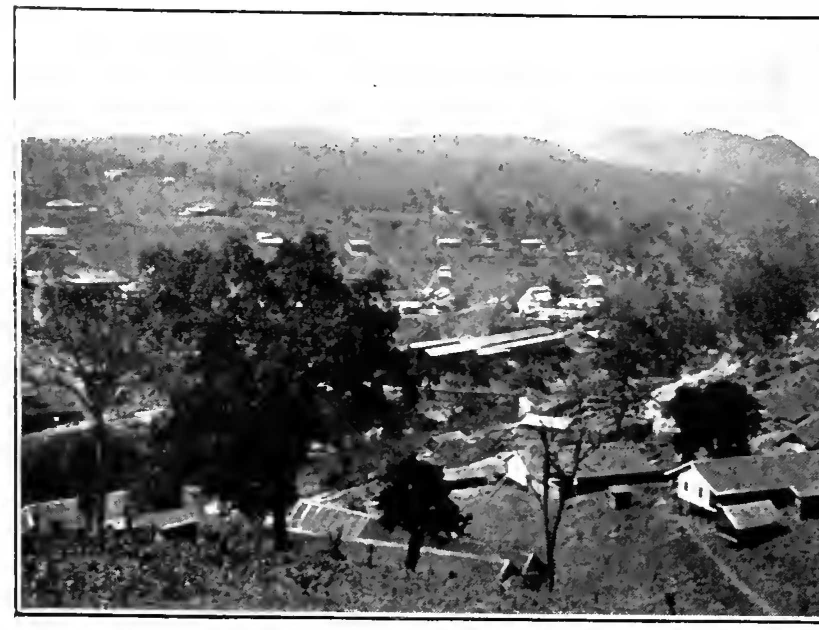
On the smelter side, owing to the absence of cart roads, the pails must be carried to the trenches near at hand, though far enough away to avoid local nuisance. In order to obviate further expense in this respect, sanitary privies are now being built instead of pail latrines. In the bungalows themselves, the use of commodes, which are emptied and cleaned twice a day by the house-sweeper, is found to be entirely satisfactory both from a sanitary and sightly standpoint.

Of many limitations to the applicability of the latrine-trenching system to the problem of conservancy, one of the most obvious is that it does not provide for the disposal of waste water from house baths and kitchen sinks. In Namtu this waste water is discharged onto the ground and flows away from the house through small ditches running down the hillside. This involves expense and trouble in keeping the water from collecting in small depressions under the houses and thereby allowing mosquitoes abundant opportunity to breed on the premises. To overcome at one stroke the disadvantages of the existing method, the sanitary department has prepared a design for a comprehensive water-carriage sewerage system to serve 60 bungalows on the European side of camp, with a new European hospital now being completed.


THESE COOLIES CLEAR JUNGLE AT $1.50 PER ACRE

The sanitary department maintains a squad of street-sweepers in the neighboring village of Pang Hai to coöperate with the local authorities in keeping the town clean. This is an important consideration in view of the fact that about a third of the 3000 coolies employed by the company live in Pang Hai and Ih Aung villages.

Prevalence of malaria throughout the region is the greatest detriment to health in Namtu. The extent to which it contributes to sickness among the company's workmen and staff is shown in the next column.


ROUGH TOPOGRAPHY IS FAVORABLE FOR DRAINAGE

In 1916 the total number of cases among the Europeans and Anglo-Indians decreased by 39% as compared with 1915. It was in 1916 that jungle clearing and drainage work was maintained with a thoroughness not attempted theretofore. The returns for the first ten months of 1917 indicated that the total number of malarial cases for that year would be about 50% that of 1915. The increase in the number of Asiatic cases noted in the table is only apparent, and is due to the greater number of imported cases and patients who avail themselves of treatment at the company's hospital.

ANALYSIS OF MALARIA INCIDENCE, BASED UPON NAMTU HOSPITAL RECORDS

Number of Cases	1915 Europeans and Anglo-Indians	1915 Asiatics	1916 Europeans and Anglo-Indians	1916 Asiatics
Malaria	238	4,589	145	5,533
All causes	706	12,243	828	13,236
Ratio malaria to all causes	0.34	0.38	0.18	0.42

In the jungle itself the bamboo is regarded as the plant most responsible for the breeding of mosquito larvæ. Especially is this the case when the bamboos are cut, thus leaving a cup in each shoot in which the larvæ thrive. After the bamboos and larger jungle growth have been removed, the weeds and grass that spring up favor the development of larvæ by arresting the surface run-off of rain water. It seems probable that in Namtu the incubation period of the mosquito egg may, under favorable conditions, be as short as one day. In order that no small collection of water shall remain for more than a day after a rain, the grass on the hillsides throughout the camp is kept as low as possible, so that the surface drainage and evaporation may be materially hastened.

Prior to 1917 jungle-cutting was done by a gang of about 12 coolies by day labor. This was found to be unsatisfactory as regards both expense and quantity of work done, so that during 1917 the work was let out on contract, with a great improvement in rapidity and thoroughness. The tool with which the cutting is done is known in Burma as the dah, and is similar to the Cuban machête. The dahs vary in weight and form according to the character of the brush to be cut. For the grass-cutting work we use the Kachin pattern, which is long and light. The ground is too uneven for the use of scythes, but short sickles are em-

ployed to advantage on the tough wire grass that grows near the streams.

The usual method of oiling mosquito-breeding collections of water finds little application in Namtu. Aside from the almost prohibitive expense, there are no ponds of importance that do not receive a thorough flushing with every tropical rainstorm, so that in any case the oil would be promptly washed away.

Open ditches drain the few low-lying places, but these require constant cleaning to keep them free from a rank growth of weeds. It is proposed eventually to underdrain the swampy areas by the use of open jointed tile. The drawback to this is the expense, since in Burma all drain tile and sewer pipe is made on the potter's wheel.

Quinine prophylaxsis is not generally practiced here. It seems to be the opinion among the company's staff that the possible injurious physiological effects of the drug when taken in the doses required to secure more or less complete immunity are more to be feared than the chances of getting malaria. The recommended dosage is 5 grains every other day during the monsoon season, or from the end of May to November. It is given in the sulphate form, in solution acidulated with citric acid. At the hospital quinine is dispensed in pill form to the natives.

IMPORTED COOLIES BRING IN MALARIA

In this remote corner of Asia the cost of supplies and materials of construction is comparatively high even in normal times, but now, due to war conditions, everything that must be imported has risen excessively in price, and many materials can scarcely be obtained at any price.

The following are now (November, 1917) a few typical prices of materials in Namtu: Sawn timber, $8 per ton of 50 cu.ft.; common red brick, $5.12 per 1000; portland cement, $6.40 per barrel of 3.8 cu.ft.; sand, $1.76 per 100 cu.ft.; stone, $1.60 per 100 cubic feet.

Such materials as earth, sand or stone are measured in cubic feet rather than cubic yards, because the former unit is more readily appreciated by the native contractors.

A recent quotation on sewer-pipe from Mandalay, the center of the ceramic industry, was 6, 10 and 12 cents per lineal foot for 4, 6 and 8-in. pipe respectively.

Wages paid coolies in the Orient are proverbially low, so likewise is the efficiency of the workmen. In India proper, coolies get from 4 to 6c. per day, but in Burma the wage scale is considerably higher. In Namtu the scale of daily wages for unskilled labor is as follows: Railway and maintenance-of-way, 20c.; all other work of a general nature, 24c.; work in the smelter, 32c. The average for such skilled labor as carpenters, pipe-fitters, masons, etc., is 80c. In terms of a day's work the above figures for unskilled labor correspond very closely with wages of $1.50 to $2 per day.

Recognizing the inferiority of day labor in India, it is the general custom here to have even the smallest piece of work done by contract. It is no uncommon thing to let a contract for a five-rupee ($1.60) job.

In Namtu contractors flourish because of the great amount of construction work that is being carried on throughout the year. The big jobs are handled almost exclusively by Chinese contractors, since the greatest proportion of construction is in timber, and all the carpenters are Chinese. Masonry work, which is next in importance, is given to Indians and Burmans, who have a monopoly in that trade. Much petty contract work is done by Burmese contractors, and very often some native foreman, or "coolie gong," will start in this business on his own account in order to make money without having to do any work himself, this being the height of his ambition.

Under average conditions, the cost of getting various kinds of work done by contract, inclusive of labor and supplies, is as follows:

Class of Work	Rate
Concrete and masonry	$32.00 per 100 cu.ft.
Brickwork	25.60 per 100 cu.ft.
Timber work	32.00 per ton of 50 cu.ft.
Excavation:	
Earth	0.24 per 100 cu.ft.
Loose rock	0.80 per 100 cu.ft.
Hard rock	1.60 per 100 cu.ft.

All new construction work undertaken by the sanitary department and nearly all of the jungle clearing work are now being done by contract, the latter being the largest single item in the operating expenses of the department. During the rainy season (May to November) it is necessary to go over the camp once every two months. Each cutting amounts to 160 acres on the European side of the camp. Under average conditions, the contractor will make a fair profit at $1.44 per acre. On a contract recently let to a Chinese 140 acres was cleared in 36 days, the average rate being 0.27 acre per coolie per day. On a previous contract undertaken by coolies from Orissa Province, India, 70 acres of jungle grass were cleared at the daily rate of 0.24 acre per coolie, but far more supervision was required than with the Chinese labor.

Those persons in America whose acquaintance with India has been gleaned from the fiction of poets and writers, who have sung the praises of India's mysterious charms, from the lovely vale of Kashmir to the golden Irawadi shore, will, if they chance to come to this country, feel under the necessity of applying a large correction factor to the sum total. The sanitarian is confronted with the problem of making what he *can* do measure up reasonably well to what he sees on every hand *ought* to be done. Since sanitary and public health work is essentially a personal problem, the habits and customs of the people whom such work is to benefit are the chief factors with which the worker has to concern himself.

It is axiomatic in the East that the native "workman" never does as much as he is paid to do. He is generally a living example of that otherwise highly useful theory in structural design known as "least work." To get more work out of him requires as much, if not more, energy from the outside in the form of active supervision than is obtained from him in return. Climate undoubtedly has been the most potent factor in arresting the development of the capacity for work on the part of the indigenous population. Namtu is more fortunate than many other places in India in possessing a climate that is about midway between temperate and tropical, although during the summer months the combination of 80° temperature, 80% relative humidity and 60 in. of rainfall approaches sufficiently close to tropical conditions.

Perhaps the most important of all the influences that govern the character and effect of the work done among the natives of India is the influence of habit. Habit is practically the sole arbiter in the lives of the entire population, in all that they do and will not do; and this ingrained force of habit attains its most far-reaching development in the caste system. This fact furnishes many novel problems to the sanitarian. The effect of the sanitarian's work upon the people of India is at one and the same time his chief reason for enthusiasm and despair. Considering the almost limitless field for his efforts and the beneficial results that appear when insanitary conditions are relieved ever so slightly, he is bound to be enthusiastic. On the other hand it appears at times an almost hopeless undertaking to attempt to make any real progress, in view of the magnitude and the difficulties of the task which confronts him.

Formation of Technical Sections Is Suggested

President A. N. Talbot in Annual Address Before American Society Advocates Changes in Present Machinery of Organization

REVIEWING the society's activities, already announced, during the past year, including the work of the Engineering Council (see *Engineering News-Record* of Jan. 9, p. 81), the retiring president of the American Society of Civil Engineers, Arthur N. Talbot, proposed several fruitful lines of development for the society, at the annual meeting on Jan. 15. The following abstracts from his address include the suggestions for more technical committees, for technical sections and for greater participation in public affairs.

The discussion of the purposes and functions of an engineering society, such as the American Society of Civil Engineers, should not be restricted to the purposes given in the constitution, which may merely follow precedent or may be worded to conform to a state statute governing the charter of the society. Some of the functions of the society, may it not be agreed, would include at least the following:

A collector and disseminator of engineering knowledge; a forum for the discussion of engineering questions; a stimulator of research and of the progress of engineering science; a developer of engineering methods and practice; an active force within and without professional circles; a creator of engineering policies and an originator and patron of constructive and progressive movements in engineering; a means of mutual helpfulness and coöperation; an instrument for advancing both professional interest and public welfare, and an agency for discussing the various phases of public problems and for participating in the service which all thinking organizations should give to society.

Technical Papers Not Sufficient

The technical activities of an engineering society are of prime importance—meaning by technical matters not merely mathematical methods and routine work of engineering, but all relations to the science and art of engineering in and out of professional circles, and also the technical relations with the public. One method of carrying on this technical activity has been the presentation and discussion of papers on engineering topics.

But is the society doing all it should in this direction? Is there not need for papers in fields not often taken up? Should there not be more short, terse papers, devoid of details, which should stimulate and set engineers to thinking? Would it not be possible and desirable to have more papers dealing with principles, with the advances of engineering, with new methods and requirements? May it not be worth considering whether to continue the policy of limiting ourselves only to those papers which are offered to the society, regardless of whether this policy leads to ignoring large fields and results in transferring to other societies the activities in these lines? Are there not opportunities for dissemination of knowledge like reviews of engineering construction and methods and digests of important engineering literature, which seem now not to have adequate expression through other agencies?

More Technical Committees Needed

Technical committees form one of the most effective means of carrying on the technical activities of an engineering society. They can coördinate and unify practice, develop methods, formulate principles and standards, and recommend improvements and advances in the art. Their influence can reach out far beyond the bounds of the society. For example, the American Railway Engineering Association has 23 technical committees, with a combined membership of 480, out of a total membership of 1100 in that society; the American Society for Testing Materials has 38 technical committees and 144 subcommittees, with a combined membership of 1094.

At the risk of seeming disloyal, the opinion may be advanced that in influence upon engineering practice, in effect in the industries, in influence upon relations of engineering business, in advancement of engineering knowledge and the methods of manufacture and construction, and in influence in the outside business world, the achievements of these two specialized societies in the past few years have been such as to make some of the national engineering societies look to their laurels for leadership. The Committee on Development will find the need and opportunity for technical committee work an important subject for study.

An opportunity for energized activities lies in the formation of specialized divisions or sections of the society, to give attention to special fields of work, such as railway engineering, structural engineering and hydraulic engineering. Members would enroll in sections in which they are interested. Sessions and convention would be held to discuss matters of common interest, and each division might affiliate in some way with the work of other societies—the American Railway Engineering Association, the American Society for Testing Materials, the American Public Health Association, for example.

Any attempt at organization of the profession throughout the country for all the national societies should involve joining forces with local societies in every possible way. In every center of engineering the local engineering society should be the basis of organization. Some plan should be devised, perhaps by increase of dues, to contribute revenue from the treasury of the national societies to the chapters for use in this union work with the local societies.

For certain purposes it may be found desirable also to have a regional organization covering territory corresponding to the geographical districts now used in the selection of the nominating committee, for handling matters of common interest in a given region.

The provision for a New York Meetings Committee to take charge of the second meeting of each month, made by the Board of Direction on the recommendation of the secretary, is a step in advance. It would seem to the president that in any new plan for local associations or regional organizations, the resident membership in New York should be granted some degree of autonomy by the formation of a local association or chapter, and that the New York membership should be set at work and stirred up to realize and utilize the opportunities and facilities at their door.

Relations With Other Societies

The four Founder societies have many activities in common. The Engineering Council may soon have its membership increased by three more societies. The Engineering Standards Committee will have the coöperation of a number of societies besides the four Founder societies. It is increasingly apparent that engineering is a single profession; the various branches ramify and merge into each other in numerous ways. Many engineers think there should be one large, inclusive society to take the place of the several national societies—to be made up of the 35,000 engineers in the four Founder societies or the 100,000 or 200,000 who may claim the right to be classed as engineers. The further union of national societies and their coöperation with the local societies in developing engineering society activity are potential factors for the future and a fruitful field for the Committee on Development.

The engineer and the engineering society now have opportunity and responsibility in the direction of public duty far beyond what they have hitherto considered as their share. This is especially true at the present time, when the successful solution of so many public problems lies within the province of the engineer. The consideration of quasi-public matters has not always been accepted as a proper field for society activity. As an illustration, the opposition to the creation of the Committee on Valuation of Public Utilities may be recalled. Fortunately, the advocates of the appointment of the committee prevailed, and a magnificent report and discussion were given to the public. Besides, the activities of the committee stimulated thought and provoked discussion throughout our membership as few subjects have done.

It would be premature to try to outline methods for accomplishing the great work in public matters which should be undertaken, or the form of organization which is needed. The formation of a large and representative Public Affairs Committee has been suggested, and also a delegate convention organized to discuss matters of public interest and intended as a forum for voicing the sentiments of the organization. Whatever is done must give opportunity for exercising initiative and providing powers for action. Leaders must then energize the machinery provided.

Use of Available Funds

The activities here referred to will require adequate funds; it takes money to do things in this world. If the activities of the society are to be extended funds must be provided, and part may well be taken from the annual balance of $20,000 or $30,000 which in normal years may be left after paying the expenses of present activities. It seems reasonable that a society which has become established financially should not continue to put aside from annual receipts very large sums as endowment; the increase in endowment may be expected to come from other sources. Increase in membership will bring increased revenue, and many believe there should be a considerable increase in membership.

If it is agreed that there are activities which the society should undertake for the benefit of the profession and society, activities that will bring results and that will help in making the society a force of greater and greater influence, who will doubt that resources will be found to finance the work?

To shun the visionary, impracticable schemes, and yet not be too complacent about past accomplishment; to seek to be national and not provincial; to try to be both democratic and efficient; to lead in the progress of the times, and yet hold to the old and proven good; to work to be a powerful engine in technical affairs and a vital force in the life of the profession; to learn how best to give service to the community and the nation; to provide methods by which the profession may lead in progressive movements—these are ideals worth striving for in making a plan.

It should be borne in mind, too, that elaborate or complicated organization is likely to be ineffective; the machinery is not self-propelling. Mere paper proposals will not suffice. Whatever is done we must keep down on earth, accept only workable plans, but still not be content with stagnation or mediocrity. A plan may be worked out befitting the needs of a great profession. With such a great opportunity before it I confidently expect the Committee on Development will evolve a plan satisfactory to the society, and that a stronger, more useful, more virile society will result. I confidently look forward to a great future for the American Society of Civil Engineers.

Defends Construction Division's Form of Contract

General Marshall Urges Engineers To Educate Those Who Would Not Permit It—Advocates League of Technical Societies

WIDESPREAD opposition to the well known Construction Division sliding-scale cost-plus form of contract is not based on a knowledge of its operation or advantages, said Gen. R. C. Marshall, Jr., head of the Construction Division of the Army, in an address before the annual meeting of the American Society of Civil Engineers Jan. 15. General Marshall also advocated an amalgamation of all engineering societies, at least to such an extent as to permit the dealing by the Government with a unit body of engineers. Parts of the address follow:

Popularly, the form of contract which the Construction Division has used is almost universally known as a "cost-plus contract," but this term is not, strictly speaking, exact. The contract which has been used from the beginning, with slight modifications in nonessential details, has been one in which the contractor was reimbursed the actual expenditures with a fee to him graduated on a sliding scale. The percentage he receives gets lower as the cost increases, and a maximum figure is set which his fee can, in no case, exceed, no matter what the cost of the work may be. Many reasons dictated the adoption of this form of contract, which, to all who understand the facts, has proved its usefulness and its value beyond the peradventure of a doubt.

Why the Contract Form Was Devised

Take for a moment's consideration the conditions under which the original camps were built. The Cantonment Division (which later was enlarged and developed into the present Construction Division) was told that in 90 days it must complete the following work: It must have quarters ready for the training of over 1,000,000 men; it must go upon 32 virgin sites and upon each one build a camp, equipped in all essential details, to house and accommodate a draft army about to be called to the colors. It must draw, coördinate and complete the plans, prepare specifications and contracts, select the contractors, organize field forces for them, appoint constructing quartermasters, supervising engineers, and attending organizations. It must see that material in immense quantities was forthcoming; it must foresee and solve the engineering problems involved, and it must build 16 cantonments, roughly estimated to cost $6,000,000 each, to house 40,000 persons each, and 16 tent camps at about half the cost of the cantonments, but to accommodate almost as many men. Rough building was not sufficient--roads must be laid out, water-supply and sewage problems developed and overcome, and the result must be, so far as public utilities are concerned, comparable, at least in efficient working ability, with those of a city of the same size; and all this in 90 days.

Could any other contract known to man, or which the ingenuity of man could devise, have taken care of this situation? The making of plans, the advising of engineering features, the procurement of material, the formation of the organization, and the building itself, had all to go hand in hand. The markets for material and labor were in a period of instability to an extraordinary degree, and no contractor on earth could have made an intelligent bid upon any one of these projects had he had plans and specifications upon which to base it. Nor, conversely, could plans and specifications have been furnished him had he been in a position to bid. Let me not be misunderstood—the sole justification for the cost-plus contract as used during the war is not the uncertain and unstable condition brought about by the war, for the cost-plus contract, properly administered, is the proper, conservative and just method of doing contracting work—just alike to the owner, the engineer and the contractor.

In this connection, I want to draw the attention of this audience to the trend of Congress in this matter, as indicated in two provisions of law. In the bill making appropriations for the support of the Army for the fiscal year ending June 30, 1919, Public No. 193, 65th Congress, the following appears:

> "Provided, That where practical so to do, no work be done or contract made under or by authority of any provision of this act on or under a percentage or cost-plus percentage basis, nor shall any contract, where circumstances so permit, be let involving more than $1000 until at least three responsible competing contractors shall have been notified and considered in connection with such contract and all contracts to be awarded to the lowest responsible bidder, the Government reserving the right to reject any and all bids."

Also an act to authorize the President to provide housing for war needs, Public No. 149, 65th Congress, Section 7, has similar provisions.

I cannot believe that this tendency of Congress has been brought about through any effort by this society, or any similar to it. I am convinced that the best thoughts are quite to the contrary. I do believe that these laws, and the similar talk in Congress, are brought about by the lack of effort on the part of this society and similar ones.

Attack on Emergency Contract

Education is, of course, the only remedy worthy the name for ignorance or for mistaken apprehension of facts. Through ignorance and through mistaken apprehension of the facts of the case, the emergency contract outlined above has been the subject of bitter attack from persons in and out of the Government service and from quarters high and low. Let me add that these attacks have, in my opinion, in most cases been sincere, but due entirely to a mistaken apprehension of the nature of the causation of the actual operations and of the results of these contracts. They have saved—and this is demonstrable—to the Government a vast amount of money. They have operated with smoothness, flexibility and with surprisingly little misunderstanding or friction between the Government and the many contractors in question. Without them the vast building program of the Army which has been successfully accomplished would have been a matter of utter impossibility.

But from the very fact that they have not been understood, that their nature is not clearly seen and that the people in general, including national legislators, have

not informed themselves concerning them, they are in bad odor in many quarters, and a more or less determined effort is being made to prohibit their further use. I trust it will not be presumptuous in me to say that I am satisfied that the remedy for this state of affairs is the education of Congress and of others who oppose this or other measures because they do not understand them, and this education should not come through the education of the people at large, and the consequent infiltration of the knowledge thus disseminated into the legislative brain; the process should be reversed. The men who make the nation's laws should themselves be informed of the truth, and in matters such as this it is the province of just such societies as yours to act as the educational agency.

Technical Societies Should Join Together

This brings me to another thought which I wish to urge to the earnest consideration of this audience. It is my belief that the dignity, the power, the learning and the history of accomplishment of the engineers of this country make them a factor in its future undertakings which must in time be realized and accepted by the Government. They should be gratefully and heartily accepted by the Government as a constructive force and as an instrument of accomplishment which, properly taken advantage of, will be second to none. But, in order that the fullest good can come from such a consummation, there must be the utmost harmony, the utmost flexibility and the most thorough coöperation among the engineers themselves.

In the building operations of the Construction Division, there has never been a time when the great engineering societies of this country have not been willing and eager to lend their assistance to the work of the division, each and every one of them, and I wish here and now to tender publicly my grateful and heartfelt thanks for this invaluable assistance extended so generously and so freely. But, in every case, the War Department had to treat with a number of more or less isolated societies. In union there is strength, and there is no axiom of the many which are so freely mouthed which is so true and so universal in its application as this one. Had there been amalgamation of these societies—a consolidation, if you will—a central governing body to which they were all subsidiary, or in some shape or form a coördination, a central direction, some one head to which they all looked and with which an outside agency could treat, the task of the War Department would have been infinitely simplified. I believe that for the greatest good of the engineers, of the Government and of the economic life of this country, some such arrangement will have to be made. Concerning the form or the method, I do not know and would not presume to advise. Concerning the wisdom of such action, I am as sure as I am of anything in the world, and I urge it upon you to consider it with thought and to make it an accomplished fact as soon as may be.

The experience of this work has shown the infinite wisdom of a close *rapport* between Governmental agencies and the large commercial and professional organizations whose aid must be enlisted at any time of national crisis. Such aid has been freely given during this war, but the method of effecting its greatest accomplishment has been hindered and hampered by the fact that the parties had, at first, to establish mutual understandings, to get each other's viewpoints and to adjust themselves to a changed and unfamiliar method of accomplishing results. There should be in the future, there must be, close touch and sympathy between such organizations and the executive departments of the Government. This, I hope, will be particularly the case with the membership of the engineering societies of America.

Director General Reviews Railroad Operation for Year

General Conclusions, and Figures Furnished on Operating Results—Reasons for Adoption of Standard Locomotives and Cars

REVIEWING the past year of railroad operation under Government control Director General W. G. McAdoo's report to the President outlines the accomplishments of the Division of Operation established Feb. 9, 1918, with Carl R. Gray as director. The difficulties in operation and the causes of congestion are enumerated, and methods of attacking the problems are presented. Abstracts are presented here of the sections on coal handling, unification of terminals, short-hauling of freight, and the standardization of locomotives and cars.

In addition, details from Mr. McAdoo's report to the Interstate Commerce Committee of the United States Senate, Jan. 3, on expenditures, on unification needs at Cincinnati, and on the elimination of circuitous routes, are included.

Causes of Railroad Congestion

The potent causes which produced serious conditions of congestion and resulted in the taking over of the railroads by the Federal Government were: (1) Accumulation of export freight at North Atlantic terminals; (2) shortage of motive power; (3) heavy building operations by different branches of the Government, the contractors for which ordered materials forwarded far in advance of their ability to receive and unload them (at one time over 5000 carloads of piling were tied up in the Hog Island shipyard); (4) feverish demands led manufacturers to purchase raw materials from unusual markets, in excessive quantities, with the frequent result that arrivals were badly bunched and unloading was slow and difficult; (5) the necessity for giving priority to shipments of Government freight, and the lack of central control, and (6) the withdrawal for overseas service of Atlantic coastwise vessels.

The controlling factor throughout the experience has not been in road transportation, but at the ultimate destination, and any serious condition of congestion obtaining on any of the trunk lines en route has been the reflex of the other conditions at the terminals themselves. Practically all transportation in the United States has been based primarily upon the desires and necessities of the consignor rather than upon the ability of the consignee to receive and digest the freight.

The most serious situation presented itself in the case of bituminous coal. This condition was the result of three factors: (1) Actual shortage of cars at the

mines; (2) lack of systematic distribution, and (3) dislocation of the New England supply, the result of the withdrawal of coastwise steamships.

The bituminous coal production for the preceding year had been the largest in the history of that industry, approximating 544,000,000 tons. The severe weather conditions in January, 1918, resulted in decreased production—due almost entirely to the car supply—of 65,294 carloads. Immediate and drastic steps were taken to remedy this situation, and, notwithstanding the severe weather throughout February and March, the railroads in February produced an increase of 24,366 cars of coal over the preceding February, and for the succeeding months continued to produce large increases, to a maximum of 150,288 tons in July over the preceding month of July. The net increase for ten months was 741,665 cars; or approximately 37,080,000 tons more of coal were obtained. New England necessities have been fully met, and the largest tonnage of coal ever known—28,153,317 tons—has been moved to the Lake Erie ports and transported to the Northwest, compared with 26,826,000 tons in 1917.

A very considerable proportion of the credit for the increase must be attributed to the operation of the zone plan, which overcame the cross-hauling of coal and insured its provision from the nearest accessible market. Under this plan various bituminous coal-mining districts east of the Rocky Mountains were separated, and to each was assigned a definite territory wherein it could market its coal. Coal from any district could be shipped to destinations beyond zones allotted to that district only upon permit of the Fuel Administration.

The coal-zoning plan not merely saved car-miles, but in addition permitted the utilization of coal produced in the plains states which would not otherwise have been produced.

Shortage of Foodstuffs

A program had been arranged by the Food Administration by which approximately 1,160,000 tons of food per month were to be forwarded to the Allies. Early in February it was found that only 750,000 tons had been forwarded in January, and at the same rate of progress only 500,000 would have been forwarded in February. Empty box cars were moved in preference from all sources in the East and South into the Western grain states, with the result that by Mar. 15 the vessel capacity of the allies had been satisfied and there was available at North Atlantic ports an excess on wheels of 6318 cars of foodstuffs, exclusive of grain on cars or in elevators.

To simplify and economize the methods of transportation, the following actions were taken under unified control:

Unification of terminals was made general throughout the country at both large and small stations; terminal managers have been appointed for the larger terminals, and where unnecessary mileage was not involved a consistent effort was made to route freight so as to arrive at the specific terminal where it is to be disposed of. Interchange switching in terminals has been eliminated, so far as this was practicable.

The following are typical examples of what has been done by unification:

1. The Southern Pacific, Atchison, Topeka & Santa Fé, and the Western Pacific, each maintained passenger ferry service between Oakland and San Francisco. The Santa Fé and Western Pacific passenger trains have been brought into the Oakland mole of the Southern Pacific. The latter's railroad facilities were ample for the three lines. Dispensing with the ferry service of the other two effected an approximate saving of $315,000 per annum. All railroad and marine facilities in New York harbor were consolidated under a marine manager and have been used in common. One hundred and seventeen coal-carrying barges and 18 tugs belonging to the Philadelphia & Reading, Lehigh Valley, New York, Ontario & Western, and Erie Railroads were pooled under a single management. All passenger trains of the Baltimore & Ohio and through passenger trains of the Lehigh Valley were brought into the Pennsylvania R.R. terminal in New York City.

2. Short-hauling of freight has been consistently followed, except where better grade conditions and less congestion were favorable factors on a somewhat longer line. An instance is the Northwestern region, where the correction of improper routing within a period of five months showed a saving of 4,054,455 car-miles on 34,941 carloads.

3. Solid trains for definite destinations were made up at Chicago, Minneapolis, St. Paul, St. Louis and at Missouri River crossings, resulting in a decrease in intermediate terminal switching and the expedition of essential Government freight.

4. Nonessential passenger trains have been eliminated, with the result that the number of trains discontinued resulted in a saving per year in passenger-train miles of 16,254,000 in the Eastern region, and a maximum of 23,280,000 in the Northwestern region.

5. Common use of freight cars.

6. Common use of repair shops.

7. The New York tubes were utilized for the movement of anthracite coal from New Jersey terminals to Long Island, affording substantial relief at a most critical time. Under its franchise this could not have been done by the Pennsylvania R.R. under private operation.

The enormous tonnage which is handled locally at the Pittsburgh gateway makes it very difficult to use it for trunk-line traffic. The trunk-line railroads through Pittsburgh should be relieved by the construction of an entirely new freight line connecting them east and west of Pittsburgh, but entirely avoiding the industrial area.

Condition of Equipment

The extended period of heavy business. high prices for material, difficulty in obtaining sufficient labor, loss of many experienced mechanics through the selective draft, followed by an early and unusually severe winter in 1917-18, resulted in a generally defective condition of locomotives and cars. The remedy was not so much the building of new locomotives and cars as the proper maintenance of those in service, and more prompt movement of trains. It was found that shop facilities were sufficient if efficiently used; therefore, the task of

nationalizing these facilities and assigning locomotives to shops where repairs could be made regardless of ownership was assigned to the chief inspector of the Bureau of Locomotive Inspection.

Roundhouses built 20 or more years ago were still being used to house locomotives more than twice the size of those for which they were designed. Repairs had to be made either out of doors or in open roundhouses at a temperature below zero. On the Baltimore & Ohio R.R. 133 locomotives froze up in the period from Dec. 28, 1917, to Jan. 5, 1918. In spite of these conditions, the situation immediately began to improve under the plan organized by the mechanical department of the Railroad Administration. After successful solution of certain labor difficulties, there was a noticeable increase in the production of the shops and engine houses where disputes had occurred. The average increase in locomotive-shop hours for the entire country amounted to about 16 per cent.

Standardized Locomotives

Designs were worked out for standardized locomotives, and orders for 1430 were given. These locomotives were built from standardized designs for the following reasons: To reduce to a minimum the time required to prepare drawings, patterns, and dies; to secure quantity deliveries—the increased production due to the standardized locomotives was about 50 per cent.; to provide a supply of equipment the parts of which are largely interchangeable and available for use anywhere in the event of congestion.

The freight-car situation was handled along the same lines, and after careful consideration designs were prepared and orders placed for 25,000 self-clearing steel hopper cars of 55 tons capacity, 25,000 single-sheathed box cars of 50 tons capacity, 25,000 double-sheathed box cars of 40 tons capacity, 20,000 composite gondolas of 50 tons capacity, with drop doors, and 5000 low-side gondolas of 70 tons capacity. In addition, many designs for other freight cars and steel baggage cars were made.

Instead of hauling new locomotives dead, orders were issued that wherever possible they should be moved under steam, hauling trains where practicable. This order relieved the railroads from 500,000,000 ton-miles of transportation annually for material which not only should be self-propelling, but should haul additional freight. The terminal facilities for the maintenance of locomotives and cars were consolidated at 417 points, and the annual saving effected thereby amounts to $2,363,500. Additional consolidations are under way. At one large shop the output of locomotives receiving classified repairs increased over 50%, and increases ranging from 10% to 25% were secured in many shops.

By rearranging methods of handling locomotives at terminals, it was possible to overcome what otherwise would have been a shortage in motive power. For example, on one railroad an appeal was made for an additional assignment of 25 Mallet locomotives, but by changing the method of handling at important terminals delay was reduced, and this road was able to release for service on other lines nine locomotives instead of requiring extra ones. There are now in reserve 1021 locomotives in various regions, and there are in storage 150 new standardized locomotives recently received to furnish surplus power to pass through the present winter.

In his report to the Interstate Commerce Committee of the United States Senate, Jan. 3, Mr. McAdoo included the following detailed figures on expenditures, on the elimination of circuitous routes, and on the special unification problem at Cincinnati.

The total improvements on all lines under Federal control, authorized to Dec. 1, 1918, amounted to $1,254,396,158, of which $656,058,745 was authorized for equipment. For this work expenditures had been made up to Nov. 1, 1918, of $477,211,012, of which $248,442,873 was for equipment.

The elimination of many circuitous routes in the handling of freight traffic has resulted in efficiency which cannot be measured only by the car-miles saved through diversions of freight in transit. The saving in distance by many of the new routes is great; for example, one from Los Angeles to Dallas and Fort Worth is over 500 miles shorter than that formerly used; another from the oil fields of Casper, Wyo., to Montana and Washington State points, is 880 miles shorter; fruit from southern California to Ogden is hauled 201 miles less and a new route between Kansas City and Galveston has been developed which is 289 miles shorter than the 1121 miles previously traversed by one line. The ore traffic moving from Minneapolis and Michigan mines to Lake Superior and Lake Michigan ports was rerouted. During the shipping season a total of 64,770 loaded and empty cars were rerouted with a saving of 3,577,464 car-miles.

Difficulties in Terminal Unification

A concrete illustration emphasizes the present difficulties in terminal unification: Three important railroads reach Cincinnati by crossing the Ohio River and four other important railroads reach it on the north bank of the Ohio River. The interchange of traffic between these lines at Cincinnati is enormous, and the conditions are such that in times of heavy traffic the freight at Cincinnati is badly congested. Under private management these railroads have never been able to get together and put into effect any comprehensive plan which would result in terminal facilities equal to the situation.

At the present time there are perhaps 25 or 30 freight houses in and around Cincinnati which have been provided primarily for the particular use of the separate railroad companies. It is estimated that there ought to be spent in the near future about $45,000,000 in the rehabilitation of Cincinnati terminals so as to make them equal to modern public needs, with probably $25,000,000 additional for passenger terminals. This involves the building of a new bridge and the reconstruction and enlargement of two other bridges, the construction of convenient and commodious freight houses, the provision of adequate belt lines and adequate facilities for intercommunication between the various railroads.

By the establishement of a permit system whereby traffic is not allowed to be loaded except upon showing that it can be delivered to the consignee at destination, there was effected practically a complete absence of congestion during the autumn months of 1918 when traffic was at its heaviest.

Find Cause of Obnoxious Tastes in Milwaukee Water

Coal Tar Derivatives from Coke and Phenol Plants Produce Taste When Diluted One Part in 500 Million

By H. P. Bohmann
Superintendent, Milwaukee Water-Works

FOR a number of years, but particularly during the present year, the water-supply of Milwaukee has been under discussion, owing to the obnoxious taste and odor present at times, and frequently referred to as a "medicinal taste" or a taste similar to that of iodoform or carbolic acid. During 1918 the taste and odor were so nauseating at times as to make the water absolutely unfit for drinking and cooking purposes, as the taste remained in the water even after boiling. In fact, the taste seemed more pronounced after the water was boiled. At first these odors and tastes were attributed to the use of chlorine in disinfecting our water-supply, and whenever the taste appeared the quantity of chlorine was reduced, although it was soon discovered that the taste frequently appeared when smaller quantities of chlorine were used, and was absent when larger quantities were being applied. It was also discovered that these objectionable tastes and odors were always accompanied by south or southwest winds, which blow the contaminated water from the harbor outlet, where the three rivers which flow through the city unite and discharge their sewage-laden contents into the lake, towards the water intake, which is only 3½ miles from the harbor outlet, in a northeasterly direction.

As the chlorine treatment is carefully supervised by a competent chemist, and the tastes and odors occurred only when the wind was from a certain direction, we were convinced that they were not due to the use of chlorine alone, but that the action of the chlorine on some of the organic matter present in the polluted lake water formed compounds that produced taste and odor. That chlorine in the quantities used (0.22 to 0.34 ppm.) did not produce the tastes and odors was also apparent from the fact that taste and odor were present on days when the free chlorine in the tap water in various parts of the city was low, and absent on other days when the free chlorine was 50% greater, although the quantity of chlorine applied was the same on both dates. Furthermore, the water of South Milwaukee, with a filtered supply, and using one-half the quantity of chlorine applied at Milwaukee, had the same obnoxious taste when wind conditions were favorable.

Suggestion at Water-Works Convention

In discussing the matter of tastes in water-supplies with a member of the American Water-Works Association in 1917 I learned that he had experienced trouble similar to ours, and that he attributed it to the industrial waste, from a coke plant, which was getting into his water-supply. With this information as a key to a possible solution of our troubles, samples were taken of the effluents being discharged at the local coke and gas plants. In the water-works laboratory chlorine was added to a sample of tasteless raw water until the ortho-tolidin test showed 0.09 ppm. of free chlorine in the sample, this amount of free chlorine representing the maximum that the tap water has ever contained. The addition of chlorine did not produce any taste in the sample. After the addition of some of the effluent from the coke plant to the chlorinated sample, the sample had a decided taste, resembling that of coal-tar derivatives, and was almost identical with the characteristic taste at times present in our water-supply. The sample was then boiled and cooled to its former temperature. The ortho-tolidin test then showed no free chlorine present, while the taste was stronger than before the boiling.

The results of the initial test of the first three samples pointed to coal-tar derivative wastes in combination with the chlorine added to our water-supply. These substitutive or additive compounds are probably the direct cause of the taste in the water. Such compounds boil at a higher temperature than water, and, therefore, would not be expelled in boiling.

Joint Investigation Made

At this point in the experimental work, all further investigations of the cause of the taste in the city water were carried on jointly by Robert L. Piper, chemist of the water-works, and Russell W. Cunliffe, chemist of the Health Department. Nearly 900 samples of sewage and trade waste were obtained and tested for taste in the manner above described, since, when greatly diluted in the lake, it is impossible to prove the presence of these substances by any chemical determination. These samples represented trade waste effluents and sewage of every description, such as those from hospitals, tanneries, packing houses, glue works, and from intercepting sewers carrying sewage from metal works, breweries, homes, etc.; also from gas plants, coke plants, and chemical industries manufacturing coal-tar products.

The results of the tests clearly indicated that the tastes and odors complained of in the water supply of Milwaukee are due to coal-tar derivative wastes from industrial plants, in combination with the chlorine used by the city for the purification of its drinking-water supply. It is only from samples of effluents of a coal-tar derivative nature that the characteristic and obnoxious taste present at times in our water-supply could be reproduced in the laboratory. All other samples failed to produce this taste. It was possible to add sufficient chlorine to a sample of tasteless raw water to produce a chlorine taste, which, however, is quite different from the taste complained of. This chlorine taste could, in every instance, be removed by boiling, or neutralized by sodium thiosulphate. The objectionable taste complained of in the water, however, could not be removed by either of these two methods. Furthermore, tests on solutions of tasteless raw lake water and various substances, such as naphthalene, benzol, phenol, petroleum oil, etc., demonstrated that upon chlorination only do these solutions which contain substances of coal-tar derivation produce tastes; in other words, only those substances which are or may be present in the taste-producing effluents mentioned above. There are, undoubtedly, substances of coal-tar derivation other than those mentioned which, when combined with chlorine, would form taste-producing bodies.

A survey made of all industrial plants whose industrial wastes contained objectionable elements of coal-tar derivation indicated that in addition to the local coke and gas plants there were five plants located outside of the city whose effluent might possibly contribute to our water pollution. Of these, three were at Carrollville, which is about 8 miles south of our southern city limits, and about 13 miles distant from our water intake. These plants were under suspicion from the start as contributors to our trouble, although it was impossible for a long time to establish this fact, owing to the difficulty of obtaining samples out in the lake when wind conditions were favorable. However, at a later trip, the fact was established beyond doubt, as samples were obtained at various points in the lake between the water intake and Carrollville, which upon chlorination produced the objectionable taste in varying degrees.

One of the three plants at Carrollville was engaged in the production of phenol for the United States Government, partly in its own plant and partly in a building owned by the Government. The combined production of phenol in the two plants, which originally amounted to only a few tons a day, had greatly increased until, during October, 1918, it amounted to 130 tons daily. It was estimated by the management that the daily trade waste flowing into the lake contained anywhere from 1100 to 2200 lb. of phenol, and the management was inclined to believe that the latter figure was more nearly correct. The possibilities of producing taste in a water-supply can best be appreciated when we learn that taste can be produced, after chlorination, in solutions containing one part of phenol to 500,000,000 parts of water. This amount of phenol could pollute from 60,000,000,000 to 120,000,000,000 gal. of water to such an extent that taste could be produced upon chlorination.

Appeal Made to State and Federal Authorities

When the obnoxious taste again appeared in a very acute form, early in November, an appeal was made to the State Board of Health to assist the local officials in obtaining immediate measures of relief. Telegrams were sent by Mayor D. W. Hoan to Dr. Rupert Blue, surgeon general, United States Public Health Service, and Newton D. Baker, secretary of war, asking them to lend their assistance, as it was asserted that some of the companies were engaged in Government work. A meeting was held in the mayor's office, which was attended by Governor Philipp, city and state officials and representatives of the coke and gas companies. After a general discussion of the subject, Governor Philipp suggested that the mayor appoint a committee to study the report made by the chemists, visit all of the plants under suspicion and, if possible, place the responsibility for the obnoxious taste. The mayor then made the following appointments: Dr. C. A. Harper, state health officer, and Prof. J. C. D. Mack, state chief engineer, representing the state; Dr. George C. Ruhland, health commissioner, H. P. Bohmann, superintendent of water-works, and William R. Copeland, chief chemist of the Sewerage Commission, representing the City of Milwaukee; R. B. Brown, general manager and chief engineer of the Milwaukee Gas Light Co.; J. W. Shaffer, vice-president in charge of operation of the Milwaukee Coke and Gas Co., the Newport Hydro-Carbon Co. and the Newport Chemical Works, Inc., representing the industrial plants.

The committee visited the various plants, and testimony was taken at each plant by Dr. C. A. Harper, state health officer. Later a meeting of the committee was held at Madison, at which the committee framed its formal report. The conclusions were:

Carbolic-Acid Plant Wastes

"That, from its personal investigation and from a careful study of the reports that have been worked out by the chemists of the water department, the health department and industrial companies, the obnoxious odor and taste complained of in the Milwaukee water-supply are essentially attributable to the effluent coming from the Newport Hydro-Carbon Co., a plant engaged in the manufacture of carbolic acid. It finds its belief substantiated in the fact that from Nov. 26 to Nov. 29, during southerly winds, when operations of the plant were suspended, there was no recurrence of the nuisance in the city's drinking water."

Since the latter date the plant of the Newport Hydro-Carbon Co. has been permanently closed, and no more phenol will be produced there. This will undoubtedly remove the largest factor in our water trouble.

The next largest contributor was the coke company, where it was estimated that about 91 lb. of phenol was discharged daily with its industrial waste. It was estimated that the amount of trade waste having taste-producing properties leaving the coke plant daily was sufficient to impart taste, of the kind complained of in our water-supply, to 10,000,000,000 to 40,000,000,000 gal. of water. The other plants contribute to this pollution according to the volume of the effluents discharged from their respective plants, all of them, however, to a far less degree. The taste-producing properties of the effluents of the plants investigated were found to range from dilutions of 1 to 100 to 1 to 400,000.

Basing opinion on the results of the many tests made, it is reasonable to assume that any water-supply which is being chlorinated, and which occasionally has a medicinal or phenol-like taste which cannot be removed by boiling, may have been contaminated with waste material produced in the destructive distillation of coal and in the recovery and manufacture of the byproducts of this process; otherwise, it should be possible to remove the taste by boiling. The only practical method known at the present time to avoid taste of this nature is to keep this particular kind of effluent out of a water-supply. No water-supply which is polluted with coal-tar derivatives and where chlorine is used as a sterilizing agent can be made palatable for drinking purposes. It is possible that by laboratory experiments some chemical may be found which will overcome the affinity of chlorine for the coal-tar bodies or change their composition so that they will not unite with chlorine. Every effort is being made by the coke and gas companies to find a method of taking care of their wastes.

Undoubtedly, some of the readers of *Engineering News-Record* know that the City of Milwaukee has planned an extensive program for improving its water-supply. With that program carried out Milwaukee can be assured of the best of water-supplies.

Light and Heavy Equipment Compared on Identical Sewer Construction

Field Costs per Unit of Sewer Are Substantially the Same for Both Plants—Greater Speed Possible with Heavier Plant, According to Results Obtained

By Ralph H. Burke

Division Engineer in charge of Sewer Work, Sanitary District of Chicago

Direct comparison of efficiency of heavy and of light equipment in nearly identical operations is afforded by the construction of the Calumet intercepting sewer for the Sanitary District of Chicago. Field construction costs per unit of completed sewer, based on the working conditions prevailing during four months in 1917 and using figures which do not apply to the whole work on either contract, averaged about the same for both sizes of plant. Speed of construction, however, was about 65% greater with the heavier equipment. It also required a 25% larger working force and cost about 17% more per day to operate than did the lighter outfit.

The preceding figures do not include the installation of equipment, special work at curves or crossings, or other items peculiar to the individual contract section. Also, they cover only the operations in the field, and do not include general expenses such as overhead, insurance, bonding and general administration charges. It should be repeated that the figures are comparative only, and do not represent the total costs for all work on either section.

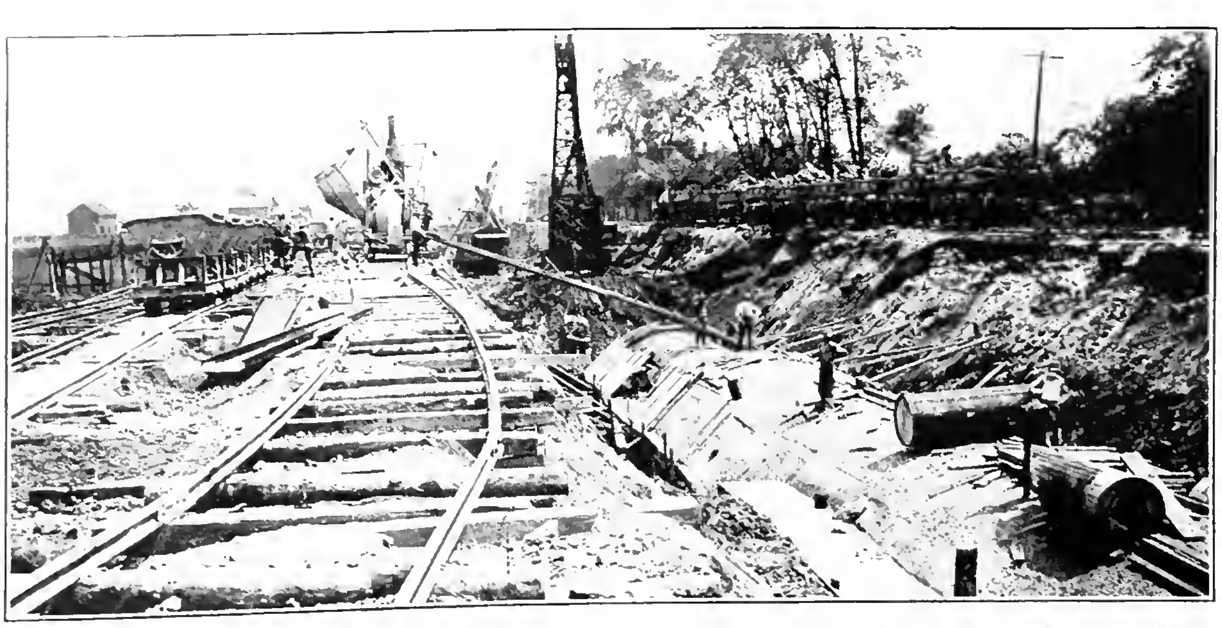
The Calumet intercepting sewer extends from South Chicago to the Calumet-Sag Channel near Blue Island, a distance of about nine miles. The total cost of the project is approximately $3,600,000. The sewer section is concrete, of horseshoe shape, with a rather flat invert and a semi-circular crown, and varies in size from 11 ft. to 17½ ft. internal width. The cuts are comparatively shallow on the easterly three miles, ranging from 14 to 18 ft., while on the westerly six miles the cut is about 30 ft. The material encountered consists of sand and sandy clay in the shallow cut, and chiefly clay, varying from soft to very hard, in the deep cut. The work is located largely through sparsely settled territory, where ample room is available for the operation of the plant. The construction has required the use of plant not ordinarily employed on sewer work in the vicinity of Chicago. The excessive width and depth of the cut preclude vertical trenching. The cost of timbering to support a steam shovel or other excavating plant capable of handling work of this size would be prohibitive. On the shallow cut, dragline excavators were employed for the entire excavation, while on the deep cut the work has been divided into two lifts, the upper lift being excavated by a steam shovel, the lower lift by a dragline moving along the bottom of the shovel cut. This method requires the sloping of the sides of the top cut not only to avoid continuous bracing, but also to allow sufficient width for the operation of the dragline. That portion of the cut below the haunches of the sewer section is vertical, as nearly as possible, and, in general, the concrete is placed against the earth without the use of back forms. The typical sections illustrated indicate the general proportions and dimensions of the work.

TABLE I. CONSTRUCTION PLANTS ON SECTIONS 4 AND 7, CALUMET INTERCEPTING SEWER

(Four Months during 1917)

Section 4	Section 7
Excavating Plant	
1. Thew revolving steam shovel, size 0; 1-cu.yd. bucket.	1. Marion standard steam shovel, model 76; 40-ft. boom, 40-ft. dipper-handle, 2½-cu.yd. bucket.
. Lidgerwood dragline; 70-ft. boom; 2-cu.yd. Page bucket.	2. Bucyrus dragline, class 14; 65-ft. boom; 2½-cu.yd. Page bucket.
3. Fifteen 1½-cu.yd. dump wagons; 16 wooden, side-dump, 4-cu.yd. cars; 1 mile 36-in. gage track, 45-lb. rails; two 14-ton Davenport locomotives.	3. Thirty-six 6-cu.yd. Western dump cars, automatic couplers; two miles standard-gage track, 60-lb. rails; four 25-ton Vulcan locomotives.
Backfilling Plant	
Timber revolving derrick with ¾-cu.yd. orange-peel bucket.	Western Wheeled Scraper Co. standard-gage spreader.
Concrete Plant	
Overhead 400-cu.yd. bins; 2000-bbl. cement house; derrick car with ¾-cu.yd. clamshell; 75 Koppel 27-ft. steel dump cars; 2 Chain Belt mixers, 1-cu.yd.; 150 lin.ft. collapsible Blaw steel forms with traveler; 1 mile 20-in. gage track, 25-lb. rail.	Overhead 600-cu.yd. bins; 2500-bbl. cement house; Brown Hoist 15-ton locomotive crane with 1½-cu.yd. clamshell bucket; 30 Easton steel dump cars 40 cu.ft., three 8-ton Vulcan locomotives; 2 Foote 40-cu.ft. mixers; 175 lin.ft. collapsible Blaw steel forms with traveler equipped with 6-hp. Fairbanks-Morse gasoline engine for moving; 2 miles 36-in. gage track, 50-lb. rail.

The work was divided into contract sections, each with a length of about a mile and a half. The plant employed is quite similar in character on all sections, but differs in details and as to the sizes of the main units. A direct comparison can, however, be made between large and small plant units, both similar in type, and both employed on work of equal magnitude. This opportunity is exceptional, since each construction job



CONSTRUCTION PLANT ON SECTION 7 DISTINGUISHED BY HEAVY EQUIPMENT UNITS

usually presents problems peculiar to itself, requiring certain adaptations of ordinary contractor's equipment not called for on other work. Also, the results cbtained in each case ordinarily cannot be applied to other work without allowances for the different requirements. On the Calumet sewer, however, the work under the separate contracts is almost identical in magnitude and as regards working conditions; the plant employed is similar in character and operation, and a comparison of results can be made without the usual introduction of inexact and unknown factors which so vitally affect costs.

Sec. No. 4 and Sec. No. 7 of the Calumet intercepting sewer were built, respectively, by Nash Bros. and by the T. J. Forschner Contracting Co., both of Chicago. Both contract sections have been handled very efficiently, and the finished work in both cases is of the highest grade in every respect. The cut in both cases was about 30 ft. The sewer section has an internal width of 16½ ft. on Sec. 4 and 16 ft. on Sec. 7.

Excavation in both cases was performed in two lifts; the top lift, about 10 ft. in depth, was handled on Sec. 4 by a small revolving steam shovel, loading dump wagons, while on Sec. 7 a large standard steam shovel was used, loading standard-gage dump cars. The bottom lift on both sections was handled by a medium-sized dragline excavator. On Sec. 4 the earth was piled on one side of the cut and was also loaded into narrow-gage 4-cu.yd. dump cars, while on Sec. 7 it was loaded into standard-gage 6-cu.yd. dump cars.

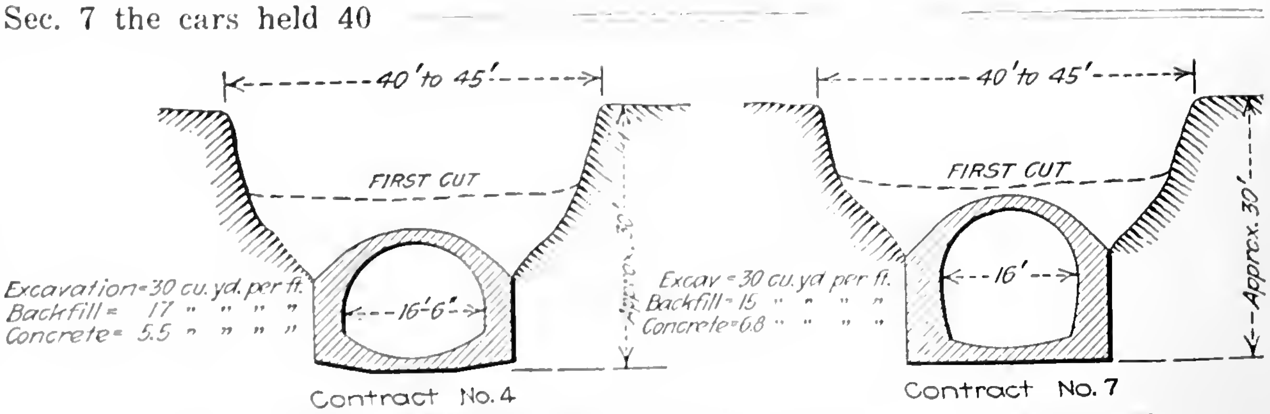
Backfilling was done with the earth excavated from the bottom cut. On some parts of Sec. 4 the earth stored along the side of the cut was placed in backfill by a revolving derrick equipped with an orange-peel bucket, while on other parts of the work the earth was hauled directly to backfill in dump cars and spread by hand. On Sec. 7 the dump cars transported the excavated material directly to backfill, grading being accomplished by a standard-gage spreader.

The concrete was placed on both sections by two batch mixers moving along one side of the cut. Crushed stone and sand were unloaded from the railroad cars and placed in overhead bins, a derrick-car equipped with clamshell bucket being employed on Sec. 4, while a locomotive crane with clamshell bucket was used on Sec. 7. The batches were proportioned at the bins by filling small steel dump cars with sand, stone and cement, each carload forming a batch of concrete. The cars passed under the bins and were filled by gates with the exact batch amount of sand and stone. The cement was charged by tipping buckets, each holding cement for one batch. The cars on Sec. 4 held 27 cu.ft. and operated on a 20-in. gage track, being hauled in trains of nine cars by means of horses. On Sec. 7 the cars held 40 cu.ft. and operated on a 36-in.-gage track, being hauled in trains of 12 cars by means of dinkey engines. From July to October, 1917, work on both sections progressed without interruption and without special features peculiar to either. Costs and output of the two plants during this period are therefore strictly comparable.

TABLE II. CONSTRUCTION ORGANIZATION ON SECTIONS 4 AND 7 CALUMET INTERCEPTING SEWER

(Four Months during 1917)

Section 4		Section 7
	General	
1 Superintendent 1 General foreman 1 Timekeeper 1 Material man 1 Pumpman 2 Watchmen 1 Waterboy		1 Superintendent 1 General foreman 1 Timekeeper 1 Blacksmith 1 Blacksmith helper 1 Pumpman 2 Watchmen
8 Total		8 Total
Excavation:		
	Steam Shovel Crew	
1 Engineer 1 Fireman 1 Pitman		1 Engineer 1 Craneman 1 Fireman 4 Pitmen 1 Coal passer 1 Laborer
3 Total		9 Total
	Dragline Crew	
1 Engineer 1 Fireman 2 Bottom men 2 Ground men		1 Engineer 1 Fireman 4 Bottom men 2 Ground men 1 Coal passer 1 Laborer
6 Total		10 Total
	Waste Disposal	
1 Foreman 12 Teams and drivers		1 Foreman 2 Dinkey engineers 2 Switchmen 12 Laborers
13 Total		17 Total
Backfilling:	Derrick Crew	
1 Engineer 1 Fireman 2 Groundmen 4 Laborers		1 Foreman 2 Dinkey engineers 2 Switchmen 16 Laborers
8 Total		
	Train Crew	
1 Dinkey engineer 1 Switchman 8 Laborers		
10 Total		21 Total
Concrete Work:		
	Unloading Materials	
1 Crane Engineer 1 Fireman 2 Laborers		1 Crane engineer 1 Fireman 2 Laborers
4 Total		4 Total
	Transportation of Materials	
5 Horses and drivers 2 Laborers on bins 5 Laborers on cemen 3 Laborers on cars		2 Dinkey engineers 2 Switchmen 3 Laborers on bins 5 Laborers on cement 3 Laborers on cars
15 Total		15 Total
	Mixing and Placing	
1 Foreman 1 Mixer engineer 4 Concrete men		1 Mixer engineer 1 Mixer helper 4 Concrete men 1 Cement finisher
6 Total		7 Total
	Forms	
4 Form movers 1 Carpenter 1 Carpenter helper		1 Foreman 4 Form movers 3 Carpenters 2 Carpenter helpers
6 Total		10 Total
Grand total, 80 men		Grand total, 100 men



SUBSTANTIALLY IDENTICAL CHARACTER OF WORK INDICATED BY COMPARATIVE DIAGRAMS

The average progress per working day was 25 lin.ft. of completed sewer on Sec. 4 and 41 lin.ft. on Sec. 7. The average force employed was 80 men on Sec. 4 and 100 men on Sec. 7. Labor costs averaged about $382 per day on Sec. 4 as compared with $407 per day on Sec. 7. Plant costs amounted to $135 per day on Sec. 4 and $200 per day on Sec. 7. The plant costs include all those of operation, such as coal, oil and other supplies, and include also an allowance for interest, maintenance and depreciation averaging about 5% per month on the value of the plant.

NARROW-GAGE TRACK AND LIGHT EQUIPMENT EMPLOYED ON SECTION 4

Summarizing and charging all costs against the two main items, excavation and concrete, the unit costs are as follows:

Item:	Sec. 4	Sec. 7
Excavation, per cubic yard	$0.40	$0.28
Concrete, per cubic yard	5.91	5.27

The quantities upon which these figures are based are the actual quantities, as shown by the accompanying typical cross-sections.

Based on the linear feet of completed sewer, the cost is $44.50 per foot on Sec. 4 and $44.15 per foot on Sec. 7.

Comparison of the items which make up the preceding totals is presented in the three accompanying tabulations.

The construction of the Calumet intercepting sewer is under the direction of the engineering department of the Sanitary District of Chicago, of which G. M. Wisner is chief engineer and the writer is division engineer, in charge of sewer work.

TABLE III. UNIT COSTS ON SECTIONS 4 AND 7, CALUMET INTERCEPTING SEWER

(Four Months during 1917)

Section 4		Section 7	
	Quantities per Foot of Sewer		
Excavation, cu.yd.	30	Excavation, cu.yd.	30
Concrete, cu.yd.	5.5	Concrete, cu.yd.	6.8
	Quantities per Working Day		
Excavation, cu.yd.	750	Excavation, cu.yd.	1,230
Concrete, cu.yd.	138	Concrete, cu.yd.	279
Completed sewer, lin.ft.	25	Completed sewer, lin.ft.	41
	Unit Costs		
Excavation	Cu.Yd.	Excavation	Cu.Yd.
Labor	$0.31	Labor	$0.20
Plant	.09	Plant	.08
Total	$0.40	Total	$0.28
	Concrete		
Labor	$1.11	Labor	$0.58
Plant	.47	Plant	.36
Total	$1.58	Total	$0.94
Materials	4.33	Materials	4.33
Total	$5.91	Total	$5.27
	Completed Sewer		
	Lin.Ft.		Lin.Ft.
Labor	$15.28	Labor	$9.93
Plant	5.40	Plant	4.78
Materials	23.82	Materials	29.44
Total	$44.50	Total	$44.15

Accidents on Railroads Reported by Interstate Commerce Commission

DURING the year which ended June 30, 1918, there were 91 train accidents investigated by the Interstate Commerce Commission, according to the latest annual report. In these accidents, comprising 63 collisions and 28 derailments, 374 persons were killed and 1730 were injured; 26 collisions occurred on block-signal lines, 13 in automatic block-signal territory, and 13 in nonautomatic block-signal territory, five occurred on track where yard rules were in effect, and 31 occurred on lines operated by the train-order and time-interval system.

Of the 13 collisions which occurred in automatic block-signal territory, eight were due to failure of enginemen to heed automatic indications, and one was caused by failure of the train crew to obey a rule; in the other four cases, the signal system in use was not involved, two of these being due to trains running away on mountain grades and two involving trains running against the current of traffic, which movements were governed by train orders.

The most disastrous accident during the year resulted in the deaths of 60 persons and the injury of 128, and occurred on a line operated by a modern automatic block-signal system; it was caused by an engineman falling asleep and failing to see a stop signal. Since accident investigations were begun by the Interstate Commerce Commission in 1911 approximately 10 per cent. of the total number investigated were caused primarily by the disregard of signal indications. As many of these accidents occurred on lines equipped with the best signal systems, properly installed and maintained, the urgent need of some further safeguards, such as automatic devices designed to compel obedience to signal indications, is apparent.

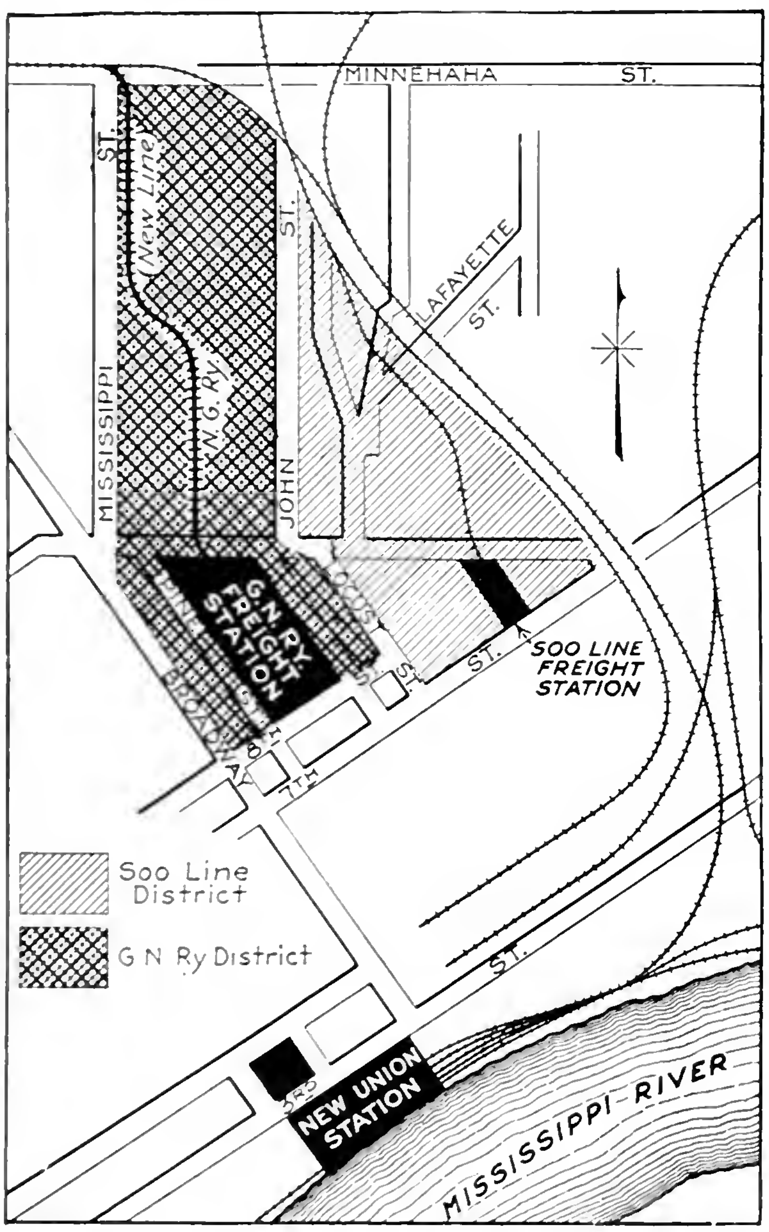
Approximately half of the collisions investigated during the year occurred on lines operated by the train-order and time-interval system; many of them were due to the inherent weaknesses of that system. Nine were due to errors in issuing, transmitting, or observing train orders; seven were caused by a train occupying the main track on the time of superior trains without proper protection; and seven others were caused by failure of flagmen to protect their trains properly; four were caused by failure of enginemen to obey prescribed speed restrictions, and four were due to purely local conditions and causes. It is stated that many of the collisions investigated during the year could have been prevented by the proper application of the block-signal principles, and it is beyond question that the adoption of the block system on lines now operated by the train-order system would result in a material reduction in the annual casualty record.

Of the 28 derailments investigated, 17 were caused by defective track and three were due to defective equipment; in three other cases the speed of trains was the primary cause, and in three cases the derailments occurred on account of local conditions.

Railways Form Industrial District At St. Paul

Over One Hundred Acres Used for Manufacturing and Freight Terminals Being Developed Near New Station

ESTABLISHMENT of an industrial district of about 117 acres at St. Paul, Minn., containing also the freight terminals of two railways, has been effected in connection with the new freight station of the Great Northern Ry., adjacent to similar facilities already provided by the Minneapolis, St. Paul & Sault St. Marie Ry. This is an important part of the improvement resulting from the construction of the new union passenger station. The area taken for this station included the freight terminal of the Great Northern Ry., and it became necessary to obtain a new location for the latter.



NEW INDUSTRIAL AND TERMINAL DISTRICT IS ESTABLISHED AT ST. PAUL, MINN.

Advantage was taken of this opportunity to establish an industrial district tributary to the new freight terminal. For this purpose the railway company acquired possession of the 85-acre oblong tract shown by the heavily shaded area on the accompanying map. The area lightly shaded is that of the other railway mentioned. All the buildings in this new territory have been or will be torn down, and the ground will be used for warehouses, manufacturing plants and trackage. No definite layout for the district has been adopted as yet. The upper or narrower portion, lying between Mississippi St. and the tracks, is high ground, rising to an elevation of about 90 ft. above the graded site. The material to be excavated is mainly gravel and clay, and will be used in 1919 as filling for the elevation of tracks leading to the new union passenger station.

Both inbound and outbound freight will be handled at the new terminal. The freight house, however, is essentially an inbound house, as about 80 per cent. of the outbound freight is handled on the team tracks. This freight is loaded into jumbo cars 60 ft. long, having two doors on each side, and is taken to Hamline Transfer, midway between the business centers of St. Paul and Minneapolis, where carloads are made up for the same shipping points. For handling the inbound freight and approximately 20 per cent. of the outbound freight, there is a one-story freight house 60 x 803 ft., with its long side fronting on Pine St. A 10-ft. transfer platform, 740 ft. long, lies parallel with this, and between it and the building are four stub tracks spaced 13 ft. on centers.

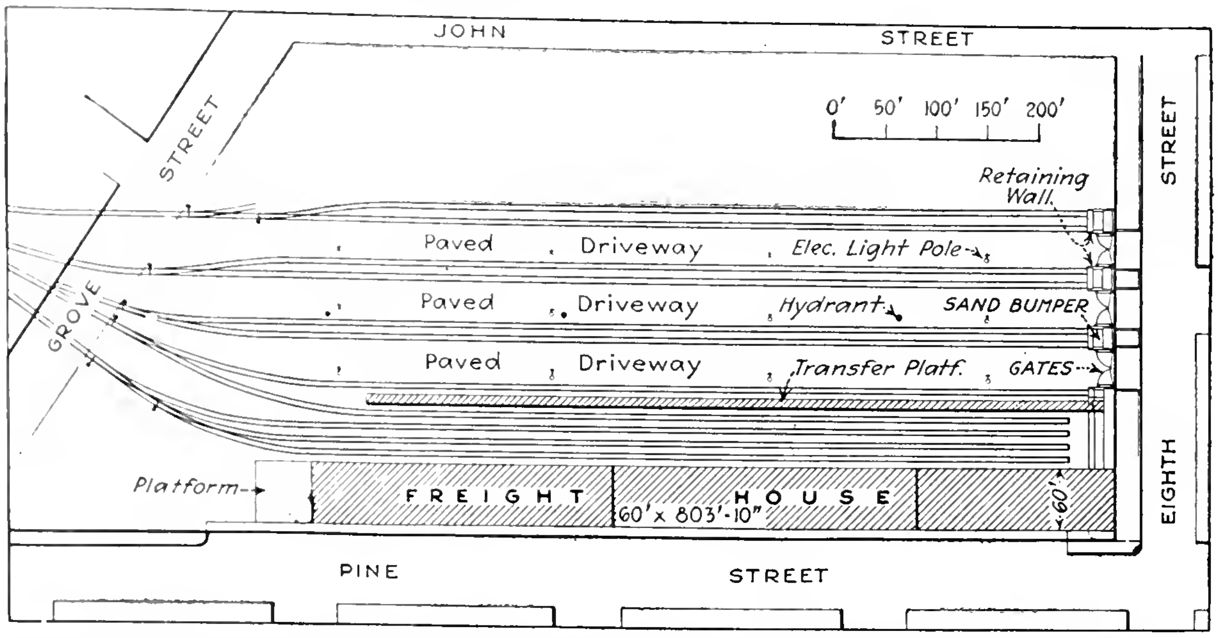
Beyond the transfer platform is the team yard, with seven tracks and three driveways, while beyond these there is room for additional trackage. Concrete curbs are placed along the driveways from which the brick-paved surface slopes down to form a central gutter, with catchbasins and sewer connections. Sand bumpers form effective stops at the ends of the team tracks. These are fills about 4 ft. deep, confined between retaining walls at the sides of the driveways. Lighting of the team yard is provided by 500-watt lamps on arms carried by 35-ft. poles, spaced 215 ft. along the driveways, the lamps being about 22 ft. above the pavement.

Brick walls and timber roof construction are used for the freight house. Its track side is entirely open, except for steel columns spaced 18 ft. 11 in. on centers and carrying a continuous reinforced-concrete lintel. The openings are fitted with steel doors which roll up behind the lintel. On the team, or street, side are 8-ft. doorways spaced 20 ft. on centers. These are fitted with steel doors which swing up on the inside but are so hung as to require a minimum of clearance space for their movements. Two firewalls divide the main floor into three sections. Owing to snow troubles, no outside platform is used on either side of the freight house. (See illustration, next page.)

A basement 300 ft. long includes a refrigerator room and a boiler room, and coal and oil storage and warehouse space, this last being served by two elevators. The basement is of concrete, with walls and columns supporting beams and girders which carry a 6-in. concrete deck slab designed for 500-lb. live load and 100-lb. dead load. Creosoted block paving 2½ in. thick covers the entire floor of the freight house. To facilitate trucking the floor has a slope of ¼ in. to the foot from the track side to the team side. The roof has plank sheathing, with tar and gravel covering, and is designed for 40-lb. live load and 20-lb. dead load. Timber construction is used for the transfer platform. Its roof is supported by side posts or bents with 20-ft. spacing, so that there is very little obstruction to movements of trucking.

A two-story section at one end of the freight house

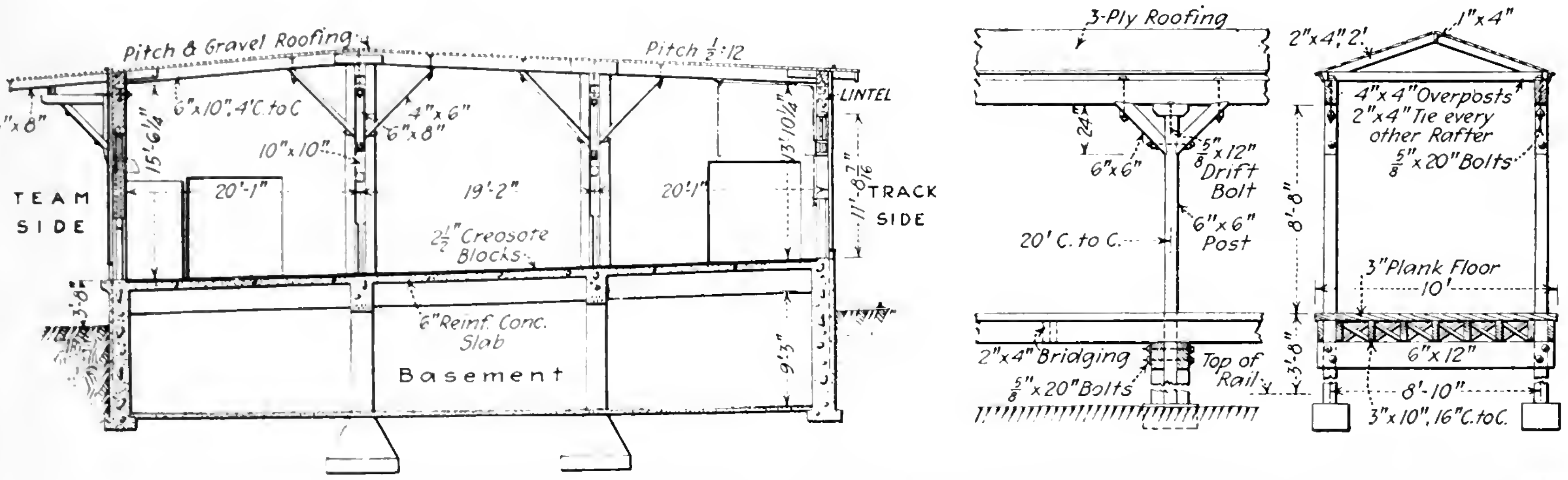
has the cashier's office on the first floor, convenient for public use. Above this are the general offices with separate locker, lunch and toilet rooms for men and women. On this floor also are a lunch room and a toilet room, with shower baths, for the freight house force, these latter accommodations being accessible directly from the main floor. Good street accommodation, permitting teams to stand at the station without interfering with traffic, is provided by paving Pine St. for a width of 63 ft. along the entire front of the freight house. The city paid for 40 ft. of roadway proper and the railroad paid for the 13-ft. boulevard or parkway and for a 10-ft. additional strip between the building and the property line. Brick paving is used, with a uniform slope from the freight house to the center of the 40-ft. roadway, beyond which the remaining 20 ft. of width has a parabolic section with a drop of 6 in. from the crown to the curb.



FREIGHT TERMINAL OF THE GREAT NORTHERN RAILWAY AT ST. PAUL IS MAINLY FOR INBOUND FREIGHT

Adjacent to the 85-acre industrial district noted above is a similar district of about 32 acres, being developed by the Minneapolis, St. Paul & Sault Ste. Marie Ry. an arterial street to the northeastern part of the city.

Making compensation for public property taken is included in the negotiations. This new industrial district replaces an old residential district, and its clearing required the abandonment of three churches, a parochial school, three public schools and a city fire station. The school department has been compensated by the Great Northern Ry. by the payment into the city treasury of $125,000 in cash and by the giving of a deed to a new site for one of the schools. The company has also purchased a site for the fire station, and will



ROLLING DOORS FORM ONE SIDE OF FREIGHT HOUSE—TRANSFER PLATFORM HAS UNOBSTRUCTED TRUCKING AREA

This includes the railway's freight terminal, built a few years ago. This gives a total of 117 acres in one area for industrial and manufacturing purposes and railway terminals.

The street layout has been improved materially in connection with this Great Northern development. Several streets and alleys in the terminal site were vacated and other streets widened or extended to improve the traffic facilities, while 14th St. is to be extended through to Lafayette Ave. A street-car line which crossed the station site has been rerouted. John St. is widened from a 30-ft. lane to a 60-ft. street, and Locust St., Eighth St. and Lafayette Ave. are to be widened 14 ft., making them 80-ft. thoroughfares. This gives wide streets along the entrance to the team tracks and the freight-house driveway, and provides for the additional traffic which will use Lafayette Ave., this being

erect a new building according to plans prepared by the city architect and approved by the railway company. The latter will pay $10,000 in addition.

To carry out this development the Great Northern Terminal Co. was organized, its chief engineer being A. H. Hogeland, chief engineer of the Great Northern Ry. H. F. Hamilton, resident engineer of the railway, is in charge of the work. T. D. McMahon, architect for the railway, drew the station plans. W. L. Johnson is contractor for the freight station and also had the contract for clearing the district. This latter was a labor contract and covered selling the houses, wrecking and selling material and clearing up the site, at cost plus ten per cent. Fielding & Shepley were the contractors for the paving. The new freight terminal represents an expenditure of $290,000, while the paving of Pine St. by the city cost $38,000.

Detail-Drawing Method Used For 8800-Ton Steel Ships

Adapted Successfully to Old-Style Ships of Fully Curved Shape—Permits Checking Pieces Before They Leave Shop

BECAUSE a civil engineer does not take naturally to pre-war shipbuilding methods of shaping a wooden templet by the cut-and-try process and then using it as a pattern, the Northwest Steel Co. at Portland, Ore., undertook to develop a better system. Even before the Hog Island plans for structural detailing had been decided upon, the scheme was under consideration at Portland, but, unlike those at Hog Island, the Portland contracts were for the old-style boats with sheer, tumble-home and camber, so that the curved surfaces complicated detail drawings considerably. The plan has worked out well, however, and boats are now being built in part from blueprints instead of by the old method of obtaining the information from the mold-loft floor lines. Only about 70% of the details have been completed, but as soon as the remainder have been worked out the blueprint plan will be used practically to the exclusion of the old method.

About 1400 drawings will be required for the complete set of details. Once these are finished, it is believed, changes which may be required from time to time can be effected to advantage, because studies of adjacent parts can be made before the change is decided upon. Advantages of this kind have already been realized in the economies that became apparent as the details were studied on the drawings with respect to one another. For example, unnecessary three-ply riveting here and there was eliminated as soon as the drawings were compared, although the advantage of this saving had never been so apparent before the drawings were used. The number of different-sized rivets in a single plate has been reduced, and minor details have frequently been simplified, without decreasing strength.

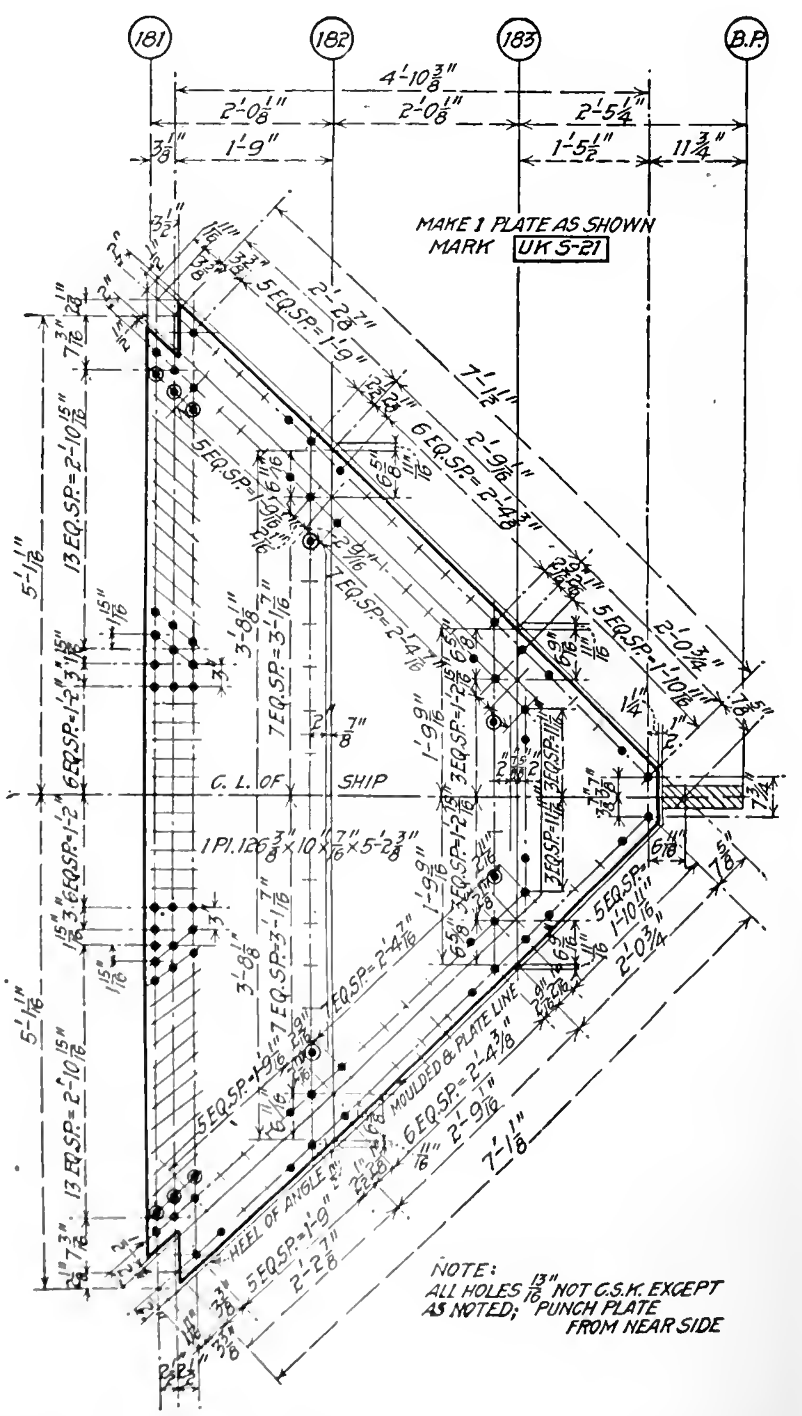
The shop-bill method of ordering shopwork, such as is usual in structural-steel practice, has been introduced in connection with the plan of using detailed drawings. Each shape or plate on which shopwork is required is now listed on a shop bill. These constitute a complete list of material for each ship and afford a means of itemizing material going through the shop and time on each separate job. This plan is commended as a means of avoiding delay and confusion as well as an aid in tracing missing material.

An important change in design was the substitution of a new type of girder. Instead of the built-up girder section, this yard is now making its girders from Bethlehem H12 column sections, with joints on pillars. This saves considerable punching, besides the time and labor required in fabrication.

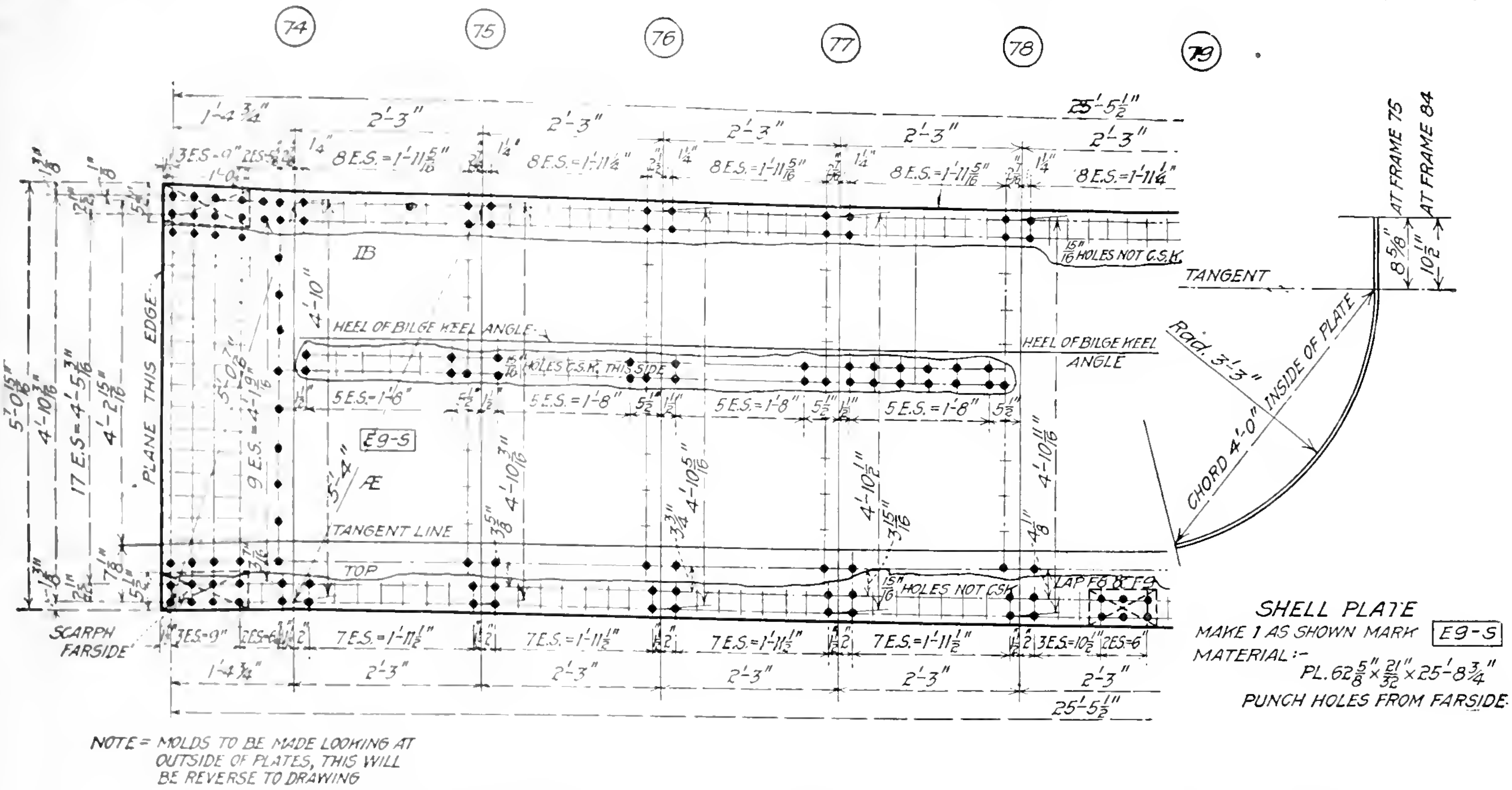
Pre-fabrication is carried out only as far as it can be done conveniently in the shop. No attempt is made to assemble in the yard, where large sections or bulkheads could be laid out. With the blueprint system, it is unnecessary to make special effort on this score, for the foreman can direct the work of assembly in the ship according to drawing. With the old system, only the shipfitter could direct the work, he being the man in whose head the layout was kept clear and from whom detailed instructions were transmitted only orally. With a system where every detail is a matter of record, notable time economies have been made and a structural-steel crew can be very quickly adapted to do this work effectively.

Although large sections are not fabricated in an assembly yard, it is the custom to make up assembled drawings just as is the case with large steel structures. These sectional drawings are issued for the guidance of inspectors and foremen, and are constantly used in checking and making comparisons. For example, an entire bulkhead drawn to small scale on one sheet, and carrying the usual enlarged details worked out for all field joints, is practically all the foreman needs in directing its assembly.

The close supervision possible when details are worked out on the drawing board is a feature that is highly commended. The number of rivets in a gusset plate, for example, is now determined according to exact analysis by a structural detailer, instead of by the man working on the floor of the mold loft. Of course it will always be desirable to make up templets for many parts,



PART OF A TYPICAL DETAIL SHEET—AN UPPER DECK STRINGER PLATE



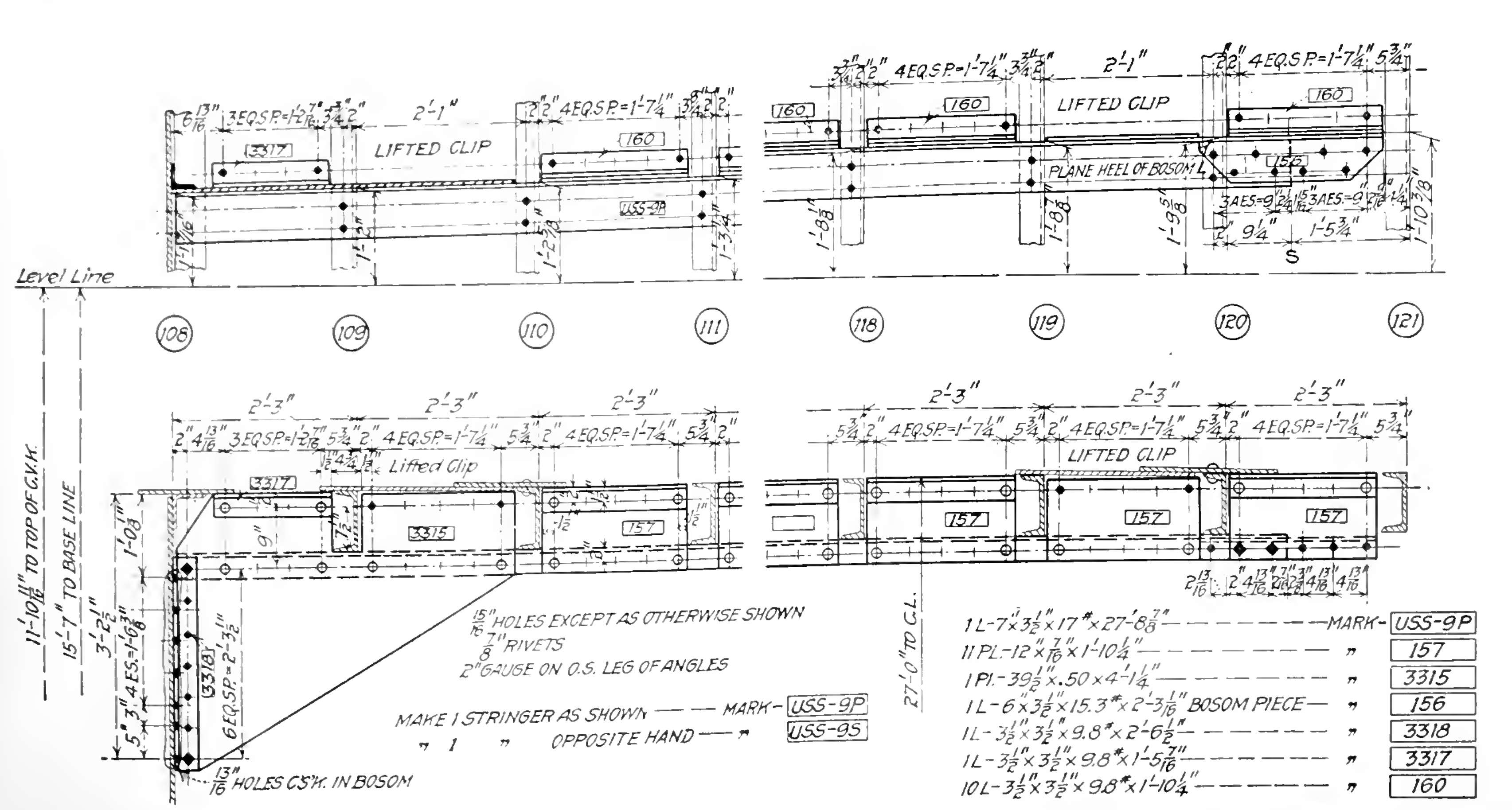
PART OF DRAWING OF A BILGE PLATE; PORT AND STARBOARD PLATES SHOWN ON SAME SHEET

just as it is desirable to keep shipfitters on the assembly work. But templets are now made up according to a blueprint. It is notable that this plan simplifies the problem of obtaining or training men for mold-loft work. Benches have been put in the mold loft on which to make up all but the largest templets. This is believed to have increased the efficiency of the force by about 25 per cent., besides making it much more comfortable for the men.

Perhaps the greatest advantage of all is the use of the blueprints by inspectors in a careful checking of plates and shapes before they leave the shop. This has resulted in the catching of errors before the piece gets into the ship and is, perhaps, partly riveted into its proper place.

With the old system the elaborate markings on the pieces, usually done with a paint brush, could not always be trusted, because there was no means of securing a second check, such as is now made with a blueprint in the hands of an inspector.

Because of the necessity of keeping the yard up to maximum output while the change from templet to blueprint method was made, the transition has had to progress slowly. It has been possible to make steady progress on the detailing and attend to other incidental drafting with a force of about 34 detailers. The most



UPPER SIDE STRINGER REPRESENTED IN TYPICAL STRUCTURAL-DETAIL MANNER; FRAME NUMBERS SHOWN IN CIRCLES

intricate part of the designing has been on those sections of the stern where warped surfaces intersect, known as the "lift plates," the templets for which were formerly made directly on the form of the ship. These have been laid out to scale by developing the surfaces involved. Plates built according to designs so prepared have thus far been satisfactory.

W. H. Cullers is chief engineer and C. D. Merrill is naval architect for the Northwest Steel Co. John Murray is general yard superintendent.

Irrigation Opportunities in Russia Are Great

Chances for Both Public and Private Enterprises—Cotton the Great Crop in Arid Russia but Insufficient for Russian Spindles—Agriculture on Steppes Conducted by Dry-Farming Method

By V. V. Tchikoff

Formerly Chief Engineer of Surveying and Designing Works in the Central Part of Golodnaya Steppe, Turkestan, and in the Lower Part of the Valley of the Dnieper River, Taurida, Russia; now of Berkeley, California.

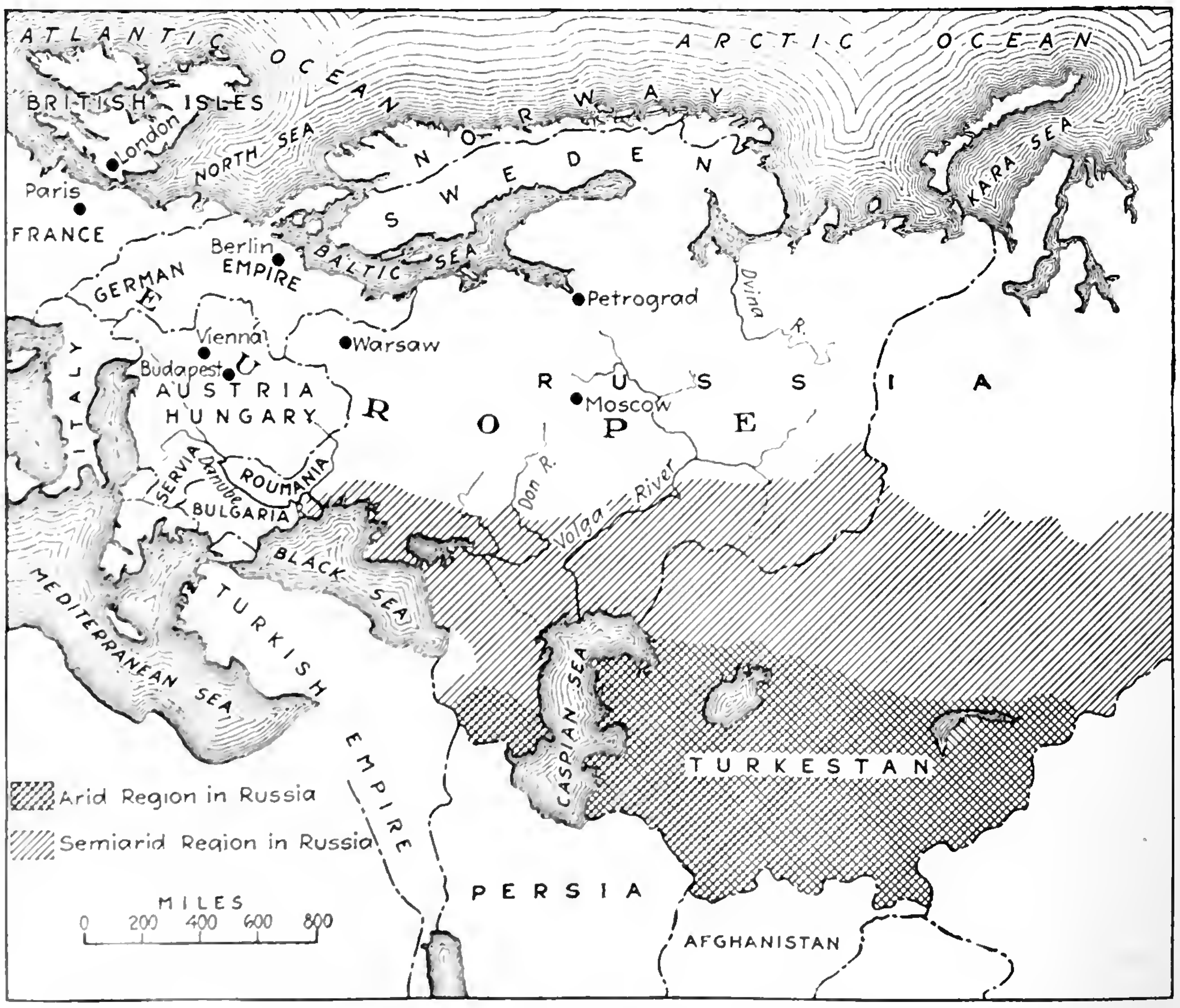
COMPARATIVELY little has been written in English about irrigation in Russia. A few articles in some magazines and a few pages in Dr. Samuel Fortier's work, "Use of Water in Irrigation," give some data. In this article I intend to fill up the gap as much as possible.

Irrigation in Russia is confined mostly to the southern part. Climatically this region may be divided into two parts, the arid and the semi-arid, as shown by the accompanying map.

The arid region, with a semi-tropical climate, comprises Russian Turkestan, including Transcaspia, Bokhara, Khiva and Transcaucasus, where about 10,000,000 acres are irrigated. Since there is very little precipitation during the growing period, agriculture in this region depends entirely on irrigation. The quantity of precipitation is variable, reaching in some places, as in Transcaspia, about 2.5 in. a year, while the evaporation is about 40 times greater. In Tashkent, the capital of Turkestan, the yearly amount of precipitation is comparatively large, averaging 356 mm., reaching 231 mm. in the driest year and 502 mm. in the year of greatest humidity. But during the growing period (from April to October, inclusive) the mean amount of rainfall is 138 mm. Of this amount 86 mm. falls during summer (June, July) and 34 mm. during autumn (August, September and October). Tashkent is situated in latitude 41° 20′, and 1570 ft. above sea level. Its average temperature for the year is 13.4° C. and the average minimum in January —6.2° C. The hottest month is July, with the mean temperature 27.40° C. The length of the irrigation season averages about 200 days, from Mar. 15 or Apr. 1 to October. In the foothills of the mountainous regions of Turkestan agriculture without irrigation is possible but only on a small scale except in the Semiryechenskaja province, where the cereal yield is large. In the arid region, irrigation farming has been practiced for innumerable years in a very primitive way. Ferghana province in Turkestan represents the biggest center, with the largest canals delivering water from the river Syr Daria.

Side by side with the old local systems of irrigation there were started and completed by the old Russian Government some new irrigation projects. Among these may be mentioned the project of the Murgabovo estate, which was built at the expense of the family of the czar for the irrigation of about 100,000 acres. The water was supplied from the Murghab River, on which were constructed a number of reservoirs with earth dams.

Recently there has been finished an irrigation project of 150,000 acres in the so-called Golodnaya (Hunger) steppe in the Syr Daria province in Turkestan, and three projects in Muganskaya, Milskaya and Karabah-



IRRIGATION IN RUSSIA IS PRACTICED MOSTLY IN THE SOUTHERN PARTS

skaya steppes in Transcaucasus. The whole Hunger steppe occupies an area of about 1,250,000 acres; Milskaya, 400,000 and Karabahskaya, 235,000 acres.

During the war there was started an irrigation project in the Semiryechenskaya province as one of the measures for obtaining lands on behalf of the returning soldiers, the heroes of war.

Pumping plants are operated here and there in the valley of Syr Daria, Murghab, Tendgen and other rivers, but more than 99% of the irrigation is from gravity canals. The water for irrigation in the arid region comes from streams which have their sources in the mountains. Because of the melting glaciers and snows, the flood season of most of the rivers occurs in summer, which is very beneficial for irrigation. In most cases the summer supply of small rivers is so small that the natives are able to handle them. But the winter discharge and part of the flood discharge even of the small rivers is left unutilized, and in many cases some reservoirs could be easily built and exploited.

The largest water sources of Turkestan, the rivers Amu Daria and Syr Daria, even without construction of reservoirs, have so much unused water that they would be sufficient to irrigate an additional few millions of acres of very fertile soil.

Bureaucratic Methods Hampered Development

Although surveys were made and data collected during the past decade which should considerably facilitate future irrigation projects, still more data are needed. Bureaucratic methods of conducting work in the public domain have greatly hampered Government and especially private enterprises. Some will remember the trip of A. P. Davis, director and chief engineer of the United States Reclamation Service, to Turkestan to investigate the practicability of constructing a large canal from the river Amu Daria to irrigate the Merv oasis. This enterprise was doomed as untimely. In other districts, as for instance in the Hunger steppe, Ferghana, etc., where the profitableness and usefulness of the erection of new systems could not be doubted at all, the old Russian Government put many obstacles in the way of private enterprises.

With difficulty there was started by private capital during the war the construction of a large project for more than 100,000 acres in the Shirabad valley, Bokhara, utilizing the water of Surkhan River near its junction with the Amu Daria, at the frontier of Afghanistan, near Termes.

Generally speaking, there is still a very small area newly irrigated in Russia, either by the Government or private capital.

Agriculture in the largest part of the arid region of Russia is almost entirely for the production of cotton. These are the only districts in Russia where cotton is cultivated. In the last few years before the war the Russian market supplied only about one-half of the cotton used by the manufacturers in Russia, the other half being imported. In 1912 the Russian mills used about 25,000,000 poods (one pood = 37.12 lb.) of raw cotton, of which was imported through European frontiers about 35% and through Asiatic frontiers about 8%. Cotton imported into Russia through European frontiers in 1912 was 8,986,145 poods, or about 665,000 bales, nearly all American. In 1912 more than 500,000 bales of United States cotton was taken by Russia through the hands of Germany, compared with 112,000 bales imported directly from the United States.

The cultivation of cotton occupies a comparatively large area in the arid region of Russia. In several places of Ferghana province, Turkestan, about 90% of the cultivated area is under cotton. On the average, in the whole Ferghana there was under cotton about one-third of all the irrigated land. The Russian agricultural experiment stations regard as most favorable the rotation with one-third of the land under cotton and one third under alfalfa.

Normally, Russia ranks third among European countries in number of cotton spindles. Most of the mills are in the central or Moscow spinning district.

Irrigated Agriculture Profitable

Agriculture in the arid region is very profitable. In Turkestan, for instance, the rent for the irrigated area is mostly paid from part of the crop. Land rented for cotton cultivation generally brings in Ferghana and Transcaspia half of the crop. The mean yield of raw cotton is about 60 poods per dessiatine, or nearly 800 lb. per acre, reaching as high as 1600 to 2000 lb. The cost of construction of an irrigation project was before the war from 75 to 200 rubles per dessiatine or about $15 to $40 per acre.

Figuring the rent as the sum of half or even a third of the crops at the prices as they stood about before the war, the cost of construction of the irrigation systems could have been paid off in only a few years. The big profit of cotton cultivation brought to the cotton growing region hundreds of enterprising men, ready to irrigate the desert land.

The new cultivation of large projects, say about 100,000 acres, would present an altogether different problem. The main problem in the creation of new irrigation systems lies not in the engineering difficulties, but in the selection of settlers and in the successful settling of the land in the shortest possible time.

The conditions of Russia in this respect before the revolution were as follows: There existed in Russia a constant migration of landless peasants. Although Turkestan and Transcaucasus were temporarily closed to settlers, the wave of migration reached even these regions and formed there some so-called "self-willed" villages. Moreover, there is in the oases of the arid region a native population so dense and land hungry, many of them being tenant farmers, that they form quite a shifting element, always ready for settlement of new irrigation projects.

Should the primitive methods of cultivation with native implements be supplanted by modern agricultural machinery, it would also help the exploitation of the new irrigation projects.

As a result of the Russian revolution the land resources of the Russian peasants will probably be improved, so that the emigration to Turkestan should be lessened, but this may influence only the size of the area to be newly irrigated.

In view of the fact that the demand for cotton is great and that the possible supply of unutilized water and land is abundant, irrigation in Turkestan and other

places of the arid region should be one of the first big problems of New Russia.

The importance of irrigation in the semi-arid region presents a problem of an altogether different character. This region comprises the southern and southeastern part of European Russia, the steppe provinces and western Siberia. The unpropitious conditions for farming in this vast region are mostly due to lack of precipitation as well as to its great fluctuation. The unfavorable periodic distribution of rain was disastrous to farming in some provinces, and the old Russian Governmnet often had to undertake public works and other measures of relieving the population stricken by crop failures. The suffering is especially acute in a whole row of provinces on the middle and lower part of the River Volga.

During the present war large sums of money were appropriated for irrigation and similar works in the above mentioned provinces; investigations were undertaken with the same purpose in southern Russia, north Caucasus and in some places in Siberia.

Among the unfavorable conditions for the development of irrigation projects in this region is the difficulty of getting water on to the land. Most of the rivers have eroded themselves deeply into the ground, and utilization of their water would require lifting to a great height. The underground waters are deep seated. The little streams of the steppe, being fed by precipitation, mostly bring their water in the spring during the thawing of snow. Reservoir construction would insure water for only a small per cent of the area. Only in the delta and in the overflowed land of some big southern rivers—Dnieper, Don, Kuban, Terek, Dniester, part of the Volga—would comparatively large irrigation projects be practicable, and these would involve the construction of levees.

Generally speaking, the irrigated area in the semi-arid region will appear as rare spots in the vast steppes, where agriculture is conducted under the method of dry farming. There are at present about ten such irrigated plots. In the semi-arid region of Russia, and especially in some parts of the steppe provinces and western Siberia, the supply of water for domestic purposes is of the first importance. There is a great similarity between the semi-arid region of Russia and that of the United States and Canada. The steppe region in Russia equals the prairie region of North America.

Fruit Culture in Russia

Crimea, Bessarabia, Caucasus and Turkestan yield the biggest supply of fruit. Apricots, peaches, quinces, pomegranates, figs and almonds grow in the open air in these provinces. In some places of Transcaucasus even oranges and lemons grow.

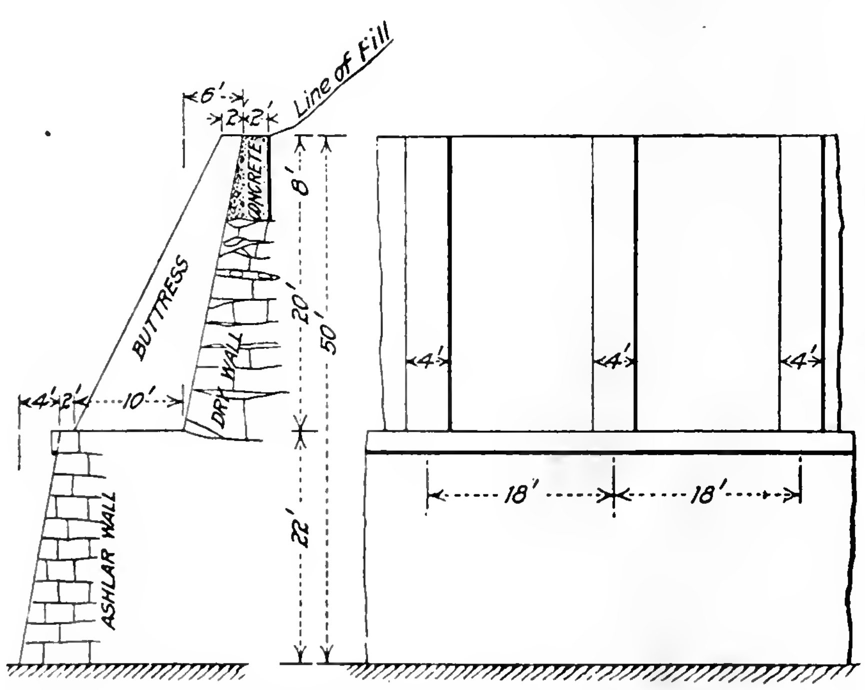
The Crimea is the chief growing center. Crimea bears the same relation to the rest of Russia as Southern California has for the United States. In the article of D. Kotcherin, "Russian Engineers Make Intensive Hydrometric Survey in Crimean Upland," in *Engineering News-Record* of Apr. 4, 1918, p. 657, are given some data on irrigation in the Crimea. The streams, with few exceptions, run dry two or three days after a rainstorm. The fluctuation of the discharges is very large. The slope of the streams is so great that the valuable agricultural lands are often destroyed by storm water. The sources of irrigation are small and the water values very high. What is necessary for Crimea is a proper storage of water, an increase of the use of underground water and the economical methods of irrigation followed in southern California.

Holding a Bulging Retaining Wall With Buttresses

High Fill of Slippery Material Forces Out Dry Wall—Grouting and Buttresses Solve Difficulty Satisfactorily

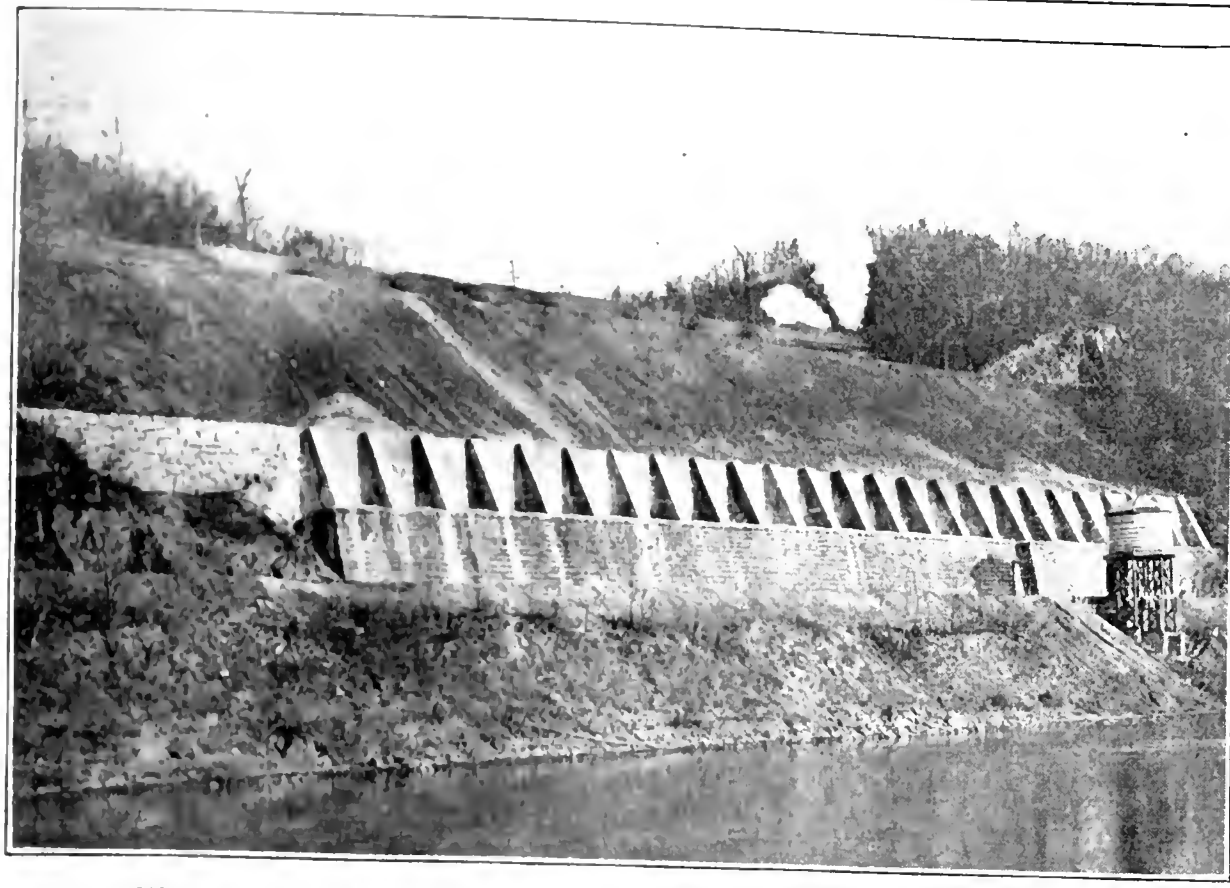
IN BUILDING the low-grade freight line of the Pennsylvania R.R. some years ago from Columbia, Penn., to Trenton, N. J., a high fill was made across a narrow ravine on the bank of the Susquehanna River near Safe Harbor, Penn. This fill was made largely of cinders, and is about 550 ft. long and 130 ft. high. At the foot of the fill runs the single-track line of the Maryland Division, about 40 ft. above the Susquehanna River.

In order that the fill might not encroach on the track at the lower level, a masonry retaining wall was built, 24 ft. high, with a face batter of 4 ft. This wall proved strong enough to stand the outward pressure but not high enough to retain the slippery cinders. Some years later, therefore, a dry masonry wall was built on top of the lower retaining wall. This dry wall was started 12 ft. back of the top of the lower wall and was carried up to a height of 22 ft. Still later a wooden cribwork 8 ft. high was placed on top of the dry wall.



CROSS-SECTION AND FRONT ELEVATION OF RETAINING WALLS AND BUTTRESSES

In November, 1917, it was found that the dry wall was bulging from the pressure of the fill behind it, and it was deemed necessary to undertake repairs to make the roadbed safe. Several plans were considered, among others the construction of a concrete wall 12 ft. high placed on top of the lower masonry wall, to hold the dry masonry from further movement. Another proposal was to place a form in front of the dry wall and one foot away from it, and fill the space between with



VIEW TAKEN AFTER DRY WALL WAS GROUTED AND BUTTRESSES WERE BUILT

concrete, which would of course work back more or less into the interstices of the dry wall.

A plan was finally suggested and carried out under contract by Harold P. Brown, of New York City, involving the strengthening of the bulging dry wall with a series of buttresses, each 4 ft. wide and 40 ft. high, placed 18 ft. apart. Between these buttresses Mr. Brown proposed to fill the dry wall with concrete, and then face the surface with his concrete atomizer. The buttresses were to be connected at the top by a concrete wall 8 ft. high built on top of the dry wall.

It was necessary to carry on this work, however, without interrupting the traffic on the single-track line of the Maryland division which ran close to the foot of the lower retaining wall. The materials for the work were brought on this line. A side track was constructed outside the main line and parallel with the top of the retaining wall. A line of rail was laid along the top of the retaining wall and a traveling crane was constructed with its lower leg supported by a flat-car on the siding and its upper arm reaching across and traveling on the rail laid on top of the retaining wall 24 ft. above. On one end of the flat-car a tower was built, and a timber truss bridge reached from the top of the tower to the retaining wall.

The wheels which carried the end of the bridge resting on the wall had long axles, loose in their bearings, so that accurate lining up of the side track with the rail on top of the wall was not necessary.

On the end of the bridge nearest the wall was set a light jib crane and also an inclined frame through whose uprights timbers could be shoved forward horizontally as far as the face of the dry wall to support scaffolding at any height.

On the end of the flat-car opposite the tower was placed a 45-hp. boiler, and between the two was a double-drum hoist. A Brown concrete mixer and steam atomizer for delivering concrete through hose was located at the bottom of the tower. On the level above was placed a measuring box discharging the concrete materials into the mixer below, and above the mixing box were bins with under-cut gates for sand and gravel. These materials were brought in by rail and were unloaded and placed in the bins by a small jib crane at the corner of the tower. Work was begun at the sixth panel, where the dry wall showed the greatest bulging and apparent danger of sliding. In filling the first panel a very large quantity of concrete was used, and the material appeared at openings in the dry masonry wall on a frontage of 90 ft. and also showed up nearly 90 ft. back of the front line of the wall in a culvert which extends underneath the fill. The jib crane on the traveling bridge proved very convenient in setting and placing the forms for the buttresses, as well as in raising the grout and the concrete.

To provide an added factor of safety against any movement of the completed structure under the pressure of the fill behind it, steel tension members cut from old car truss-rods rescued from the scrap pile were embedded in the heel of the buttresses, the lower end being carried down to a secure anchorage. The entire work of buttressing the wall was carried on to completion without interfering in any way with train movements.

Mr. Brown and his associates designed and supervised the work, the railway company furnishing the

BULGING DRY MASONRY WALL UNDER A HIGH FILL

TRAVELING TOWER-CRANE SPANNING MAIN-LINE RAILWAY

labor and materials; the whole was under the direction of Elmer Irving, division engineer of the Pennsylvania R.R. at Harrisburg, Penn.

Chicago Plan Commission Proposes Great Improvement Scheme

A COMPREHENSIVE program for the development of the City of Chicago, as a means of meeting the problems of the reconstruction period, has been submitted to the mayor and the city council by the Chicago Plan Commission. The individual projects are not new and some are already under way, but the program lists them all as component parts of one great scheme of improvement. The projects in the downtown portion of the city are shown on the accompanying map. The projects which are under construction and should be pushed vigorously, according to this program, are as follows: Widening Twelfth St. to form a new thoroughfare between the west side and the lake front; widening and extending Michigan Ave. to form a direct connection between the North Side and South Side boulevards, including a double-deck bridge over the river; revision of the West Side terminals, with construction of the new union station and the widening and double-decking of Canal St. from Twelfth St. north to the river, which is to be crossed by a double-deck bridge at Kinzie Street.

Completion of the outer circle boulevard from the lake, on the North Side, along the Des Plaines River and through the forest preserves. Only two miles of this remain to be formed by the opening of Rogers Avenue.

The projects already formulated, but not yet commenced or officially adopted, include the following:

Revision of the Illinois Central R.R. terminals, with a new passenger station, electric operation, track elevation and harbor and park development along the shore. All this is covered in an ordinance submitted recently by the Railway Terminal Commission.

Straightening the south branch of the Chicago River to improve the street layout and give opportunities for property development.

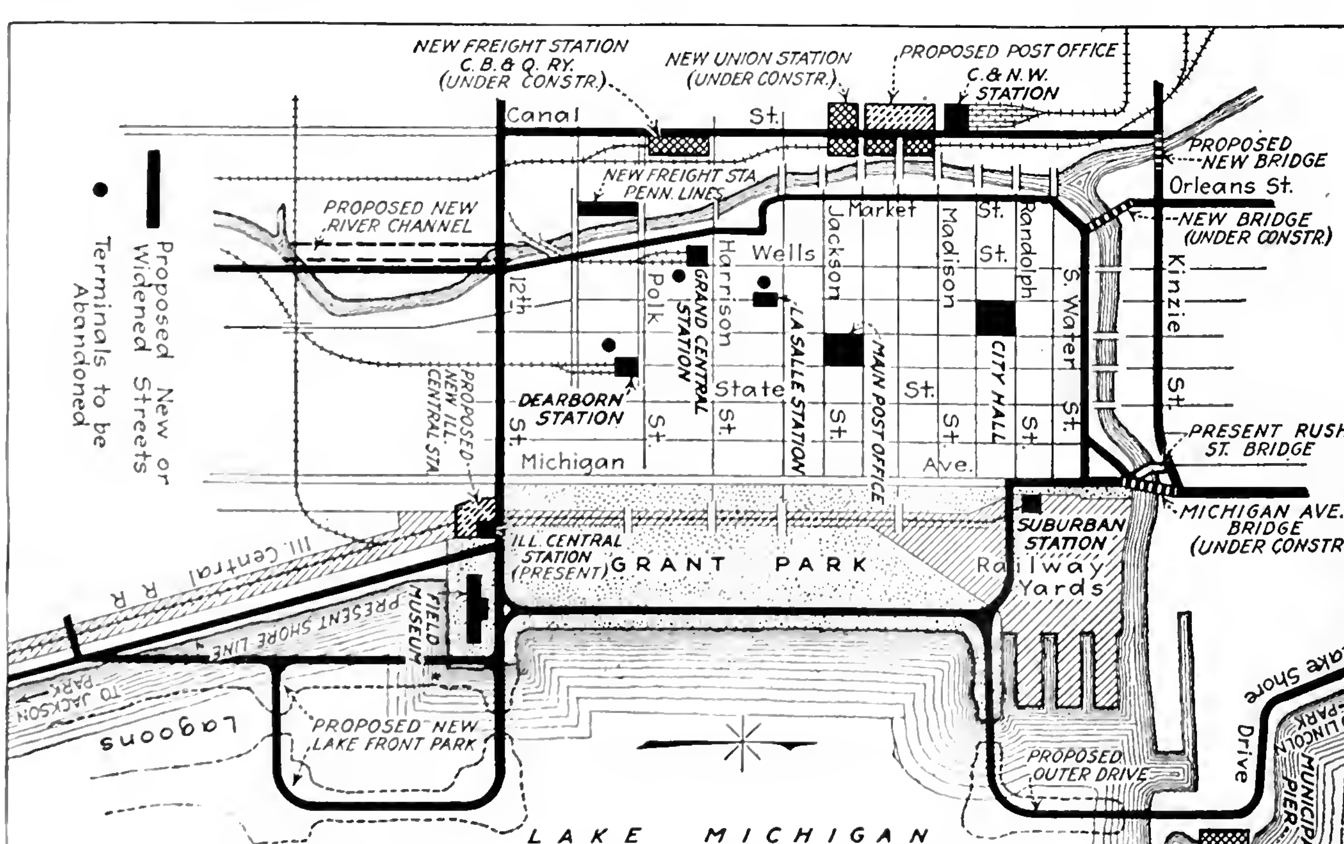
The removal of three South Side passenger terminals to the new Illinois Central terminal on the lake front and the revision of freight terminals, thus opening a number of important streets now closed by railway yards and tracks, and releasing valuable property now occupied by freight yards.

Extending Ogden Ave. to form a new diagonal thoroughfare between the northeast and southwest districts, thus diverting considerable traffic from the congested loop district and opening up a new industrial district.

Widening Western Ave. and widening and extending Ashland Ave. and Robey St. to form two continuous thoroughfares. These are three north and south streets on the West Side of the city.

Improving So. Water St., which is now practically a produce and poultry market, and reclaiming it for public use. This includes a double-deck construction.

Building an outer drive along the lake front to connect the north and south parks, and thus afford an independent route for the use of pleasure traffic, also boulevards along the right-of-way of the Drainage Canal.



SOME DOWNTOWN IMPROVEMENTS ADVOCATED BY CHICAGO PLAN COMMISSION

The construction of a new West Side postoffice, adjacent to the West Side railway terminals, where 62% of the city's mail is handled.

Other matters advocated are the completion of the city's bridge program; the settlement of the rapid-transit controversy; the development of the forest reserves, and the construction of highways connecting Chicago with the good-roads system of the state. The Chicago Plan Commission also indorses a new city charter, the study of the zoning and housing problems, and passage of an excess condemnation act to eliminate objections to the present method of making public improvements.

Appropriations are recommended for preliminary work on the Ogden Ave., Western Ave., Ashland Ave., Robey St. and So. Water St. improvements noted above.

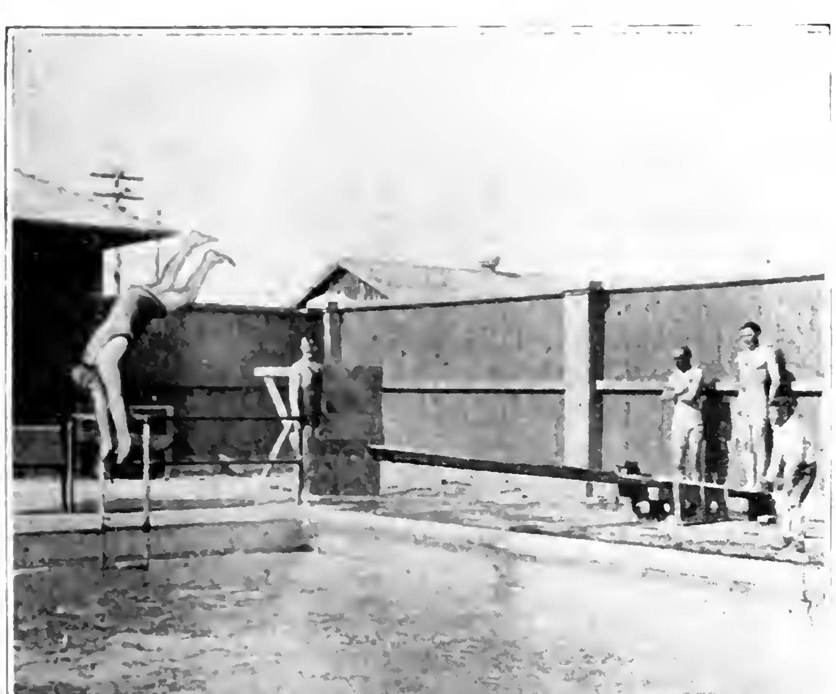
Reinforced-Concrete Swimming Tank Was Carefully Designed

Fort Bliss Pool Has Combined Wave Break and Scum Gutter—Adjustable Springboard Holder—Form Details

By R. McC. Beanfield
Captain of Engineers, United States Army, Camp A. A. Humphreys, Virginia

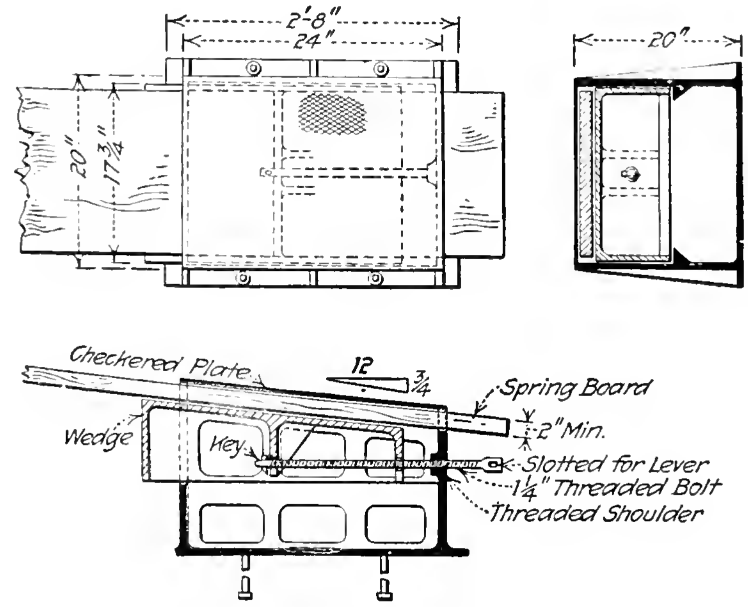
IN THE design and construction of the reinforced-concrete swimming tank at Fort Bliss, Texas, many interesting details were worked out which may contain suggestions for engineers contemplating the design of a swimming pool.

For a tank large enough to meet the requirements of this post, considerable study had to be given to the economics of the problem, as the money available, do-



DIVING FROM ADJUSTABLE SPRING BOARD

nated by the War Camp Service Board of El Paso, was limited to $2500. The tank was built with skilled labor—such as carpenters, men handling the concrete mixer and cement finishers—furnished mostly by the battalion of the 8th Engineers (Mounted). This enabled the engineer troops to obtain practical instruction in work closely related to their future duties—the building of concrete dugouts, gun emplacements, and the like. For common labor prisoners from the Fort Bliss prison stockade were used. A ½-yd. concrete mixer and four concrete buggies were lent by an El Paso contractor. Sand was obtained close to the site of the tank, and was screened and loaded by prisoners into Army wagons. Trap rock for concrete was hauled to the job by Government auto trucks. The $2500 donation, therefore,



SPECIAL CASTING FOR ADJUSTABLE SPRING BOARD

was utilized only for the purchasing of materials required in the construction of the tank. These materials were supplied at cost by El Paso merchants.

From previous experience in the design of swimming tanks, the writer based the present one on the following fundamental requirements: (1) Locate below the natural ground the level part of the tank and use the excavated material later as fill around the walls of the tank above the natural ground level—this economizes in excavation and grading; (2) cast each side of the tank as a monolithic unit up to the water line designed as a cantilever wall—this results in a minimum of construction joints and the most economic wall section; (3) cast the bottom, or floor, of the tank as a monolithic unit, independent of the walls and wall footings—this tends to eliminate cracks due to unequal settlement and shrinkage; (4) locate expansion joints of the diaphragm type in each corner of the tank, to facilitate the construction by reducing the joints to a minimum; (5) install a combination scum gutter, overflow and wave break, of concrete cast with the wall; (6) construct the tank of proper shape and size to hold swimming contests regulated according to the National Amateur Athletic Association rules.

The tank is 40 x 100 ft. in plan, with a maximum water depth of about 9 ft., a water depth of about 7 ft. at the diving end and of some 4 ft. at the other end. For future work the writer suggests a 6-ft. water depth at the diving end, with a maximum depth of 8 to 9 ft., some 16 to 25 ft. from that end wall.

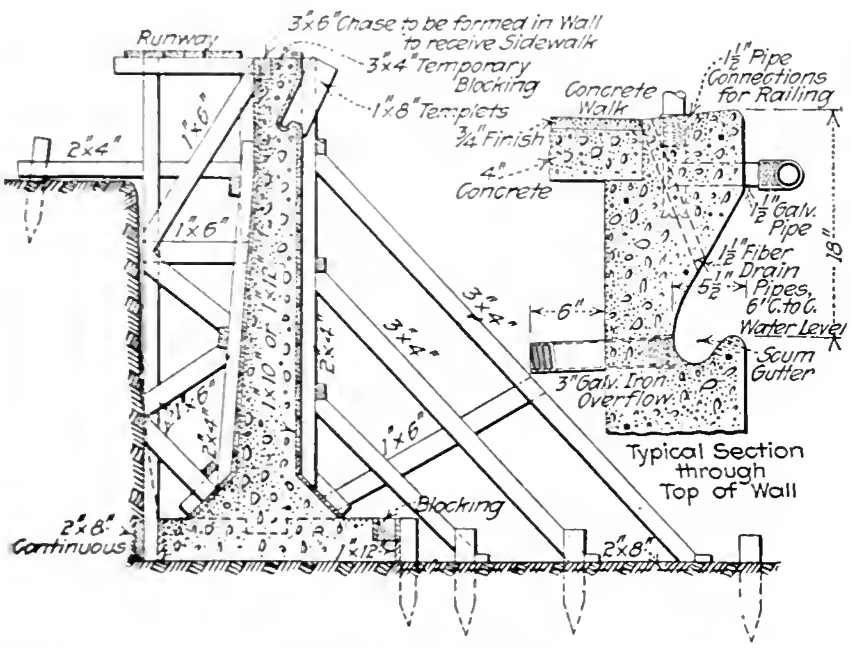
The site on which the tank was located had a surface stratum of 4 to 5 ft. of caliche, under which a deep layer of sand was found. The excavation was started by a rooter plow, which broke the caliche sufficiently to permit its excavation with fresnos and slip scrapers.

The accompanying sketch of the wall form shows a very efficient method of exterior bracing.

The concrete was proportioned for maximum density on the basis of a 1 to 6 mix. No integral waterproofing was used. The consistency of the concrete was

gaged by the visual test; that is, by keeping the stone always in suspension in the mixture. Some of the concrete was mixed by hand for practical instruction. Each side of the tank was poured continuously until completed. The walls could have been poured up to the water line in one operation, which would have facilitated the work, as the scum gutter forms were somewhat difficult to strip in order to avoid breaking of the nosing of the scum gutter. Before the 6-in. floor of the tank was poured, the sand subgrade was well compacted with water and tamped. The 6-in. base was poured continuously until completed. Negative moment was provided for by bending the slab reinforcement up at all supports.

The scum gutter was designed to serve both as a wave break and as an overflow and drain to collect floating



WALL FORM BRACING AND DETAIL OF SCUM GUTTER

débris and scum. The water draining into the scum gutter flows through 3-in. drain pipes to a drop manhole in which is set an 8-in. gate valve, with an extension key, which controls the discharge line. An open invert in the concrete base of the manhole connects the gate valve to an 8-in. terra-cotta pipe line 250 ft. long, which is connected with one of the manholes of the Fort Bliss sewer system. The invert eliminates a rather difficult joint between the screw flange of the gate valve and the terra-cotta drain pipe. By reason of the open invert, a leak in the gate valve can be easily seen. The drains lead from the scum gutter and discharge directly into the manhole, eliminating connections to the discharge pipe.

Often the rungs of ladders for use in swimming tanks are made of small diameter bar iron or other material which tends to hurt the feet. The ladders for the Fort Bliss tank were entirely constructed of 1½-in. galvanized-iron pipe. The fittings for the ladder and part of the fittings for the hand rails were reamed to permit the pipe to pass through them. The fittings were afterward bored for setting countersunk rivets, which were filed smooth with the pipe surface.

Expansion joints were located at the four corners of the tank. The joint was made with two 24-gage galvanized iron diaphragms, notched for bond, with hot California asphalt poured between the diaphragms. The joints were carried up only to the top of the scum gutter. A plain asphalt paper construction joint was used from the scum gutter to the top of the tank. A board covered with asphalt paper was used to form the joint while the concrete was being poured. After the concrete had set a little the joint board was carefully pulled from the joint.

A two-ply, 14-lb. felt, mopped in hot asphalt, was laid on top of the 6-in. concrete floor to serve as a waterproofing membrane. A 3-in. 1 : 6 mix concrete slab, divided into 10-ft. squares by asphalt joints, was placed over the membrane coat to protect it.

A 5-in. 1 : 7½ mix concrete floor subdivided by two marginal brick joints was placed around the entire tank. The brick joints were placed as planes of weakness, separating the greater part of the slab on the fill from those parts bearing on the walls of the tank and on the curb beam between the columns, thus avoiding unsightly cracks should the fill settle. The brick were especially chosen for their varying colors. Between the ¾-in. deep V-grooved joints the slab received a troweled finish followed by a toothed roller which neatly roughs the smooth finish, preventing slipping.

A special casting designed by the writer was used as a spring-board holder. This holder contains a cast wedge, adjusted by means of a screw bolt turning in a threaded shoulder cast with the exterior frame, that clamps the spring board at any desired length, thus varying the elasticity of the board as well as increasing its life.

The swimming tank, in addition to its use for bathing, is available as the source of an auxiliary water-supply for fire fighting, an important feature in isolated Army posts. The water in the tank is sterilized with hyperchlorite.

The work was done under the direction of Col. V. L. Peterson, commanding the 8th Engineers (Mounted). The writer designed the tank and supervised its construction.

Direct Microscopic Count of Sewage Bacteria

In studying, by the usual method, the agglutination of bacteria and attempts to separate masses of these organisms before plating, Milton F. Stein, Chicago, investigated the direct microscopic counting method, using a blood-counting cell. His results were described in the course of a recent paper read before the sanitary engineering section of the American Public Health Association. In one instance, where the average of 10 tests by the usual method gave 3,950,000 per cubic centimeter, the direct count gave 70,720,000 as the average of 10 counts made by two observers. Mr. Stein attempted, by shaking for various periods, to separate bacteria clinging in bunches to particles of foreign matter. For the 10-min. period the increase was 67% over the usual method. He concludes that the number developed by plating is not over 10% of the total number present. A review of the governing conditions indicates that no constant proportion can exist, that under unusual conditions the standard method gives distorted results, and that for special work modifications to reduce these distortions seem advisable. The full paper, which is a mathematical discussion of chances of error in water and sewage bacterial counts, was published in the November *American Journal of Public Health.*

Medical Inspection at Miami Camps Checks Influenza

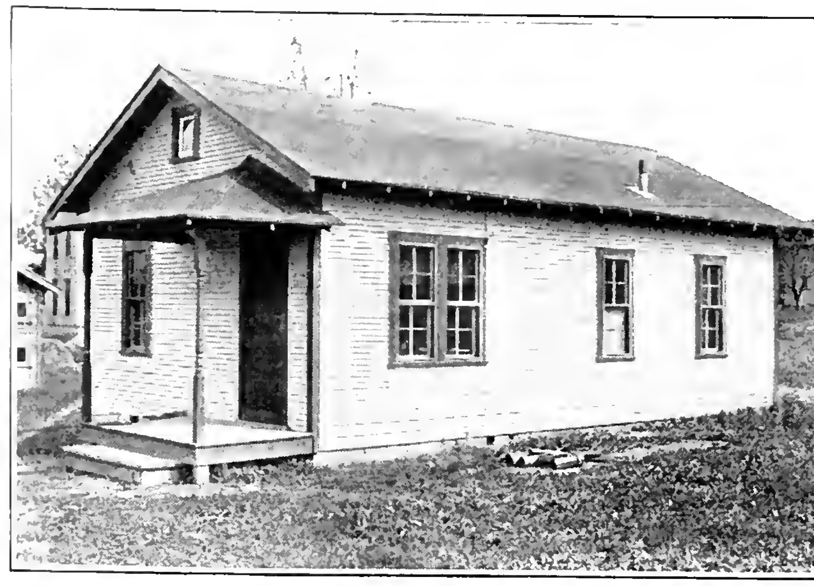
First-Aid Hospitals, Local Doctors and Chief District Physician Held Back Epidemic at Five Conservancy Dams

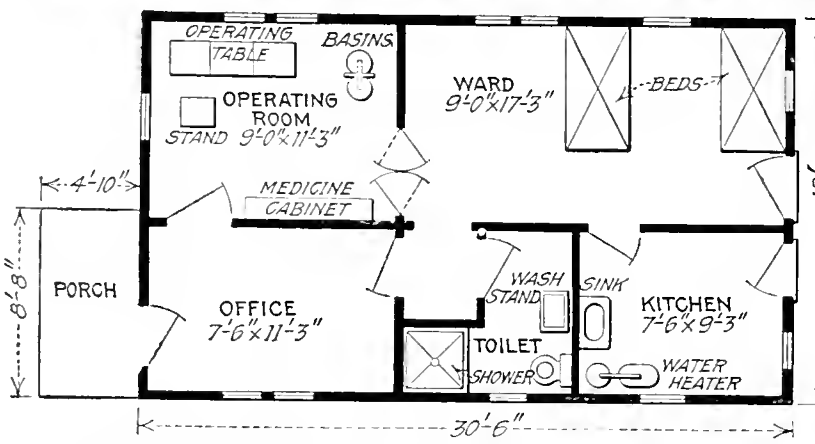
MEDICAL inspection reduced to barely a score of mild cases sickness from influenza at the five dam-construction camps, housing some 400 persons each, of the Miami Valley flood-protection works. The methods, somewhat intensified for the period of the epidemic, were those regularly provided for protecting health and caring for injuries on this work. They comprise attendance of a physician and provision of a small first-aid hospital at each camp and, if the cases are serious, removal to city hospitals.

Local physicians at the camps and a chief physician at headquarters compose the medical staff. The chief physician gives all his time; the local physicians, one for each camp, serve only on call, except at the Huffman Dam, where a doctor gives all his time to the camp work. The procedure is about as follows: The camp overseer or superintendent is held responsible for first aid and for calling the local physicians and notifying the chief physician. If the case is serious and the worker has no home of his own, or if he requires better care than is practicable at home, he is sent to the city hospital. The Conservancy District assumes no financial responsibility for cases of sickness, except that the chief physician on his regular inspection trips visits the sick person without charge. For special visits payment is asked.

At each camp a hospital building is provided and equipped for first-aid work and as an office for the physician when he is at camp. All the essential features of these field hospitals are indicated by the illustrations. So far during the work no serious accidents have occurred and sickness has been rare. The medical staff and the sanitary inspectors proceed always on the theory that prevention is better than cure.

Direction of camp hygiene is in the hands of Dr. W.





FIVE CAMP HOSPITALS GIVE FIRST AID TO EMPLOYEES

M. Smalley for the Miami Conservancy District. Arthur E. Morgan as chief engineer, Charles H. Paul as assistant chief engineer, and C. H. Locher as construction manager for the district supervise all activities.

At the outbreak of the influenza epidemic, the district camp inspector and the chief physician immediately took steps to safeguard the camps. It was arranged that the resident physician at the Huffman Dam should visit the cottages there and at the Taylorsville Dam; that the chief physician should visit the camps at Englewood and Germantown, and that a local physician should similarly care for the camp at Lockington. These visits were much more than perfunctory. The physicians interviewed the workmen and their families, gave instructions regarding the nature of the disease, the symptoms denoting it and the steps to be taken, emphasizing the necessity of prompt action and of calling a doctor at once. In addition, the district printed a circular which was distributed through all the camps and which was in effect a repetition of the instructions given orally by the physicians. Only a few scattered cases of influenza developed. At Englewood there were seven or eight cases, at Huffman three or four, at Germantown five or six, and at Taylorsville only one or two. Only two cases of the disease, however, could be classed as severe.

OPERATING ROOM IS EQUIPPED WITH ALL APPARATUS REQUIRED FOR FIRST-AID

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Growth Chart on Postcard Boosts Society Membership

In a new-member campaign being pushed by the Iowa Engineering Society, postcards the size of a blotter are distributed, showing a chart of the growth, since the organization started 30 years ago with 40 members, to the present membership of 220. At the side of the chart are these "selling" arguments: "Is it worth while to broaden your acquaintance, to contribute your share to the progress of the engineering profession, and to serve the highest interests of state and nation in whole-hearted coöperation with your professional brothers?"

A census of all engineers in Iowa is proposed, the state to be districted to correspond with a membership of a special committee which represents the various sections and organizations of the state. If possible, a permanent system is to be developed to keep the census up to date. Based upon this census, local clubs can be formed and affiliated with the state society.

Duluth Engineers Propose United Society for Nontechnical Work

A combined organization, formed by the coöperation of all of the recognized societies, to supplement, but not supplant, the latter, is a step proposed by the Duluth Engineers' Club, which has appointed a committee representing the four national societies of civil, mechanical, electrical and mining engineers and the chemical society. Technical work would be carried on by the separate societies as at present, the new organization dealing with such matters as the status of the engineer, his relation to the public, ethics, employment and publicity. According to a circular issued by the committee, the new combination must not destroy the identity of the present societies; it must take their good points, add what may be desirable and eliminate any undesirable features.

Iowa Society Will Promote License Bill and Encourage Affiliations

At a recent meeting of the executive committee of the Iowa Engineering Society, it was decided to present to the next legislature a bill for the licensing of engineers. It was considered desirable to carry out the plan previously developed for this end as the war is practically finished and the reconstruction period is at hand. It was decided also to proceed with the plans for forming Iowa sections of the national societies of civil, mechanical and electrical engineers, with a view to affiliating these with the Iowa Engineering Society. In fact, it is hoped to affiliate all the engineering societies of the state in one united state society, with the idea that if other states take similar action it will be possible eventually to form one national united engineering society, comprising nearly all the nation's engineers.

Local Society Admits National Society Members Without Fee

For some time the Engineers' Society of Western Pennsylvania has been omitting initiation fees of candidates who were already members of the four Founder societies. In addition, on Oct. 1, the Board of Direction approved recommendations of the membership committee that members of the American Chemical Society be admitted as associates on the same basis. Following this order, the question of organizing a chemical section was taken up. The proposition of adding still further to the accredited list of societies whose members would be exempt from initiation fees was discussed with the request that the Society for the Promotion of Engineering Education be considered by the membership committee.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

C. L. Christensen Replies to Dr. Steinman on Equivalent Uniform Loads

Sir—Permit me to make some few concluding remarks in answer to Dr. D. B. Steinman, in your issue of Dec. 26, 1918, p. 1193.

1. The uniform load method proposed by me is not intended for cases where Dr. Steinman's carefully worked out values can be used, but for cases in which they cannot be used. I stated this clearly in my preceding letter, but Dr. Steinman seems to lose sight of it.

2. The error made in using Dr. Steinman's curves for reversal is not small. In a design for a 640-ft. two-hinged arch it amounted to about 35% in the reversal live-load stress, and more than 10% in the resulting design stress for the diagonals adjacent to the center vertical. In a 252-ft. simple through truss span the inaccuracy in the reversal stresses for the diagonals near the center was about 25%, but in the resulting design stress it was only 5 per cent.

There is nothing far-fetched or unusual in computing the actually occurring reversal stress, since the A. R. E. A. specifications, as well as the New York Central R.R. specifications call for this. Dr. J. A. L. Waddell makes a clear distinction between reversal occurring during the passage of the train and reversal occurring later for a different live load, and calls for a higher percentage of reversal to be used in the former case.

It may have occurred to many bridge designers that the requirements in case of reversal are rather severe for long-span bridges, since it may take more than 5 sec. to make the reversal. There is then so much more reason for being exact and not extravagant in adhering to the specifications; otherwise the result will be a freakish detail design for the panel point and a waste of material and rivets.

3. Dr. Steinman states that by applying the uniform load method proposed by me the amount of error found was from 2% to 5%. I believe that an error of 5%

can only be found in case the loading is used to find the end reaction for a 200- to 250-ft. span. In case of finding the end reaction, the pilot wheel is not on the bridge for the E 65 loading; this upsets the proportion between the exact loading and the substitute loading; the latter was of course not intended for use in finding end reactions for Cooper's loading—neither were Dr. Steinman's curves, as the end reactions are given in a separate table. Neither is it my intention to propose the 8500 lb. per 100 ft. followed by 6500 lb. as a substitute for all cases.

In a 640-ft. two-hinged arch, the writer has used 9000 lb. for 110 ft., followed by 7000 lb. as a substitute for E 70, which would correspond to 8350 lb. for 110 ft. for E 65.

The method saves a considerable amount of time in reading curved influence lines.

4. I wish to mention the computations for the actually occurring engine loadings on railroad bridges 10 to 20 years old, of which, on most railroads, there are some of long span and many of shorter span. The following practical questions have frequently to be answered by the bridge departments, with short time available to answer them: Can these bridges carry some new heavy engines in permanent service or in transfer to some other railroad? Can they carry them as single engines or as double-headers? Can they carry them followed by 4000, 5000 or 6000 lb. per lineal foot? Can they carry them with or without speed restrictions? In such cases a uniform load substitute for the engine and another for the tender will be found useful and time-saving, especially if influence lines have been drawn up for the bridges in question.

C. L. CHRISTENSEN,
Assistant Bridge Engineer, Niagara River Bridge,
Michigan Central Railroad Company.
Detroit, Mich.

More Light on Fair-Compensation Contracts

Sir—Your editorial in the issue of Dec. 26, 1918, p. 1156, relative to fair-compensation contracts, is very much to the point, and suggests the need for vigorous action to secure an equitable form of contract for public works practice. May I suggest that such action might well take the form of an editorial or article showing how the cost-plus contract should be drawn to guarantee the public interest, and that the rule of equity requires that equity must be done if it is to be invoked?

You state that this form of contract has demonstrated itself to the public. Then why, unless the demonstration has been unfavorable, has Congress legislated it out of existence? Why does one constantly hear that boys of 16 and 18 are hired as carpenters at fancy wages, that they are sometimes put to digging ditches, that they are encouraged to take Saturdays off and work Sundays at double pay, that everyone who ever asked for a raise got it, that men check in in the morning and then spend the day working somewhere else, and many similar tales, all to the benefit of the contractor's per cent.? There is a wide-spread belief that the cost-plus contract has enabled many contractors to get rich by deliberately increasing the cost of the job, and sometimes this belief rests upon facts personally known to those holding it.

Many of these things are petty, most of them can be explained by the emergency of war and are not the deliberate act of the contractor, but if this form of contract is to be restored to public favor their recurrence must be prevented by the terms of the contract itself, and the public convinced that such terms are in such contracts. Any other action by associated contractors will be regarded by the public as actuated by selfish, if not dishonest, motives and will fail to restore such contracts to public favor.

H. E. PHELPS,
Assistant Sanitary Engineer,
United States Public Health Service.
Petersburg, Va.

Repair Heaved Brick Pavement at Oak Park, Illinois

Sir—During 1917, three-quarters of a mile of brick pavement was laid at Oak Park, Ill. The specifications were drawn for the monolithic type. After ¼ mile had been laid according to this method, permission was given to lay the remainder according to standard specifications for the cement-sand-bed type. One-half mile of the latter type was laid in 1918. Expansion joints ⅝ in. wide were provided at the curbs, and a prepared asphalt filler was used. In the cement-sand-bed type, a 1-in. bed of 1 : 4 cement and torpedo sand was used.

CONCRETE BASE CRUSHED AND BRICK LOOSENED FROM CEMENT-SAND BED BY HEAVE

During the winter of 1917-18, the monolithic pavement developed several longitudinal cracks, some of which were 150 to 200 ft. long. All of these cracks appeared on or near the center line of the pavement. Fine transverse cracks were noticeable in pavements of both types early last spring.

When the first warm weather came in the summer, the upheaval shown in the view occurred at the joint between a brick pavement of the cement-sand-bed type and an asphaltic concrete pavement on a 6-in. concrete base. The brick pavement which caused this "heave" was laid in the fall of 1917, average temperature about 40° F. The heave at this joint reached a maximum of about 5 in. above the normal surface of the pavement. Heavy

traffic was also destroying the grout filler between the bricks for a distance of about 2 ft. from the joint.

Investigation showed that the concrete beneath the asphaltic concrete pavement was pushed up and shattered by the expansion of the brick wearing surface. The grout-filled brick expanded independently of the base. It was found that the brick had pulled away from the base. and in some cases from the cement-sand bed.

No great difficulty was encountered in breaking through the concrete under the bituminous pavement, as the bond was completely destroyed. The concrete beneath the brick was found to be intact. The fact that the base under the bituminous pavement was destroyed, while that under the brick remained whole, may be explained by the fact that the subgrade beneath the asphaltic concrete pavement is 3 in. above that under the brick pavement. Because the brick pavement with its base was the stronger structure, the weaker one gave way.

The contractor who laid the brick pavement was instructed to make repairs as follows: (1) Remove the pavement and base on both sides of the joint, back as far as there was evidence of any disturbance; (2) instead of relaying the concrete base, lay a bituminous concrete base. similar to "closed binder"; (3) relay both brick and asphaltic wearing courses on this new foundation; (4) Fill spaces between bricks with some first-class bituminous paving filler.

After the experience of two seasons with brick pavements of the two types mentioned, we have decided to abandon both and specify an asphalt or pitch mastic bed and asphalt filler for all brick pavements on concrete base.

The writer cannot help but emphasize again the necessity of having a dry subgrade when paving foundations are laid, and the all-important need of providing real drainage beneath pavements. General paving practice does not consider the drainage question as it must be considered in order to have good pavements. It seems that any initial saving made by the present methods of construction is in reality false economy.

H. W. SKIDMORE,
Construction Engineer, Public Works Department.
Oak Park, Ill.

Further Tests on Time of Mixing Concrete

Sir—I was much interested in your editorial in the issue of Nov. 28, 1918, p. 966, under the heading "Minute Mix Justified by Extensive Tests." In that connection, I am handing you herewith the results of some experiments, which—although not extensive enough to be conclusive—point, I think, in the direction of the truth.

It was my privilege to be employed as engineer of tests on one of the large Government projects last summer, and I carried out, rather hastily, some experiments along this line, incidental to routine testing. The stimulus for my investigation was the "batch-a-minute" slogan of the manufacturers of which you speak, and a specification of one of our larger railroads which requires that "after all the ingredients are in the mixer the drum shall be given four complete revolutions before discharging."

There were in use on the job more than 50 mixers, representing all the well known makes. The aggregates in use were crushed limestone, river gravel, bank gravel, river sand, bank sand and limestone screenings. In connection with the routine testing, full notes were kept regarding the field conditions, the consistency of the concrete, the length of the period of mixing, the size and kind of mixer, and the proportions of the mixture. A wide variation was found in the compressive strength of the concrete, and when an attempt was made to group the results so that a study could be made of the effect of the time of mixing, no conclusions could be drawn because of the great diversity of elements in each group. It would be obviously unfair to compare, for instance, a sloppy concrete made with bank gravel and limestone screenings with a concrete of normal consistency, using crushed limestone and river sand as aggregate.

Accordingly, near the close of the work a series of experiments was undertaken, using the same aggregate in each of six different mixers, representing two distinct types. Particular care was exercised to secure the same consistency, as nearly as could be judged. There was no means available for measuring the amount of water. Four batches were made with each mixer, one each at four turns, eight turns, 12 turns and 16 turns of the mixer. From each batch six 6-in. cubes were made, three of which were tested in seven days and three in 14 days. The specimens were stored in wet sand in the interval between making and testing. The results are summarized in the accompanying table.

TABLE SHOWING EFFECT OF TIME OF MIXING ON STRENGTH OF CONCRETE

Mixer No.	Compressive Strength in Pounds at Seven Days, Average of Three 6-inch Cubes			
	4 Turns	8 Turns	12 Turns	16 Turns
1	1080	1520	1340	1140
2	1280	1480	1030	1270
3	1600	1100		1080
4	850	1050	1120	1220
5	830	1050	1090	1090
6	1060	1090	1140	1190
	Compressive Strength in Pounds at 14 Days, Average of Three 5-in. Cubes			
	4 turns	8 turns	12 turns	16 turns
1	960	1650	1440	1360
2	1370	1630	1190	1320
3	1490	1490		1290
4	1100	1610	1610	1660
5	990	1140	1220	1250

Mixer No.	Size in Cu.Ft. of Unmixed Material	Revolutions per Minute of Mixer Drum
1	21	13
2	21	13
3	14	13½
4	17	14½
5	21	10½
6	14	14

As an explanation of the above reference to types, it may be said that mixers may be classified, according to the construction in the drum, into two well defined types: Those with buckets which carry the concrete up near to the top and then drop it, and those without buckets. In all of them the arrangement of vanes and buckets varies somewhat, but the bucket is the principal distinguishing feature.

Mixers 2, 3 and 6 are of one type, and 1, 4 and 5 are of the other, although No. 1 is on the borderland between the two, having some of the features of both. Attention is called to the results of the tests on mixers 2 and 3. Both produced better concrete at four turns and eight turns than at 12 turns and 16 turns. The

cause of this cannot be ascertained from the data at hand, but it is significant that such excellent concrete was produced in such a brief period of mixing.

I am of the opinion that the ability to produce good concrete in a brief period of time depends a good deal on the construction of the mixer. It is unwise to claim much on the evidence of a few experiments. Nevertheless, it seems to me that this point deserves the careful consideration of engineers and manufacturers, and more careful and more nearly complete experimental data.

University of Kansas, Lawrence. J. O. JONES.

What Is A Right-Hand Door?

Sir—There seems to be a difference in opinion as to the definition of right- and left-hand doors. Can you quote any authority which will settle the question?

The writer has always been guided by the following definition:

"The hand of a door is determined from the stop side. If the butts are on the right-hand side, it is a right-hand door. If the butts are on the left-hand side, it is a left-hand door." H. L. CONRAD,

South Bend, Ind. Engineer, H. G. Christman Co.

A Hint to Engineer Employers

Sir—Referring to "Positions Vacant": You might drop a hint to the Illinois Highway Department to the effect that if it needs civil engineers competent to make surveys, prepare plans and supervise construction, it will have to offer more than $100 to $140 per month. Trolley conductors and motormen get $5 and over per day, time and a half for overtime and double time for Sunday work. It takes about a week to qualify for a conductor or motorman, while an engineer has to spend four years in a college or university and about $3600.

Why *Engineering News-Record* should continue to publish such ridiculous advertisements is more than one can understand. Your editorial utterances and advertising columns do not seem to agree.

There are secretaries of our national engineering societies, engineering foundations and councils who draw salaries of $10,000 or more per annum—four or five times as much as the average civil engineer gets. They enjoy two or three months' vacation every year, and do nothing but write letters, reports and resolutions, which in the end amount to nothing. And we are fools enough to continue paying our dues. Can you explain it? M. AM. SOC. C. E.

Engineers and Draftsmen Are Organizing

Sir—Referring to the letter in your issue of Dec. 26, p. 1192, by A. F. Barnes, dean of engineering, State College of New Mexico, relative to the low salaries paid by the Government to engineers, and the necessity for an organization of engineers to promote economics, I take this means of informing Mr. Barnes and all other engineers that there is now in the course of formation a union of engineers and draftsmen, throughout the United States, which is affiliated with the American Federation of Labor.

It is the object of the organization to promote the general welfare of all engineers and draftsmen, and particularly those in the Government service, who have been shamefully neglected for many years past; even at this time they are compelled to make a desperate fight in order to put in effect the wage adjustment of the War Labor Board.

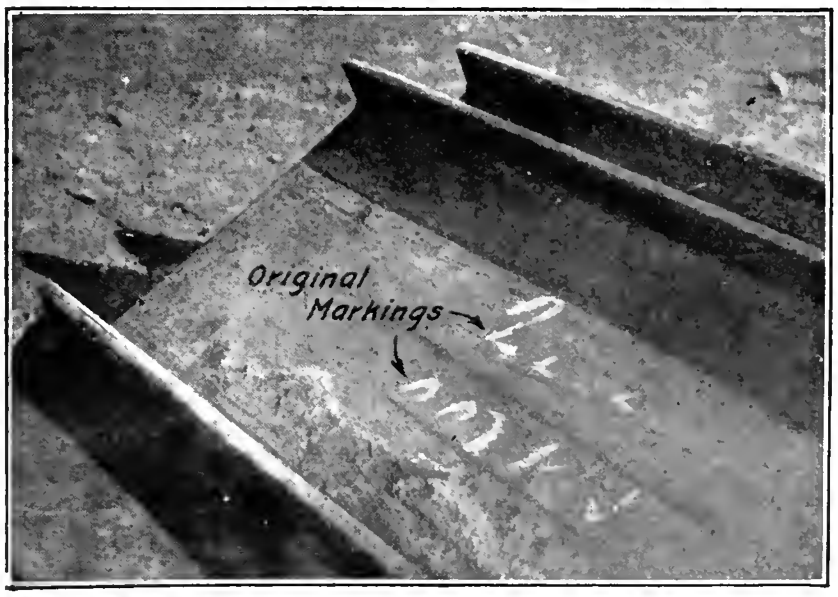
As stated by Mr. Barnes, the engineers and draftsmen have spent their every effort for the successful conclusion of the war, and in return have not received the slightest consideration from the Government. The other trades have forged ahead, raising their wages, bettering their working conditions through the influence of organization, but the engineers, mainly on account of lack of organization, have lagged behind. It is their intention, however, to make the influence of their organization felt, and for the information of any who may be interested, I solicit their correspondence.

This may be interesting information not only to Mr. Barnes but also to all engineers and draftsmen throughout the country. I know of no better means of putting it before them than through the columns of your paper.

R. N. ATHERTON, M. E.,
Vice President, Washington Society of Draftsmen.
Ordnance Department, Washington, D. C., Navy Yard.

I-Beams Retain Marks Thirty Years

Sir—The photograph here reproduced shows I-beams removed in November, 1918, from the Woodcliff reservoir, Woodcliff, N. J. These beams were used in the construction of bridges built by the County of Bergen approximately 25 or 30 years ago. They were abandoned when the area was converted into a storage reservoir by the Hackensack Water Co., in 1905. Since then



MARKS ON BEAMS VISIBLE AFTER THIRTY YEARS

there have been two occasions when the reservoir has been drawn down so that the I-beams were exposed; in one case for a period of about 30 days and in the second case about six weeks. Other than the two periods mentioned, the I-beams have been constantly under water. The beams were incased by brick arches, and when they were removed, it was noted that the paint was still on the surfaces of the beams where they had come in contact with the masonry. It was further noted that the white pointed figures, denoting lengths, were still visible in a great many cases. R. P. MCCLAYE,

Hackensack, N. J. County Engineer.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Single Air Header Supplies Eleven Drills

ONE 3-in. air hose was made to supply eleven drills, in shaft sinking, by feeding to the suspended metal "header" hung from a cable in the center of the shaft just above the bottom being drilled. Eleven 14-ft. hose lines led off from the bottom of the header. There was also one connection for a blowpipe. Eleven drills were operated and two drills were kept as spares. When all was in readiness for blasting, the header and hose were hoisted out of danger, and were lowered again when drilling was resumed. A round of 45 holes, averaging 8 ft., were drilled in 2½ to 3 hours. The 11 x 21-ft. shaft was sunk for the Seneca Mining Co., Mohawk, Mich.

Progress Chart for Recording Preparation of Construction Plans

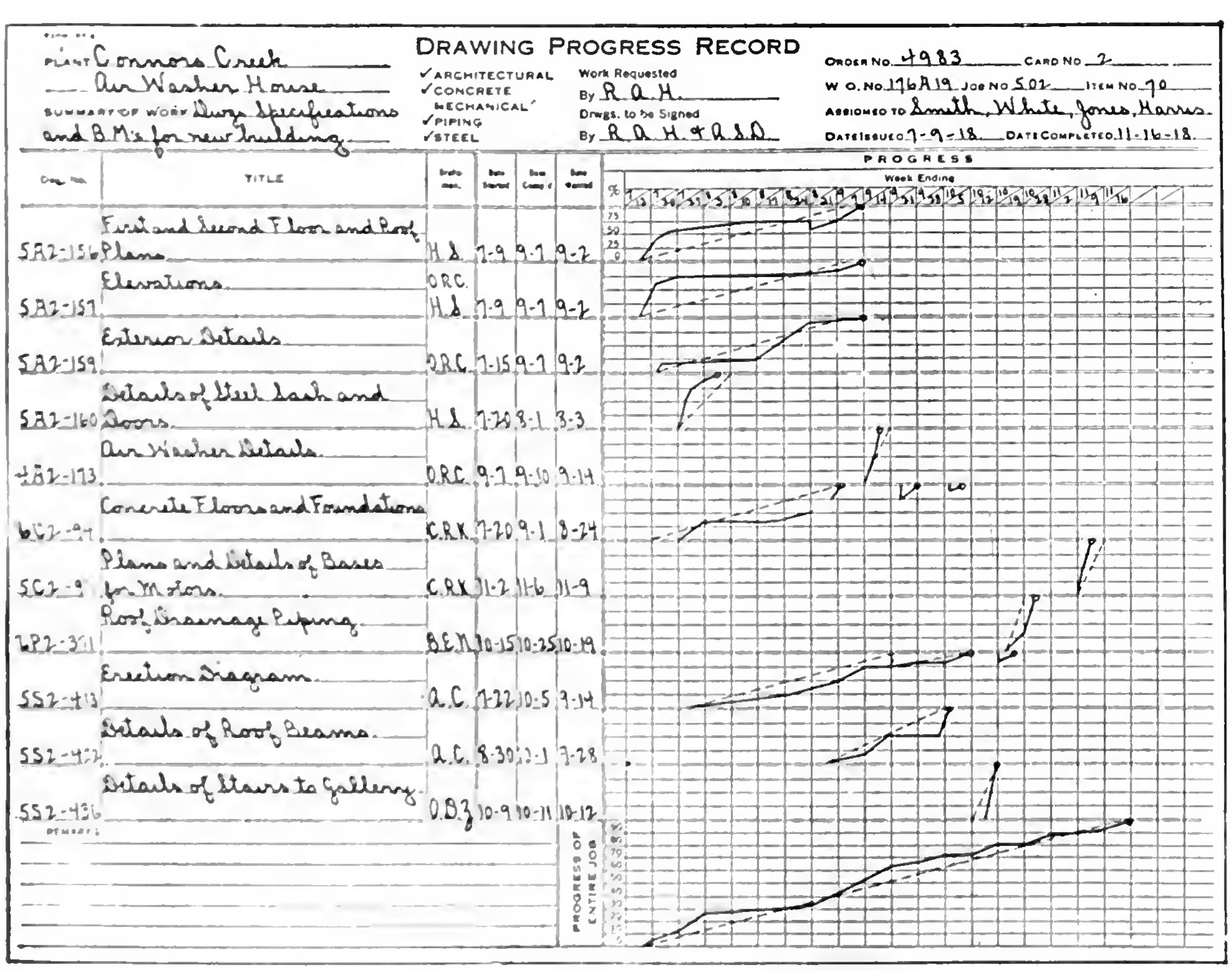
THE progress of every drawing required for the construction work of the Detroit Edison Co. is recorded on 8½ x 11-in. cards of the type shown by the illustration. For small jobs, one card is used, but for larger jobs as many cards are made out as there are important divisions of the work. In the illustration, a number of drawings from different cards are entered, to show the variety of records possible.

All the drawings to be made are entered on the card with the other information, as shown. The date on which each drawing is wanted is also shown, and a dotted line shows the progress that should be made to complete it in the required time. The actual progress made is shown by a full line for each drawing, while at the bottom of the card a curve on a larger vertical scale shows the progress for the entire job.

Watching these curves, one can readily see which drawings are progressing properly and which are being held up, for when a horizontal line appears it signifies that work has stopped. The reason is entered on the back of the card, where there is also a place to note all changes made that retard completion; also any information that is essential before the drawings can proceed is noted in a place for that purpose.

When a change is made, which is not an uncommon occurrence, the curve drops in proportion to the extent of the change. The back of the card also contains the order for the work in full and a list of all the bills of material, which are entered as they are completed. This is of great assistance in determining if everything has been ordered for the job. It can be seen that the card becomes a reference card after the office work is completed and its function as a progress record is done.

When the drawing is completed and leaves the drafting room, a circle is placed at the end of the curve, as shown. In case revisions are made after the drawing has been completed, they are indicated as shown for drawings "6 C 2 — 94" and "5 S 2 — 413." The drawings and the bills of material, upon leaving the drafting room, go to the estimating department for estimates and work orders. They then proceed to the office of the construction engineer for approval, after which they are sent to the order department, where materials are ordered and blueprints sent to the field or elsewhere, as the occasion demands.



PROGRESS CHART SHOWS STATUS OF EACH CONSTRUCTION DRAWING

It is necessary that each drawing be completed on time so that the material billed from the drawing will be on the job when it is needed. A glance at drawing "5 A 2 — 160" will show how this is done. The steel sash must be ordered many weeks before it is needed; therefore, when the plans and elevations are far enough advanced so that the number and size of the windows can be determined, the sash details are started and brought to completion as rapidly as possible. The direct opposite of this is shown by

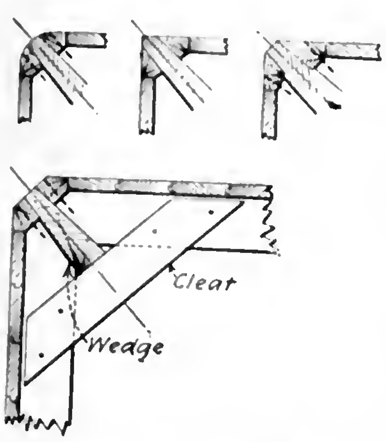
drawing "5 C 2 — 96." These bases were not needed until the building was well under way, so nothing was done on the drawing until the other drawings were completed.

This method of recording progress of drawings is described by J. C. Thornton in the *Synchroscope* for January, 1919.

Formwork Easily Stripped by Use of Special Corner Detail

By L. Kopczynski
Wilmington, N. C.

THERE has always been some trouble in stripping of forms in reinforced-concrete work, especially in angles which become wedged tightly. The sketch is self-explanatory. All the pieces are milled; no handwork fitting is necessary. Using a gage for holding the corner, it can easily be assembled by one man, and the forms will be made rigid and strong by nailing the corner cleat, if possible, with double-headed nails. The removal of this cleat will allow the wedge to be driven out, and the forms are easily stripped. This appliance is called "Kop's Corner," and I would be pleased if the contractors would introduce it in their work by that name, as it is cheap and no royalty is involved. It saves material and labor—also the religion of the strippers. The corner can be elaborated, made as shown in the sketch, or rounded off, or given any form desired.



CORNER DETAILS MAKE STRIPPING EASY

Ample Clearance on Scaffold Runways Saves Working Time

MAKING scaffold runways around the hull of ample width is an important detail in good shipyard management, says a shipbuilder who had occasion to work in various shipyards last summer. The runways should be wide enough to let the men passing along clear the men working on the side of the ship. In one or two yards the walks are so narrow that men coming up the stairways and going along a runway are bound to interfere with the work of reaming and riveting gangs. Such an encounter means that both parties lose time. In addition to the waste of labor expense, the progress of the ship is delayed, which means a distinct additional expense item.

At one yard the rule was made, in the initial design of the scaffolding and the layout of berth space to accommodate it, to provide for three 10-in. planks as minimum runway width on the overhang of the scaffold ledges. This is by no means ample provision, says the shipbuilder, but it is vastly better than an arrangement that provides for only two planks.

In details of this kind it is easy to lose a large part of the gain in working efficiency secured through well studied plant layout and good equipment. Failure to provide proper runway capacity can only be attributed to lack of care, because there is no advantage in compactness of scaffolding in itself.

Caisson Chambers Concreted in Sections

ASSURANCE that the concrete seal would fill closely all corners was sought by concreting the working chambers of the large pneumatic caissons of the Metropolis bridge in four sections.

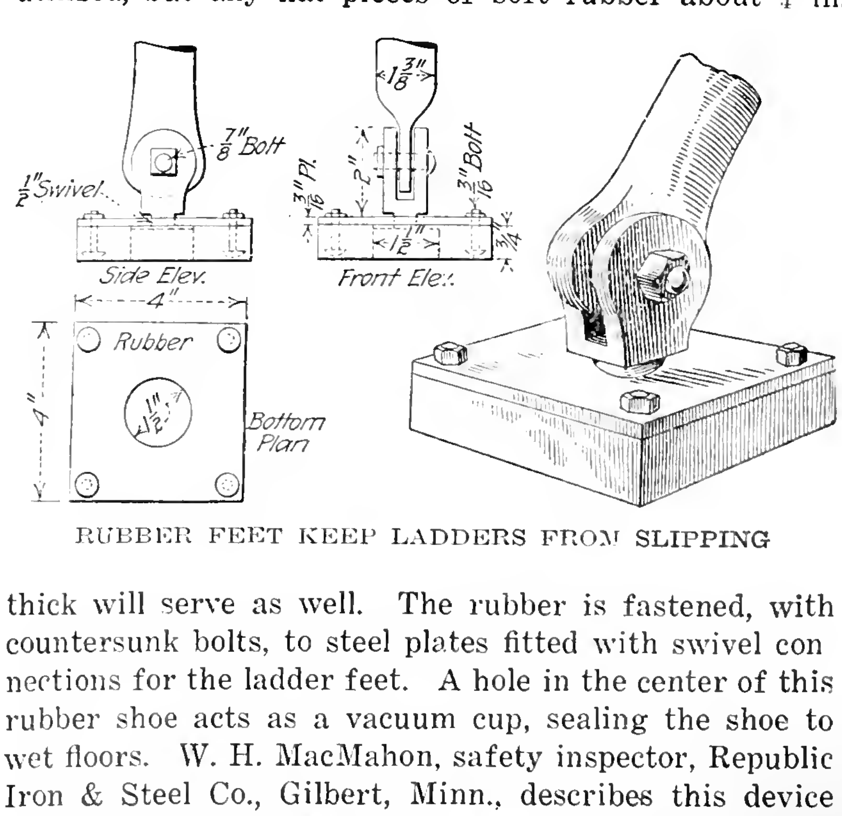
These caisson chambers varied in size from 80 x 47 ft. to 110 x 60 ft. Ordinarily, in filling such chambers there is a doubt whether the concrete has penetrated to the farthest corners of the caissons, after they have been filled to such an extent that men cannot work in them. To relieve this doubt at Metropolis, bulkheads were built across the working chambers so as to divide them into four sections each. The two end sections were concreted first. Then holes were bored through the bulkheads to determine whether at any point cavities existed in the concrete filling. One of the middle sections was then concreted and tested for solidity.

Finally, the last section was concreted. This section could not, of course, be tested as were the others, but its small size decreased the chances that the concrete would not flow to all parts.

According to G. A. Haggander, bridge engineer of the Chicago, Burlington & Quincy R.R., the sectional method of sealing the caissons probably presented no construction advantage such as reducing cost of plant or amount of labor, but it did enable the engineers to ascertain with certainty whether the chamber had been solidly concreted.

Safety Feet for Ladders Made With Rubber Pump Valves

LADDERS to be used on concrete or metal floors can be made safe from slipping by fitting them with rubber feet, as indicated by the accompanying sketches. In this particular case soft rubber pump valves were utilized, but any flat pieces of soft rubber about ¾ in. thick will serve as well. The rubber is fastened, with countersunk bolts, to steel plates fitted with swivel connections for the ladder feet. A hole in the center of this rubber shoe acts as a vacuum cup, sealing the shoe to wet floors. W. H. MacMahon, safety inspector, Republic Iron & Steel Co., Gilbert, Minn., describes this device in *Engineering and Mining Journal*.



RUBBER FEET KEEP LADDERS FROM SLIPPING

News of the Week

New York, January 23, 1919

Committee to Revise Federal Shipbuilding Program

Five Shipping Men and Two Officials from Fleet Corporation to Examine Present Plans

The United States Shipping Board has announced the personnel of the committee to examine the building plans of the Emergency Fleet Corporation, with a view to such revision as might be wise in view of the altered international situation.

This committee is to consist of J. A. Farrell, president of the United States Steel Corporation; P. A. S. Franklin, president of the International Mercantile Marine Co.; George S. Dearborn, president of the American-Hawaiian Steamship Co.; H. H. Raymond, president and general manager of the Mallory Steamship Co., and F. D. M. Strachan, president of Strachan Shipping Corporation. In addition to the foregoing, Charles Piez, director general of the Emergency Fleet Corporation, and John H. Rosseter, director of operations of the United States Shipping Board, will be ex officio members of the committee. Of these, Mr. Dearborn and Mr. Raymond are the nominees of the American Steamship Association, which was asked to designate two of its members for places on the committee.

New Questions Arising

Until hositilities ceased the purpose and effort of the Fleet Corporation was to produce useful tonnage in the largest possible quantity to keep pace with the growing need of tonnage as our overseas forces increased, and to repair the destruction wrought by submarines. With the signing of the armistice, the problem of the Fleet Corporation took on a different aspect, and the question now is, "What revisions of type are advisable and what modifications of plan or practice can be undertaken to give the Fleet Corporation's output of ships as high an economic value in world trade as possible?"

The lifting of the pressure, both of need and time, which controlled the Fleet Corporation's decisions during the actual continuance of war, makes it possible to give more consideration to economic standards, and the Director General and the other officials of the Fleet Corporation have for many weeks been engaged in a thorough examination of the corporation's building plans, and have themselves developed some important suggestions. It is to test these proposed alterations of program that the committee above named has been appointed.

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

Division of Engineering, United States Employment Service; A. H. Krom, director, 29 South La Salle St., Chicago, Ill.

Professional and Special Section, United States Employment Service; George W. Kirchwey, state director, 1? East 42nd St., New York City.

Bill Provides for Federal Public Works

Senator Kenyon, of Iowa, chairman of the Senate committee to investigate labor conditions, has introduced a bill appropriating $100,000,000 for expenditure on public works. It would create an agency known as the United States Emergency Public Works Board to supervise expenditure of the fund and to have general charge of Federal, state and municipal developments to check unemployment.

Besides the $100,000,000 emergency fund Senator Kenyon proposes to authorize advances by the War Finance Corporation to the extent of $300,000,000, upon approval of the Federal board, for public works certified to be necessary by the Secretary of Labor to prevent unemployment.

Kansas Good Roads Association Favors $60,000,000 Bond Issue

At a recent meeting in Topeka the Kansas Good Roads Association started a campaign to have the coming legislature submit a constitutional amendment at the next election that will permit the state to aid in good roads construction, and also to submit a bond issue for $60,000,000 to provide for this aid.

A system of 5000 miles of hard-surface highways, which will connect every county seat and market center in the state, is planned. To help finance the system, it is proposed to change the motor-car registration and license law, from one based upon a flat fee of $5 per year, to one based on the horsepower of the car, the revenue to be utilized to pay the interest and principal.

Tariff Commission Favors Free Zones

Urges Immediate Congressional Action Permitting Their Creation, To Foster Foreign Trade

Free ports or zones should be permitted in the United States, in the opinion of the United States Tariff Commission, which has just made an exhaustive report on the subject to the Committee on Commerce of the United States Senate. The legislation which it recommends—a revision, in part, of two bills now before Congress—is merely permissive in character. It leaves the initiative to the locality and puts upon it all risks and responsibilities. Each state or political subdivision thereof is permitted to establish and equip at its own expense a zone wherein foreign merchandise may be entered free of duty.

As defined by the report, a free zone is "an isolated, inclosed and policed area in or adjacent to a port of entry, without resident population, furnished with the necessary facilities for lading and unlading, for supplying fuel and ship stores, for storing goods and for reshipping them by land and water; an area within which goods may be landed, stored, mixed, blended, repacked, manufactured, and reshipped without payment of duty and without the intervention of customs officials. It is subject equally with adjacent regions to all the laws relating to public health, vessel inspection, postal service, labor conditions, immigration, and, indeed, everything except the customs." The purpose of the free zone is to encourage and expedite that part of a nation's foreign trade which its Government wishes to free from the restrictions necessitated by customs duties. It aims to foster the dealing in foreign goods that are imported, not for domestic consumption but for reëxport to foreign markets and for conditioning or for combining with domestic products previous to export.

At present the only provisions to take care of such reëxporting lie in the bonded warehouse, the bonded manufacturing warehouse and the drawback system. None of these, in the opinion of the Commission, is adequate to foster the foreign reëxport trade which is now necessary to this country. All three are cumbersome in their operation and limited in their application. In the opinion of the commission, the business proper to a free zone consists in receiving and manipulating the foreign products and reshipping them in the direction and at the time to take advantage of the best foreign markets. This is not only a profitable business, but is also becoming

a necessary business in our industrial growth, for, however wide the range of goods we produce and however effective our methods of production, we can sell our products to best advantage only when the purchasers are able to pay for them with products of their own. If we do not accept their products they must sell them in some third country and transfer to us the credits that they thus acquire — unless, indeed, they forego buying our goods at all and make their purchases in the country where they make their sales.

Transshipment trade in the United States has been steadily declining since the banner days of American shipping, but the present conditions are very favorable to its revival. In the opinion of the commission, however, the burden of the free port or zone must lie upon the locality which desires it, and the only function of the Federal Government is to provide laws whereby the zone may be operated.

The report details under the following heads the advantages to be expected from the free zone system: The simplification of entry and clearance, the equalization of the inbound and outbound traffic, the facilitation of dealings in foreign products, the stimulation of certain branches of manufacturing and the stabilization of transshipment trade under varying tariff policies. The commission feels sure, after a lengthy study of the theory of the subject—amplified by hearings in many of the ports of the country and the study of the answers to questionnaires sent out to merchants and shippers—that the time is now ripe for the development in the United States of this type of port, which has already proved successful in several European cities, notably Copenhagen, and Hamburg.

Engineering Council Acts on Public Service Engineers' Discharge

Following the hearing held last week on the dismissal of over 300 engineers of the Public Service Commission of New York City, as reported in *Engineering News-Record* of Jan. 16, p. 163, the Engineering Council Jan. 16 adopted a resolution urging the Board of Estimate and Apportionment of the city to reconsider its action. The resolution is based on a statement of findings in which it is asserted that the city's rapid-transit construction work will be seriously hampered and delayed by the disruption of a highly specialized trained organization built up to carry on this work; that the dismissal of 339 men of the engineering force by effect of the "line budget" adopted by the Board of Estimate Dec. 30 was an injustice of which no employer should be guilty; that the alarm of the laboring men employed on subway work over the curtailment of proper engineering inspection and supervision is justified and should be heeded; that the Board of Estimate's action will result in the discharge of a considerable body of labor and will prevent the employment of additional labor for the sections for which contracts were to have been let, which action is contrary to economic wisdom; that large loss to New York City is threatened through claims for delay which will arise from the disruption of the engineering force; and that the noncompletion of certain subway sections, preventing operation of trains in other sections, involves a striking waste of public funds. On this showing the action described below was taken:

"In view of the above facts, Engineering Council, representing the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, having a membership of over 36,000, which body is vitally interested in engineering and is qualified to speak in matters involving the satisfactory direction of engineering work, hereby adopts the following resolution:

"Resolved, that in view of the above facts, the Board of Estimate and Apportionment be urged to reconsider at once its action of Dec. 30 and to make such appropriation as will enable the Public Service Commission to carry on with safety and economy the rapid completion of the subway work, and that the Board of Estimate should leave to the Public Service Commission, on which the law places the responsibility, the detailed apportionment of these funds in accordance with a practical schedule to be prepared by it and submitted to the Board of Estimate for its information."

Little Government Surplus of Building Material

Conference Called By War Industries Board Shows That Excess Material Can Be Absorbed Readily

At a conference called by Richard L. Humphrey, director of building materials, War Industries Board, at Washington last week, it was announced that little trouble was anticipated in disposing of the Government's surplus stock of building materials. At the conference were represented the various Government agencies which had been purchasing and using building materials, and representatives of the building material War Service Committees.

The subject of the disposal of surplus stock was thoroughly discussed, and the following facts were developed:

1. That the Government agencies are not going to dispose of surplus stocks of building materials in such a way as to disturb market conditions.

2. That these surplus stocks are being rapidly absorbed by redistribution among the several Government departments so that the greater portion of these materials will be thus cared for.

3. That, with the exception of lumber, the amount of these surplus stocks is very small, and cannot materially affect market conditions.

4. That the largest single material was lumber, and in connection with it a plan was unanimously agreed to, and is now being considered by the industry, whereby the Government will in a suitable manner dispose of amounts too small to affect the market in any way; where large amounts are concentrated the disposal will be made in conjunction with the industry. It is estimated that the total amount of this surplus stock does not constitute more than one-sixth of the normal monthly output of lumber for the entire country. The same plan is to be applied to other building materials, and is being considered by these industries.

Estimates of the amount of building materials the Government has on hand are given below. Accuracy in the estimates is not possible, but there is reason to believe the figures do not contain an error larger than 25 per cent.:

Commodity	Quantity
Brick	14,516,000
Hollow tile	2,235,403 pc.
Lumber ft. b. m., veneers and plywood	350,000,000
Cement	115,523 bbl.
Lime	77,560 bbl.
Flue linings, lin.ft.	29,226
Metal Lath, sq.ft.	1,122,313
Wood Lath	2,695,000
Wallboard (all kinds)	5,406,429
Roofing, rolls	202,208
Building Papers, rolls	52,377
Nails, assorted sizes	159,622 kegs
Reinforcing steel	3,000 tons
Sewer pipe, assorted sizes, lin.ft.	577,407
Wood shingles	908,000

Indiana Highway Commission Law Declared Constitutional

After several months of litigation, the State Highway Commission of Indiana and the statute under which it operates have been declared constitutional by the State Supreme Court. This will allow extensive highway improvements, which had been held up pending the decision, to go forward.

The decision was rendered in a taxpayer's suit instituted by Robert M. House of Hamilton County, who averred through his attorney that the law in its operation would be confiscatory, in that it took money from him without giving him a return equal to that given to taxpayers living on the road or nearer it than he. It was claimed that this is contrary to the 14th amendment of the Constitution of the United States, which prohibits taking property without due process of law.

It was argued that the statute was void in that it created offices and provided for the expenditure of money not specifically authorized by the state constitution. A lower court sustained these contentions and declared the law unconstitutional, as reported in *Engineering News-Record* of May 16 ,1918, p. 976. Editorial comment upon the action of the state Supreme Court in taking a three months' vacation, further delaying a decision on appeal, will be found in *Engineering News-Record* of July 18, p. 109.

The state Supreme Court has finally overruled the lower court, and, as a result of this decision, it is proposed

to start immediately construction on approximately 120 miles of main market highway, from Indianapolis to South Bend, which is estimated to cost $3,000,000.

It is further asserted that the decision upholds the validity of acts creating other state offices, and in general indicates that the Indiana constitution is a guaranteeing rather than a limiting instrument.

Ohio Good Roads Congress in Joint Sessions

The second annual joint convention of the Ohio Good Roads Federation, the Ohio Engineering Society and the County Commissioners' Association of Ohio held in Columbus, Ohio, Jan. 14-16, developed a variety of topics, but the central theme of all discussions was, "Get Ohio out of the mud."

The first session of the Ohio Engineering Society was addressed by Pres. Thomas J. Smull, who reviewed the work of the society for the past year and made recommendations for the present year. Among them was the further improvement of the service bureau inaugurated by Sec. John Laylin, and the desirability of final action upon the question of licensing engineers. C. E. Drayer, of Chicago, discussed "Licensing Engineers," and as stated elsewhere a resolution favoring licensing was passed unanimously.

Other speakers of the week on subjects of special interest were: "Recent Military Achievements with Concrete," by A. J. R. Curtiss, Portland Cement Association, Chicago; "Federal Highways," by H. S. Shirley, secretary of the Highway Industries Association, Washington, D. C.; "Road Improvements in Ashtabula County," by Ray Case, county engineer of Ashtabula County, Ohio; "Military Engineering with the American Expeditionary Force in France," by Capt. J. F. Mollenkopf, Van Wert, Ohio; "Report of Codifying Commission, Ohio Drainage Laws," by P. T. Ford, secretary of the commission, Ottawa, Ohio; "Public Utilities," by the Hon. Beecher W. Waltermire, of the Ohio Public Utilities Commission, Columbus, Ohio; "Production and Uses of Asphalt," by William Howe, Texas Co., Chicago.

The following officers of the Ohio Engineering Society were elected: President, Ett S. Smith, Youngstown; vice-president, Cecil L. Rood, Toledo; secretary-treasurer, John Laylin, Norwalk.

Akron Will Vote on $3,000,000 Sewerage Bonds

The city council of Akron, Ohio, has passed a resolution to submit to the voters Mar. 4 a proposed bond issue of $3,000,000 for the construction of trunk sewers and to pay the city's part of the cost of other sewerage work. This is part of a sewerage program estimated to cost $6,000,000, exclusive of the cost of sewage treatment. H. S. Morse is director of public service.

National Service Committee in Washington Office

Engineering Council Establishes Service for Engineers—Names of Members Announced

In order more completely to provide for united action upon matters of common concern to engineers, the Engineering Council has recently organized a National Service Committee and has established an office in the national capital. This action was based upon a tentative plan for representation of engineers at Washington, submitted to the council at a special meeting on Nov. 21, 1918, by Philip N. Moore, of the American Institute of Mining Engineers. (See the December *Proceedings* of the American Society of Civil Engineers.) The present member societies of the Engineering Council are the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the United Engineering Society and the American Society for Testing Materials.

The Engineering Council, through this National Service Committee and its Washington office, intends to accomplish the following general purposes, this committee acting always under the direction of the council and within limitations fixed for it:

1. To discover public services which may best be performed by engineering societies, and, when desired, to offer the proper men for such services.

2. To speak authoritatively for the Engineering Council before committees of Congress and departments of the Government on all public questions of common interest to engineers, within such limitations as the council may set from time to time.

3. To give promptly wide circulation among engineers to authentic information regarding pending legislation and executive actions which may affect the interests of engineers in any way.

4. To gather opinions of engineers on these matters.

The Engineering Council's aim is disinterested usefulness to the nation and the profession—not advocacy of any selfish ends—by giving unbiased information and counsel on technical matters, chiefly when asked. A modest start is being made. The work will be enlarged only as a real demand for services develops.

The members of the National Service Committee have been chosen so as to represent different parts of the country. The appointees are the following: Chairman, M. O. Leighton, M. Am. Soc. C. E., Washington, D. C.; C. B. Burdick, M. Am. Soc. C. E., Chicago, Ill.; George F. Swain, M. Am. Soc. C. E., Boston, Mass.; Philip N. Moore, M. A. I. M. E., St. Louis, Mo.; L. D. Ricketts, M. A. I. M. E., Warren, Arizona; Andrew M. Hunt, M. Am. Soc. M. E., San Francisco and New York; Andrew M. Lockett, M. Am. Soc. M. E., New Orleans, La.; W. C. L. Elgin, M. A. I. E. E., Philadelphia, Penn.; Bancroft Gherardi, M. A. I. E. E., New York.

The Washington office is located at 502 McLachlen Building, 10th and G Streets.

To Ask $500,000,000 for New Railroad Improvements

Director General Walker D. Hines announced Jan. 15 that the Railroad Administration is preparing to ask Congress for another revolving fund of $500,000,000 to be used in financing the program of railroad improvement that is now being planned by the Government. This program calls for a total of authorized capital expenditures for the years 1918 and 1919 of $1,627,000,000, and the Director General estimates that the minimum additional amount in the budget for 1919 must be $350,000,000. The new fund would bring the total appropriated by Congress for the Railroad Administration up to $1,000,000,000.

The Director General states that it is to be understood that none of this fund is to used to pay the deficit of nearly $200,000,000 incurred by the war emergency operation of the railroads in 1918. He distinguishes two functions of the Railroad Administration under Federal control: (1) To render public service through operation of the railroads, collecting of the revenues therefor, and paying the expenses and the rental due the railroad companies. The other function is to require that necessary permanent improvements be made, including purchases of new equipment. He believes that the carrying out of the second function may call for the temporary use of a great deal more Government money than is needed for the first.

American Railway Association Is Reorganized

The Director General of Railroads announces that during the period of Federal control, in order to provide a responsible channel through which he may obtain recommendations for the advancement of railroad practice, the American Railway Association will change its name to the American Railroad Association. Its scope has been enlarged and will cover the former activities of the following organizations: The American Railway Association; American Railway Master Mechanics' Association; Association of Railway Telegraph Superintendents; Association of Transportation and Car-Accounting Officers; Freight Claim Association; Master Car Builders' Association; Railway Signal Association; and Railway Storekeepers' Association.

The new organization will consist of five sections: 1, Operating; 2, engineering; 3, mechanical; 4, traffic, and 5, transportation. Railroads under Federal control are members of the association and are directed to appoint representatives and participate in the activities of the association through their proper officers.

Honor Achievements of Construction Division

Brilliant Dinner at Washington to General Marshall and Officers Marked by High Enthusiasm

To celebrate fittingly the construction achievements of the Army in this country during the war, Brig.-Gen. R. C. Marshall, Jr., and the officers of the Construction Division were entertained at a dinner by their friends at the New Willard Hotel, Washington, last Friday night. Four hundred and thirty persons were present, half of them being officers and the others the hosts of the evening. An elaborate program had been prepared, consisting of vaudeville acts and a sketch, written and acted by officers of the division, hitting off the little failings of their prominent brother officers and making good-natured fun of incidents and practices in the work of the division. The evening was notable for the remarkable enthusiasm and spirit of fellowship which prevailed throughout the evening, experienced diners-out declaring it one of the most successful of big Washington dinners.

The reason for the celebration was well expressed by Assistant Secretary of War Benedict Crowell when he declared that the Construction Division "had done a 100% job." The toastmaster, E. J. Mehren, editor of *Engineering News-Record*, paid high tribute to General Marshall and the officers of the division, declaring their work to be the greatest construction achievement under a single organization in the history of the world. He commended the vision displayed in outlining the policy of the division, and attributed the success of the work to the high character of the personnel, to the decentralization of authority, and to the spirit of fair dealing with contractors, manufacturers and labor which characterized the work of the division.

General Marshall, in acknowledging the tribute of the toastmaster, gave the credit for the Construction Division's work to the officers and men of his organization. He also gave full credit to the work of the manufacturers, declaring that those who stayed behind and produced supplies were the "unsung heroes of the war."

Tribute to the Construction Division

Mr. Mehren spoke in part as follows:

"In a general way we know what the Construction Division has done, but a few figures will serve to impress on us the magnitude of the task. It built in 90 days 16 soldier cities, each for a population of 40,000 (now increased to about 50,000), with all the utilities, such as water, sewerage, electric power and fire protection, that a modern city requires. This feat remains still the greatest single achievement of our war preparations. We had to have the cantonments quickly. We unloaded this unprecedented job on the Construction Division and they came back in 90 days with the job done.

"The work done by the division will total about $800,000,000 in cost, and of that huge sum $[illegible],000,000 was spent in a period of 15 months, a record for construction under a single organization that has never been approximated in the history of the world.

"Needless to say, the accomplishment of such a huge task economically and efficiently and at the same time at top speed required an extraordinary organization and exceptional vision and administrative ability at the top. The organization drew to itself the best brains of the country in the field of construction, and those in charge wisely gave full authority to the men in the field.

"With this type of personnel, and this broad-gaged delegation of authority from Washington, went a policy, handed down from the top, of fair dealing with the various contracting and manufacturing organizations selected to do the work and supply the materials. The Construction Division has done more in its brief life to establish a fair contract for Government work than have the contractors themselves in a whole generation. The cost-plus-limited-fee contract, as applied by the Construction Division, guaranteed justice to the Government and the contractor alike, and when that contract was challenged in the general criticism of cost-plus contracts, a board composed of the presidents of the leading engineering societies of the country studied the contract, and approved it in the very highest terms.

The Division's Labor Record

"Further evidence of the spirit of co-operation and fair play that characterized the work of the division is shown by its extraordinary labor record. Though during its operations its contractors employed 400,000 men, the labor troubles were negligible, all of them being handled by a staff of five, some of whom had other duties besides.

"Never has a body of engineers and constructors been called on to do so tremendous a job. Never were the conditions more unfavorable for success. The material that was in hand had to be used, rather than that which was most suited to the work, transportation facilities were terribly congested, labor was frequently inefficient. With these bad conditions were combined the enormous size of the job and the terrific speed with which every part of it had to be put through. Had there been in waiting a fully prepared organization, composed of trained men who had long worked together, the job would have been hard enough. But there was no organization. Thirty men constituted the available force in April, 1917. In a few months, however, the big job was running smoothly. By selecting the ablest construction men the country afforded, and uniting them under an intelligent, open-minded leadership, it has been possible not merely to master the job, but to do it with a brilliance that has attracted attention throughout the country.

"It is fitting, therefore, that those who have seen the organization at close range, and watched it expand from the original band of 30 to a smoothly functioning organization of 6000, should join in a public tribute to those who have written the name of the Construction Division so brilliantly not only into the history of the war, but into the engineering and construction annals of this country."

General Marshall's Reply

General Marshall paid tribute to his officers and the manufacturers, in the following words:

"In all modesty, I now distribute to the members of the Construction Division here tonight all of the kind words and the thoughts they express, which have just been uttered. Theirs the credit, and to them must it be given. Such statements as have just been made prove embarrassing to me, for to the success of this war there have been many contributors.

"Homeward the boys come—and to each shipload that lands at our ports there goes forth the gratitude of a nation. In pictures, in poetry, and in song are their valorous deeds portrayed. It is their just due. I do not in the least detract from the value of their bravery when I tell you of another hero.

"The unsung hero of this war is the man who remained behind, and, in the intensity of his devotion, to the very commonplace occupation of producing supplies for our Army gave his utmost to the Great Cause. He it is whose constant efforts made possible the victorious onslaught of the man whose privilege it was to face the enemy. In and out of uniform, on this side of the ocean, an entire nation contributed to its utmost capacity.

"The incessant booming of the guns on the Hindenburg line was only the echo of the constant whir of machinery on the manufacturers' line. The shout and battle-cry of our brave ones overseas was the reverberation of the order to workers on this side to produce. The camp-fires of France were kept brightly burning by the furnaces of America.

"From the very inception of our participation in this world war, the unanimous response of the man in business spelled 'Victory.' His loom, his lathe, his furnace—yes, his every energy—turned the profitable output of commercial products into the production of whatever form of munitions and supplies was asked for by the Government. From his door belched forth the contributions of an earnestly patriotic effort to wrest victory from a common enemy.

"To this American, represented by our hosts tonight, I lay the tribute of the Construction Division in gratitude for the help he has been in accomplishing the task given us to perform."

Brief Biographies of Engineers Who Handled War Construction Work in America

Men Who Have Had the Handling of $800,000,000 Worth of Buildings, From Cantonments to Huge Terminal Warehouses

Biographical sketches of the leaders in the Construction Division of the United States Army who have been handling over 300 projects in Army construction in this country, totaling $800,000,000 and ranging from cantonments — miniature cities in themselves — up to the $40,000,000 terminal supply base and warehouses in Brooklyn are here recorded to indicate the type of men who have successfully carried through one of the greatest construction activities of history. This work required at one time 300,000 men, and included camps, cantonments, arsenals, wharves, docks, forts, great port terminals, reserve storage warehouses, hospitals of all sizes and descriptions, aviation fields, proving grounds, embarkation camps, engineers' camps, gunnery schools, housing, lighterage, power plants, factories, additions to manufacturing plants, munitions works, and special new plants for the production of nitrates, phosphorus, etc.

Brigadier General R. C. Marshall, Jr.

America's Army cantonments stand as a monument to the energy and resourcefulness of Brig. Gen. Richard C. Marshall, Jr., chief of the Construction Division, a native of Virginia. As Colonel Marshall he undertook with Col. Isaac W. Littell the organization of the Cantonment Division of the Quartermaster Corps of the National Army in May, 1917. So successfully was this work prosecuted that mushroom cities on 32 sites were soon completed.

General Marshall was born in Portsmouth, Va., in 1879, and was graduated from the Virginia Military Institute in 1899. He was appointed captain in the Fourth United States Infantry on June 29 of that year, and honorably mustered out of service after having served through the Cuban campaign. In 1901 he was appointed second lieutenant in the Artillery Corps. He was an honor graduate at Fort Monroe, Virginia, class of 1904, was promoted to a lieutenancy in January, 1904, and in December, 1907, was made captain. In June he was detailed to the Quartermaster Corps, and served in the construction and repair branch until the beginning of the 1917 emergency.

When the cantonment construction was finished, all construction work of the Army was turned over to the Cantonment Division, on account of its excellent work, and it was made a separate corps, known as the Construction Division of the Army. Colonel Marshall, then a major, was made lieutenant colonel and placed in charge, and in March, 1918, he was promoted to a colonelcy. He became brigadier general in July, 1918.

Colonel Gunby—Engineering Division

Formerly a partner in the firm of Charles T. Main, of Boston, Col. F. M. Gunby, in charge of the Engineering Division, was called to Washington in May, 1917, to take charge of the engineering for the construction of the cantonments. An important part of his work has been done in connection with obtaining appropriations from Congress and the handling of funds and authorizations for the work of the Construction Division. He was graduated from Clemson Agricultural and Mechanical College, Clemson, S. C., in 1902. In April, 1913, he enlisted in Company G, Fourth Infantry, Georgia State Troops, and was discharged as first lieutenant in May, 1905.

He enlisted in Company C, First Corps Cadets, Massachusetts Volunteer Militia, in May, 1908, and was discharged in December, 1911. He was commissioned major in the Quartermaster Corps in 1917, made lieutenant colonel in February, 1918, and commissioned as colonel in March, 1918.

Colonel Bush—Engineering Division

Col. Lincoln Bush, assistant to chief of the Engineering Division, was born in Orland, Ill., in 1860. He was graduated from the Cook County Normal School in 1881 and from the University of Illinois in 1888. Before entering the service he had been division engineer of the Chicago & Northwestern Ry., Chicago, bridge engineer, and then chief engineer of the Delaware, Lackawanna & Western R.R.; consulting engineer, vice-president and treasurer of Flickwir & Bush, Inc., New York City. As consulting and contracting engineer he has been engaged in bridge work, foundation work, steam-shovel work, tunnels and subway construction, and is the inventor of the well known Bush trainshed.

Since joining the Construction Division he has designed terminal ports, warehouses, some ordnance projects, miscellaneous engineering works, etc., has given advice relating to field execution, and has acted as representative on projects designed and constructed for storage and port terminals, harmonizing to some extent the work done by employees within the Construction Division and other branches of the Army service.

Colonel Shelby—Contracts Division

Colonel Evan Shelby, chief of the Contracts Division, was admitted to the bar of New York in 1896. He practiced law from 1898 to 1906, when he formed a partnership with R. C. Taylor. Since 1912 he has practiced alone, and for four years was New York attorney for the Panama Railroad. He is a member of the Bar Association of the City of New York. He was born in Fayette County, Kentucky, in 1872, was graduated from Kentucky University in 1893, and obtained the degree of LL.B. from the University of the State of New York in 1896.

Upon his entry into the service he was made legal adviser to the Cantonment Division, and was made chief of the Contracts Division in June, 1917. He has had charge of drafting contracts and bonds and also all matters relating to insurance, fire casualties and workmen's compensation.

Colonel Willcutt—Materials Division

Col. Joseph N. Willcutt, chief of the Procurement Division, was born in Cohasset, Mass., in 1875, and was graduated from Harvard University in 1898. Before becoming an Army officer he had been in the construction business, with offices in Boston, doing construction and engineering work. He entered the Army service during the Spanish war in 1898, in the Quartermaster Corps, and during the Texas mobilization for protection against Mexico was camp quartermaster, with the rank of major. He held that rank when he entered the United States service in July, 1917.

Since becoming connected with the Construction Division he has been assistant to Colonel Whitson, in charge of construction of the National Guard camps, and after eight months was put in charge of the Procurement or Materials Division of the Army.

When he joined the division he was president of the L. D. Willcutt & Sons Co. of Boston, Mass.

Colonel Junkersfeld—Building Division

Col. Peter Junkersfeld, chief of the Building Division, before entering the service was, successively, assistant mechanical engineer, electrical engineer, and assistant vice president of the Commonwealth Edison Co., Chicago. He was president of the Association of Edison Companies, with supervision of, or doing consultant work in, contracting, engineering, construction and operation, including allied interests having electric, gas, railway, heating, ice-making, and other utility properties in several states. Colonel Junkersfeld was born in Sadorus, Ill., in 1869, and was graduated from the University of Illinois in 1895, taking the degree of electrical engineer at that university in 1907.

Since joining the division he has been associate officer in charge of the Building Division, obtaining requirements, authorizations, and funds for projects, directing the constructing forces in the field and advising on the commercial relations of the Construction Division.

(*Concluded on page* 210)

LEADERS of the CONSTRUCTION DIVISION of the UNITED STATES ARMY

Handling $800,000,000 Worth of Work in This Country

COL. F. M. GUNBY

IN CHARGE OF THE ENGINEERING DIVISION

COL. LINCOLN BUSH

COL. JOSEPH N. WILLCUTT
IN CHARGE OF THE MATERIALS DIVISION

BRIG. GEN. R. C. MARSHALL, JR.
CHIEF OF THE CONSTRUCTION DIVISION OF THE U. S. ARMY

COL. EVAN SHELBY
IN CHARGE OF THE CONTRACTS DIVISION

COL. PETER JUNKERSFELD

IN CHARGE OF THE BUILDING DIVISION

COL. M. J. WHITSON

COL. C. D. HARTMAN
IN CHARGE OF THE MAINTENANCE DIVISION

COL. J. H. ALEXANDER
IN CHARGE OF THE ADMINISTRATIVE DIVISION

COL. CHARLES NEVILLE
IN CHARGE OF THE ACCOUNTING DIVISION

Engineers of Construction Division

(*Continued from page* 208)

Colonel Whitson—Building Division

Col. M. J. Whitson, assistant to chief of the Building Division, was born in Le Claire, Iowa, in 1878, and was graduated from the University of Illinois in 1902. Before entering the service he was in charge of construction work for Stone & Webster in the Northwest. Seven years ago he joined Grant Smith & Co. on a partnership basis, and later as director in the corporation. He resigned from this concern in June, 1917, in order to become an Army officer.

In the service he helped organize the Cantonment Division and was in charge of the Construction Branch, which was changed to the Building Division when the Construction Division of the army was organized.

Colonel Hartman—Maintenance and Repair

Col. C. D. Hartman, now in charge of the Maintenance and Repair Division, was born in Brookhaven, Miss., in 1886. He was graduated from the United States Military Academy at West Point in 1908, and was assigned to duty with the Third Infantry, Spokane, Wash., for eight months, thence transferred to Seattle in February, 1909, where he remained until July of the same year. He served in Jolo, Philippine Islands, until March, 1912, under General Pershing, during the clean-up of the southern islands.

After being relieved from duty in the Philippines he was stationed at the Madison Barracks, New York, until May, 1916, when he was sent to the border and stationed at Eagle Pass, Tex., until May, 1917. He was then again detailed to the Madison Barracks, in the first officers' training camp. In October, 1917, he was detailed to the Construction Division, and in March, 1918, was made lieutenant colonel and placed in charge of the Maintenance and Repair Division. He was made colonel in June, 1918.

Colonel Alexander—Administrative Division

Col. J. H. Alexander, chief of the Administrative Division, was born in New Haven, Conn., in 1884, and is a graduate of the University of Minnesota and of the Case School of Applied Science. Before entering the service he had wide experience in construction and engineering work as chief engineer of the Municipal Traction Co. of Cleveland, Ohio; assistant general manager of the Pittsburgh Railway Co., Pittsburgh; chief engineer of the City Street Railway Co. of Cleveland, and assistant to the president of the Cleveland Railway Co., Cleveland. In these positions he has handled all phases of engineering construction, management, and administration of large public utilities, and obtained a broad experience in labor and transportation matters.

The Administrative Division establishes and lays down the fundamental standards and policies for the general administration of the division, approves all labor rates, and supervises labor matters and conditions at all projects. In addition, it compiles and keeps a record of labor rates, conditions and agreements, also records of officers assigned to duty with the division, and supervises clerical routine, files, mail and messenger service, and conducts a general information bureau.

Colonel Neville—Accounting Division

Col. Charles Neville, chief of the Accounting Division, was born in New York City in 1875. Before entering the service he was traffic manager of the Stillmore Airline Ry., general freight and passenger agent and auditor of the Coast and Piedmont Ry., vice-president of the Brinson Ry. (now the Savannah & Atlantic Ry.), and subsequently practiced as a public accountant in Savannah, Tampa and Birmingham. He was senior partner of Neville, McIver, Barnes & Co., certified public accountants, and member of the American Institute of Accountants.

In the service he had full charge of policy, organization, commissions, civilian personnel, requests for commissions, travel orders, etc., and acted for the chief of the Construction Division in all accounting matters.

Rainfall and Run-off Committee Appointed

A committee on the standardization of rainfall and run-off measurements was created at a recent meeting of the New England Water-Works Association. The chairman of the committee is William T. Barnes, of Metcalf & Eddy, 14 Beacon St., Boston, Mass. The other members are Robert E. Horton, Albany, N. Y., who suggested the creation of the committee; George A. Carpenter, Sidney K. Clapp, George H. Leland and John L. Howard. A paper on "Measurements and Records of Rainfall and Snow" will be presented by Mr. Horton at the meeting of the association to be held in Boston Feb. 6.

Work Resumed on Welland Canal

Construction operations on the new Welland Canal, which shut down some years ago on account of the war, have been resumed, according to information from the Canadian Department of Railways and Canals. Work is to be taken up at once on Secs. 1, 2, 3 and 5 under a temporary arrangement with the former contractors. These contractors, with their locations, are as follows: Sec. 1, the Dominion Dredging Co., Ltd., Ottawa; Sec. 2, Baldry, Yerburgh & Hutchinson, Ltd., St. Catherine's; Sec. 3, Doheny, Quinlan & Robertson, Montreal; Sec. 5, the Canadian Dredging Co., Ltd., Midland, Ont.

Supreme Court Upholds Ohio Conservancy Act

In a decision on a taxpayer's action against the Miami Conservancy District directors, the United States Supreme Court recently affirmed the constitutionality of the Ohio Conservancy Act, which had been attacked.

The suit was brought in the form of an injunction to restrain the directors from collecting assessments against the property of the plaintiff, W. P. Orr, and other persons in Piqua, who had been declared to be benefited by the construction of the flood-control work. In the United States District Court of Southern Ohio the case was decided against the plaintiff, and the Supreme Court's decision now disposes of the matter finally. It affirms specifically the legality of taxation and expenditures for conservancy purposes within the Miami district. According to the Miami Conservancy *Bulletin* of January, this was the final step in the litigation instituted against the construction of the Miami River flood-protection work.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN WOOD PRESERVERS' ASSOCIATION; F. J. Angier, Mt. Royal Station, Baltimore, Md.; Jan. 28-29, St. Louis.

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Feb. 17-20, New York.

The Cleveland Engineers' Veteran Corps has recently been organized by veteran members of the old 10th Ohio Engineers, which afterward became the 112th Engineers, under Col. John R. McQuigg, and saw service on the Western front. Charles Ollenbacher is temporary chairman and Edward Baxter is secretary.

The American Water-Works Association's nominating committee has named the following candidates for office for the year 1919-20: For president, Carleton E. Davis, Philadelphia; for vice-president, M. L. Worrell, Meridian, Mass.; for treasurer, James M. Caird, Troy, N. Y.; for trustees, District No. 1, W. H. Randall, Toronto, Ont.; District No. 2, F. C. Jordan, Indianapolis, Ind.

The Engineers' Society of Milwaukee held its regular monthly meeting Jan. 15 under the auspices of the Milwaukee

Section of the American Society of Mechanical Engineers. Maj. Henry L. Dale, Corps of Engineers, U. S. A., spoke on "Engineering Experiences at the Front."

The Illinois County Superintendents of Highways will meet at Springfield Feb. 13-15. The short course in highways engineering at the University of Illinois will be held at Urbana Feb. 17-22 in connection with the Springfield meeting. The course is open to any one without examination, and there are no charges. The State Highway Department is giving its coöperation and a number of its engineers will appear on the program.

The North Dakota Society of Engineers will hold its annual meeting at Valley City, Jan. 30-31. E. J. Thomas of Minot is president of the society and E. F. Chandler, of the University of North Dakota, is secretary.

The Kansas Engineering Society will hold its annual meeting at Topeka Jan. 30-31. Con M. Buck, division engineer, Santa Fé Ry., is president of the society and Lloyd B. Smith is secretary.

The Engineers' Club of Trenton will hold a meeting this evening to discuss a plan for acquiring permanent quarters of the club, the policy of the club during the coming year on civic matters, and the matter of an American international submarine cable system as a necessary adjunct to the development of foreign commerce.

The Montreal Branch of the Engineering Institute of Canada held a meeting Jan. 16, at which the following papers were read: "Design and Construction of Reinforced-Concrete Viaducts on the North Toronto Subdivision, Canadian Pacific Ry.," by B. O. Eriksen and S. H. Deubelbeiss, and "Some Problems of National Reconstruction," by W. F. Chipman. A meeting of the branch will be held this evening, and will be addressed by J. A. Burnett on a "Coaling Plant for Locomotives" and by George K. McDougall on "Industrial Illumination." A meeting, to be held Jan. 30, will be devoted to fuel problems; Paul Seurot will speak on "Coal Briquetting" and the R. E. Cleaton Co. will show a motion picture entitled "Coal Is King."

The South Dakota Society of Engineers and Surveyors will hold its annual meeting at Mitchell Jan. 28. R. E. Easton, of Aberdeen, is secretary of the society.

The Engineers' Society of St. Paul elected the following officers at the meeting held Jan. 13: President, W. C. Armstrong, chief engineer, Union Depot Co.; vice-president, E. V. Willard, drainage engineer of Minnesota; secretary, Paul C. Gauger, engineer and superintendent, George J. Grant Construction Co.; treasurer, George L. Nason, landscape architect.

The Rochester Engineering Society will be addressed Jan. 24 by S. M. Day, of the General Railway Signal Co., who will speak on "Elements of Alternating Current Signaling." The society will hold a meeting Jan. 27, before which Isaac Adler will read a paper on "A League of Nations."

The Engineers' Club of Philadelphia will be addressed by P. H. W. Ross, president of the National Marine League, on "Public Participation in Maritime Development," at the weekly luncheon of the club to be held Jan. 28.

The Springfield Engineers' Club, Springfield, Ill., elected the following officers at the recent annual meeting: President, H. B. Lewis; vice-president, J. Leisenring; secretary, D. A. Henry.

Personal Notes

Readers who are returning to civil life from military, naval or other Government service are strongly urged to send in items about themselves and about their friends who are in similar situation. Items should give former position, describe character of military or other service and state the civil work to which the engineer or contractor in question is going. In the case of those with service abroad, information regarding the activities of the units to which they were assigned is especially desired.

COL. WILLIAM J. WILGUS, Corps of Engineers, U. S. A., deputy director general of transportation with the American Expeditionary Forces in France, has returned to this country. Colonel Wilgus was formerly vice-president and chief engineer of the New York Central & Hudson River R.R., and before entering the Army had been in consulting practice in New York City.

LIEUT.-COL. A. S. CUSHMAN, who, for 18 months, was in charge of metallurgical and explosives investigations for the Ordnance Department at the Frankford arsenal, has been discharged from the Army and has returned to Washington to assume the directorship of the Institute of Industrial Research, Incorporated.

D. W. MURPHY, drainage engineer, United States Reclamation Service, Los Angeles, has resigned to engage in private practice as consulting engineer, with office in the Hollingsworth Building, Los Angeles, specializing in irrigation and drainage and the care and protection of soils. He has been connected with the Reclamation Service since 1904 and was appointed drainage engineer in 1911.

CHARLES W. STANIFORD has resigned as chief engineer of the Department of Docks and Ferries of New York City to enter consulting practice in dock, port and harbor work. He will be located at 50 Church St., New York, in the same office as B. F. Cresson, with whom he is associated at present in a number of port and harbor studies. Mr. Staniford has been in the dock department of New York for 30 years and has been chief engineer 14 years. In that time he has had charge of such well known dock construction as the Chelsea development on the West Side and the deep cofferdam at the 47th St. piers, also on the North River. During the war he was a member of the committee on port terminals of the Council of National Defense, which planned the storage and terminal facilities for the overseas shipments to the troops in France. He also made the appraisal in 1918 of the German dock property in Hoboken.

MAJ. GEORGE SYKES, Corps of Engineers, U. S. A., has returned to the United States from service overseas and will reëngage in business in New York as head of the George Sykes Co., specialists in the building of country houses. Major Sykes was, until July 1, 1918, executive officer for the chief engineer of lines of communication, and was then placed in charge of the construction of cantonments in rest areas for the advance section.

CAPT. CHARLES F. HEALEY, Corps of Engineers, U. S. A., who was division engineer on the northwest lines of the American railroads of the American Expeditionary Forces in France, has returned to the United States and has been discharged from the Army. He is at present at his home in Goshen, Ind.

A. W. THOMPSON, Federal manager of the Baltimore & Ohio R.R. and associated lines east of Parkersburg and Pittsburgh, has tendered his resignation to the Government, to become president of the Duquesne Light Co. of Philadelphia, and the Philadelphia Co., the public service company of that city. Mr. Thompson was previously chief engineer of the Baltimore & Ohio, and in 1912 was appointed vice-president in charge of operation and afterward vice-president in charge of traffic and commercial development. He became Federal manager of the system last year. He was graduated from Allegheny College in 1897 and entered the service of the Baltimore & Ohio in 1899 as assistant engineer of surveys on the Pittsburgh division. A year later he was

appointed division engineer of the Pittsburgh division. In 1903 he became superintendent of the Cumberland division and later of the Wheeling division. In 1907 he was appointed chief engineer maintenance of way, becoming chief engineer three years later. It is expected that Mr. Thompson will assume his duties as president of the Philadelphia Co. in February.

MAJ. R. S. BUCK, 11th Engineers, U. S. A., has returned from France and has received his discharge from the Army. He will resume his position as engineer maintenance of way of the New York Railways Co.

JACOB LOUIS JACOBS, who has been engaged on special staff work for the United States Shipping Board, Emergency Fleet Corporation, has returned to his work as head of J. L. Jacobs & Co., industrial engineers, Monadnock Building, Chicago.

MORRIS L. COOKE, BOYD FISHER, KEPPELE HALL, HORACE K. HATHAWAY, CLYDE L. KING and JOHN H. WILLIAMS have become associated as consulting engineers in management, with offices in the Finance Building, South Penn Square, Philadelphia.

COL. WILLIAM B. LADUE, 207th Engineers, U. S. A., who recently returned from France, has been appointed district engineer, Delaware River and Bay district, with headquarters in the Witherspoon Building, Philadelphia. He was previously in charge of the Contract Division of the War Department, with the rank of major, and in 1913 was placed in charge of the river and harbor improvements at Jacksonville, Fla.

JOSEPH MELTZER, previously engineer, Casper Ranger Construction Co., Boston, and lately resident manager, United States Housing Corporation, Quincy, Mass., has organized the firm of Joseph Meltzer & Co., engineers and contractors, with office at 31 Beach St., Boston, to engage in general contracting work, specializing in the construction of paper mills and other industrial buildings.

LIEUT. FRANCIS W. DU BOIS, Sanitary Corps, U. S. A., who has been stationed at Selfridge Field, Michigan, as camp sanitary engineer for the past five months, has been discharged from the service and will resume the practice of civil and municipal engineering at an early date. He was previously a member of the firm of Cory and Du Bois, Inc., engineers, Baker, Mont.

H. LOU MILLER, formerly engineer with the duPont Engineering Co., on the construction of the power plant at Nashville, has entered the service of the Portland Cement Association, at Kansas City, Mo.

O. W. CHILDS, senior highway engineer and highway bridge engineer, Bureau of Public Roads, Washington, D. C., has removed to Denver, to become superintendent of the Denver Steel & Iron Works. In 1890 Mr. Childs entered the employ of the Chicago Bridge & Iron Co., remaining in structural work until he entered the Bureau of Public Roads five years ago.

LIEUT. WILLIAM P. DANFORD, 139th Engineers, U. S. A., has received his discharge from the service and has returned to the Oklahoma State Highway Department as district engineer, in which he previously served as assistant state engineer.

R. A. MILLER, F. D. HOLBROOK, and W. D. P. WARREN have become associated under the firm name of Miller, Holbrook, Warren & Co., civil engineers, Decatur, Ill., combining the firms originally known as the Miller-Holbrook Engineering Co. and the Warren Engineering Co. The new firm will specialize in general municipal improvements and reinforced-concrete structures.

HARRISON GRAY OTIS, city manager of Auburn, Me., has resigned to become associated with the American City Bureau, with office in the Tribune Building, New York City. Mr. Otis is secretary of the City Managers' Association.

MAJ. LEWIS E. MOORE, Corps of Engineers, U. S. A., who was in charge of heavy highway bridge work with the American Expeditionary Forces in France, has returned to the United States and has received his discharge, reassuming his connection as engineer of the Massachusetts Public Service Commission.

F. J. WALSH, consulting engineer, Astoria, Ore., who was engineer of sewer construction at Camp Lewis, has been appointed consulting engineer of the Port of Tacoma, Wash., in the development of plans for harbor improvements.

MAJ. MURRAY BLANCHARD, 520th Engineers, has returned from France and has received his discharge from the service. He was formerly connected with the Sanitary District of Chicago.

JAMES A. BUTLER and F. ALBERT HAYES have become associated under the firm name of Butler & Hayes, Inc., experimental engineers and mechanical and chemical consultants, with office and laboratories at 220 Devonshire St., Boston.

JOHN M. MALANG, superintendent of the special road district, Joplin, Mo., has been appointed secretary of the Missouri State Highway Commission.

OBITUARY

ROLLA C. CARPENTER, professor emeritus of experimental engineering, Cornell University, died at his home at Ithaca, Jan. 19. He was born in 1852, and was graduated from the University of Michigan in 1877, after which he served for one year as assistant engineer on the construction of the Detroit & Bay City R.R. From 1878 to 1890 he was professor in charge of the department of mathematics and civil engineering, Michigan Agricultural College. In 1890 he became associate professor of experimental engineering and was in charge of that department at Sibley College, Cornell University. He had engaged in a considerable amount of consulting engineering work, particularly in the installation of water-supplies.

GEORGE SHERWOOD HODGINS, editor of *Railway and Locomotive Engineering*, died in New York, Jan. 18, at the age of 59. He was born in Toronto, and for a number of years was mechanical engineer of the Canadian Pacific Ry. He went to New York about 20 years ago and since then served as an editor of *Gas Age* and *Railway Age*, later becoming associated with *Railway and Locomotive Engineering*, with which he was connected for 15 years.

CHARLES E. VOGDES, engineer, Second District of the Highway Bureau of Philadelphia, died in that city Jan. 12. He entered the service of the Park Commission of the city in 1894 and in 1901 was appointed one of the highway commissioners who later were succeeded by the district engineers in the Highway Bureau.

FREDERICK BROOKS, past president of the Boston Society of Civil Engineers, died in Boston Jan. 10. He was graduated from Harvard in the class of 1868 and afterward took a course at the Massachusetts Institute of Technology. Besides his work in this country, he was at one time engaged on the construction of the Mexican Central R.R. For several years he was secretary of the Association of Engineering Societies, acting also as editor of the *Journal* of the association.

BERNT BERGER, consulting engineer, New York, died in that city Jan. 16. He was born in Norway in 1866 and came to this country in 1886, becoming associated with Theodore Cooper, under whom he served for some time as assistant engineer on various bridge and railway projects. He was engaged in the construction of the Mexican National Ry. shops at Laredo, Tex. Mr. Berger was a past president of the Brooklyn Engineers' Club.

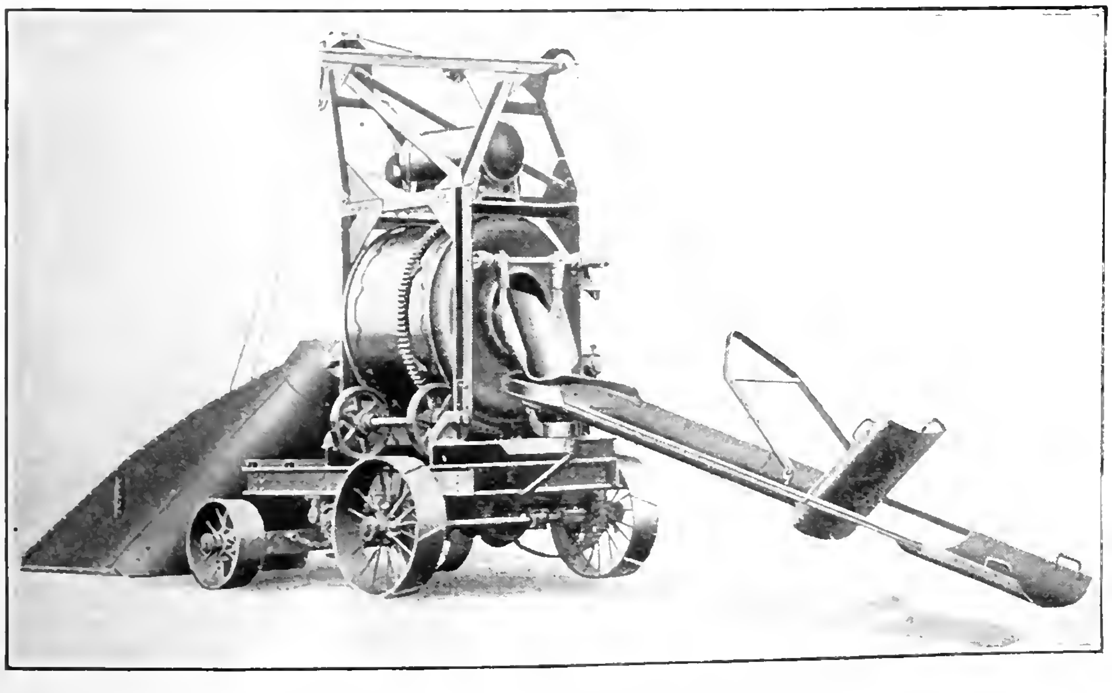
Dunn Wire-Cut-Lug-Brick Patents Are Sustained

The Dunn Wire-Cut-Lug Brick Co., of Conneaut, Ohio, was sustained by the United States Circuit Court of Appeals of the Sixth District in its suit against Joseph Nicholson et al, of Toronto, Ohio, for infringement of its patent number 918,980 dated Apr. 20, 1909, on wire-cut-lug paving bricks. The court affirmed the validity of the patent, declaring it basic and requiring a discontinuance of manufacture and an accounting by the defendant.

The suit grew out of the making and selling by the defendant of wire-cut brick having lugs cut with a knife instead of wires. In rendering its decision the court held that the Dunn brick was a new and useful invention; that its wide, general use aided in establishing its character; that it was an improvement on other wire-cut brick, and was produced by simple means; that the invention was protected by a basic patent, and that the method of cutting the lugs made no difference, since, whether the cutting be done by wire or knife or saw, the methods are equivalent, and the Dunn company is entitled to protection.

Paver That Can Be Used in Alleys as Well as in Streets

A concrete mixer and paver of a new design in which larger capacity is attained without sacrificing compactness, is shown in the accompanying illustration. It is adapted to work in alleys and other tight places as well as to the usual street work. It is 7 ft. 3 in. wide and 14 ft. 4 in. long, with loader down as shown, but without spout. Its height is 11 ft., allowing ample head room for the ordinary bridges and viaducts. It is self-propelled at speeds up to 1½ miles per hour, and has a capacity of 10, cu.ft. dry material per batch, or 8 cu.ft. wet mix. The distributing spout swings in 180° limits, has adjustable pitch and is provided with gates for discharging the concrete in three places. It is manufactured by the Lansing Co., Lansing, Mich.



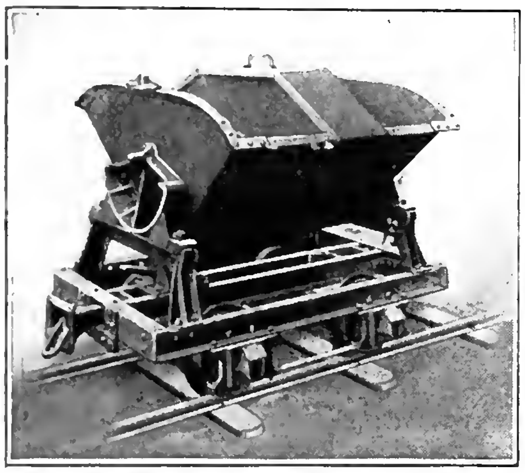
PAVER FOR USE IN RESTRICTED AREAS

Material-Handling Machinery Makers Form Association

Manufacturers of material-handling machinery met in New York Jan. 15-16 to organize an association to promote the development of their products. A temporary organization under the leadership of James A. Shepard, of the Shepard Electric Crane & Hoist Co., was effected. It is expected that the permanent association will be complete in a few days.

Car Measures Correct Amounts for Concrete Mix

A 1-yd. tram car has been designed to hold and convey complete and properly proportioned quantities of concrete material from a central storage or loading plant to the concrete mixer. After the car is loaded with sand and stone it is run past the cement shed where the cement box, which is water-tight,



CAR FOR CONCRETE INGREDIENTS

is filled, either with bulk or bag cement. This makes possible the use of bulk cement on the job exclusively, but if bag cement is used the cement compartment may be employed to return the salvaged bags to storage. When the cars reach the mixer the body is lifted off the running gear, and the complete batch is dumped into the charging skip of the mixer. The cement box is removable, making the car a 1-yd. V-dump, and the entire body may also be removed from the truck, thus converting it into a flat-car on which forms, track or other material may be hauled. The car is manufactured by the Lakewood Engineering Co., Cleveland, Ohio.

Business Notes

Walter Snyder, former associate of Frederick A. Waldron, has formed a partnership with Addison G. McKean, under the firm name of Snyder & McKean, industrial and consulting engineers, with offices in the Kinney Building, Newark, N. J.

H. W. Clarke, who was until recently connected with the advertising department of the McGraw-Hill Co. in Chicago, has been appointed manager of advertising for the Chicago Pneumatic Tool Co., Chicago. Mr. Clarke has been identified with the engineering advertising field for several years.

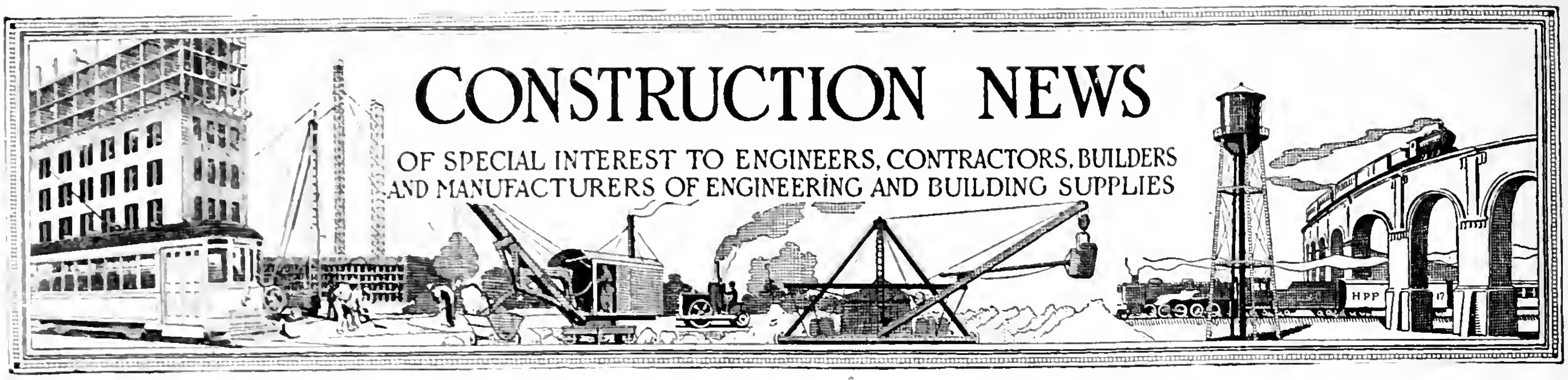
The Whiting Foundry Equipment Co., Marquette Building, Chicago, Ill., whose general office and works are at Harvey, Ill., announces that Samuel Moore, formerly general manager of the Bond plant of the American Radiator Co., succeeds F. A. Rundle as general superintendent, and E. V. Brown and Walter R. Hans, of the company's engineering staff, will be attached to the Chicago office of the company.

First Lieut. C. F. Messinger, chemical warfare section, stationed at Camp Kendrick, Lanehurst, N. J., has been mustered out of service and has returned to his former position as manager of the sales department of the Chain Belt Co., Milwaukee.

Trade Publications

"Steel Tile Forms" is the title of bulletin 12A issued by the Northwestern Iron Works of Eau Claire, Wis., incorrectly noted in *Engineering News-Record* of Jan. 2, p. 70, due to a typographical error.

"Jeffrey Bucket Elevators" is the title of catalogue No. 244, issued by the Jeffrey Mfg. Co., Columbus, Ohio. The book contains 40 pages, illustrated by half tones and line cuts, and gives other information regarding the styles used in handling materials of all kinds. The book is in pamphlet form, 8½ x 11 in., making it convenient for filing in ordinary letter files.



PROPOSALS

For Proposals Advertised See Pages 52-54 Inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Jan. 31	Poteau, Okla. Adv. Dec. 19 and 26.	Dec. 26
Jan. 31	Bradentown, Fla.	Jan. 16
Feb. 3	Maple Heights, O.	Jan. 16

SEWERS

Feb. 1	Lincoln, Neb.	Jan. 23
Feb. 5	Portvue, Pa.	Jan. 16
Feb. 8	Granite City, Ill.	Jan. 23

BRIDGES

Feb. 3	Charlotte Harbor, Fla. Adv. Dec. 19, 26, Jan. 2 and 9.	Jan. 2

STREETS AND ROADS

Jan. 27	Louisiana	Jan. 16
Jan. 27	Nevada	Jan. 9
Jan. 29	New York, N. Y.	Jan. 23
Jan. 30	Crestview, Fla.	Jan. 23
Jan. 31	Ohio	Jan. 16
Feb. 3	Santa Barbara, Cal.	Jan. 23
Feb. 3	Indiana	Jan. 23
Feb. 3	Wichita, Kan.	Jan. 9
Feb. 4	Indiana	Jan. 23
Feb. 5	Indiana	Jan. 23
Feb. 5	Hartville, Mo.	Jan. 23
Feb. 5	Indiana	Jan. 9
Feb. 7	Norton, Kan.	Jan. 23
Feb. 10	Fayetteville, W. Va.	Jan. 16
Feb. 11	Indiana	Jan. 23
Feb. 11	Moulton, Ala.	Jan. 16
Feb. 17	Philippi, W. Va. Adv. Jan. 23.	Jan. 23
Feb. 18	Indiana	Jan. 23
Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 20	Hamlin, W. Va.	aJn. 23
Feb. 20	Rumson, N. J. Adv. Jan. 23.	Jan. 23
Mar. 4	Ripley, W. Va.	Jan. 23

EXCAVATION AND DREDGING

Jan. 27	Madison, S. D.	Jan. 9
Feb. 3	Madisonville, Ky. Adv. Dec. 5, 12 and 19.	Dec. 12
Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 19	Albany, N. Y. Adv. Jan. 23.	Jan. 23

INDUSTRIAL WORKS

Jan. 28	New York, N. Y.	Jan. 9
Jan. 28	New York, N. Y.	Jan. 23
Feb. 3	New York, N. Y.	Jan. 23
Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Mar. 4	Thiells, N. Y.	Jan. 16
Apr. 1	Sioux City, Ia.	Jan. 16

BUILDINGS

Bids Close		See Eng. News-Record
Jan. 24	Detroit, Mich.	Jan. 23
Jan. 25	Asbury Park, N. J.	Jan. 9
Jan. 27	Hillsboro, Kan.	Jan. 23
Jan. 28	Phila., Pa.	Jan. 23
Jan. 29	West New York, N. J.	Jan. 23
Jan. 30	Phoenix, Ariz.	Jan. 2
Jan. 30	Eagle, Neb.	Jan. 16
Feb. 1	Irvington, N. J.	aJn. 23
Feb. 3	Melbourne, Fla.	Jan. 9
Feb. 3	St. Paul, Minn.	Oct. 31
Feb. 3	Leavenworth, Kan.	Jan. 23
Feb. 5	Portland, Mich.	aJn. 23
Feb. 11	Lusk, Wyo.	Jan. 23
Feb. 14	Brooklyn, N. Y.	aJn. 23
Feb. 24	Norwood, O.	Jan. 23
Mar. 1	Duluth, Minn.	Jan. 23
Mar. 3	Rockport, Ind.	Jan. 23
Mar. 15	Culver, Ind.	Dec. 26
Apr. 2	New York, N. Y.	Jan. 23

FEDERAL GOVERNMENT WORK

Jan. 27	Extending Pneumatic Tube System, etc.—Spec. 3658—Hampton Roads, Va.	Jan. 16
Jan. 27	Heating Hangar—Spec. 3748—Anacostia, D. C.	Jan. 16
Jan. 27	Gas Holder, Removing System, etc.—Spec. 3594—North Ft. Worth, Tex.	Jan. 16
Jan. 28	Dredging—Key West, Fla. Adv. Jan. 2 and 9.	Jan. 2
Feb. 3	Dredging — Spec. 3579 — Ft. Lafayette, N. Y.	Jan. 16
Feb. 3	Kitchen Equipment—Spec. 3730—Chelsea, Mass.	Jan. 16
Feb. 3	Water Tower, Pump and Tank House Equipment—Spec. 3682 — Philadelphia, Pa.	Jan. 16
Feb. 4	Boilers—Memphis, Tenn. Adv. Jan. 9.	Jan. 9
Feb. 4	Turbine, Pumpset, etc. — Memphis, Tenn. Adv. Jan. 9.	Jan. 9
Feb. 10	—Metal and Glass—Baltimore, Md. — Adv. Jan. 16.	Jan. 16
Feb. 10	Portland Cement — Denver, Colo.	Jan. 23
Feb. 11	Bridge—Washington, D. C. Adv. Jan. 16.	Jan. 16
Feb. 12	Elevator, etc. — Ft. Worth, Tex. Adv. Jan. 23.	Jan. 23
Feb. 15	Laboratory — Washington, D. C. Adv. Jan. 23.	Jan. 23
Feb. 21	Dredging, etc. — Norfolk, Va. Adv. Jan. 23.	Jan. 23
Feb. 25	Jetty Work—Sabine Pass, Tex. Adv. Jan. 23.	Jan. 23
Mar. 1	Foundation and Rip Rap—Baltimore, Md. Adv. Jan. 16.	Jan. 16
Mar. 1	Dredging—Superior, Wis.	Jan. 16

MISCELLANEOUS

Feb. 3	Dam—Los Angeles, Cal.	Jan. 9
Feb. 11	Boilers and Piping, etc. — Utica, N. Y.	Jan. 23
Feb. 14	Additional Window Guards —Bedford Hills, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 14	Pier—Phila., Pa. Adv. Jan. 23.	Jan. 23
Feb. 19	Gantry Crane — Seattle, Wash. Adv. Jan. 2 and 9.	Jan. 2

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Mass., Danvers—Town applied to State Legislature for authority to borrow $200,000 to rebuild and relay watermains, improve storage, pumping and distributing facilities.

Mass., Fitchburg—City applied to State Legislature for authority to borrow $300,000 to extend present water-works system. F. H. Foss, mayor.

Mass., Watertown—(Middlesex P. O.)—Metropolitan Water & Sewer Comn., Ashburton Pl., Boston, asked State Legislature for authority to issue $115,000 bonds to build mains, pipe lines, conduits, etc., and provide additional water supply from southern high service for Watertown and Belmont Twps.

Md., Princess Anne—Town Comrs. plan to build water distribution system including 1 or more wood stave tanks, installing gasoline pump and laying terra cotta and c.i. pipe. About $60,000. C. Laukford, pres. L. J. Houston, Fredericksburg, Va., engr.

Minn., St. Paul—City plans to build 7 mi. concrete conduit 7 ft. diameter, to carry water from Lake Vadnais to McCarron Lake. About $300,000. O. Claussen, city engr.

Kan., Hiawatha—Comrs. Brown Co. having plans prepared for new water supply pump house, pumps and about 2 mi. pipe and transmission lines. About $25,000. Black & Veatch, Interstate Bldg., Kansas City, Mo., engrs. Noted Dec. 26.

Okla., Miami—City plans to build rein.-con. reservoir, 12 x 85 x 145 ft. deep with 1,500,000 gal. capacity. R. Q. James, city clk.

Ore., Astoria—Capital Issues Com. granted permission to Astoria Water Comn. to sell $50,000 bonds to complete high service reservoir. A. Johnson, supt.

Cal., Hayward—City retained Olmsted & Gillelen, engrs., 1112 Hollingsworth Bldg., Los Angeles, to prepare plans and submit estimate for water works system.

Cal., Pittsburg—City retained Olmsted & Gillelen, engrs., 1112 Hollingworth Bldg., Los Angeles, to prepare plans and submit estimate for water works system.

Cal., Sacramento—City election Apr. 30, to vote on $1,200,000 bonds for water filtration plant. F. C. Miller, city engr.

Ont., Peterborough—Utilities Comn. purchased site at north end of city and plans to build filtration plant.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract.)

Mich., Detroit—H. S. Starkey, secy. water comn., 232 Jefferson Ave., received bids Jan. 14, furnishing 1000 tons 6 in. c. i. pipe and 1000 tons 8 in. c. i. pipe, from Amer. Cast Iron Pipe Co., 512 1st Natl. Bank Bldg., U. S. Cast Iron Pipe Co., 122 South Michigan Blvd., J. B. Clew & Son, Harrison St. Bridge. Contractors all of Chicago and each bid $63.60 per ton. Noted Jan. 9.

★**Mich., Wyandotte**—City let contract furnishing and laying 1450 ft. submerged intake pipe and elbows equipped with flanges and joints, removal of existing elbow, relocating existing crib, final testing, dredging and backfilling and all labor and material involving 1450 ft. 24 in. c. i. pipe, to A. Q. Thatcher Constr. Co., 8 Marine Bldg., Toledo, O. About $37,500. Noted Jan. 9.

Sewers

PROPOSED WORK

Conn., Bridgeport—City plans to build sewers in east end section. About $300,000. J. A. McElroy, city engr.

Pa., Scranton—City receives bids in June building sewerage system in 21st Ward. About $165,000. W. A. Schunk, city engr. Noted Aug 15.

Ia., Davenport—City plans to build 400 ft. 66 in. storm drain sewer and 1300 ft. tunnel in Blackhawk Creek Dist. About $100,120. R. E. Sawistowsky, city engr.

Ark., Hot Springs—City soon lets contract building sewers in Sewer Impvt. Dist. No. 40, 6 in. mains, cost, $4200; also in Impvt. Dist. No. 43, 6 and 8 in. mains, $9000. F. A. Stearns, comr.

Tex., Dallas—City plans to build 1300 ft. monolithic concrete and tile pipe storm sewer in Grand Ave., from Oakland to Meyers Sts., cost. $7766; 800 ft. 30 in. rein.-con. sewer in Oakland Ave. from Forest Ave. to South Blvd., $4040; 12,000 ft. 30-60 in. monolithic concrete pipe and 15 to 24 in. tile sewer in Douglas St. Dist., $70,150; 1500 ft. 15-24 in. tile pipe sewer in Fair Park, $8941. G. D. Fairtrace, city engr.

A Consolidation of Engineering News and Engineering Record

McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, JANUARY 30, 1919 — Number 5

Self-Government of Construction Camps

A NOTABLE experiment in construction camp democracy is outlined on p. 235. Camp rule ordinarily is imposed by the contractor. Instead, on the Miami flood-protection works all affairs pertaining to community life are in the hands of the camp residents. Outside of, and above the community organization, stands the Conservancy District administration, but its authority is imposed only as a beneficent influence for sound self-government. It guards democracy. This undertaking in construction camp self-government promises to create a more stable working organization, to intensify community interest and pride in the basic enterprise, and to make the workman a partner. Contractors should watch the experiment closely.

Will the Railroad Administration Discourage Building?

JUST at this time, when the country is becoming seriously worried over the business inaction which is leaving thousands of men on the street unemployed and threatening bread lines in the near future, comes a movement in the Middle West to increase freight rates on sand, gravel, stone and slag in Central Freight Association territory—the increases for two-line haul running as much as 90 per cent above rates for the same mileage for single-line-haul producers. Hearings are to be held in Chicago on Thursday of this week before C. J. Brister, chairman of the Central District Freight Traffic Committee, and it is hoped that wise counsel, taking into consideration the national interest in the large, will prevail. Freight increases on these vital building materials will still further defer the opening of a large volume of construction work, and on the renascence of the construction industry every thinking man in the United States, from the President down, is pinning his hope that disaster may be averted. The proposed increase is a simple case of loading on to the traffic more than it will bear. At present there is little tonnage in these materials, and there is sure to be less if the rates are increased. From the standpoint of the Government, therefore, which must bear railroad deficits now, it will be better to leave the rates as they are, or even to reduce them, and thus get some revenue in hauling these commodities, than to scare away prospective business by prohibitive rate increases. Moreover, even if there should be some losses at the present, or at lowered, rates, the Government can afford to bear them rather than have the country suffer the serious economic loss which will come from unemployment and its attendant evils. Anything which tends further to discourage construction work is a blow to the country. For patriotic, for sound economic, reasons rates in the Central Freight Association territory should not be disturbed.

Not Only By Their Work Shall Ye Know Them

ENGINEERS have fondly believed that most of the problems that come under that much overworked word "reconstruction," as currently used, are within their province. Certainly, every day is proving that industry and labor will loom larger in the readjustment period than anything else, and who has a more intimate knowledge of industrial conditions and labor difficulties than the engineer? It is, then, disappointing to find in Governor Smith's New York reconstruction commission of 36 men and women only one engineer, and he a man of intense specialization. Business men have nine representatives; bankers, eight; lawyers, four; sociological experts, three, and labor, two. Editors, doctors, farmers, and engineers have one each; the rest are difficult to classify. The distribution is significant of current opinion, for all published comments agree that the Governor has carefully selected an able and representative group. The engineer is in part responsible for this attitude. What a man thinks and does may make little impress on the world at large, unless the world is told of his thoughts and actions. So it is with the engineering profession. Until it becomes vocal, through its individuals and organized societies, the world will consider it a group of master artisans, quite capable of solving the material problems of construction and manufacture and distribution, but subservient to the banker, the business man, and the lawyer in the great science of living.

Little Room for American Endeavor in France

IN THE issue of Jan. 2 *Engineering News-Record* answered the question frequently asked, "Are American engineers and contractors wanted in France and Belgium?" The answer, viewing conditions as they are now, was, emphatically, "No." Following up that answer we are fortunate in being able to present in this issue two articles that go into the French situation more fully—that give the facts as to the extent of the destruction, and discuss the plans for rehabilitation. Mr. Ford, the author of the longer article, has had, in his capacity as head of research for the American Red Cross, exceptional facilities for ascertaining the facts. There could be no higher authority. Mr. Williams, oc-

cupying the position of commercial attaché of the American embassy in France, gets a somewhat different light on the situation. Looking into the spirit of those who are planning the rehabilitation, he reports a disposition to abandon ruins which have been replaced by properties elsewhere in France. On one point he is decidedly specific—that the prospects for getting business for Americans from the devastated zone are not encouraging. Moreover, this idea is conveyed, too, by Mr. Ford's article, when he reviews the ability of France to supply her own building materials. Altogether, it seems advisable for American engineers, contractors and manufacturers who want engagements or business in foreign lands to look elsewhere than in France. While *Engineering News-Record* has not been able to get equally full information regarding Belgium, such word as has come to hand indicates conditions identical with those of France, so far as prospects for American endeavor are concerned.

Have the Railways Used the Engineering Profession Well?

THE engineering profession may justly claim to be the creator of the railway. All its structures and machinery existed in the engineer's brain before they assumed concrete form. Yet there is probably not an industry which has so signally failed to give the engineer proper position and compensation.

The low pay of engineers in railway service has been long notorious. It was prominently brought forward in the statistics of the earnings of engineers in various occupations collected by the American Society of Civil Engineers a few years ago. Elsewhere in this issue detailed figures are given for railway engineers' pay, compiled from the Government's official statistics. The showing is one that may well command the attention of the profession and ought to awaken public interest.

For it is not difficult to establish a relation between the failure of the railways properly to use and reward the engineer and their failure to earn the profits which they should. It is well to recall that famous definition of an engineer as "a man who makes a dollar earn the most interest." That definition was the result of a noted engineer's practical experience in railway work.

There is no claim here that engineers can perform miracles. They cannot prevent the great increase in wage rates and the eight-hour day from producing a huge increase in railway operating expenses. The engineers and draftsmen who are kept doing mere routine work can do very little, admittedly, to help the railways out of the financial slough in which they now lie. But there are engineers in railway service who with proper authority and funds could do a great deal to save money for the railways.

Director General Hines has just announced that $491,000,000 will be spent this year on additions and betterments. This work must be done under the direction of engineers. Has all this work received thorough investigation by competent engineers, so as to insure maximum economy? That the work has been passed on by a board of engineers is doubtless true; but every experienced construction man knows that time and money spent in preliminary investigations will often result in saving ten times the amount in the cost of carrying out the work.

There is no doubt that in many railway companies an engineering organization has been built up which has done able and conscientious work, notwithstanding the handicap of inadequate pay; but it is not fair to the men who render this service nor safe to the railway's financial position to continue to pay less for good service than it is worth. The railway engineer has as good a right to a living wage as the blacksmith or the baggageman and as good a claim to a return on his investment in education and experience.

Sanity In Planning Passenger Terminals

HAVE we arrived at any degree of sanity in the consideration of railway terminal problems? The action at Cleveland, in endorsing by popular vote the railway-terminal project described elsewhere in this issue, puts the problem squarely, not only before the engineers who have dealt with the Cleveland situation, but before the whole profession. The question concerns the larger elements involved in terminal planning, such as location, desirability of centralizing all roads in one station, etc. Moreover, the situation makes opportune a discussion of the justification for exceedingly heavy terminal expenditures.

Briefly, the situation at Cleveland is this: For years there has been agitation for a new station on the lake front, resulting finally in a well matured plan of making the new station fit in with a civic-center development. Then, as out of a clear sky, comes a proposal to scrap these plans of long consideration and to place a terminal to accommodate all roads, and electric interurbans also, in a station adjoining the Public Square. With a hurrah, Cleveland's citizens drop the former plan and approve the new one—despite the declared disapproval of the Cleveland Engineering Society, and the condemnatory import of the report by Col. Bion J. Arnold, engineer to the Chamber of Commerce, on the terminal problem.

Apparently, the points that won the day were the proximity to the Public Square and the union of all railroads and interurbans under one roof. Yet are not these the very reasons why sound planners for a city's future should reject the scheme? The Public Square is already the point of maximum congestion in Cleveland—yet the new scheme would concentrate still more people there. Again, is not the unification of all passenger terminals a fetish too long pursued by terminal planners? It, too, tends toward more severe rather than lessened congestion.

"Convenience to the public demands a single station," is the answering cry. Convenience to how many of the public? For what percentage of passengers is this accommodation allowed to work all manner of inconvenience to every other passenger and to every citizen coming near the congestion-creating union station?

Is it not time to find out how many passengers transfer from road to road, and to balance against the benefit to these strangers the rights of all other travelers and of the city and its inhabitants as a whole?

Finally, is this not the time to challenge the whole idea of $20,000,000 and $40,000,000 and $50,000,000

passenger-terminal projects? Who has studied the operating costs of a number of modest stations, as against one huge central terminal? Who has frankly faced the added capital cost of new lines (property costs and all), to reach the central point? Who has data to show that from the railroads' point of view the huge central station is a profitable business venture?

Rank heresy—so will this be branded. But there is urgent need of new thinking on the whole question of city railroad terminals. There needs to be a new appraisal of all the factors, there needs to be a frank breaking away from previous methods of terminal thought. Above all, there needs to be a spade-calling era in which there will be no mincing of words as to the business aspect of large union stations. If a city demands a great monumental terminal—which may be a monumental white elephant, financially, in an operating way and even to the city, on account of the creation of congestion—let the truth be known, and then, if the city demands this addition to its architectural beauties in order to tickle its civic pride, let it assume the burdens which the plan involves over and above those of a sound business solution of the problem.

If this be heresy, we are glad to be heretical.

Why Not Use Machinery for Snow Removal at Railway Terminals?

AN IMPENDING emergency problem which is likely to be presented to railway officials on short notice at this season is that of handling heavy snow at city terminals and yards. As this is a recurrent problem, it should be studied jointly, and evidently in advance, by the engineering, operating and mechanical departments. Speaking generally, however, there seems to be a continual state of unpreparedness, except for reliance upon old and inadequate methods. Consequently, when heavy snowfalls occur, terminals are likely to be blocked and traffic interrupted, or even stopped in exceptional cases, although on the open road trains may be able to operate with some degree of regularity.

Machinery for snow handling at terminals has not received much attention in the past, but present labor conditions should be an incentive to active consideration of the possibilities of mechanical devices. Man-power is the main factor in the old-time methods, and in former years an abundance of temporary labor has been available. The serious shortage of such labor in the winter of 1917-18 showed the unwisdom of relying continually upon man-power.

Moreover, manual labor is largely ineffective, even when the supply is ample, a fact made evident in some cases last winter. When large terminals were nearly or entirely closed, owing to deep snow, the measures adopted consisted almost entirely of the use of large gangs of shovelers. Crowds of men were to be seen, each carrying his shovelful of snow for some considerable distance to a dumping point between or beyond the tracks, and then returning for another load. Progress was necessarily slow on account of the storm and cold, the heavy clothing of the men, and because they had to tramp through snow and across numerous tracks and obstructions.

Steam-heated pits to receive the snow, with connections to city sewers, are provided in the Chicago station yard of the Chicago & Northwestern Ry., but these apparently are not sufficient for the need. As a rule, the snow is piled in some more or less convenient place where it has to be loaded into cars for removal.

That snow-handling machines would be required only occasionally, and for short periods, has been urged as one reason for failure to develop them. But when snow removal is necessary it is urgent, and the needed machines come into the same category as snow plows, snow fences and other special equipment.

A type of machine that suggests itself consists of a wide continuous chain or belt excavator, carried on an inclined pivoted boom attached to the forward end of a car, and delivering the snow to a horizontal conveyor extended back to load cars placed between the excavator and the propelling locomotive. A frame carried by wheels riding on the track rails would support the outboard end of the boom and would be fitted with flangers to clear the rail heads and so prevent derailment. Flangers in the shape of revolving wire brushes might be less liable to injury at frogs and switches than ordinary flanger blades.

Pilot plows and flanger cars may suffice to keep tracks open during a moderate snowfall, but when a heavy fall buries the tracks these devices become largely ineffective. Bucking plows can rarely be used to advantage at terminal yards, as they cannot be operated at the necessary speed, and there is likelihood of derailment on the numerous frogs and switches, especially when these are clogged with ice and snow. Rotary plows are not often available, and for effective work they need a greater depth of snow than is usually encountered near cities, while throwing the snow to a considerable distance by such a machine might cause greater trouble than the snow blockade.

Freight yards constitute a specially difficult problem, since, with snow drifted under long lines of cars, it becomes almost impossible to get the cars out. If attempt is made to move them with a locomotive there is likelihood of pulling out drawbars, or of derailment by wheels riding up on the snow packed in front of them. Shoveling seems to be the only method practicable for such cases, although it is likely that even this problem might be solved in some simple manner if it were given careful study. Spreader cars may be useful in clearing yard entrances and unoccupied tracks.

Blocked switches cause serious delay where frequent train movements are involved, and both gas and electric heaters for these moving parts have been used to a limited extent. Such installations on the New York Central Railroad were noted in *Engineering News-Record* of Dec. 19, 1918, p. 1120. The total cost, including purchase price and operating cost, is probably negligible, considering the very important result of keeping the tracks open and reducing detention of trains.

Two months of winter are still to be faced on a large part of our railway system, so that there is opportunity as well as reason for the study of this important problem. Surely, the present methods of grappling with it indicate clearly a failure to apply to it the same sort of analytical and constructive study that is generally associated with problems of traffic maintenance.

The Facts on the Devastation and the Present Reconstruction Efforts in France

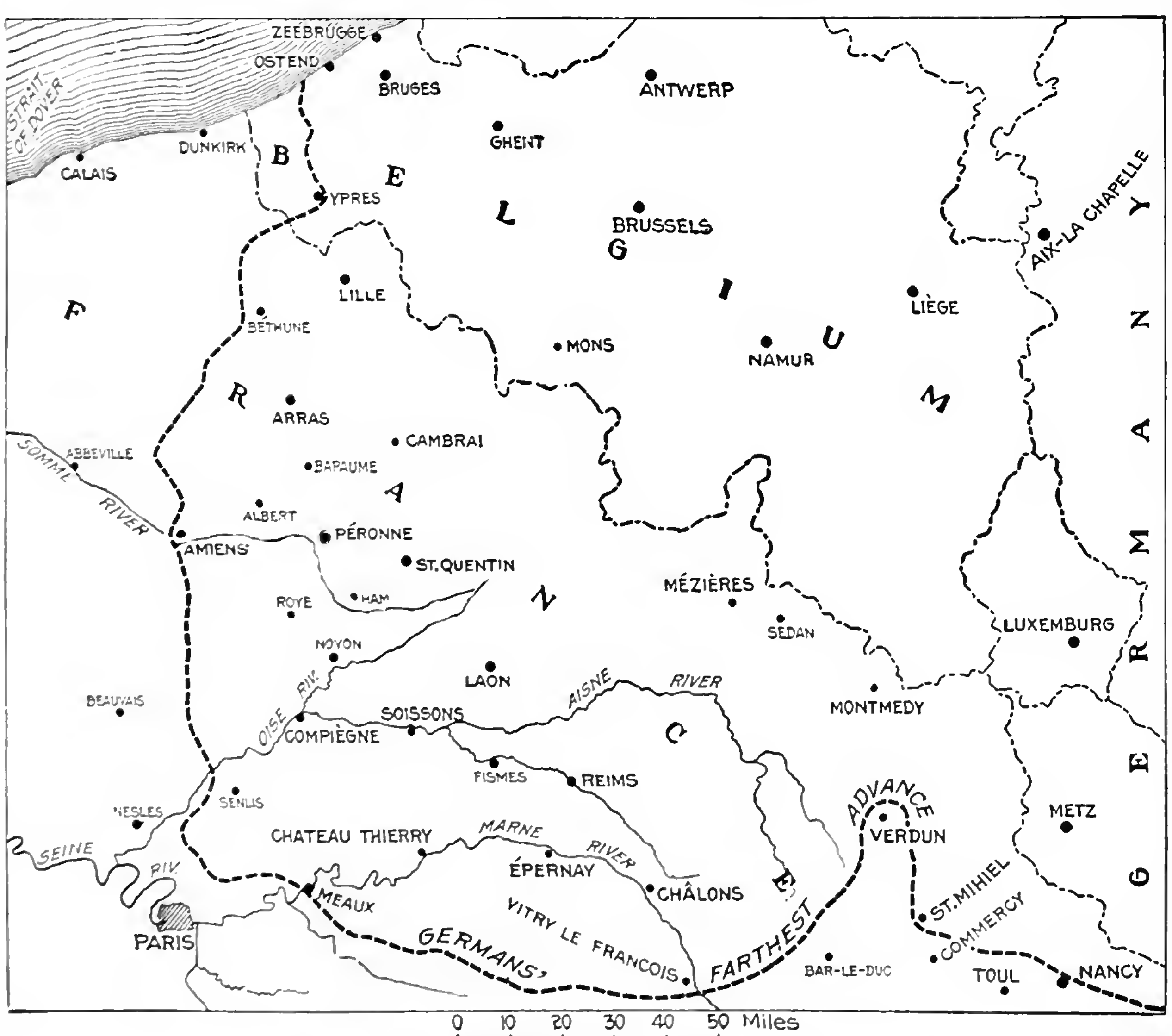
Detailed Summary of the Extent and Character of the Destruction, With a Complete Account to Date of the Measures, Official and Otherwise, to Reëstablish the Invaded Regions

By George B. Ford

Deputy Commissioner of the American Red Cross, Paris, in Charge of Research Work; Formerly Consulting Specialist on Town-Planning, New York City

Further light on the situation in France will be found in the news section of this issue, in the form of a most illuminating interview with Pierce C. Williams, commerical attaché of the American embassy in Paris, who has just returned from France. He answers more specifically the questions regarding trade possibilities and the financial difficulties involved in the rehabilitation work.—Editor.

So stupendous is the destruction in the devastated regions of France that no one can begin to realize what it means. It is only by traveling day after day in an automobile through village after village and town after town, often where nothing is standing erect more than a few feet above the ground, that one can begin to have any conception of its enormousness. The destruction varies much in its completeness. Often where there has been only minor shellfire, one finds just the roofs and the windows gone. Or again, in towns like Vaux or Suippes, that have been through a terrific bombardment, one hardly appreciates that he is passing what was formerly a village, so thoroughly churned up are the buildings and the ground.

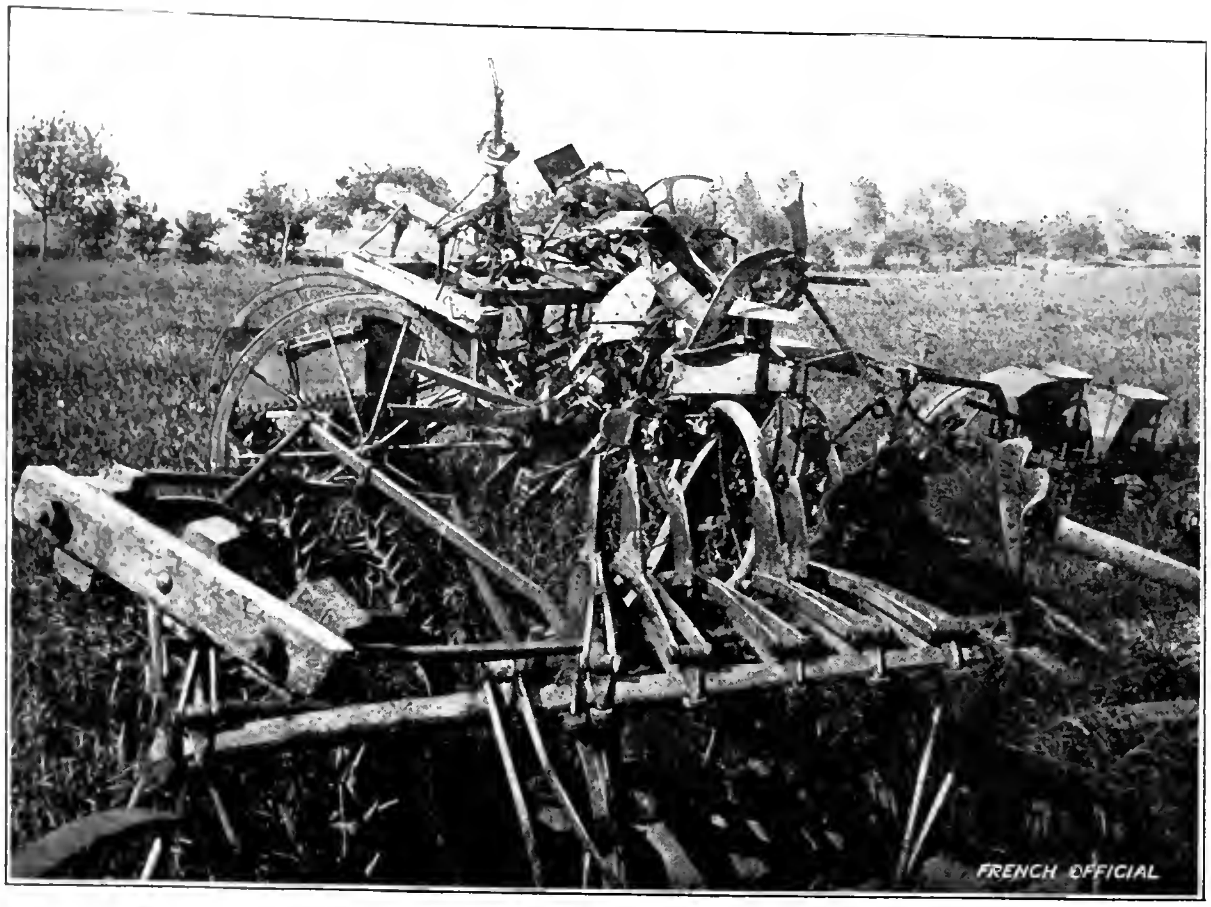


MAP SHOWS DEVASTATED REGION OF FRANCE

In general, where there has been a rapid advance or retreat there has been very little destruction, but where the opposing armies have faced each other for a considerable length of time in one spot the destruction is almost always intense and often complete. For example, in the great German drive of September, 1914, very little destruction was caused, but at the places where the hardest fighting occurred, at the turning of the battle of the Marne—that is, along by Meaux, Sezanne, Vitry-le-François and Revigny—the destruction is quite complete, but only for a narrow fringe where the battle was hardest. The same thing is true along the battlefronts in the Somme and the Aisne, where the hardest fighting took place; there is complete destruction extending over a belt rarely over 10 or 12 miles wide at most.

The other kind of destruction is the wilful devastation by the retreating enemy as in the Somme, the Oise and the Aisne in the spring of 1917. In the first part of the retreat only minor destruction took place, but later he had had time to do a thorough piece of work, with the result that a wide belt east of Peronne, Ham and Noyon was completely destroyed. The same was true in the retreat of the autumn of 1918. It is interesting to see how the destruction developed. For instance, in September, 1914, at the time of the great German advance and during the battle of the Marne, there was comparatively little destruction in the North and in Champagne. It is only when we get down to the Marne, Meuse, Meurthe-et-Moselle and Vosges, that we find the places of any great destruction. In the Marne, 258 communes were damaged, including a total of 3500 buildings entirely destroyed and nearly 12,000 partly destroyed, while 40 communes remained on the German side of the lines. In the Meuse, 59 communes were damaged, with about 1800

buildings completely destroyed and nearly 700 partly destroyed, with 236 communes remaining in the hands of the Germans. In the Vosges, 53 communes were damaged, with a total of 1256 buildings completely destroyed and nearly 2000 partly destroyed, with 25 communes remaining in the hands of the Germans. In the Marne and the Meuse most of the destruction took place during the battle of the Marne, along both sides of the lines, where the fighting was heaviest. It started in at Meaux and did not get really serious until near Sezanne. Then, in the farming villages south of Chalons-sur-Marne and west of Vitry-le-François running up past Revigny and Bar-le-Duc and Verdun and down to St. Mihiel and Commercy, the destruction by shell-fire is intense. This makes a belt about 150 miles long where the destroyed area is anywhere from five to ten miles wide.



AGRICULTURAL MACHINERY WRECKED BY DYNAMITE

Around Nancy there is comparatively little destruction, but north and east of Nancy the destruction is again very serious, almost all by shell fire, including cities like Lunéville, Gerbevillier (which was systematically burned) part of Ramberviller, St. Dié, etc., down to the border of Alsace, where the buildings, especially in the larger town of Thann, are largely destroyed.

In addition, there were various cities behind the lines which were within the range of German guns and in which quite a little destruction has been caused. This is especially true of Belfort, also of Bar-le-Duc, and to a less degree of Nancy.

During the German retreat of March, 1917, in battles of the Somme, the Aisne and the Oise, in the first part of the retreat in the Oise and the Aisne, they destroyed the buildings only partially, usually by burning, so that in most towns the exterior walls and partitions are standing in many buildings; they could be repaired by putting on roofs and putting in windows and doors, but east of the line extending from Noyon to Ham and north of a line extending due west from Ham, the Germans had time to burn systematically and blow up almost all of the villages, with the result that destruction was complete, and in some cases one can ride through a village without knowing it.

Little Is Left of Many Towns

At the time of the German advance in March and in May, 1918, they came within shelling and bombing range of a number of large cities and towns, so that today little is left of Hazebrouck, Béthune, Arras, Albert, Compiègne and Rheims, and severe destruction is seen in Amiens, Clermont, Beauvais, Senlis, Épernay, Chalons, Bar-le-Duc, Toul and Nancy.

In the German retreat, during the last four months in the Somme, Aisne and Oise, a large area southwest of Ham, which before had only been partially destroyed, is now found to be completely destroyed, and cities like Noyon, Ham, Guiscard, Nesle, Roye, Soissons, Dormans and Fismes are almost completely ruined. The devastation in the region around Peronne and Bapaume was so severe before that very little more happened to them.

During the last four months of the war the allies won back from Germany nearly 8050 square miles of land in France, or an area nearly as large as the States of Delaware, Connecticut and Rhode Island. This is nearly 3% of the total area of France, includes about 2000 communes, with a total population before the war of some 2,500,000.

The German advance in March and May of 1918 covered a little over 2300 square miles. The German retreat of March, 1917, covered about 1550 square miles. This was about 80 miles long and had a maximum depth of about 25 miles, making about 0.5% of the total area of France, and including about 500 communes with a total population of about 325,000.

Four years ago the total invaded area exceeded 15,000 square miles, or something over 5% of the area of France, including over 3500 communes with a total population of over 4,000,000, embracing the best manufacturing district and the best farming country of France. This area is larger than Maryland and Delaware combined, or as large as Massachusetts, Rhode Island and Connecticut, or one-third as large as Pennsylvania.

The devastated area in France covers approximately 6000 square miles in all, about 2% of France, with a total population of nearly 2,000,000 people. This is about equal to the area of Connecticut and Rhode Island.

The area reconquered in Alsace until the last phase of the war equalled about 450 square miles, or about two-fifths the area of Rhode Island. Outside of the

half-destroyed town of Thann there was almost no destruction. In all there are about 6000 square miles in Alsace-Lorraine, with 1,874,014 inhabitants in 1910.

Alsace-Lorraine had over 1,000,000 acres of forests. Its chief crops were hay and potatoes. It produced 3,538,722 tons of coal, 20,083,238 tons of iron ore, 102,644 tons of potash. The potash deposits are estimated at 2,000,000,000 tons. It made 2,908,230 tons of pig

EVEN THE TREES AROUND THE RUINED CHATEAU WERE DESTROYED

iron and 1,444,953 tons of steel. There were 5691 textile plants, employing 80,423 persons. These included 1,900,000 cotton spindles.

Belgium has suffered at least $2,000,000,000 worth of destruction in all and there are $2,000,000,000 worth of thefts made and taxes imposed by Germany. Of this amount $1,150,000,000 is loss of machinery, tools and stock. Some 150,000 working men have been taken into Germany.

Belgium covers about 12,000 square miles and had 7,423,784 inhabitants before the war. It had nearly 1,500,000 acres of forest. It produced annually 3,253,067 tons of potatoes, 1,702,535 tons of sugar beets and great quantities of oats, rye and wheat. A total of 22,972,000 tons of coal a year were mined by 145,670 miners and 2,301,290 tons of pig iron were made. There were 1,492,258 cotton spindles in use. In 1913 the Government revenue was $160,000,000 and the total debt $750,000,000.

French Reports on Destruction

On July 24, 1917, the French Ministry of the Interior prepared a report on the destruction, as closely as it could be determined, on the French side of the lines. This report followed one made at the end of May, 1916. The later report covered 1223 communes in 11 departments, whereas the earlier report covered 754 communes in 10 departments. In all these communes there has been more or less destruction, and this number does not include 450 communes that were still too near the front to make it possible to make a complete survey of conditions. The total number of communes freed from the enemy by the advance of the spring of 1917 was 499, thereby reducing the total number of communes resting in the hands of the Germans from 2554 to 2055, all of which are now freed. Most of these communes are strictly agricultural, so that the destruction hits particularly hard the richest farming area of France.

It was reckoned that in the 1223 communes reported on a year ago the number of buildings damaged was 102,697, as compared with 46,263 in May, 1916, and of these the statistics show that in 1917 50,756 of the buildings were completely destroyed. Of the latter, 18,824 were in the Somme and 12,701 in the Aisne.

The hasty investigation since the signing of the armistice shows that *the total destruction in France has been quintupled, with something like 500,000 buildings damaged, of which at least 250,000 are completely destroyed.*

The average cost of these buildings before the war was nearly $5000. As the present cost of a building is about 2½ times greater than it was then, we can say that the total *destruction in France of the buildings alone is today over $6,000,000,000* as estimated by the Government engineers and $4,000,000,000 as estimated by the architects' and contractors' associations.

The total cost of repairing and replacing the *used up or destroyed public works is estimated at about $2,000,000,000* of which $200,000,000 is for the Nord R.R., $150,000,000 for the Est, and $50,000,000 for the other railroads. About $200,000,000 will cover the rebuilding of the canals. The Nord R.R. alone has lost 1731 bridges and 338 stations.

In 1917 there were 527 communes in which over half of the buildings had been completely destroyed. This number has probably reached today something like 1500 communes in all. In 1917 in 400 communes over 80% of the buildings had been damaged, and this proportion probably reaches today over 1000 communes. In the summer of 1917 there were counted over 435 town halls destroyed, 600 schools, 472 churches and 377 other public buildings, and it can be safely said that over 1200 churches are destroyed and over 1500 schools.

Industrial Means of Support of 500,000 Gone

In 1917 were counted over 414 industrial plants destroyed, which supported 105,000 persons. It can probably be said today that there are in all over 1000 plants destroyed, supporting at least 500,000.

On Oct. 25, 1916, a report was made by the Minister of the Interior on the building materials destroyed that would have to be replaced. It was made for 790 communes, or for 41,223 buildings totally or approximately destroyed, and it comprises the destruction of 1,700,000 cu.yd. of stone masonry, 600,000 cu.yd. of brick masonry, 300,000 tons of lime, etc. The largest part of this destruction was in the Pas-de-Calais and the next larger in the Meurthe-et-Moselle. It also showed the destruction of 200,000,000 ft. of lumber, 33,000 tons of iron and steel, 91,000,000 roof tiles and 32,000,000 roofing slates. The total destruction today is probably at least five times as large—which gives a slight idea of the problem before France in reëstablishing this area.

The total loss of furniture and furnishings today, exclusive of machinery, amounts to at least $2,225,000,000 as estimated by the Government engineers and over $1,000,000,000 as estimated by insurance companies.

According to a report made by the *Office de Reconstitution Agricole* to the Minister of Liberated Regions in May, 1918, it was reckoned that at that time about 8000 square miles of French land was in the hand of the Germans. About three-quarters of that area is

tillable and a large proportion of the rest is good for hay or pasturage. This is some of the very best and richest agricultural land in Europe. The 10 invaded and liberated departments produced in 1913 nearly $400,000,000 worth of crops. The average yield of this land is about 32 bushels of wheat to the acre. In the Marne this drops down to about 22 bushels to the acre, and in the Meuse and Meurthe-et-Moselle to about 17 bushels. These regions constitute about 15% of the total tillable area of France, and the crops constitute about 20% of the total for France. The agricultural population here is about 807,000, or about 10% of the working agricultural population of France. It is estimated that *250,000 acres were rendered uncultivable by the war.*

Damage to Farms and Their Contents

In this region there are about 250,000 farms, of which 110,000 are less than 2½ acres apiece and about 100,000 between 2½ and 25 acres. About 26,000 are between 25 acres and 100 acres, and 5500 farms are over 100 acres in size. A great many of these farms belong to people who are working in factories, which accounts for there being such a large proportion of small farms. This is quite unusual in France. The capital investment in these farms is reckoned at $400,000,000, or an average of $1600 per farm. The value of farms has more than doubled in France since the beginning of the war, so the total value of these farms today stands nearer $800,000,000 or $3200 each, without counting the value of the buildings.

To get an idea of the number of agricultural implements that would be needed, a list was made by the Government engineer in charge which showed that to replace the losses they would need about 51,000 side-hill plows, 33,000 other plows, 56,000 cultivators, 30,000 mowing machines, 115,000 farm wagons, 88,000 harrows, 50,000 rollers, 48,000 hoes, 36,000 seed drills, 13,000 fertilizers, 16,000 beet extractors, 21,000 winnowing machines, 18,000 horse rakes, 32,000 reapers and binders, 53,000 root cutters, etc.

With regard to the cattle lost, it is very hard to get at the exact figures, but in these departments in 1913 there were 607,000 horses, whereas in 1915 there were only 242,000, showing a loss of 60%. Of cattle of all kinds there was a loss of 850,000, or 55%, and of pigs the loss was 380,000, or about 55%. The loss in wheat amounts to about 1,300,000 acres and in hay to about 850;000 acres. *The total damage to the soil, to live-stock, crops, forests, tools, etc., is estimated at $2,000,000,000.*

Before the war, France used 59,407,000 tons of coal a year, with 9,166,000 tons more in coke equivalent. Of this France produced about 40,844,000 tons and 5,357,000 tons of coke equivalent. Of the deficiency 27,389,000 tons of coal came from the Valenciennes basin. In all, something over 70% of the total coal supply of France came from the invaded regions, and very much the best quality of coal at that. About 140,000 men were employed in the mines in the invaded regions, out of 203,208 coal miners for all of France. Three-quarters of a million persons were largely dependent on the coal mines. Over $200,000,000 worth of machinery has probably been destroyed.

Before the war the total production of iron ore in France was about 21,918,000 tons, of which 19,629,000 tons came from the Briey and Longwy basins in the Meurthe-et-Moselle; that is, 90% of the total, of which 16,500,000 tons was in the hands of the Germans. The miners who were employed in these invaded mines, with their families, represent at least 150,000 persons out of employment. It is interesting to know that just before the war the total of German iron production was 35,941,000 tons. In the United States it was 63,000,000 tons. Over $500,000,000 worth of machinery has been destroyed, including that of steel and iron mills. Before the war 3,000,000 tons of steel were manufactured in the region invaded by Germany, out of 4,686,000 tons for all of France, or nearly 65%. The same percentage holds for cast iron. The effect of the German invasion on other metals has not been so serious, as most of them come from the interior of France.

The chemical industries have suffered very little from the invasion, proportionally.

The textile industry consisted before the war of about 7,530,000 cotton spindles throughout France, of which 4,500,000 were in the region invaded by Germany and of which almost all were either destroyed or carried back into Germany and France. Out of 2,365,000 wool spindles 2,000,000 were in the invaded districts. Out of 550,000 linen spindles, 500,000 were in the invaded regions and destroyed or removed. The same is true of looms, of which there were 140,000 in France, and over 81,000 of these were in the invaded districts. Over $120,000,000 worth of machinery has been wrecked.

Of 210 sugar refineries in France 140 were destroyed by the Germans, and of 3000 brush factories, 2000 were destroyed. Over $25,000,000 worth of machinery has been ruined. Electric power stations, totaling 300,000 kw. have been destroyed, with an equipment loss of $50,000,000. From breweries over $25,000,000, from machine shops $100,000,000 and from foundries, etc. $60,000,000 worth of machinery is gone. None of these damages includes land or buildings. Furthermore, almost all of this machinery *costs three times as much* to replace today so that it can safely be said that *$4,000,-*

THE FARMER'S CART WAS RUINED

000,000 worth of machinery will be needed to replace that destroyed or carried away. This includes the stock and raw materials damaged and damage done to the mines.

Injury to Cement Plants and Forests

Before the war France manufactured 3,000,000 tons of cement a year. In February, 1918, it was manufacturing only 400,000 tons, which amount since increased and has later diminished through the difficulty of obtaining coal. A large proportion of this was in the invaded departments.

The Service of Forests and Water-Supply in the Department of Agriculture estimates that 1,200,000 acres of forest land have been destroyed by the enemy. Over half of this wooded area belongs to the Government or to the communes. There were about 750,000 acres of woodland within the war zone which have not been cared for since the beginning of the war, and which have thereby lost a great deal of their value. We can count on the complete loss of at least one-quarter of this latter area, or a total loss of nearly 1,500,000 acres. Therefore France has lost nearly 10% of its lumber and 6½% of its firewood. The war has destroyed over two billion board feet of lumber.

Before the war there were about 750,000 men in the various building trades, of whom about 75,000 were located in the invaded departments. The total building done throughout France before the war in any one year was less than 7% of the building that would have to be done to replace what has been destroyed in the invaded departments. Therefore, if no building were to be done elsewhere in France after the war, and reckoning that 500,000 of the building tradesmen of France would be available to work in the devastated regions, it would take over 20 years to rebuild them.

The total damage in the north of France, including that to buildings, agriculture, industry and public works, is estimated at 64,500,000,000 francs, or about $13,000,000,000. These were the figures reported by M. Dubois for the Committee on Budget in the Chamber of Deputies in December, 1918. We have checked most of these figures from various official and private sources, and believe they are somewhat high.

What the French Government Has Done to ReËstablish the Liberated Regions

Early in December, 1914, the French Government, then sitting in Bordeaux, appropriated $600,000 for the immediate assistance of the invaded communes of the Marne. In December, 1914, Parliament incorporated in the budget for 1915 an appropriation of $60,000,000 for the use of the Ministry of the Interior in meeting the most urgent needs of the inhabitants of the region. On Aug. 5, 1918, the Minister of Liberated Regions reported to Parliament that out of this sum, $36,000,000 had been expended, divided by departments as follows: Marne, $3,000,000; Somme, $2,000,000; Oise, $1,500,000; Meurthe-et-Moselle, $1,400,000; the Aisne, $1,300,000; Meuse, $1,000,000; Vosges, $500,000; Seine-et-Marne, $500,000; Nord, $500,000; general supplies, $2,500,000. To this sum should be added $6,000,000 spent to drain out the mines, another $6,000,000 for stocking up with building, industrial and agricultural materials.

In 1916 the Minister of the Interior started a special service to prepare for reconstruction, and in May, 1916, the President of the council created the Interministerial Committee, whose function it was to coördinate the work of reconstruction undertaken by the various ministries. In January, 1915, the Chamber of Deputies adopted a bill known as the *Loi Cordunet* which provides compulsory city planning for the whole of France, particularly the devastated regions. This is not yet law. In September, 1916, the Minister of the Interior asked the *préfets* of the devastated departments to make city plans for their destroyed towns.

Early in 1917 the Minister of the Interior established a fully organized service for handling the interests of the refugees in the devastated regions, and the technical service was organized for repairing damaged buildings and for the manufacturing of demountable barracks. Meanwhile, arrangements were made for giving advances to returning refugees, up to a certain proportion of the eventual indemnity, which they will receive from the state for their damages when the war indemnity bill is passed.

In August, 1917, Parliament passed two laws granting appropriations of $20,000,000 each to the Ministry of Commerce and the Ministry of Agriculture, to make purchases for industrial and agricultural reconstruction. In the autumn of 1917 a special service for reconstruction and for putting the soil back into shape was created in the Ministry of Public Works.

A New Ministry Created

In November, 1917, it became so apparent that there must be a single head and control for all this civilian work in the war zone that the Government created the Ministry of Blockade and the Liberated Regions, of which M. Lebrun is the head. Aside from the work in connection with the blockade, the work in the liberated regions is divided into four main services in the ministry: (1) A general service for the reorganization of general local life, for payment of war indemnities and the coördination of public and private relief agencies, under M. Bluzet; (2) a technical service of reconstruction and putting the soil back into a state for use, under Colonel Suquet; (3) an office of agricultural reconstitution, under M. le Seigneur; (4) an office of industrial reconstitution, under M. de Boisson. Thus, all the different functions of the French Government which have to do with the invaded regions are brought together under one head. Since Nov. 15, 1918, they are at last under one roof at 223 Rue St. Honoré, in Paris.

To the agricultural office was voted a credit of $60,000,000 and a revolving fund of $20,000,000 for its work. To the industrial office was voted a credit of $50,000,000 and a revolving fund of $20,000,000.

The Interministerial Committee continues in an advisory capacity. There is also the parliamentary committee, composed of all the senators and deputies from the invaded departments. This committee keeps a general oversight and legislative and budgetary control over all the Government action for the refugees and their property.

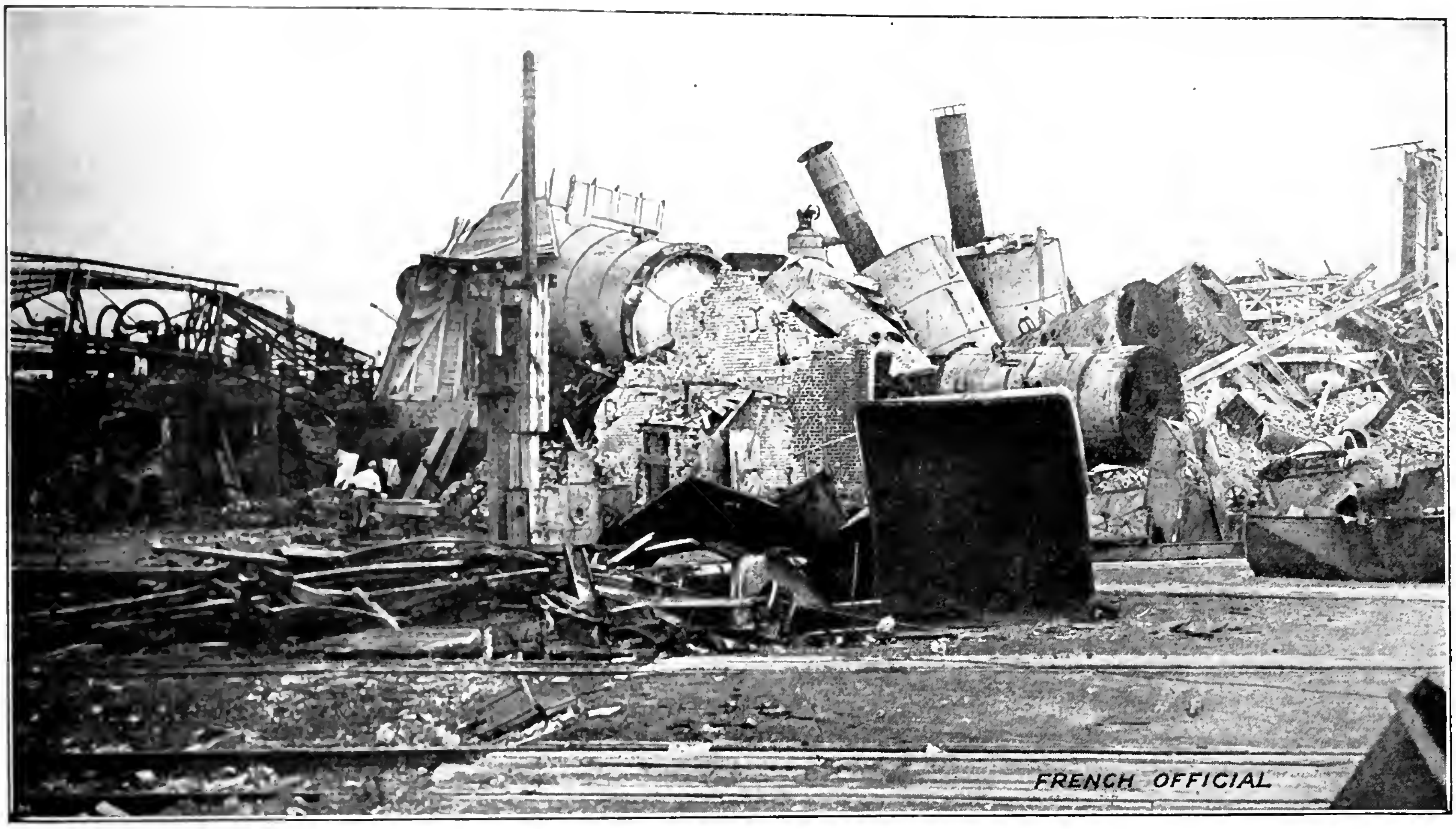
Since the signing of the armistice, the Minister of Armament, with M. Loucheur as minister, has become a Ministry of Industrial Reconstitution, for changing

the munitions plants to peace manufacturing, and absorbing the Office of Industrial Reconstitution from the Ministry of Liberated Regions. A credit of $400,000,000 has been granted to this new ministry.

The Ministry of Liberated Regions has created two new special associates to the minister, a *commissaire général* to act as liaison officer with the other ministries, and a *controleur général* for accounting and follow-up.

In general, the government has (1) been giving immediate aid and relief to the returning refugees, clothing them, feeding them, giving them shelter and the necessary utensils and tools, and (2) it has been helping ate is being considered in the Chamber of Deputies, only one point remaining to be settled, and that is whether the reëstablishment of a business or industry or a home within the same town shall be obligatory or optional, if the damaged person would touch the full indemnity that will be paid to him.

In general, everyone has agreed that every kind of damage should be paid in full, including any extra expenses caused by the increased cost of living, materials and labor. It is expected that this bill will become law within a few weeks. Meanwhile, the Minister of Liberated Regions has been making advances as above



ONE OF MANY SUGAR FACTORIES LEFT IN RUINS BY THE GERMANS

them reëstablish themselves permanently by giving them advances on the indemnities which they will probably receive from the Government, and helping them start the reconstitution of their own livelihood, and helping them to construct the necessary buildings. Mention has already been made of the $34,000,000 distributed for immediate aid, out of a total credit of $60,000,000 voted in December, 1916.

Up to Mar. 31, 1918, $28,000,000 had been advanced to returning refugees against their eventual indemnity, to help them get started in reëstablishing themselves. In addition, about $10,000,000 has been advanced against industrial indemnity. Besides these sums, $12,000,000 has been advanced to the farmers to help them start recultivation of abandoned farm land, out of a total credit available of $3,000,000 granted under what is known as the *Compère Morel Loi* for aiding agriculture in France.

The Government bill providing indemnities in full to those who have suffered full damage was voted by the Chamber of Deputies in 1916. In a somewhat changed form it was voted unanimously by the Senate early in 1918, and at present the version as voted by the Senoted to damaged people who wish to reëstablish their property right away, to the extent of paying them in cash or in kind up to 90% of the appraised value of the property damaged, on the basis of values as they were at the beginning of the war. As the cost of building has more than doubled since that time and almost everything has gone up proportionately, this means that the actual advance is only about two-fifths of what it costs to replace the buildings today.

On Dec. 12, 1918, a law went into effect providing that the state could requisition the piled-up ruins of buildings to work over for new buildings.

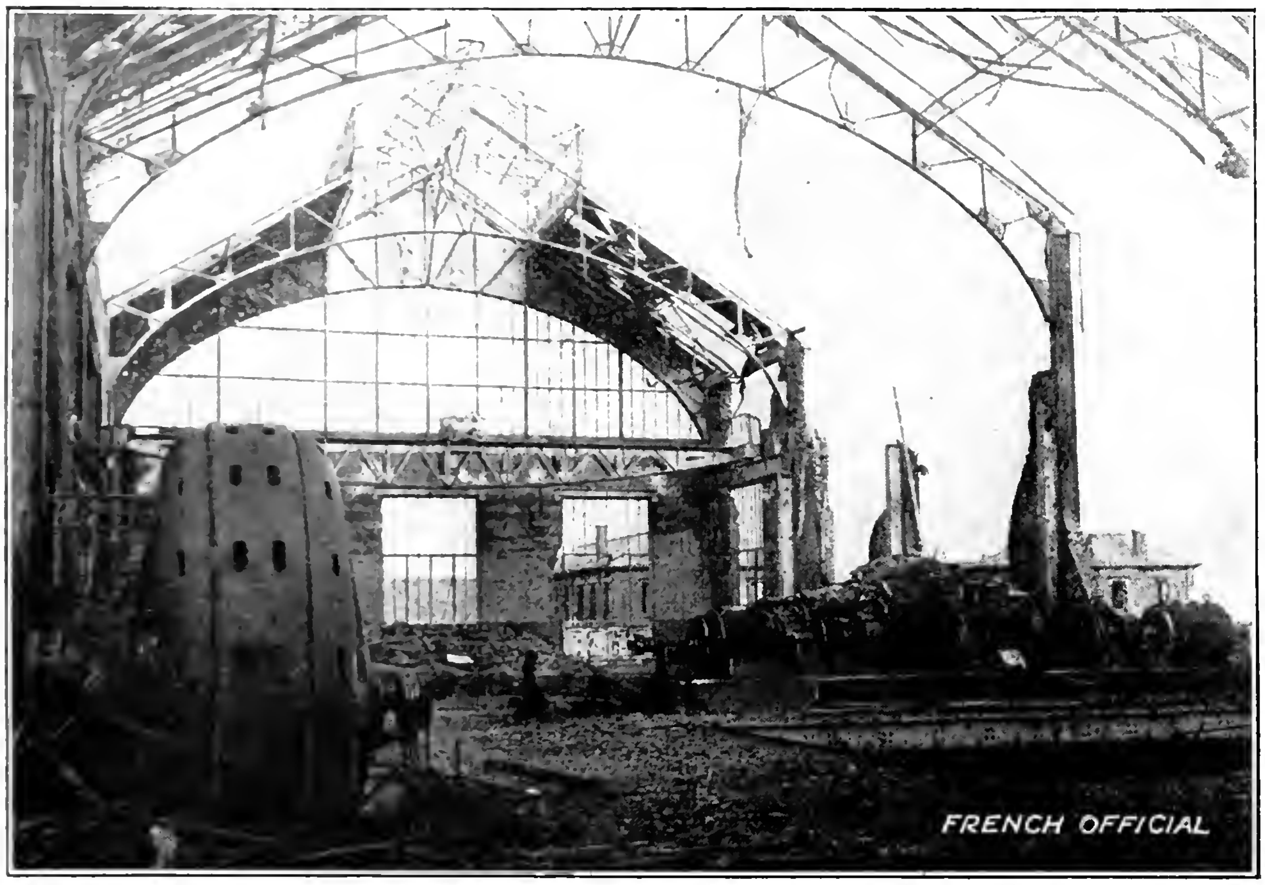
The technical service of reconstruction in the Ministry of Liberated Regions has for the past two years been doing repair work, wherever called for in the devastated regions, working through the local engineers in chief and the Minister of Public Works. It had at work in the Somme, the Aisne, and the Oise, after the German retreat in the spring of 1917, about 1000 German prisoners and 1000 civilians, working under civilian contractors.

Against the eventual indemnities that will be paid, many partially destroyed buildings were repaired and put,

more or less summarily, in a state of use. Almost all of these repairs were in agricultural districts, and the larger part of repairing was on buildings that would house the farm animals, crops, etc. Most of this repair work was wiped out by the German advance in the spring of 1918, but now that the Germans have retreated again and all this area is uncovered this same repair work is starting again.

In the Marne, the Meuse and the Meurthe-et-Moselle, where most of the destruction was caused in 1914, there has been some permanent reconstruction, particularly where the villages are over 30 kilometers from the front. Private contractors, working under the direction of local engineers of public works, have built a number of farm buildings in the region of Meaux and Chateau Thierry and summary repairs have been made to several towns and villages near the front. In 12 or 15 farming villages, south of Chalons-sur-Marne and around Vitry-le-François, the Government has organized coöperative societies for reconstruction. They have grouped almost all the property owners in the village in the society, and, by employing an architect and a contractor in common, they have not only been able to save a great deal of time, money and duplication in the rebuilding of their farm buildings, but they have been able to go to the Government and obtain the service of German prisoners and also to obtain special dispensation from the Army for procuring the necessary lumber, lime and cement, and transportation. In each case they have received the maximum advance on the eventual indemnity for their losses, which has allowed them to rebuild at once about one-quarter of the necessary buildings. In most cases they have started with the grange or grain barn. Over one hundred such have been permanently reconstructed in this region, costing, in all, $230,000.

The technical service of reconstruction has placed orders with private contractors throughout France for about 25,000 demountable wooden houses with two rooms and a shed in each case, costing $700 to $1000 each, and for 10,000 demountable wooden farm buildings, to cost $150 to $800 each.



ALL BUT THE HEAVIEST MACHINERY WAS REMOVED FROM THIS RUINED POWER PLANT IN NORTHERN FRANCE

Between 3000 and 4000 of these had been set up in the Somme and the Aisne and the Oise before the German advance of this spring, all of which were lost. To date, there are between 1000 and 2000 of these demountable buildings either in the newly liberated regions or on their way there, the great difficulty being to secure transportation and the necessary labor for mounting them. Since the armistice, however, the labor problem is being solved rapidly. As to labor, on Aug. 10, 1918, General Pétain sent a general order to the commanders of all divisions, regiments or companies, that when they found themselves located for several days or more in a devastated town or village, they should apply immediately to the engineer in charge of reconstruction work, to see how the soldiers could help either in cleaning up the ruins or putting the roads or water-supply in usable condition, or in doing agricultural work. On Sept. 6, 1918, the Minister of Liberated Regions instructed the local engineers in charge and the mayors of the towns to prepare advance programs of the work that such troops might do, so that no time should be lost. To prepare for eventual full reconstruction, the technical service of reconstruction of the Government is organizing a bureau to purchase building material in advance. It is expected that a credit of $60,000,000 will now be voted to this bureau, $20,000,000 to be available to house and feed workmen in the devastated regions while they are starting reconstruction. Materials and housing will be allocated from the Government storage yards to coöperative groups of contractors according to priority rules.

On Dec. 13, 1918, there was created in the Ministry of War a special service for supplying and setting up temporary barracks wherever needed for workmen or refugees.

Government Supplying Furniture

In July, 1918, the Minister of Liberated Regions asked for bids from private manufacturers on 75,000 articles of furniture, including chairs, tables, cupboards and wardrobes. At the end of August, 1918, it asked for bids on a lot of standardized doors and windows that could be made up ahead, including 20,000 exterior doors, 42,000 interior doors, 37,000 windows and 25,000 shutters. Today it is rapidly increasing these orders, especially to the plants that until the signing of the armistice were manufacturing airplane parts.

With regard to the Furniture Indemnity Law about

to be voted, which provides for paying damages for furniture loss up to $2000, the decree was issued by the Minister of Liberated Regions on Nov. 2, 1918, which allows the individual who has suffered loss of furniture to go out and buy his own furniture with an advance which will be made to him by the state of a sum which must not exceed $200 for the head of the family, and $40 for each other member of the family. If the damaged person prefers, the state will provide him with the furniture out of the stock which it is accumulating.

Virtually all the furniture in the regions which have been overrun by the Germans has been taken back by them into Germany or destroyed. The same is true of utensils, tools, bedding, clothing, etc. In the rich regions of the North of France this furniture was particularly valuable.

Furthermore, the technical reconstruction service is making experiments with building materials that can be found on the spot in devastated regions, and which do not require transportation or special labor for their extraction and preparation, and it is erecting an experimental building in Paris to try out methods of construction, new materials, new types of plans, etc.

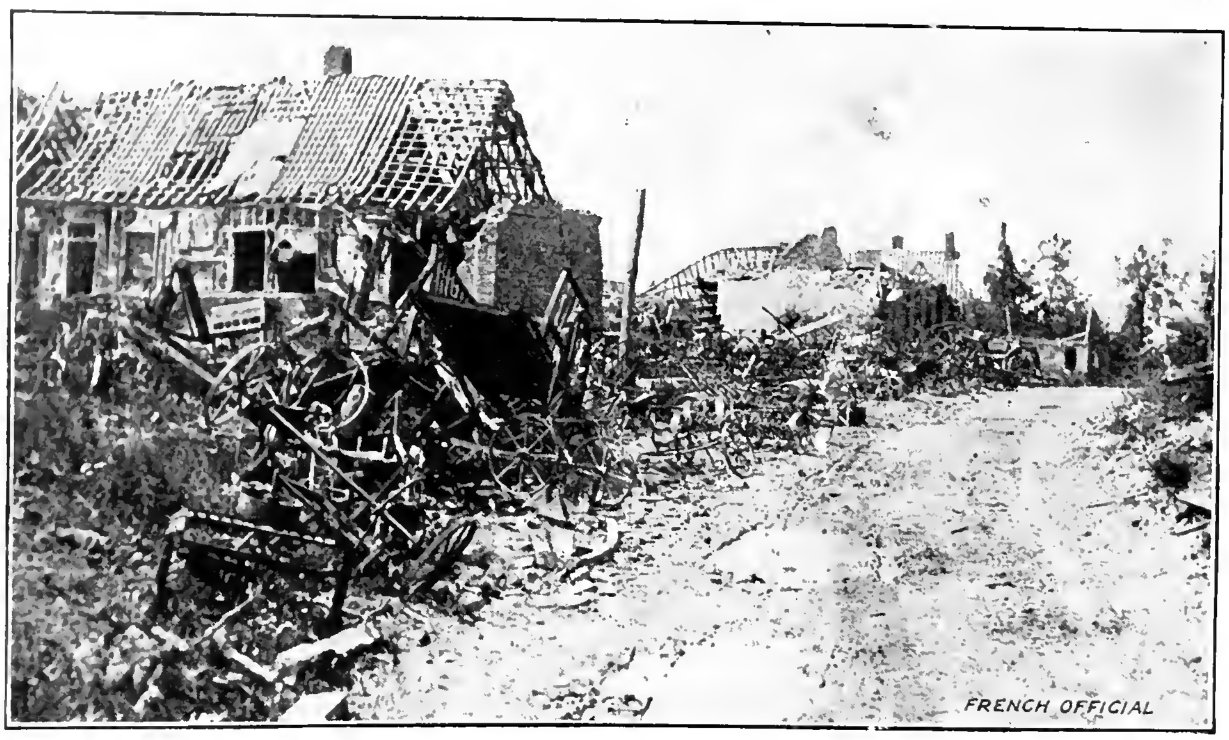
The service published on Oct. 22, 1916, a report showing the distribution of quarries and, in general, the places where the raw building material could be obtained in the individual departments. For example, good building stone can be found in almost all of the departments except the Nord and the Somme. Brick clay can be found in almost all the departments, especially in the North. The only difficulty would be getting the necessary coal for burning the brick. There is plenty of good building sand in all the departments. Cement can be produced in large quantities in the departments of the Pas-de-Calais, Marne, Meuse, and Meurthe-et-Moselle, provided the plants can have the necessary coal and labor. Most of the departments can furnish plenty of lime, which will probably play a much more important part in the reconstruction than it did in construction before the war. Tile can be produced in quantity, and in the Ardennes there used to be thousands of little shops that produced hardware. As for wood, all the departments can furnish some, but how much will be available will not be known for some time. Roofing slates can be produced in large quantities in the Ardennes and the Meurthe-et-Moselle, also in the Nord and the Pas-de-Calais. Glass comes from the North, from the Aisne and from Belgium. The chief things needed, however, to provide each of these materials, are the necessary tools and machinery for extracting and preparing them for general use, and the technical service of reconstruction is trying to accumulate stocks of such supplies in advance.

In the spring of 1917 a million acres of land were released, of which at least 500,000 were tillable. During 1917 the tractor service of the Department of Agriculture plowed 80,000 acres, the French Army plowed 12,000 acres and the British Army plowed about 50,000 acres. At that time the Government owned 800 tractors and had on order 1500 more. It is probable that it has today over 1500 tractors, of which half are available for the devastated regions.

During the last German retreat the wheat was cut on 130,000 acres of released land. In this work, 16,993 men were employed, mostly military; 3324 horses, 9895 scythes and sickles and 823 binders.

During the summer and autumn of 1917 the Office of Agricultural Reconstitution, through the special mission of the agricultural coöperative societies, founded 120 agricultural coöperative associations in as many villages in the Somme, Aisne and the Pas-de-Calais. These coöperatives include in some cases in their membership nearly all the farmers in the commune. Among them they had nearly 100,000 acres of land under cultivation, and had a total membership of nearly 8000. Virtually all of them were wiped out by the German advance in the spring of 1918. The mission is trying to reorganize them and to create other coöperatives to stock them with implements, machines and cattle, so that they can start operation as units on their return to their native villages. The $20,000,000 credit which was recently voted for encouraging agriculture is being used in part for the founding of these coöperatives.

The Office of Agricultural Reconstitution is in charge of the work. It did all that it could to prepare for plowing and planting a section of released land last autumn. It would like to allow many thousands of the land proprietors to return, with their families where necessary, and to provide them with German prisoners or soldiers to help them. But, most unfortunately, it was almost impossible to provide for the plowing and cultivation of this land, aside from the fact that labor is extremely difficult to get, as there were very few horses and oxen available. Some 12,000 horses were taken every month for the American or French Armies, and even where the horses are available they cost today about $1000.



WRECKED FARMING IMPLEMENTS LIE HEAPED ABOUT RUINED COTTAGES

But what is worse, if the horses and cattle had been taken into the devastated regions it would have been almost impossible to feed them, for the Army needed all the oats that could be brought into the regions. To replace the horses the Government ordered a large number of tractors and several types of agricultural machinery, but deliveries are slow and not adequate to the demands. The Government has contracted for $8,000,000 worth of agricultural implements, but so far very few of them have been delivered. The Government is making advances up to $160 per acre, to help put back under cultivation land overrun by the Germans.

The result is, that while France needs all the crops that can be raised on the liberated farms, it seems to be impossible to get the crops started and taken care of, until the military situation permits. The immediate need is for large quantities of agricultural machinery and implements, and especially for horses and oats.

WRECKED BUILDINGS AT COAL MINES

About Dec. 1, 15,000 horses were released by the Army for agricultural work in the devastated region.

To meet the enormous need for industrial materials, machinery and tools, after the war, the Office of Industrial Reconstitution has been organized and has been composed half of officials and half of manufacturers. It has a credit of $50,000,000 to arrange for buying up raw materials, machinery, tools, etc., and it arranges for ceding them to the injured manufacturers. It is not equipped to buy and sell on a large scale itself, but has entrusted its credit to a private body organized for this purpose. This organization, formed in the first year of the war, is called *L'Association Centrale pour la Réprise de l'Activité Industrielle dans les Régions Envahies.* It is composed of most of the industrial people in the invaded departments. Its object is to employ every useful means for restoring the machinery and stocks destroyed. However, according to French law, the group cannot trade. It can only be a consulting and plan-forming body, therefore it created the *Comptoir Centrale d'Achats Industriels pour les Régions Envahies.*

The latter has a capital of $200,000. It has a council which controls all buying and selling and which authorizes the projects of each of the subcommittees for each kind of industry to buy and sell. Each project must also be approved by the Office of Reconstitution, which allocates the necessary funds from its credit. The *comptoir* can buy directly for a private owner, or it can constitute general stocks for later use. The recipient can pay for tools or machinery in cash, or he can have the total deducted from his eventual state indemnity. Cash is not given to the manufacturer. This is to save his money by wholesale quantity buying and to prevent the unfortunate effect on the market of a number of little buyers competing against one another.

At present these services have effected purchases to the amount of about $12,000,000 and prepared orders for machinery, tools, and raw materials for more than $40,000,000. These orders are especially assigned to the reconstitution of coal mines, of central electric power plants and of their distribution works, of general tools, etc. Other orders, to a total amount of $30,000,000, are now being prepared for textile industries, breweries, sugar mills, oil and grease plants. Supplementary credit on new orders is expected in a short while. The *comptoir* can, by its constitution, make no profits; merely its running expenses and 5% on its actually paid-in private capital.

Latterly, the association has been agitating for the organization of coöperative societies among manufacturers of the same kind of material. One such has already been formed among the steel manufacturers. As they cannot all be reëstablished at once, the first one or more to start operate against capital or advanced indemnity credit, furnished pro rata by all, and the profits are divided pro rata. Aside from allowing all to get some start almost immediately, it means a considerable saving to all by permitting extensive standardization of building plant, machinery, tools and stocks. The association is also keeping track of skilled labor in the respective industries, so as to have it ready when the plants are available.

The leading societies of architects in France have been working since the beginning of the war to make plans for reconstruction. They have a great deal to do with the recent organization in the French Government for handling the work in the invaded departments. They are now organizing coöperative societies among themselves for reconstruction. They have organized an exhibition of cheap housing, which took place in the garden of the Tuileries in the summer of 1916. In the autumn of 1917, together with the Ministry of Fine Arts, they organized a competition among architects, engineers, sanitarians and agricultural experts throughout France, for the production of better types of farm houses and town buildings of various sorts, with due reference to the regional architecture and customs.

The contractors of France, through their large associations, have worked with the Government in the creation of its present policy, and many smaller groups have been formed to prepare for reconstruction. The national associations have just formed a group of coöperative societies for handling reconstruction. The initial buying of materials and caring for labor will be aided by the Government.

The agricultural societies have also taken an active part in preparing for the reëstablishment of agriculture, and meanwhile they have been a great help in bringing immediate relief to the returning refugee farmers.

The sanitarian and public health groups have also taken an active part in preparing for the industrial reconstitution of the invaded departments, and in particular the new society called the *Association Nationale pour l'Expansion Économique* has made full studies of the industrial, commercial and agricultural needs, and has made extensive preparations for after the war.

From the standpoint of town planning, the society created since the war called *La Renaissance des Citiés* has already made full studies for the improvement of the plans of Arras, Albert and other towns. It is now collaborating with the mayor and the council of Chauny to hold a big competition for plans for the improvement of the layout of the town.

From the legal side, *La Fédération Nationale des Associations Départmentales des Ministrés*, the judicial committee of *La Renaissance des Citiés*, the judicial committee of the *Union Centrale des Comités-des Réfugies and the Comité d'Action pour la Reparation Integrale des Dommages de Guerre* have all made extensive studies of laws affecting refugees, war indemnities, redistribution of farm land, sanitation, etc. They are all having a strong influence on the legislation now before the French Parliament.

Reconstitution Work Done by Private Groups

A great many societies and individuals have been doing important relief work in the invaded departments. Their work is now coördinated in a special bureau of the Ministry of the Liberated Regions. They have been giving or selling clothing, furniture, cooking utensils, farming implements, seeds, fertilizers, farm animals, bedding and food to the returning refugees. The American Red Cross has had a delegate in each of the invaded departments, with several assistants in each department. They worked directly with the French authorities, and have distributed large amounts of urgency supplies in these regions.

The Anglo-American Friends' Mission has been working in the devastated regions ever since the beginning of the war. Its first work was in the Meuse and the Marne in the district between Vitry-le-François and Bar-le-Duc. In the spring and summer of 1917 they did splendid work in the Aisne and the Somme. They have several workers, men and women, in the field distributing relief of all kinds. Now they are planning a big reconstruction effort southwest of Verdun.

The Smith College Unit did similar relief work in about 25 communes around Grécourt in the Somme, until driven out last spring. Some 30 or 40 other French, British or American groups have been doing general or local relief work in the devastated regions. The Minister of Liberated Regions is now distributing among these and other groups the relief work to be done soon.

As regards repair work, the American Red Cross during 1917 repaired with its own labor about 75 buildings in five villages in the Somme, northeast of Nesle and northwest of Ham, and south of Péronne. The Anglo-American Friends mounted 51 demountable barracks in six villages near Ham and at Gruny, near Roye, in the Somme and repaired about 30 or 40 buildings in the Marne and the Meuse; during the first three years of the war they repaired several hundred buildings, especially in the towns of Sernaize, Pagny, Heiltz-le-Maurupt. They are now back at work in the Aisne and the Meuse.

The Californian Mission of Mrs. Crocker and Miss Daisy Polk adopted the village of Vitrimont in the Meurthe-et-Moselle and have repaired almost all of the 50 properties in the town. Various French cities and towns have adopted destroyed towns and villages. For example, St. Mihiel has recently been adopted by Nantes, Lyons has adopted St. Quentin and other towns in the devastated regions, and there are many other more or less official cases of such adoption.

The Reconstitution Research service of the American Red Cross has been working directly with the French Government and with most of the leading French associations and societies, to help them to establish a program of after-war reconstitution work, especially to aid the small farmer and workingman. The policy has been to bring together the leading French specialists and authorities to consider the problems of common interest with regard to after-war reëstablishment, and to secure an agreement on standards of practical improvements to be adopted in the planning, construction, furnishing and equipping of houses, farms and town buildings, with a special view to sanitation, economy and operation. The intent is, that once these standards are determined they shall be given general publicity among the returning refugees, with a view to getting them adopted in the reconstruction of the buildings and the reëstablishment of the livelihood of the people. A number of tracts have been published and a number of typical improved plans, with specifications and data, have been prepared. An extensive library and documentation on all phases of reconstruction have been collected, and the most useful material has been briefed. Everything is ready to start a big campaign of propaganda, with special emphasis on improving sanitation and hygiene.

Control of Main Routes by State Commissions

That the control of a state-wide system of roads should be vested in the State Highway Commission is the opinion expressed in the latest annual report of the Alabama commission. The present law gives the initiative in all construction work to the counties, but the report states that while this generally works to the benefit of the county, it frequently is not to the best advantage of the state. A trunk-road system of about 3000 miles was designated by the last legislature, of which about 1500 miles are constructed and in good condition. However, many short gaps in important trunk lines occur at the borders of counties, as the county officials neglect these portions and will not apply for state or Federal aid for their improvement. It is held, therefore, that the State Highway Commission should have authority to improve these neglected sections, in order to make the trunk roads continuous as intended.

Pay and Position of Engineers in Railway Service

Comparison with Wages Paid to Solicitors, Machinists and Trainmen Shows Low Relative Compensation For Technical Men

By Charles Whiting Baker
Consulting Editor "Engineering News-Record"

At this time, when public attention is concentrated as never before on the railway transportation lines of the country, it is surely opportune to call attention to the position which is held by professional engineers in the railway service. Rather let us say the *lack* of position; for the unfortunate fact is that the average engineer who works for a railway company receives lower pay than the mechanics working in the repair shops and very much lower pay than the employees in train service.

Many of the men engaged in railway engineering have spent four years or more in acquiring a technical education, have long experience in practical work, and are performing responsible tasks, where the application of their technical knowledge and ability has an important influence on the economical use of both material and labor; yet the average compensation of these engineers is about the same as that of the hostler who cleans a locomotive in the roundhouse, or of the man who handles trunks in the baggage car. As for the aristocrat of the railway service—the man who handles the throttle of a passenger locomotive and whose right to the title "engineer" has often been protested by the men who hold engineering to be a profession—he draws monthly from the pay car nearly twice as much money as the average assistant engineer or draftsman receives.

The inadequate compensation of railway professional engineers is not merely a flagrant injustice to men who give to the railway service the results of long years of technical study and experience; it is the most wasteful sort of economy thus to misuse the men whose ability the railways greatly need in order to solve the difficult problem of increasing the economy and efficiency of railway operation.

Inadequate Compensation of Long Standing

The inadequate compensation and lack of position of engineers in the railway service is a matter of long standing. It has come to the fore recently, since Government control of railways was established, because the organization of the Railroad Wage Commission by the Director General gave opportunity for the engineering employees to present their pleas for higher pay.

Furthermore, the engineer, like every other man, has had to face a rapidly mounting increase in the cost of living for himself and his family during the four years of the war. While his salary was meager enough for his living expenses in 1914, he received practically no increase of any consequence since then until the general advance in all railway wages was put into effect by the Railroad Administration last year.

It has long been known in a general way that railway engineering service was inadequately paid. The professors in leading engineering schools, in advising their young graduates where to look for positions, have in many cases warned them of the small pay and slow promotion which they could expect in the railway service. There are probably few, however, in the profession—outside of those directly in railway service—who realize what the engineer who works for a railway company has had to contend with.

It seems worth while, therefore, to present in considerable detail the facts and figures as to the pay of railway engineers, compared with that of other classes of employees. These have been obtained from the official statistical reports of the Interstate Commerce Commission and the report of the Railroad Wage Commission, supplemented by the recent official orders increasing wage rates. The last published statistical report of the Interstate Commerce Commission was for the year which ended June 30, 1916. The report of the Railway Wage Commission continues the figures down to 1917.

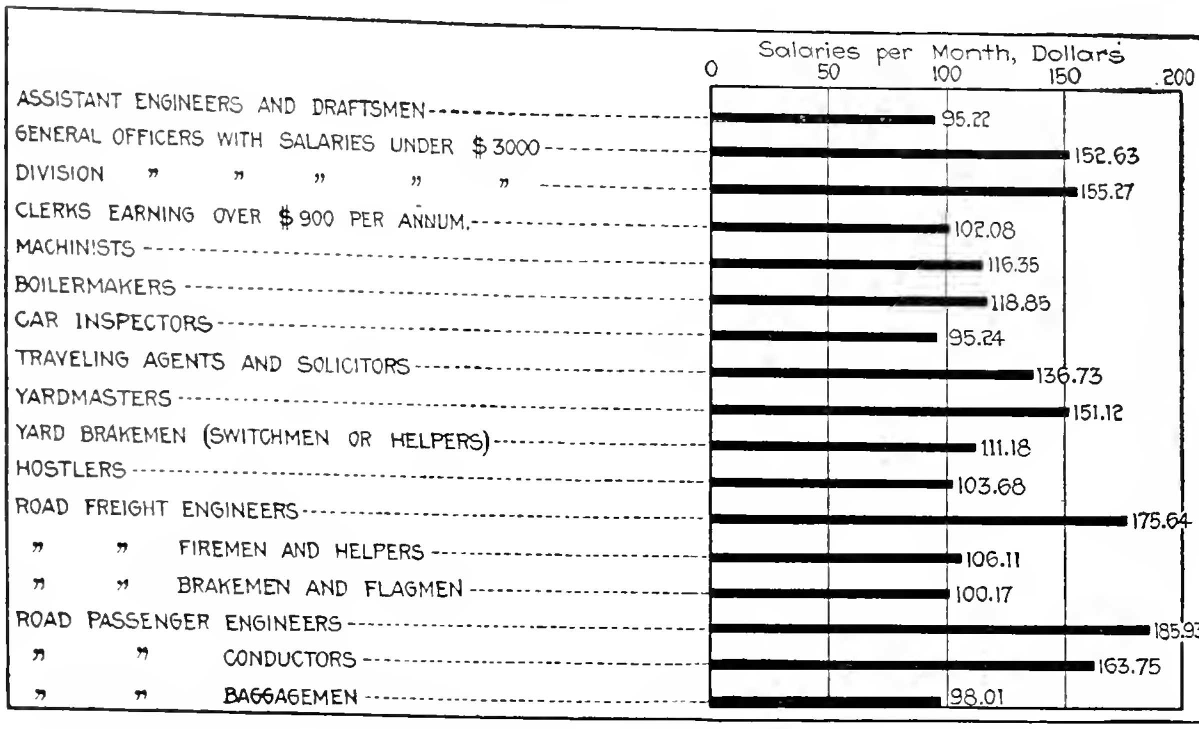
Salaries of Railway Officers

The Interstate Commerce Commission classes all those engaged in railway engineering service under the title "Assistant Engineers and Draftsmen," with the exception of engineers who hold such positions of authority that they are included under the heading of "general" or "division" officers.

Of course, a considerable number of the engineers engaged in railway work are classed as "officers," and it may be well just here, therefore, to drive a nail into the current fallacy that the average railway officer is in receipt of a princely income. The fact is, that while a very few of the highest railway officers, such as the president and the vice-presidents on a large system, receive liberal salaries (especially when they are in close relation with the financial interests which control the company) the rank and file of the officers on whom the responsibility for operation chiefly falls receive salaries which are on the average much below those paid by manufacturing or commercial bodies for the assumption of similar heavy responsibilities.

The Interstate Commerce Commission's figures for the year which ended June 30, 1916, make the following showing for the officers of Class I companies (those having gross earnings exceeding $1,000,000 per annum): The total number of general officers drawing salaries above $3000 per annum was 3958, an average of two per 100 miles of line. The average daily pay of these general officers was $20.75. Their total salaries amounted to only $26,217,000, which was less than 2% of the total payroll of these railway companies. Of the general officers with salaries under $3000 per annum, the total number was 3312. Their average salary was $5.60 per day. Of the division officers there were 1098 who drew salaries above $3000 per annum, and 8878 whose salaries were less than that amount. The average daily pay of these higher division officials was $7.10 and of the lowest paid men $5.01.

When it is borne in mind that these figures include the officials of all departments of the railway service it will be obvious that the engineers constitute no very large percentage of the number. These figures make it evident also that the men who are holding these official positions are not in receipt of what can be called high salaries. If the salaries of the few very highly paid officials, such as the president, had been deducted from the above figures before the averages were made up, it would be even more obvious that the rank and file of the railway officers were receiving nothing extravagant in the way of salaries in 1915. The figures presented in the table which accompanies this article show that, like many other salaried men, they have had to face the rapidly mounting cost of living during the war with practically stationary incomes.



COMPARISON OF SALARIES PAID TO RAILWAY PROFESSIONAL ENGINEERS AND OTHERS

Assistant Engineers and Draftsmen

Let us turn now to the rank and file of engineers in railway service who are not listed as officers. They are all grouped together, whether employed in the chief engineer's department, the motive-power department, or in any other branch of railway work, as "assistant engineers and draftsmen." There were 8879 such men employed by Class I railway companies in 1916, *and their average monthly pay was $93.76*. The Interstate Commerce Commission figures state the average compensation per day of these men as $3.45.

It has been said that the best way for a man to cultivate optimism is to regard the lot of someone who is worse off than he is. It is well to set down, therefore, for the benefit of assistant engineers who are lucky enough to have jobs with the Class I railway companies, that their fellow members of the profession who had jobs with the Class II railway companies (those having earnings between $100,000 and $1,000,000 per annum) made average daily earnings in 1916 of only $2.88.

The draftsmen and assistant engineers who worked for the little branch railways, included in Class III (earning less than $100,000 per annum) earned on the average $2.817 per day. No doubt the seven-tenths of a cent looked good to these men. Fortunately for the profession, these Class III railway companies get along with only 41 assistant engineers and draftsmen, though their total extent is 8762 miles. It is evident, therefore, that the financial slough in which these small branch railway companies, almost without exception, wallow is not due to extravagance in payment for engineering service!

Turning back to the assistant engineers and draftsmen working for the Class I railway companies, it is worth noting that their pay varies considerably in different parts of the country. Those working in the Eastern district, which includes the principal trunk lines, were paid in 1916 an average of $3.58 per day. Engineers in the South have to get along with $3.38, and on the railways west of Chicago the compensation is $3.33 per day.

Now let us see how the pay of these assistant engineers and draftsmen in railway service compares with the pay received by other classes of railway employees. In the accompanying table a comparison is made for certain selected classes of employees, including a number of those which have earnings approximating or exceeding those of the engineers. The first two columns of this table give the total number of employees in each class in 1916 and the total wages paid to them as given in the statistical report of the Interstate Commerce Commission for that year. The next three columns, showing the average monthly earnings in 1915, 1916 and 1917, are taken directly from the report of the Railroad Wage Commission to the Director General of Railroads. The last column contains figures computed from the general order increasing wages issued by the Director General last May, modified by various supplementary orders, under which railway employees of all classes have received in 1918, it is stated, $636,000,000 more than they did in the year previous.

Only an Approximation Possible

It should be said for this last column that it is necessarily only an approximation. The allowances for overtime, minimum wage rate, etc., for the mechanics working on the hourly basis and for the train employees paid on the mileage basis make an accurate statement of actual average yearly earnings impossible until the statistics of the Interstate Commerce Commission for 1918 are finally made up. The figures in this last column are accurate enough, however, to give a fair idea of where the professional engineer finds himself at the present day in comparison with the mechanics in the shops, the employees in the train service, and other railway men.

There is no intention here to discuss at length the increases which have been made in railway wages, or to criticize the action of the Federal railway managers. They had to cope with conditions which compelled large

increases to the mechanics in the shops and to the train-service employees. The men in the repair shops were absolutely essential to the railway organization under the conditions existing a year ago. Something had to be done to offset the temptingly high wages in the munition plants and to recognize the situation of these men on account of the mounting cost of living. The rights of the train-service employees under the Congressional enactment of 1916 establishing the eight-hour day had to be recognized; and the Brotherhood officers were not negligent in insisting on these rights.

It is well to set down here just what the basis of pay is, for these classes of employees. The wages of machinists, boiler makers and other skilled mechanics employed in railway shops were raised last year by "Supplement 4 to General Order 27," in the following manner: A basic minimum rate of 55c. per hour was established, and to this rate and any higher rates which were in effect Jan. 1, 1918, there was added 13c. per hour, making the minimum base rate 68c. per hour. For any work in excess of eight hours, time and a half is allowed. At this rate, with no overtime earnings, a machinist would receive $5.44 per day or $141.44 per month of 26 days.

Most of the employees in railway train service are paid on a mileage basis, and an elaborate table was published in General Order 27 showing the amount of increase in proportion to past wages for each class of train-service employees. It is impossible to apply these increases to the past average earnings of men in train service, shown in the table herewith, so as to determine just what average pay these men are now drawing.

It has been assumed, therefore, that the general percentage of increases in mileage rates which was established by Order 27 will represent a fair average for all classes of train-service employees. These percentages of increase were as follows:

	Per cent
Road freight engineers	15½
Road freight firemen and helpers	34¼
Road freight brakemen	39½
Road passengers engineers	11¼
Road conductors	15½
Road baggagemen	38¼

These figures, however, obviously do not tell all the story, for under the Adamson law as enacted in September, 1916, all the train-service employees now receive time and a half for all work over eight hours.

How much the eight-hour day is increasing the average earnings of railway employees in addition to the increases in wage rates established by the Railroad Administration will not be known until the Interstate Commerce statistics are available, nearly two years hence.

Those who know what is going on in the railway service, however, believe that a very considerable amount of railway revenue is now being paid out for overtime which is only made necessary by the employees themselves. In fact the time-and-a-half pay for overtime establishes a premium on petty graft in the railway service—petty, that is, as far as the individual is concerned, but anything but petty in its effect on railway revenues.

It need not be assumed that the train-service employees are satisfied with the increases which they received last year. Late reports from Washington state that they are seeking additional increases from the Railway Wage Board which will raise their total pay by something like $100,000,000 per annum, and a possible further increase in freight rates is said to be under consideration to meet this new demand.

It may be said that all this is not pertinent to the question here discussed as to whether the professional engineers in railway service are adequately paid for their work. But the standing excuse for the meager pay to engineers has long been that the railways were too poor to pay any more. It is therefore, pertinent to show that if the railways can let their revenues be dissipated for over-time pay for work that could often be obviated they can surely afford to pay a living salary to their professional engineers.

Let it be here set down also that the professional engineer in many cases gets neither time-and-a-half nor any extra pay whatever when he works overtime, as he is often obliged to do. In the days when railway surveys were a big factor in American engineering work, the engineer was accustomed to work from daylight to dark in the field, and to amuse himself in the evenings by writing up notebooks, drawing maps and in similar pleasant recreation. Somewhat of that tradition still survives among railway engineers. They are supposed to be on the job whenever the exigencies of the service demand, all at so much per, and their esprit de corps dignity would suffer, it is assumed, by the payment of extra compensation for over-time work!*

In the orders which have been issued granting increases of pay to various classes of railway employees the engineer *has never attained the dignity of a separate classification.* According to our information, all the men in railway service classed as "assistant engineers and draftsmen" by the Interstate Commerce Commission are included under "Supplement 7 to General Order 27." We quote as follows from this order: "For all employees who devote a majority of their time to clerical work of any description, including train announcers, gatemen, checkers, baggage and parcel-room employees, train and engine callers, and the operators of all office or station equipment devices, establish a basic minimum rate of $62.50 per month. To this basic minimum rate and all rates above, in effect Jan. 1, 1918, add $25 per month."

Thus, the professional engineer with technical education and experience finds himself classed with clerks, train announcers and the men who check baggage, as far as pay is concerned, and, it is a fair corollary, as far as position also is concerned!

What does all this mean to the professional engineers who are striving to do their work under such conditions? It means that for the past four years they have had to support themselves and their families on an average salary smaller than the wages of a chauffeur; that they have had to do this while year by year the cost of food and clothing and other necessaries of life

*Recent orders of the Federal Railway Administration have made some allowance for overtime work by engineers. For example, in a certain railroad office in New York City the assistant engineers and draftsmen have the same hours as most office workers there, from 9 a.m. to 5 p.m. with an hour for luncheon. This is a 7-hour day. If the work demands an extra hour time, no extra pay is given for it. For the 9th and 10th hour extra pay at single time rates is given and after ten hours, time and a half. Where work is required on Sundays or holidays, extra pay is given at the rate of single time for 8 hours and after that the same as above. This is much more favorable treatment as respects extra pay for overtime work than has before been granted to engineers.

has gone on mounting. When an increase was finally granted this year it averaged only 27%, while the cost of the necessaries of life, according to the statistics of the Railway Wage Commission itself, has increased over 40% and general experience places the increase in the cost of living during the past five years at fully 70 to 100 per cent.

To expect a man to do good work under such conditions is to expect the impossible. The inevitable result is to tend to drive engineers out of the railway service into some other occupation where they can earn a decent living for themselves and their families.

Let us not comfort ourselves with the idea, either, that some of the engineers in railway service who hold responsible positions are earning salaries considerably larger than the averages here shown. We cannot get away from the fact that if a considerable number of railway engineers are drawing better salaries than are indicated by the figures above, then another lot of poor fellows are getting even less than the starvation pay which the above averages represent.

This situation above set forth, however, is of much more serious import to the public than are the hardships suffered by the ten thousand or so engineers and draftsmen in railway service. *The railway business is today suffering from its failure to give the engineer proper position and responsibility and compensation.* These engineers are using their brains, not their muscles, in the railway service. Upon their ability and initiative depend to a very large extent *the economy and efficiency with which the materials and the labor which the railway company buys will be utilized.*

As one studies the accompanying table of wage rates and the diagram, one must seriously ask the question: Where is the incentive for the railway engineer to use his best efforts to save money for the company? Does anyone thank him if he exerts himself to find a way to save material here, or to dispense with an extra man there? Director General McAdoo has called public attention to the serious breakdown of morale in the railway service. How could anything else be expected? Engineers are supposed to be in a position of authority over construction and other work. Their authority and their ability to look after the railway company's interests are neutralized by inadequate pay and position.

Contractors' employees doing work under direction of railway engineers are in many cases earning twice as much as the engineer who gives them orders. A recent letter describes the experience of an engineer of long experience in charge of construction work who had occasion to give an order to the brakeman of a train. The answer was prompt, "Who the hell are you to tell me what to do? My pay check is bigger than yours!"

How long would discipline and efficiency last in an army if the captains and colonels were paid less than the noncommissioned officers?

It is pretty well known in railway circles that the reason for the enormous increase in railway operating expenses is not merely the increase in the rate of wages but the falling off in the efficiency and industry of the employees. How is this to be remedied if the men who should be in authority are so treated as to destroy their initiative and their interest in their work?

AVERAGE MONTHLY EARNINGS OF CERTAIN CLASSES OF RAILWAY OFFICERS AND EMPLOYEES OF CLASS I RAILWAY COMPANIES (THOSE HAVING GROSS EARNINGS IN EXCESS OF $1,000,000 PER ANNUM) FOR SUCCESSIVE YEARS

			Average Monthly Earnings for the Year Ending			
Occupation	Total No. Employed in 1916	Total Wages in 1916	June 30, 1915	Dec. 31, 1916	Dec. 31, 1917	Dec. 31, 1918
Assistant engineers and draftsmen	8,879	$9,925,050	$93.42	$93.76	$95.22	$120.22
General officers with salaries below $3000	3,312	5,909,462	151.88	151.91	152.63	175.95
Division officers with salaries below $3000	8,878	15,228,380	147.62	147.64	155.27	172.55
Clerks earning $900 and upward	61,667	70,788,932	94.05	99.16	102.08	127.08
Machinists	36,602	40,837,054	85.87	100.42	116.35	See note
Boilermakers	11,944	13,772,489	89.88	102.46	118.85	See note
Car inspectors	17,904	16,281,753	73.48	81.11	95.24	See note
Traveling agents and solicitors	5,925	8,858,663	123.83	130.54	136.73	158.10
Yardmasters	3,415	5,463,154	131.09	135.35	151.12	162.35
Yard brakemen (switchmen or helpers)	37,476	44,370,600	91.93	99.81	111.18	See note
Hostlers	7,031	7,229,807	80.95	87.93	103.68	See note
Road freight engineers	29,645	55,030,111	152.75	154.32	175.64	178.24*
Road freight firemen and helpers	31,499	55,511,425	94.10	93.82	106.11	125.72*
Road freight brakemen and flagmen	60,019	62,636,087	85.83	87.70	100.17	110.78*
Road freight passenger engineers	13,318	28,014,930	178.46	177.04	185.93	196.51*
Road passenger conductors	10,676	19,682,805	153.57	156.41	163.75	175.60*
Road passenger baggagemen	5,617	6,005,841	87.03	91.49	98.01	126.35*

NOTE—The establishment of minimum rates of wages with the eight-hour day and time and a half for overtime makes it impossible to state present average pay of employees paid by the hour. The increase, however, is undoubtedly much larger proportionally than the increase received by the engineers.

* Most of these men in train service are paid on a mileage basis and with the eight-hour day in force probably receive on the average considerably higher rates than those here given.

In this connection let emphasis be given to Director General McAdoo's recent declaration that "upon the efficiency of the country's transportation system the future prospect of the nation largely depends." Where is one to look in the railway service for the men of technical education and experience who have made a thorough study of the larger problems of transportation economies such as will fit them for leadership as railway officers? Where save in the ranks of engineers?

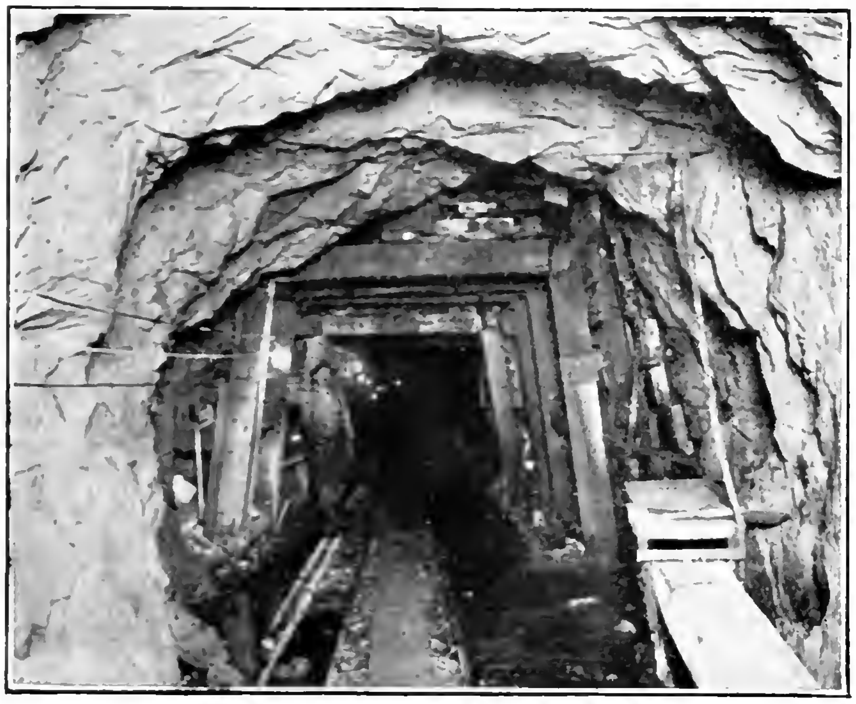
It is of the greatest importance to the country's welfare that young men of character and ability should be attracted to the railway service, and that their treatment and opportunities there should be such as to retain them. Obviously, the very reverse of such conditions exist today. The showing of the accompanying table and diagram will of itself be sufficient to make the bright young graduate engineer hunt anywhere else than in the railway service for a position.

What can the engineering profession do to remedy the conditions here depicted? The Engineering Council has appealed to the Board on Railroad Wages and Working Conditions, and is continuing its efforts; but the fact that the council is at work should stimulate rather than retard action by individual engineers and by organizations. Protests to that board (whose offices are at 1300 Pennsylvania Ave., Washington, D. C.) should emphasize not merely the inadequate pay of the professional engineers in railway service, but the unwisdom of classing them with clerks and low-grade workmen, when their authority and initiative are so important to the railway service.

The engineer is not asking better pay and position merely because he earns it and deserves it, as he undoubtedly does. It is because of the service that engineers can render in increasing economy, and efficiency in railway operations that the value of that service should be adequately recognized.

Fluming a Stream to Unwater a Tunnel

When the South Fork heading of the 18-mile tunnel on the Hetch Hetchy aqueduct had advanced about 300 ft., a heavy flow of water filled the 11-ft. width of the tunnel to a depth of about 4 ft. An examination showed that this water came entirely from the adjacent stream bed, through a geological fault line. Along this fault the rock had separated



FLUMING A STREAM STOPPED THE TUNNEL LEAK

about 6 ft., the fissure being filled with decomposed rock and gravel. The fault extends to the surface of the ground above and can be easily traced on both sides of the cañon.

Soon after the heading struck the fault the stream flow decreased by about as much as the flow in the tunnel, and plans were immediately made for diverting the stream into a flume above the fault line. The fall of the stream was such that 30 ft. of flume sufficed to bypass the water around the fault line. In the meantime timbers had been floated into the tunnel and work was continued; first the loose section, about 30 ft. long, where the tunnel crossed the fault line, was shored up.

After the stream was turned into the diversion flume, the flow in the tunnel decreased to an amount that could be conveniently handled by a 16-in. pipe. Some of this water is considered to be drainage from the fissure, and the remainder is ascribed to underflow beneath the stream bed. Beyond the fault line no water whatever was encountered. The heading was in about 700 ft. when visited by a representative of this journal in August. This work is being carried out by the City of San Francisco under the direction of M. M. O'Shaughnessy, city engineer.

Chlorination Interruptions Costly

Failure to operate water-supply chlorination plants continuously and effectively in several municipalities in New York has resulted disastrously for the inhabitants. Serious outbreaks of typhoid have been experienced, and, in one instance, the State Department of Health reports, 100 cases occurred in a town of 10,000 population three weeks (the usual incubation period) after the sterilization apparatus, through neglect, had failed to operate for five days.

Tests Show Value of Fine Grinding of Portland Cement

Fine-ground cement, specified to pass 90% through a 200-mesh sieve, is being used in the Government concrete ships. The tests on which this use was based are reported as follows in the annual report of the Bureau of Standards for the fiscal year which ended June 30, 1918:

"The series of tests, started in 1916, to determine the effect of increased fineness on the cementing value of cement in mortar and concrete has been continued. The two-year results show the same marked decrease in strength with the finer ground cements as did the tests of the previous year.

"With knowledge of the general results of this investigation the Emergency Fleet Corporation requested further comparative tests on various cements produced in the Southern districts, both as normally ground and as reground to a fineness of 90% passing the 200-mesh sieve. These cements were tested in 1: 1: 2, 1: 1½: 3, and 1: 2: 4 concretes and in 1: 2 mortar. In practically all cases the increase in compressive strength obtained with the finer cements was from 50 to 100 lb. per square inch for each per cent. increase in fineness. From all the data obtained in this investigation the order of increase in strength which may be expected from finer grinding by ordinary methods is now fairly well established, and the question of requiring higher fineness in the standard specification for portland cement is a purely economic one. There remains, however, the highly interesting and almost wholly unattacked problem of producing cements of much higher fineness than is possible by ordinary methods of grinding. It may confidently be expected that if practical methods can be found of reducing cement clinker to a very fine state of subdivision, a decided improvement in quality will result. To determine what degree of improvement may be obtained is properly the next step in this investigation.

"The importance of further progress along these lines is commensurate with the difficulties to be overcome in developing new methods of grinding, and concentrated effort will be required to deal with the new problem effectively. Fortunately, some progress was made before the war by the development of an air separator and an air analyzer for the production and mechanical analysis of very fine cements."

Bonus Payments Speed Up Shaft Sinking

Well-organized shifts and bonus payments were largely responsible for the unusual speed of nearly 200 ft. a month for five months in sinking a 11 x 21-ft. rock shaft for the Seneca Mining Co., at Mohawk, Mich. A flat rate per day was paid up to the first 100 ft. per month; 2c. per foot per day bonus was paid for all over 100 ft. up to 150 ft.; 3c. per foot per day for all over 150 up to 200 ft. and 4c. per foot per day for all over 200 ft. per month. A total of 994 ft. of shaft was sunk in 129 working days in five months from May to September, or an average of 7.7 ft. per day. The highest monthly rate was 208 ft. in 27 days in May, and the lowest was 184 ft. in 24 days in September.

Experimental Data on Wood-Blocks—Use of Zinc-Treated Ties

Extracts from two of the papers presented at the fifteenth annual meeting of the American Wood Preservers' Association at St. Louis, Jan. 28-29, giving (1) the results of investigations on experimental wood-block pavement in Minneapolis, and (2) the influence of rainfall upon the durability of zinc-treated cross-ties.—EDITOR.

Progress Reported on Wood-Block Experiments in Minneapolis

BY C. H. TEESDALE AND J. D. MACLEAN
Engineers in Forest Products, Forest Products Laboratory, Madison, Wis.

THE object of this report is to discuss the results of investigations made on an experimental wood-block pavement, after 12 years' service under heavy traffic conditions. This pavement was laid in coöperation with the City of Minneapolis for the purpose of studying the relative merits of various species of wood for paving material, and to investigate the influence of the following variables: (a) Heartwood and sapwood; (b) length of blocks, and (c) angle of courses.

Seven species of wood were employed: Tamarack, Norway pine, long-leaf pine, white birch, douglas fir, Western larch, and hemlock. On account of the wide use of long-leaf pine as a paving material, this species was used in the test to provide a basis of comparison for the other woods. A detailed discussion of the material used, the method of treating the blocks, and the construction of the pavement, is given in Forest Service Circulars 141 and 194, the latter issued Jan. 16, 1918.

One of the difficulties encountered in an experiment of this nature is in the selection of a method for judging the conditions from year to year. In order to determine a basis of comparison, the following method was adopted: (1) Measurement of the blocks to determine the average wear; (2) estimation of the total number of square feet in a section below the general level of the street; (3) estimation of the total number of square feet ½ in. or more below the general level of the pavement.

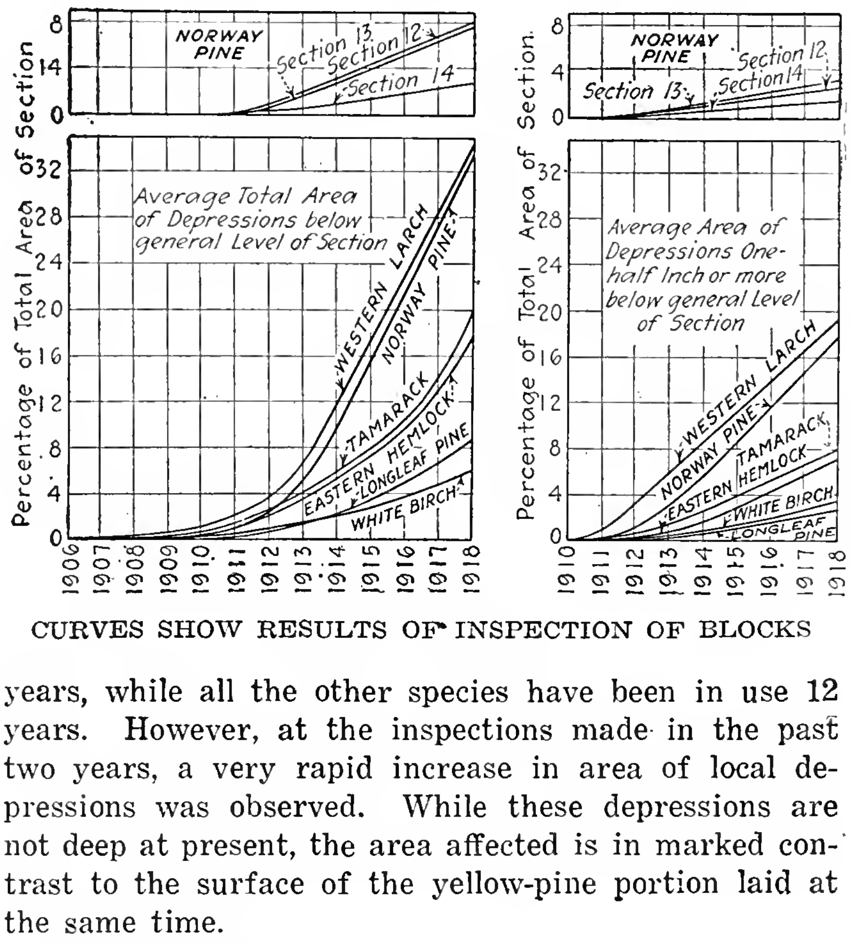
The wear of the various species was measured on a block removed from each section from a position about midway between the curb and the center of the street. It was selected from a portion of the pavement where the surface was fairly uniform. Measurements to the nearest $\frac{1}{16}$ in. were made at a number of points, and the average depth was determined. The difference between this and the original depth of the blocks was taken as the average wear of the section.

HOW ESTIMATES OF DEPRESSION WERE MADE

Estimates of the total number of square feet of depression below the general level of the surface, and ½ in. or more below the general level, were made independently by each member of the inspection party. These estimates were averaged and recorded. The data were plotted for each of the inspections and curves drawn showing the average results, as indicated in the diagrams in the next column.

In the early part of the summer of 1911 the douglas fir blocks were in such bad condition that it was necessary to relay the two sections composed of this species. Deep depressions had developed, and some of the blocks were badly broken. The failure of this wood after five years' service was probably due to the poor quality of the original blocks. To test this species further a quantity of Grade A material was obtained. There was not a sufficient amount of this douglas fir to replace entirely the sections removed, so the remaining area was paved with the regular yellow-pine blocks supplied by the city.

A good comparison of the durability of douglas fir with respect to the other species cannot be made at present, as the relaid material has been in use only seven



CURVES SHOW RESULTS OF INSPECTION OF BLOCKS

years, while all the other species have been in use 12 years. However, at the inspections made in the past two years, a very rapid increase in area of local depressions was observed. While these depressions are not deep at present, the area affected is in marked contrast to the surface of the yellow-pine portion laid at the same time.

Blocks of douglas fir which were removed for inspection showed an average wear and brooming from $\frac{5}{16}$ to ½ in., as compared with $\frac{3}{16}$ to ¼ in. for the yellow pine placed at the same time.

It will be noted from an inspection of the curves that it is impossible to predict the deterioration of a particular species from conditions observed during seven or eight years' service. Practically all of the species showed very small areas of depression for the first five or six years. After this period, however, the depressions suddenly increased in area at a very rapid rate. Results of the more recent inspections seem to indicate that the increase in depressions will be much more rapid in the future, and will necessitate the early replacement of some species.

There is no question that specimens of long-leaf pine and white birch are in a much better condition than

most of the others. The depressions in the white birch are somewhat more numerous and deeper than those in the long-leaf pine, but these depressions are largely due to the crushing down of blocks which were partly decayed before they were treated. Depressions in the long-leaf pine seemed to be due in a large degree to decay in the sapwood of individual blocks. Poor penetration, on account of moisture in the wood at the time of treatment, probably accounts for most of the cases of decay found in the sapwood.

Apparently, the white birch and the long-leaf pine may be classified on the basis of this experiment as about equally durable for paving purposes. An objectionable feature of white birch seems to be the difficulty in selecting material free from decay. The Norway pine section has large areas of depression and a considerable number of deep pockets. The bad condition of this section, however, is not a good criterion of the wearing qualities of the species. This section is triangular in shape, and therefore has but a small area which is not subjected to continually severe traffic conditions.

The Eastern hemlock seems to be in slightly better condition than the tamarack. However, there is not a very pronounced difference in the condition of these two species. The Western larch sections are in very poor condition. Compared with the other species, this wood has the largest percentage of area affected by depressions.

Measurements of wear were taken on all of the species until 1915. At this time the depressions had reached a state where it was not practicable to select blocks representing average conditions. In subsequent inspections a general estimate of the relative wear has been made. Beginning with the species showing the least wear at the last inspection, the approximate average wear and brooming is as follows: White birch, $\frac{3}{16}$ to $\frac{1}{4}$ in.; long-leaf pine, $\frac{5}{16}$ to $\frac{7}{16}$ in.; Norway pine, $\frac{1}{2}$ to $\frac{9}{16}$ in.; tamarack, $\frac{7}{16}$ to $\frac{5}{8}$ in., Eastern hemlock and Western larch, $\frac{5}{8}$ to $\frac{3}{4}$ inch.

Most of the wear on long-leaf pine and white birch blocks seemed to have taken place during the first five or six years of service. This was probably due largely to brooming of the fibers. Some of the other species, in which the wear was most pronounced, showed a general increase in wear from year to year.

Summary

1. The order of efficiency of service is as follows: (a) Long-leaf pine; (b) white birch; (c) Eastern hemlock; (d) tamarack; (e) Norway pine; (f) Western larch.

2. Since the relaid douglas fir has only been in service seven years, a good comparison of this wood cannot be made with the woods which have been in use for 12 years. At present the depressions and wear of this species are from two to three times as much as that of the long-leaf pine portion laid at the same time.

3. For most of the species the depressions were very slight during the first four or five years' service. After this period the depressions increased at a very rapid rate.

4. Certain sections show wearing qualities of Norway pine which compare favorably with those of long-leaf pine and white birch. These sections probably give a better comparison of the durability of this species than does the section which is subjected to unusually severe traffic conditions on account of its shape and location.

5. The Western larch sections have the greatest percentage of area affected by depression. This is also one of the species which shows the heaviest wear.

6. The order of the species, beginning with that showing the least wear, is as follows: White birch, long-leaf pine, Norway pine, tamarack, Eastern hemlock, and Western larch.

7. The presence of sapwood did not seem to be an important factor affecting the durability of the pavement.

8. The various lengths of blocks employed had no apparent influence on the wearing qualities of the pavement.

9. Less joint wear was noted in sections laid at 45° and 67½° than in the section of blocks laid at an angle of 90° with the curb.

Rainfall Influence on Durability of Zinc-Treated Cross-Ties

By C. H. Teesdale and S. W. Allen
Engineer in Forest Products — Industrial Examiner in Forest Products
Forest Products Laboratory, Madison, Wis.

The scarcity of creosote needed in timber treating for the past two years, due to the restrictions on imports and the increased use of coal tar for fuel by the steel industry, has directed attention to the possible wider use of other treating materials, especially for cross-ties. Among those under consideration zinc chloride has been most commonly used, and a large number of service records on zinc-treated cross-ties were available.

Accordingly, it was proposed to plot these records on a map of the United States to determine if possible the relation between the location of successful tests of zinc-treated ties for different periods of service, on the one hand, and lines of equal rainfall, on the other. By this means it was hoped to suggest a more or less definite area where zinc chloride could be used to the exclusion of creosote.

The *Proceedings* of the American Railway Engineering Association and of the American Wood Preservers' Association were consulted for data on service tests of zinc-treated ties, and where exact locations were not shown they were determined by consulting original records from various roads, on file at the Forest Products Laboratory. The location of lines of equal rainfall were taken from Bulletin Q of the Weather Bureau, United States Department of Agriculture.

Three outline maps of the United States were prepared, showing the geographical location of test tracks containing zinc-treated cross-ties which had been in service for eight years, for 10 years and for 12 years. Those tracks where 25% or less of all zinc-treated ties had been removed in this period, and those where 50 to 100% had been removed, were designated by different symbols.

Comparatively few records are available south and east of the 40-in. rainfall line, which extends roughly from Galveston, Tex., through St. Louis, Pittsburgh, Albany, N. Y., and on to northeastern Maine. On the

map showing eight years' service, however, the tracks with less than 25% renewals, or the "successful" tests, are numerous near this 40-in. rainfall line, while seven out of a total of 13 "failures" are south or east of this line. Four "successful" tests are also located south and east of the line.

The data as plotted on these maps, while rather meager, indicate in a general way that the arid Western states, and the Central, Atlantic Coast and New England states north of the 40-in. rainfall line form a definite area where cross-ties treated with straight zinc chloride may be expected to give from eight to ten years' service. It is felt that the line might well be extended in its central part to include all the area north and west of the Ohio River drainage area, but sufficient data are not available to support this opinion.

Construction Camp Community Association Like Commission Government

TAYLORSVILLE, the camp community created by the construction forces of the Taylorsville Dam of the Miami Conservancy District, near Dayton, Ohio, has adopted a self-government plan modeled on commission government. The plan was initiated Nov. 29, 1918, by the organization of the Taylorsville Community Association and the adoption of a constitution. Work started with 67 members, and on Jan. 1 community government was in full operation.

All employees in the dam construction and members of their families who are over 16 years of age are eligible as members of the community association. Election is by ballot. Members pay an entrance fee of 50c., and annual dues of $1. Officers of the association are five commissioners who are elected from members in good standing who have resided at least three months at the dam site. Commissioners serve six months. The one receiving the largest number of votes becomes chairman and designates the heads of four departments from the commissioners elected. Each works through committees appointed by the commission. The present incumbents are D. D. Rogers, chairman and commissioner of social service; E. P. Come, education; F. A. Meyer, community safety; B. H. Petty, community service, and Roy Hutzelman, unassigned.

At present 13 committees are organized and at work. These include committees on schools and library, entertainment, relief, religious activities, fire prevention, law and order, health and sanitation, transportation, and gardens. Day and night schools and a Sunday school are in full operation. There is a regular program of entertainment, comprising moving pictures, concerts, lectures and dances, also provision for regular union church services.

The association meets regularly once a month and the commission meets as often as there is business to transact. Similar associations are in process of creation at the other construction camps of the flood-protection works.

Of course, it must be understood by the reader that these associations do not supersede in any way the legally constituted authorities of the minor civil divisions of the State of Ohio.

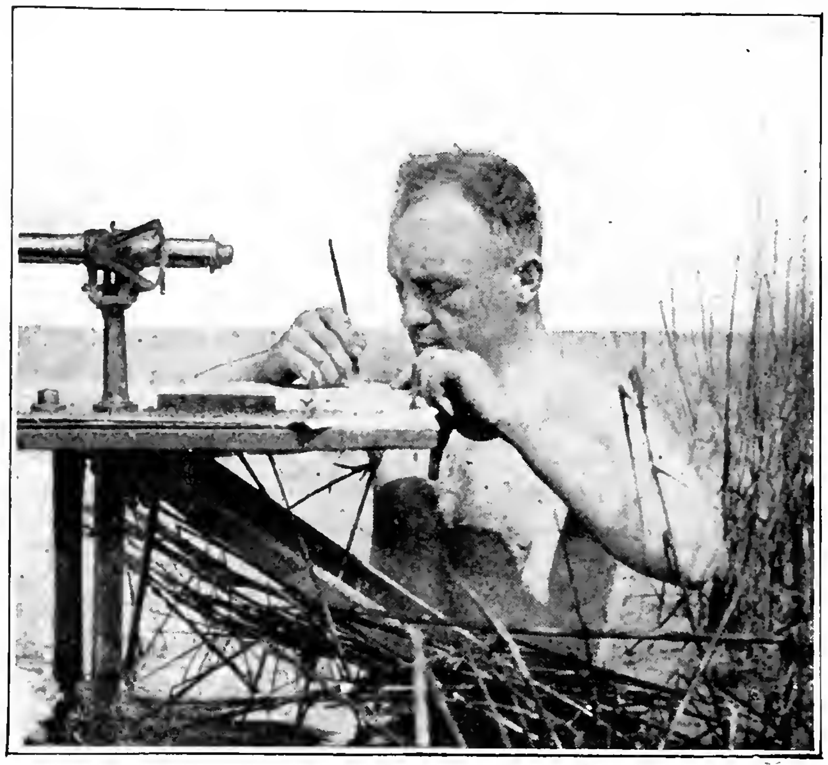
Topographic Engineers Assist in Military Mapping

Special Work of United States Geological Survey Meets Needs of War Department—School Trains New Topographers Quickly

By R. B. Marshall

Major, Engineers, United States Reserve, Chief Geographer, United States Geological Survey

WHEN the call for mobilization came in the spring of 1917, there was a demand from the War Department for topographic maps of our borders and our coasts. No other scientific bureau of the Government was more ready to respond to the call than the United States Geological Survey. No other single large group

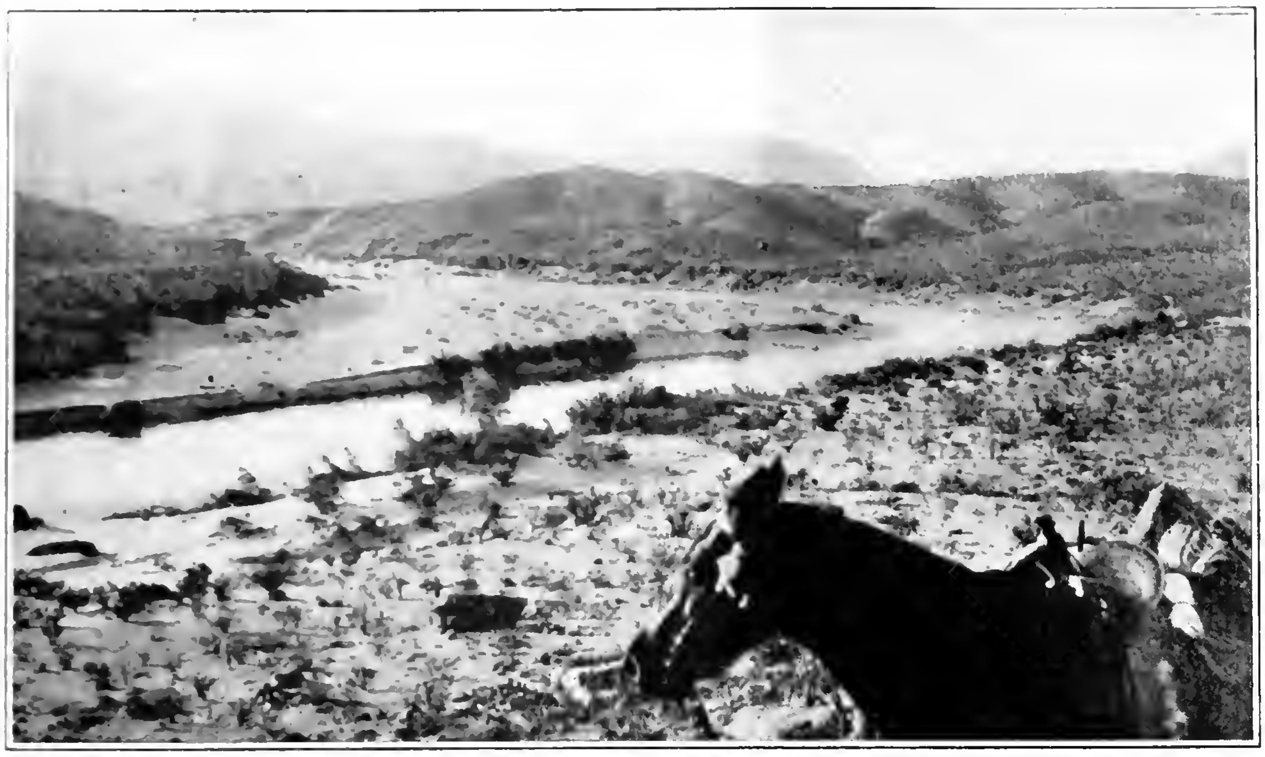


SURVEYING THE COOPER RIVER AT HIGH TIDE

of technical men in the country offered their services so early or in so large proportion to their numbers as the survey's topographic engineers.

In requesting that the Geological Survey divert its maximum activity toward topographic work, the War Department merely sought to utilize an organization already existing and fully equipped. To provide further support for this work continuously throughout the year, it allotted practically all its appropriations for topographic surveys, and Congress appropriated large additional sums for military mapping. In order that the department might exercise full authority over the plans for this work, Geological Survey men, as fast as commissioned in the Reserve Corps, have been detailed to report to the director of the survey "for duty in connection with military mapping now being done for the War Department." Thus the organization for topographic work is essentially military, the former chief topographer being now a major in charge of all Geological Survey topographic work under the War Department, and practically all his division-staff assistants and many of the topographic engineers are commissioned men.

When Villa raided Columbus, N. M., and Pershing struck off southward through Mexico, and when bandits ventured into the "big bend" country of southern Texas, there were no accurate maps of those areas for ref-



COUNTRY RECENTLY MAPPED ALONG THE RIO GRANDE RIVER

erence. Today such maps exist, and many more maps of areas along the border are ready and in the making. There was no delay when the need came for men both trained in topographic engineering, inured to the life of the desert, the swamp or the mountain fastness, and equipped to serve far from base, in country lacking in water and fuel.

It was only necessary to divert to new fields men who had had years of topographic experience in all sorts of country and climate. When, therefore, the request came overnight for such mapping, in two days parties fully organized were on their way to new stations on our coasts and borders. The areas mapped by these military surveys from Apr. 1, 1917, to Feb. 1, 1918, aggregate 23,552 square miles.

The organization and field methods of any one of these parties thus spread out along the Mexican border in several states are typical. The unit of survey is a 15-min. "quadrangle," an area measuring 15 min. in latitude and in longitude. An experienced Geological Survey topographic engineer is the party chief and is assisted by two or three associates; each of these men is individually responsible for the mapping of the portion of the quadrangle assigned to him. Scientific field assistants, recorders and rodmen complete the technical organization, and these are supplemented by the necessary teamsters, cooks and other helpers.

Transportation to and from the railroad base, perhaps 50 to 70 miles distant, is furnished by Army auto trucks and Army drivers. The men live in tents and travel to and from the day's work in the saddle, for roads are few and cross-country travel is customary. The motor trucks maintain the necessary subsistence and forage, but the camp must find such fuel as the country affords, or even pack water to a camp that is dry. This latter condition is frequently met, for the country is largely desert or "bad lands" and most of the streams are intermittent, such as are found where the annual rainfall rarely exceeds 10 in. Water is obtained from deep wells sunk at much expense by cattlemen, and also from surface "tanks" which impound the run-off resulting from torrential rains. As the work progresses camp is moved by the supply trucks.

In advance of the detailed topographic mapping smaller control parties carry triangulation and primary levels over the areas to be mapped, and the results of this control are computed for the immediate use of the main camps that are to follow. Mapping is done by the plane-table method, supplemented by the plane-table and stadia along the roads or trails and in the less exposed lowlands. The mapping also includes a complete classification of the land as to woodland, brush, water-supply and other features, so as to yield a complete inventory of the physical and economic aspects of these parts of our border. The topographic engineer is thus a pioneer also; those who follow him need not to ask or wonder what it is like "beyond," for his map will tell.

To prepare the field sheets for reproduction and immediate printing, a largely augmented force of draftsmen, of which women are forming an increasing number, has been organized at the Washington office. All field data are sent there as fast as they are completed. The resulting topographic maps are photolithographed in colors for the immediate use of the War Department. They are published on a scale of approximately 1 in to 1 mile, and with a contour interval of 10 to 50 ft., the interval employed depending on the surface relief.

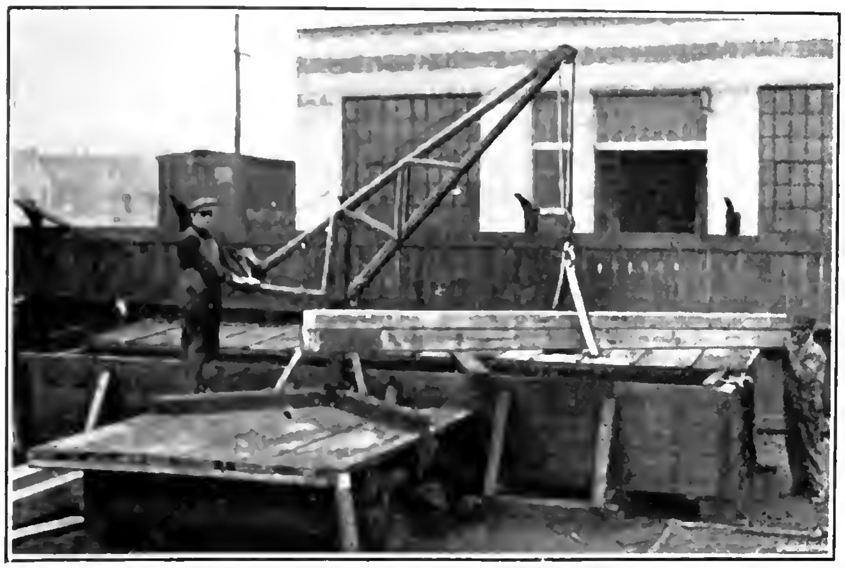
In order to maintain this force of engineers, to offset the detail of topographic officers to France on the one hand and the increasing war demands for topographic mapping at home on the other, some fifty officers, not heretofore connected with the Survey, were detailed to it from the Engineer Officers' Reserve Corps. A training school for topographers also was established. The officers detailed from the Reserve Corps were sent direct to the parties already in the field, for gradual training in the topographic work. The training school gave candidates about a month's actual field experience in a day "camp," established just outside of Washington, the men returning to the city each night as contact with office headquarters is thought to be essential to give the training its full value.

Permission having been obtained to appoint topographic field assistants without recourse to the Civil Service Commission, and without establishing a status in the classified service, about 100 such men were appointed. Most of them were obtained from the technical schools. After about a month's observation and training they were detailed to the field parties where they were most needed or where their special fitness indicated that they might be most useful. Most of these men were subject to the draft, and some were called. Others have had opportunity to enlist or to be inducted into engineering regiments where their training was needed, and they served largely as assistants to former Survey men who held engineer commissions.

Non-Pressure Treatment of Wood for Buildings

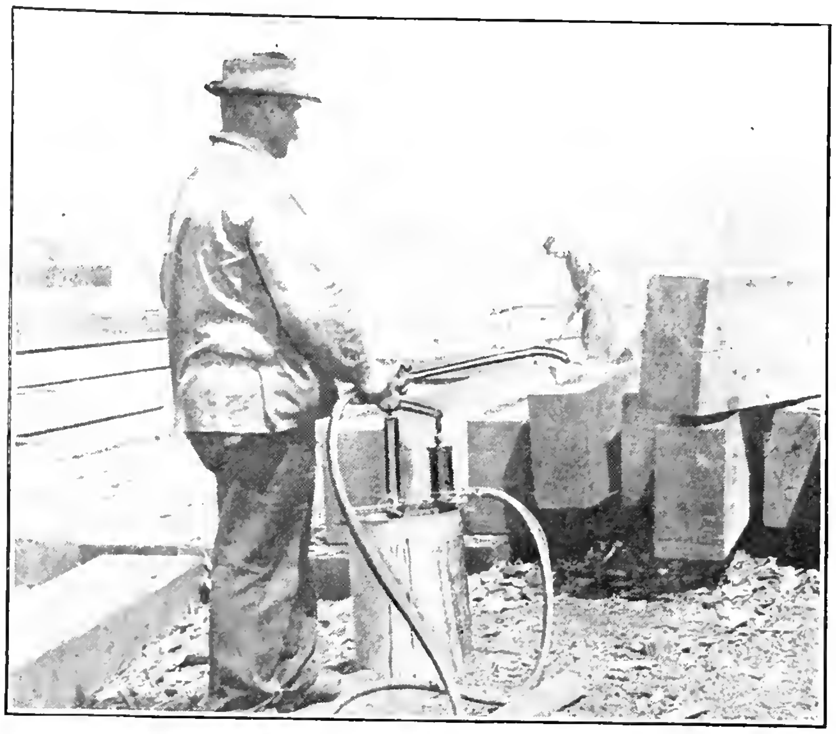
Applying Preservative at Site by Simple Processes Prevents Decay at Low Cost and Allows Use of Local Supplies

OPPORTUNITIES for extending the use of creosoted timber in the construction and repair of industrial buildings and structures, by wider use of the simpler and cheaper methods of treatment which give a sufficient degree of protection and which can be applied at the site without elaborate or expensive plant, are indicated in information compiled recently by Kurt C. Barth for the Barrett Co., Chicago. While it is admitted that the pressure or closed-tank process gives the most efficient results and the deepest penetration, its cost may be prohibitive when the amount of timber treated is comparatively small, when heavy treatment is not essential, when the buildings must be of low cost, or where distance from a treating plant would involve high freight charges on the treated timber.


SMALL TANK AND HAND CRANE FOR TREATING TIMBER

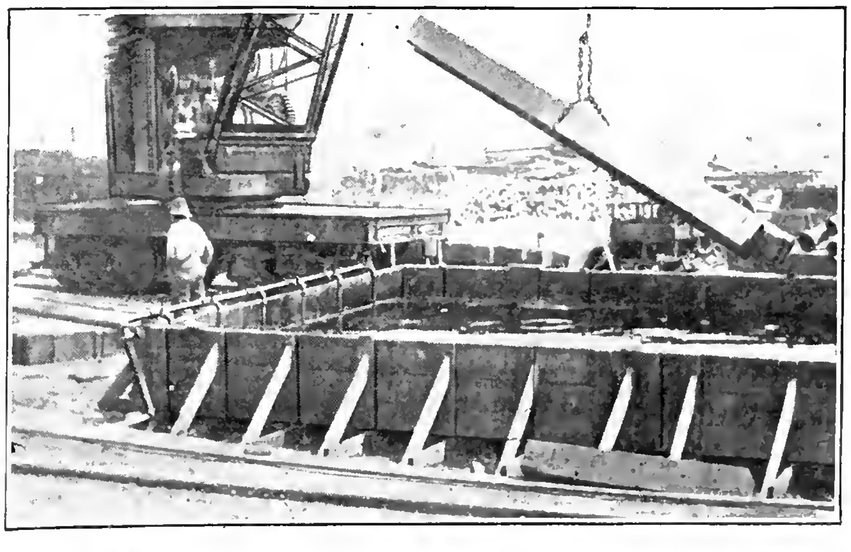
Non-pressure processes which can be employed at any point and are effective in retarding decay are shown to be applicable under the above conditions and to have been used with success on timber for mills, mines, industrial buildings, coal and gravel bins, dwellings and other structures. They are of two classes, the open-tank treatment and surface treatment. For the open-tank process the framed and bored timbers are immersed first in a bath of refined creosote oil having a temperature of 150° F. to 200° F., and are then transferred to another bath in which the oil is not over 100° F. The cooling effect, following the hot bath, results in a condensation of the heated air and moisture which assists the atmospheric pressure and capillary attraction in causing penetration of the oil.

The time is the same for each bath, and depends upon the kind of wood and the size of the piece. One hour per inch of maximum thickness is the average for close-grained woods, and 15 to 30 minutes per inch for species more susceptible to treatment. For large sticks, however, the one bath may serve both purposes, the timber being left immersed and the liquid allowed to cool after the required period for the hot treatment. For planks and small pieces the hot bath may be sufficient. Loblolly pine has absorbed 8 lb. of oil per cubic foot after one hour in the hot bath. Large yellow-pine sticks absorbed 10 lb. per cubic foot after being in hot oil for six hours and then left for 12 hours while the liquid was cooling.


APPLYING PRESERVATIVE TO TIMBERS BY SPRAYING

Surface treatment with oil may be effected by means of a brush or mop, a spraying device, or by dipping, the last named being a modification of the open-tank process. Heated refined oil is used in all cases. Two coats are required for brush application, while spraying with one coat is said to give better results besides requiring less time, material and labor. All framing and boring must be done before treatment, so as to avoid removal of any of the treated surface wood. The brush and spray methods can be applied to wood after erection.

Investigations show that timber treated by these simple processes has given particularly good results in the roofs of paper mills and weaving sheds, where the high degree of humidity is conducive to decay. While the life of the best grades of untreated timber under such conditions is seldom more than nine years, and often only four years, roofs built of treated timber have been found in good condition after seven to nine years' service.


LOCOMOTIVE CRANE HANDLES LARGE TIMBERS AT TREATING TANK

In one case the 2 x 6-in. white-pine roof covering of a paper-mill machine room built in 1900 was removed in 1908 on account of decay. It was replaced by douglas fir, and hot preservative was poured upon the finished roof, which was found to be in good condition eight

years later. In a similar machine room a roof sheathing of Norway pine, painted with white lead and oil on the inside, was removed in three years on account of decay. The new Norway pine roofing received two brush coats of coal-tar preservative before being set in place, and this roofing gave 14 years of service. A floor of brush-treated yellow pine, alternately wet and dry but protected from mechanical wear by steel plates, was in good condition after five years, although an untreated part of the floor had begun to fail from decay.

Where numercus low-priced dwellings are to be erected, as for workmen's houses or suburban development, it is claimed that timber treated by these simpler processes will prove economical, by permitting the use of cheaper and less durable kinds of lumber and reducing the cost of painting, since creosote applied as a preservative may serve also in place of paint or stain. For such work the open-tank process is considered desirable, the tank being installed on the site and the treated timber stacked to dry for a few days before being used, the time depending upon the atmospheric conditions. The treatment may be applied to all lumber used in the first-floor framing and porches, to the shingles and to the fence posts and boards.

Philippine Water-Supplies Get Strict Sanitary Supervision

Good Water Reduces Death Rate 50 Per Cent—Government Encourages Wells by Paying Two-Thirds Cost—Amoebæ Normally in Water Not Removed by Filtration but Not Disease Producers

By George W. Heise

Saltville, Va., formerly Chief of the Section of Water Analysis, Bureau of Science, Philippine Islands

Before American occupation of the Philippine Islands a vast majority of the 8,000,000 inhabitants was dependent upon streams or shallow dug wells for its water-supply. Primitive methods of living and lack of sanitary facilities and sewerage systems made pollution of the supply inevitable, with detriment to the public health. Torrential rains of the wet season also caused periodical contamination, by washing débris into the water courses and wells. The only municipal system worthy of the name, that of the City of Manila (installed in 1882), derived its water from a river which drained a thickly inhabited watershed and was in effect the sewerage system for this area.

Spanish Efforts Not Successful

Attempts of the Spanish to secure potable water for towns located on mountain sides deserve mention. In these installations, some of which are still in use, water from springs located above the town was carried in open runways or ditches to the edge of the town, whence it was distributed through open laterals. As these ditches and laterals served as convenient places for washing clothes and as sewers (and in many cases are still used thus), these attempts to improve the water-supply could not be regarded as an unqualified success.

Even the water from sources of naturally potable supplies, such as certain springs, was frequently contaminated through careless handling and improper methods of storing. Under such conditions, it is hardly surprising that the Filipinos as a whole were weakened by disease, that dysentery and other intestinal illnesses were common, and that devastating epidemics of cholera occurred repeatedly. The state of affairs may be inferred from the fact that as late as 1909, after great improvements had been made, it was estimated that from 80 to 90% of the Filipinos were afflicted with intestinal parasites. In the low lands the temperature in general is over 85° F., rarely going above 90° or below 65, while the humidity is high. Temperature of surface water averages about 80 deg. Conditions are therefore relatively favorable for bacterial growth.

With the establishment of civil government, after the American occupation, much work was done in sanitation and the improvement of public water-supplies. The intimate connection between public health and the character of water was clearly demonstrated by the fact that in some localities the substitution of good water-supplies for the polluted sources previously in use led to a 50% reduction in the annual death rate. In Manila the installation of a new water-supply system was followed by a reduction of 66% in the annual deaths from intestinal diseases.

Construction of artesian wells was a most important factor in the improvement of existing water-supplies. Previous to American occupation there were two or three comparatively shallow flowing wells that had been constructed by the Spaniards. Drilling of artesian wells, begun by the insular Government in 1906, proceeded steadily until, at the end of 1917, about 1500 wells had been bored by the Bureau of Public Works, besides numerous wells constructed by private enterprise. For a period of years the annual Government expenditure for well drilling has been about $225,000. The drilling of wells was greatly stimulated by an act of the Philippine legislature, whereby the insular Government paid 66% of the cost of all successful wells, the municipality paying the balance, whereas the entire cost of an unsuccessful boring was borne by the Government. A well was considered unsuccessful if water was found in insufficient quantities or if analysis showed that it was not desirable for human consumption.

Water from Wells Is Satisfactory

Deep wells were generally properly constructed and tightly cased, with the tops embedded in cement. Their water, though frequently heavily mineralized, is bacterially pure and usually potable. Flowing wells are very common and are the most satisfactory, but unfortunately no attempt has been made to conserve the artesian supply, and some wells are already showing marked decrease in flow.

Deep pump wells are far less desirable. Great difficulty was experienced in securing a pump which would stand the service, as the local authorities, to

whom a well, on completion, was turned over by the insular Government, usually failed utterly to keep the equipment in repair. From personal observation in a number of provinces it may be stated that between 25% and 66% of the pumps were out of order or entirely inoperative all the time. Failure to drain waste water away from the well side, and use of dirty water for priming the pumps, served further to make the situation unsatisfactory.

Considerable progress was made in supplying towns with municipal water systems. In some of the larger installations (Manila, Cebu, Zamboanga) rivers from carefully guarded watersheds serve as a source of supply. In other cases springs or artesian wells are utilized. In one town, where the existing surface and underground supplies were not potable, a large rainwater cistern was constructed which supplies limited amounts of water for drinking purposes only. At the present time over 20 towns have water-supply systems in operation or under construction.

In none but the larger towns was any attempt made to supply individual houses with water. Even there the people in general were supplied, as in the smaller towns, from hydrants placed at intervals about the town, whence water was carried in 5-gal. gasoline cans, earthenware jars (ollas) or even in bamboo tubes.

The consumption per capita is relatively low, but this is of little significance in view of the scarcity of house connections and the general absence of sewerage systems. In Manila, which has the most elaborate system and where much water is used for industrial purposes, the average daily consumption is about 60 gal. per capita. In small towns, where potable water is the vital necessity, town projects have been based on an available supply as low as 10 gallons.

In only three towns is storage practiced on a large scale. As one of these has relatively small storage capacity and the other installations are comparatively recent, no great difficulties from stagnation have developed. In the isolated cases where disagreeable tastes and odors occurred, removal of the accumulations of sediment in the impounding reservoir was sufficient to restore normal conditions. Reservoirs usually must be abnormally large, since in many parts of the islands the rainfall, though high, is not distributed throughout the year, but occurs mainly during a period of about three months. Naturally, the water courses become greatly depleted during the dry season. The rainfall is 76.5 in. in Manila, on the island of Luzon, and two or three times as great in certain other islands.

Attempts to Purify Water

Some attempt has been made at water purification, principally on the Manila supply. This water is somewhat turbid and high in organic matter, and should be filtered and perhaps further purified. Sand filtration was proposed when the present system was being installed, until it was shown that amœbæ would grow through a filter. Although more recent study has shown that the omœbæ normally found in practically all tropical surface waters are not the kind that cause dysentery in man, the appropriation for an adequate filtration system has not been forthcoming. Copper-sulphate treatment was not deemed advisable, because of the excessive concentration (one part per 150,000) required to kill cholera vibrios. At the present time treatment with chloride of lime is practiced, but as the method of administration is crude and not very efficient, the water frequently acquires distinct odor and taste. Chlorination undoubtedly has effected a marked improvement in the water-supply, though the Americans, Europeans and wealthy native residents either boil the water before drinking, or, preferably, buy bottled distilled, artesian or spring water for table use.

Typhoid, dysentery and cholera are the principal water-borne diseases in the Philippines, but it is recognized that the organisms of these diseases are found in water only as the result of direct contamination. Accordingly, the best safeguards against infection are protection of the source, and measures to prevent careless handling of water after it is taken from the source.

Health Officials of the Islands

Progress has been due primarily to the coöperative efforts of three bureaus of the insular Government: Public Works, Health, and Science. The Bureau of Public Works has conducted the construction of artesian wells and water-supply systems. The Bureau of Health has established an organization which operates over the principal portion of the islands. Each province has a health officer and a corps of assistants whose work deals with matters pertaining to health and sanitation. In recent years this bureau has started a line of work which already has been productive of much good. This consists of the organization of "sanitary commissions," composed of sanitary engineers, bacteriologists, doctors and nurses. The work is intensive. A commission stays in a single town collecting vital statistics, establishing clinics and dispensaries, examining all available water-supplies and in general conducting a campaign of sanitation and education.

The Bureau of Science is the central scientific laboratory for all branches of the insular service. It has conducted the routine examinations, both chemical and biological, of sources of water, and has conducted medical surveys of certain districts with the coöperation of other bureaus. It tests every new artesian well and has conducted many investigations on water-supply problems in general.

Difficulties inherent in water examination are exaggerated in the tropics. Samples sent in for analysis are often taken improperly and are unaccompanied by necessary data concerning the source, while, owing to the climate and to difficulties of transportation, they rarely reach the central laboratory in proper condition for examination. European or American standards are of little value. The writer virtually abandoned nitrogen determinations in chemical water analysis. Colony counts on plain agar; presumptive and, if necessary, confirmatory tests for b. coli. and a test for protozoa served for the routine biological examinations. The organism of dysentery is not readily detected, and the presence of amœbæ in surface water is of little significance, as noted above.

For a field survey undertaken by the Bureau of Sience a field laboratory was devised, patterned after that of the United States Geological Survey, with which it was possible to make both chemical and bacteriological

examinations. Though lacking the refinements of laboratory analyses, the field examinations gave results superior to those usually obtained in the central laboratory, since field methods were sufficiently accurate for ordinary purposes; and as the analyst obtained his own sample he could make valuable observations regarding the nature of the source.

The water-supply situation is still very unsatisfactory, in spite of the progress which has been made. Ignorance of the first principles of sanitation, superstition regarding the use of artesian well water, and unwillingness to abandon unsafe surface supplies, are some of the unfavorable factors. Surface wells still furnish a large part of the water used for domestic purposes, although examination has shown practically all these sources to be dangerously contaminated. The average surface well is close to human habitations and is open and unprotected. Water is obtained by dipping, frequently with dirty vessels. Clothes are washed at the well side, and animals are allowed in the immediate vicinity.

In six typical towns studied by a sanitary commission only 2% of the homes were supplied with privies, of which 10% were flush closets. More than 95% of the inhabitants of these towns have been found to be infected with intestinal parasites. One of the larger cities, with a population of 50,000, is still unsupplied with a municipal water or sewerage system, although practically all available sources in that locality are unpalatable or dangerous.

The outlook for improvement of sanitary conditions is none too favorable. Capable men have not been encouraged to remain in the service, and in a large number of instances their places have been filled with comparatively untrained natives. However, the foundation for good work has been laid, much gratifying progress has been made, and it is to be hoped that further improvements will come.

Comparison of Railroad Terminal Projects at Cleveland

Relative Advantages of Lake-Front Project Decided Upon Some Years Ago and Public-Square Location Approved by Recent Vote, as Seen by Various Engineers

TWO rival railroad-terminal projects have been under discussion in Cleveland for many months past. By vote of the people Jan. 6 one of the projects was ostensibly adopted, but there remain so many legal and financial details to be settled before the project is finally approved that a résumé of the two projects, purely as solutions of a railroad-terminal problem, seems worth while.

In 1915 contracts authorized by vote of the City of Cleveland were entered into between the city and the New York Central, the Pennsylvania, the Cleveland & Pittsburgh and the Big Four R.Rs., whereby these railroads agreed to build a union station on the lake front forming the northerly end of the elaborate public-building group which had been started by studies in 1903. Various agreements as to exchange of property and improvement costs were fixed in the contract, which further stipulated that actual work should begin within six months after the deeds to the property had been delivered. Such delivery has never been made. In 1912 the Cleveland & Youngstown R.R. was empowered by the city council to operate a railroad across certain streets in Cleveland, and in 1917 this railroad, together with the Wheeling & Lake Erie, the Erie, the Baltimore & Ohio, and the Nickel Plate, which latter had been purchased by the Cleveland & Youngstown, prepared plans for a stub-end passenger station on the Cuyahoga River Valley just south and west of the Public Square. Early in 1918 these plans were submitted to the United States Railroad Administration. In the discussion which followed it was suggested by the regional director that the plans be changed from a stub-end to a through passenger station, to be used by all the railroads entering the city. On Aug. 17, 1918, the plan and report were adopted by the representatives of the seven railroads interested, which include the railroads which had hitherto agreed to build a union station on the lake front. A company was therefore organized, known as the Cleveland Union Terminals Co., to build the union station on the Public Square, and an ordinance was adopted by the city council and approved Jan. 6, by a vote of 31,000 to 20,000 (as noted in *Engineering News-Record* of Jan. 16, p. 165), authorized its construction.

Previous to the vote Jan. 6, however, a lively controversy arose in the city as to the desirability of the two sites, and the Chamber of Commerce retained Lieut. Col. Bion J. Arnold to report on their relative advantages. Following Colonel Arnold's report a statement was made by W. E. Pease, engineer for the Cleveland Union Terminals Co., and by the Board of Supervision for Public Buildings and Grounds, which is the body having control of the public-building group plan for which Cleveland has become so noted. All of these reports have been made up by the Cleveland Chamber of Commerce under one cover, and they give a very clear exposition of a difficult problem, and one which by no means is settled by the recent vote.

The three maps given herewith show the present and prospective railway terminal situations. One map gives the present location of lines entering the city; the second, the proposed lake-front union-station scheme, and the third, the proposed Public-Square union-station plan. The lake-front scheme retains the present lake-shore lines in approximately their present location, but provides for expansion, as noted in Colonel Arnold's report. In the original scheme, some other arrangement of terminals had to be provided for all the railroads now entering the city from the south, but the drawing gives the possible entrance of the Cleveland & Youngstown and other lines via the Cuyahoga Valley.

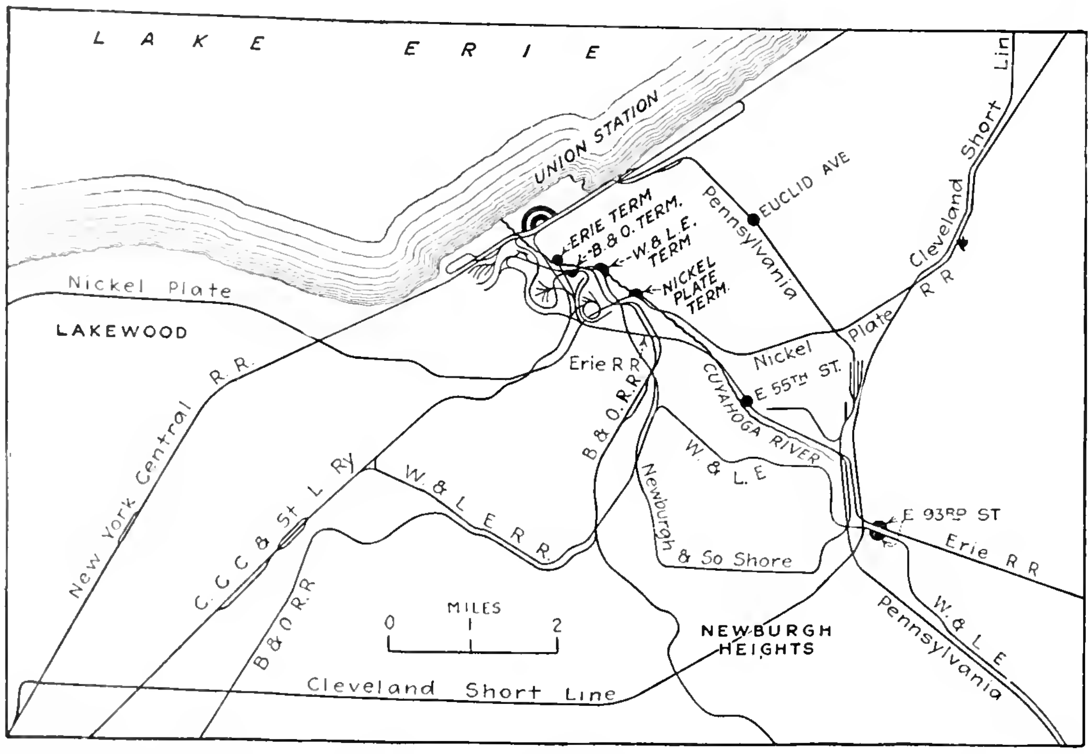
The plaza scheme involves the construction of a through passenger station southwest of the Public

Square, with railroads entering via the Cuyahoga Valley. Provision is made for two train levels in the station, the upper level to be used for express and limited train service, and the lower level for suburban and local trains. Interurban tracks would also be laid alongside of the main-line tracks, thus removing a number of present tracks from the city streets. Provision is furthermore made for a subway connection to the Public Square, in which now all the city's trolleys center. Behind the main passenger station there would be laid out a number of freight terminals, with adjacent warehouses. The present lake-shore roads would have to be relocated as shown on the map in order to bring their passenger traffic into the city via the valley, retaining the shore line for freight use.

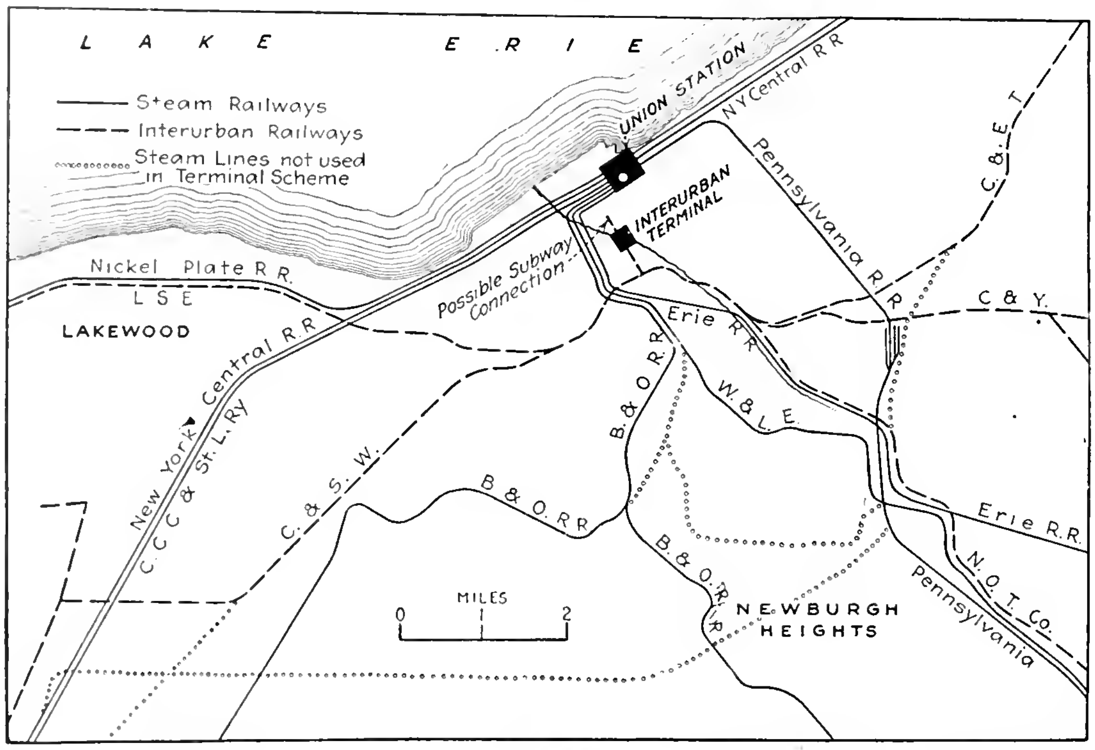
Five terminal stations now existing would be consolidated into one union station, in either case. Of these five, the largest is the old lake-front union station, used by the Pennsylvania and the New York Central lines. This, according to report, handles 85% of the total ticket sales and 66% of the daily total of 156 trains. Only 36 of these trains pass the most congested part of the New York Central main line, noted below. The other terminal stations are those of the Erie, the Baltimore & Ohio, the Wheeling & Lake Erie and the New York, Chicago & St. Louis.

A straight and direct route for the principal lines is provided by the lake-front site, with other lines coming in from the side, along the Cuyahoga Valley. The Public-Square site, however, necessitates approach by a sinuous location, with the union station placed at the apex of a V, so that entrance curves at each end are unavoidable. Interurban lines by this latter project would be transferred from streets and highways to the railways' right-of-way and brought into the lower level of the station.

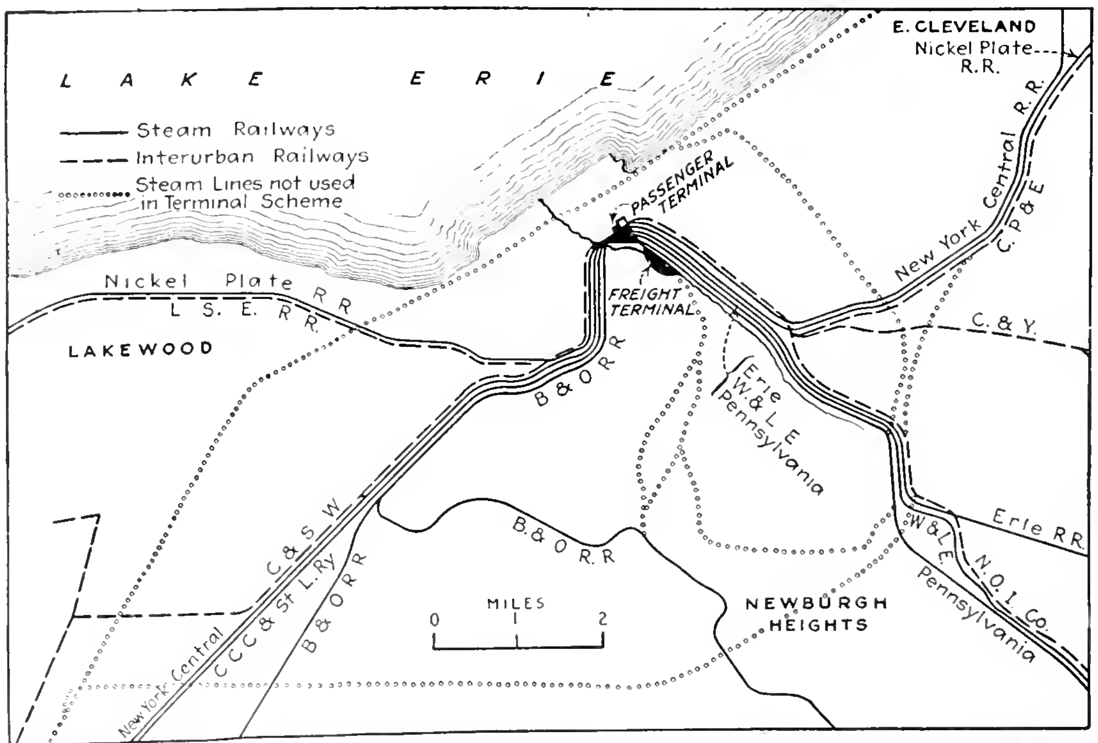
The main conclusion of Colonel Arnold's report is that the whole subject should be thrown open to further study. Three subjects submitted to him as the basis of his report were as follows: A comparison of the two projects; the possibilities of developing the lake-front site to meet the future requirements of the city; and the likelihood that the Public-Square project would cause extreme traffic congestion on the square. Comparison of



PRESENT RAILWAY SYSTEM OF CLEVELAND, OHIO, HAS FIVE TERMINAL STATIONS



MAP SHOWS POSSIBILITIES OF ACCOMMODATING ALL LINES AT A UNION STATION ON THE LAKE FRONT



MAP SHOWS PROJECT FOR DIVERTING ALL LINES TO A CENTRAL UNION STATION ON THE PUBLIC SQUARE

the projects is made on their merits, and does not include estimates of cost, although it is shown that very high cost of land is involved in the central project.

Reconstruction of a lake-front union station to accommodate not only the roads now using this site, but all the steam railways entering Cleveland, is recommended on account of the possibilities of readjustment of freight and passenger terminals, the space available and the general facility of access. Conditions of grades and topography favor such development at minimum capital expenditure.

Terminal development at the lake front could proceed even now on a temporary two-level plan, as pointed out by Colonel Arnold, the present roads on this location using the permanent upper level and the roads coming in along the Cuyahoga Valley occupying the lower level. If electrification were feasible immediately the lower lines could be placed beneath the upper deck, but, failing this, they would be operated alongside of the high-level lines. When the Cuyahoga River is straightened, as now proposed, the Big Four trunk-line entrance through the valley would be elevated, all main lines then using the upper level of the station and the lower lines being reserved for service tracks or other purposes.

Lake-Front and Central Sites Are Compared

Critical comparison of the two sites is given in some detail in Colonel Arnold's report. Area available for development at the lake front is practically unlimited. Plans for the Public-Square site provide for 24 tracks ultimately, which in the author's opinion represents the limit of possibility at this site for steam-railway purposes. He considers this sufficient for 15 or 20 years, provided that extensive commuter traffic does not develop as in New York, Chicago, Pittsburgh and other cities. From his investigations, however, it seems possible that such traffic may develop in Cleveland to the extent of requiring at least half of the station capacity during the rush hours. With the Public-Square station admitting of no further expansion, the only remedy would be to utilize some of its tracks on the lower deck, provided that the electric interurban traffic on this deck could be handled in less space than originally intended for that purpose.

Sharply curved entrances form a distinctly unfortunate feature of the Public-Square site, but are unavoidable here on account of the location. Thus, while the average platform length is about 1000 ft. (13 cars) the average length on tangent is only 600 ft. (eight cars). There is no such limitation at the lake-front site, which is on a straight line.

Cost of the Public-Square station is bound to be very high for the amount of trackage available, in Colonel Arnold's opinion, owing not only to the high commercial value of the land, but also to street reconstruction and the demolition of existing structures. In fact, nearly half the cost of this terminal appears to be in land and right-of-way. Most of the land required for the lake-front site is owned by the railways, and the balance can be acquired at a very low rate, compared with the other project, so that, Colonel Arnold estimates, the total cost of site might not exceed 25 or 20% of that of the Public-Square site.

Approaches and grades also appear decidedly favorable to the lake-front site, as the location is straight and the present maximum grade of 0.75% for five miles west of the river could be reduced to 0.56% for at least 1¼ miles. The other location is sharply curved, and would have short grades of 1.1% on the east and 0.72% on the west approach. Furthermore, the latter would require expensive grade improvement on the east and a long cut on the west about 45 ft. deep, with a ¾-mile viaduct across the valley.

Rerouting of trains would enable the present New York Central main line on the lake front to accommodate through traffic for some time. Both projects provide for four-track approaches at present, with a future increase to six tracks.

Obstruction to the above New York Central main line, due to certain yards and industries, which obstruction has been emphasized as a serious objection, is only a temporary difficulty and can be remedied, according to Colonel Arnold. He shows that removal of the yards in question is proposed already, while the city's policy of encouraging industries to transfer to points where ample space is available at low cost will result in relieving this part of the congestion automatically.

In facility of access for the public the Public-Square site has an advantage as long as this point remains as the commercial center. But eastward extension of the retail business section seems probable, according to the report, so that this advantage might be reduced in the future. Establishment of through lines of surface and subway local transit might place the lake-front site relatively at a disadvantage, but Colonel Arnold points out that frequent station service can be established, and that while concentration of local transit service at a large railway station is primarily desirable it often produces undesirable results. The lake-front site has the advantage of numerous wide streets, as compared with the cramped and detoured street system proposed around the Public-Square station. It is urged that subsurface levels for this latter station should not be developed without full consideration of the possibilities of future rapid-transit subway development, to which such station sublevels might be an obstruction if not planned with such subways in view.

Electrification of Prime Importance

Electrification is of maximum importance in the Public-Square project, because of high-grade commercial property in proximity to the parking space for the locomotives. It is imperative, in fact, on account of the proposed development of buildings over the station site. This condition does not affect the lake-front site, although Colonel Arnold points out that the station should be designed with a view to future electrification. Location of coach yards and engine terminals is favorable to the lake-front site, as in the other case these facilities would be from two to five miles distant, necessitating considerable dead mileage.

For through-freight service Colonel Arnold suggests two alternative high-level, low-grade routes, independent of the New York Central main line on the lake front and requiring but little construction work. This, he considers, would give a better balance of traffic than the diversion of all passenger traffic from the direct

lake-front route to the circuitous route leading to a central station, and of all eastbound freight traffic to the existing belt line.

The freight-terminal facilities as provided by the Public-Square project are unsatisfactory in their relation to the city, in Colonel Arnold's opinion. While the terminal itself is well planned, it gives undue concentration at a point where only a few thoroughfares are available for distributing the team traffic. It would involve a large amount of trucking across the retail district to the warehouse and wholesale district, while all the trucking to and from a yard handling 500 to 1000 cars daily must concentrate at the only viaduct connecting the east and south sides. At the lake-front site, freight-house and team-track facilities of ample capacity can be provided at such elevation as to reach the streets by grades of 3.5 to 3.7 per cent. This location also would avoid trucking across the retail district.

Facilities for interurban package freight are recommended in the report. In the Public-Square project some provision is made for handling farm products on the lower deck of the passenger station, but Colonel Arnold considers that good facilities for handling electric freight and express matter at the freight houses should be provided, in order to remove traffic from the most congested point of the downtown streets.

The removal of electric interurban traffic from streets and highways is provided in the Public-Square project, to the extent of 46 miles within the city limits and 60 miles within the Cleveland district, but this will require the construction of about 13 miles of new line for the necessary connections. While this is advantageous to the city, according to Colonel Arnold, the cost to the electric lines in traffic readjustment, new track-entrance facilities and cost of terminal service appears to be indefinite. Ability of the interurban lines to pay their share of the cost is questioned.

Under the lake-front plan the interurban lines would have to be accommodated in a separate terminal (as originally considered in the Cleveland & Youngstown ordinance), connecting with a possible future subway in the Public Square. Colonel Arnold suggests that they might be accommodated at considerably less expense in a double-deck terminal occupying about the site of the present station of the Wheeling & Lake Erie Railroad.

Congestion of Street Traffic

Serious traffic congestion in the Public Square and adjacent thoroughfares, without rapid-transit subways, would result from the establishment of a single union railway terminal at this point, in Colonel Arnold's opinion. Eventually such a concentration of railway, interurban and local traffic would necessitate three successive developments: The rerouting of surface cars; the provision of rapid-transit subways and connecting viaducts across the Cuyahoga Valley to relieve and by-pass the Public Square traffic; and, very probably, the construction of a second union station on some other site to accommodate the long-haul steam traffic crowded out by the growth of suburban electric traffic.

In giving this opinion, Colonel Arnold considers the desirability of decentralizing intensive commercial development in accordance with modern city-planning movements. He considers also "such inefficient and improper concentration" as has occurred in the downtown districts of New York, Chicago and other cities. While various expedients might be provided to relieve the congestion, they can be regarded only as temporary, even with lavish expenditure of capital and engineering skill.

Viewed broadly, says Colonel Arnold, the question of congestion calls for a distinctly unfavorable reply if transit development is to continue along present lines. The reply can be favorable only if extensive capital investment is assumed to be forthcoming for such complementary undertakings as subways and viaducts. Construction of such works would be imposed upon the city, and would not be a part of the terminal project.

Contentions of Union Station Advocates

About the time when Colonel Arnold's report was made, the Board of Supervision for Public Buildings and Grounds made a report to the Chamber of Commerce in which it urged strongly that further consideration of the proposed lake-shore project be given. It is the feeling of this board that the removal of the railway station from the lake-shore end of the Mall will be a serious detriment to the proper development of the new building plan, and would, in addition, force upon the city the financial obligation of supplying something to take the place of the station, which was a necessary architectural feature of the group.

In partial answer to the Board of Supervision and to Colonel Arnold, the Cleveland Union Terminals Co. says that the original scheme for the group plan did not include a railway station at the lake end of the Mall, and that the station was placed there only after it was thought there was no other place for it. The terminals company passes over Colonel Arnold's report with the mere statement that it must be an academic dissertation upon the comparative merits of the two projects, because of his admited failure, for want of time, to make the preliminary studies of the problem which he states are so vitally necessary. The company asserts that the union terminal would reduce the average running time of the suburban roads entering the city at least 30 min. and remove the suburban cars from the city streets. It would (1) provide Cleveland with the advantages of commuter service; (2) wipe out the bad architectural conditions existing on the south side of the Public Square; (3) provide a magnificent architectural development, involving perhaps in its ultimate cost an expenditure of $50,000,000, and (4) remove from the group plan a building to which its originators earnestly objected at the start, and render the Plaza or Mall available for more appropriate architectural treatment.

Road Engineers Will Be Wanted in Alabama

An insufficient supply of field engineers has hampered the supervision of road work by the Alabama State Highway Commission. In its latest annual report. dated Nov. 2, 1918, the commission states that with the steady increase of Federal-aid work it will be absolutely necessary to have additional engineering assistance, to keep faith with the United States Government by seeing that this work is executed properly.

Design and Operation of Fort Myer Sewage-Treatment Plant

Pioneer Among Standard Camp Sewage-Works Consists of One-Story Tank, Dosing Chamber and Sprinkling Filters—Low First Costs—Produces Good Effluent

By Leonard S. Doten
Major, Quartermaster Corps, Sanitation Section, Engineering Branch, Construction Division of the Army, War Department, Washington, D. C.

THE officers' training camp at Fort Myer, Virginia, was one of the first military camps constructed by the War Department following the declaration of war. As constructed this camp had a capacity of 2500 men. Work was started in the latter part of April, 1917, and completed on May 14.

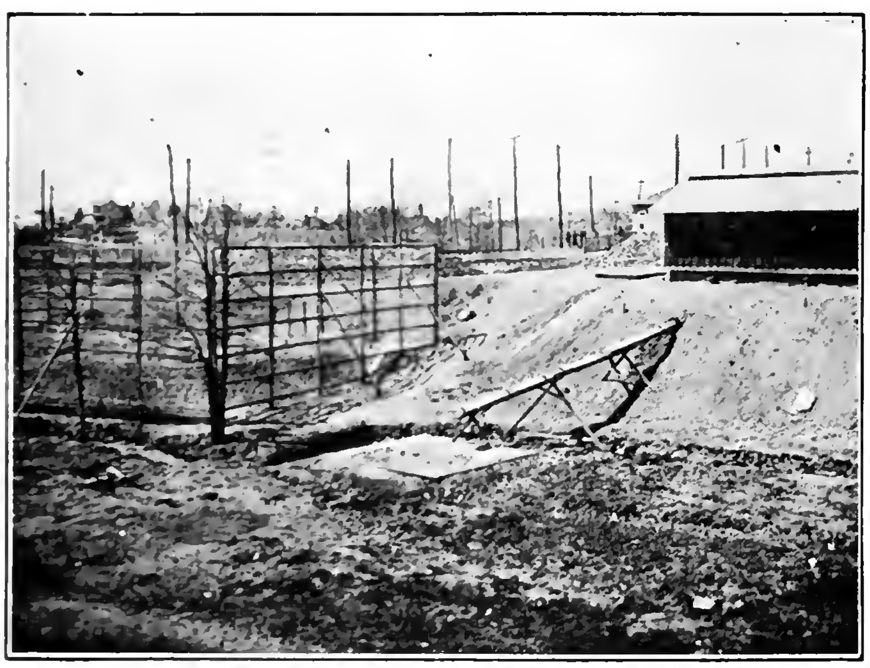
The writer was called upon to design a complete water-carriage sewerage system for this camp. The conclusion was soon reached, after an investigation of conditions at the camp site, that to dispose of the sewage adequately it would be necessary to construct either a pumping station with a long force main, or a sewage-treatment plant. Owing to the fact that the time was limited for completing the system, and in consideration of the difficulty of obtaining suitable pumping equipment, it was decided to construct a sewage-treatment plant near the southern limit of the camp, and to discharge the effluent therefrom into a small watercourse leading away from the camp site. The sewers and treatment works were built in about three weeks and put in operation on May 14, 1917, the date of opening the camp.

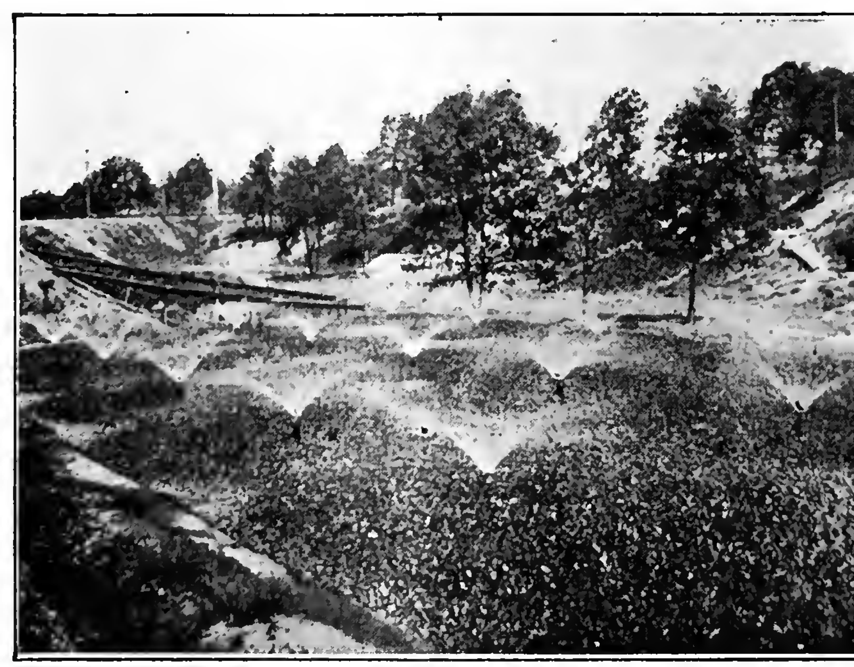
The treatment works consist of a settling and sludge-digestion tank, a siphon chamber and a sprinkling filter. The design of the tank was somewhat similar to that of several tanks which had previously been designed by the writer for military post purposes, but was much simpler in details of construction. It has a gross capacity of 26,000 gal., and is divided into three compartments of equal size. The baffles are much deeper than were those used in previous designs. The filter is 5 ft. deep and has an effective area of approximately 3000 square feet.

The entire plant was designed on the most economical lines possible. Many features which had previously been considered essential by the writer and other designing engineers for municipal plants were omitted. All filter cross-sections were identical, and the concrete in the retaining walls and the underdrainage was reduced to a minimum. Advantage was also taken of the conformation of the site to reduce the amount of excavation to the lowest possible limit. The plant, which was designed for a population of about 2000, cost only some $8000, although crushed rock delivered at the site cost $3.10 per cubic yard.

Soon after the completion of this plant the writer prepared typical drawings for sewage-treatment plants suitable for camps accommodating from one regiment to a division. The designs were similar to that of the Fort Myer plant, except certain details of baffles. Later, when the Cantonment Division (now the Construction Division) was organized, and the writer was placed in charge of sewerage work, this type of plant was adopted as the standard for use at all cantonments and camps. Carefully prepared estimates of the cost of tanks showed a great saving in cost of construction over Imhoff tanks of equal capacity, the average cost being approximately one-third that of the latter type. Another factor of great importance was the time saved in construction. Furthermore, it had the advantage of being simpler to operate than the deep separate digestion-chamber type and more suitable for handling the sewage, which was fresh and uncomminuted and therefore characteristic of camp and institutional sewage.

It has been the established practice of the Construction Division since April, 1918, to install large grease traps of special design on all kitchen sewer connections in new camps, and to replace with the same the small, vitrified-clay traps originally installed in old





THE COVERED SETTLING TANK IS ABOVE AND NEAR THE WIRE-FENCED SPRINKLING FILTER

camps. The Fort Myer system was equipped with these traps this season. As a result, the grease load on the sewage-disposal plant has been greatly lessened, giving the plant additional capacity.

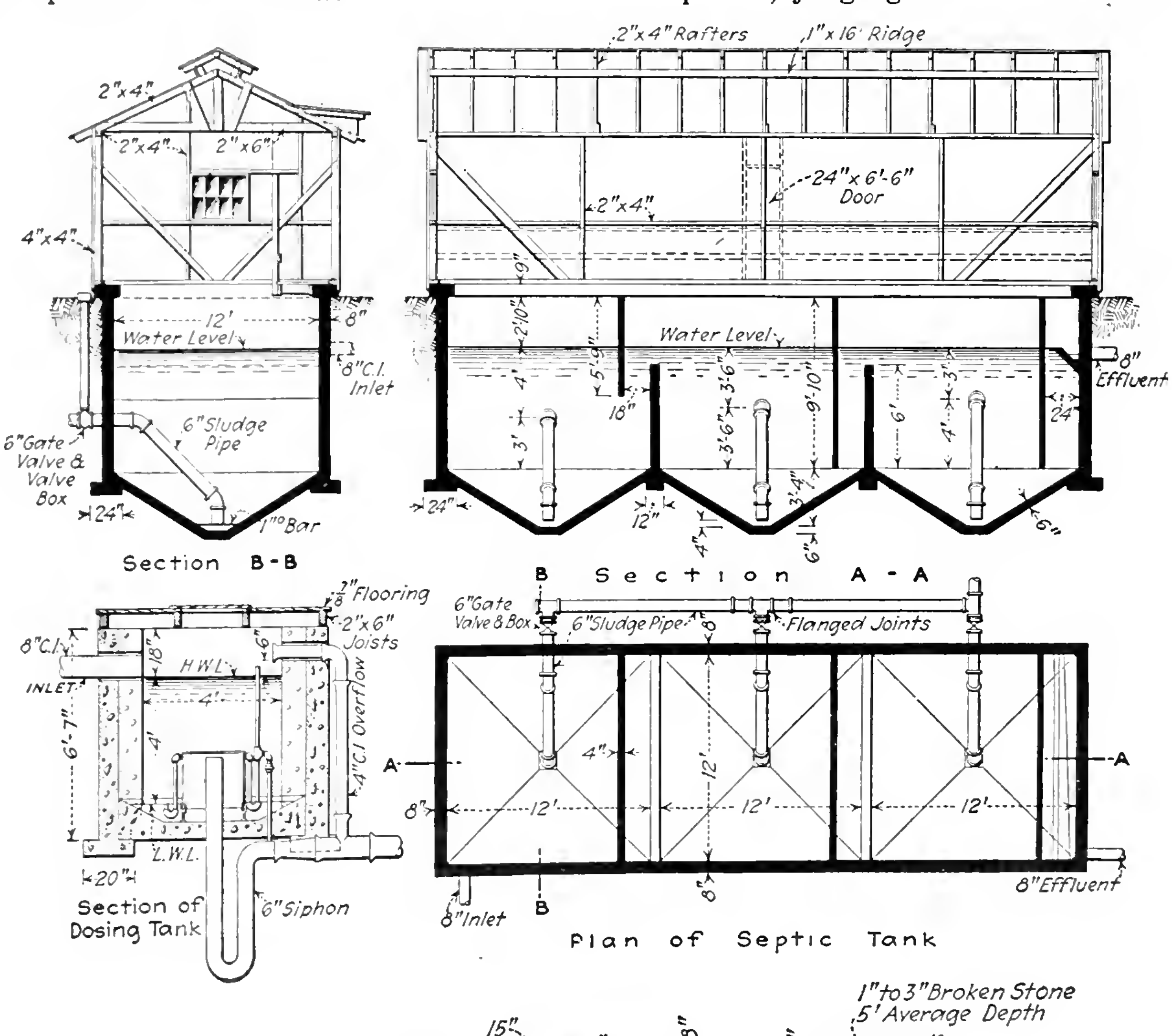
The new grease traps have a capacity of approximately two-thirds of a gallon per capita and are designed to avoid as far as possible the retention of settleable solids. It has been found possible to recover grease ranging in amount from 50 to 75 lb. per company per week. It is estimated that the grease recovered by means of these traps will be over 12 lb. per man per year. At the present time, this grease is being rendered and made into soap for camp use. At the cantonments, grease and many other wastes are sold under contract.

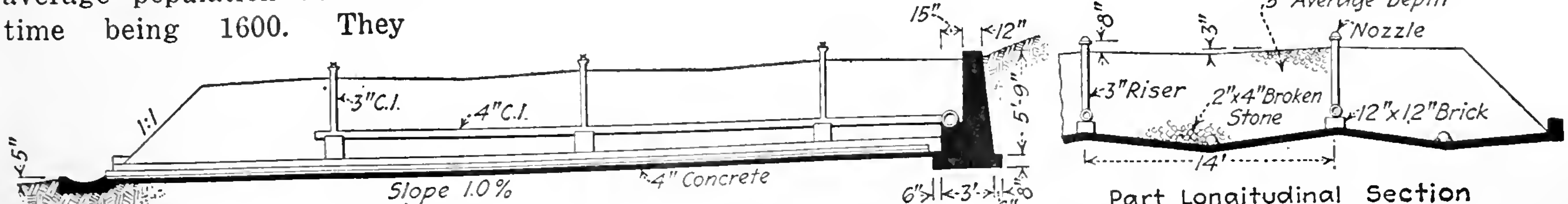
The plant has been in continuous operation since its completion, handling the sewage from a population generally ranging from about 1500 to 2200.

Although located only about 150 ft. from the nearest barracks building and a little over 100 ft. from a small railway station, no nuisance has resulted. The tank was slow in "ripening," due undoubtedly to the large amount of grease which was later found to be characteristic of the sewage at the cantonments. As a result of this, it was found necessary, about four months after the tank was placed in commission, to remove a part of the accumulated solids in the first compartment and to make certain structural alterations in the tank. (The sections shown herewith represent the tank as it now stands.) The tank since that date has developed normally, yielding at all times a very satisfactory effluent and a well digested, rapid-drying, odorless sludge. There was one period of over four months during which almost no attention was given to the plant, the doors of the tank not even having been opened for inspection. The filter continued to operate satisfactorily during this period, which extended from approximately Oct. 1 to the middle of February. Ice formed to a depth of about 1 ft. on certain portions of the filter during the winter. In April, 1918, Capt. E. J. Tucker, Sanitary Corps, U. S. A., assisted by First Lieut. J. J. Newman, of the same corps, conducted a series of tests on the plant, the average population at that time being 1600. They made analyses of raw sewage, tank effluent and filter effluent. The tests were continued from April 18 to 24, inclusive. The data thus obtained confirmed the writer's opinion relative to the excessive quantities of grease carried in cantonment sewage. It also showed that the sewage contained much larger quantities of suspended organic matter than had previously been supposed. It was found that the average sewage flow was approximately 47 gal. per capita per day. The average grease content, as shown by these tests, was about 115 ppm.; total solids, 1169; suspended organic matter, 571. Although the average detention period was approximately 4½ hours, 72% of all suspended organic matter was removed by the tank. The filter yielded a uniformly satisfactory effluent, although operating most of the time at the rate of 30,000 population per acre.

During the present season numerous putrescibility tests of the effluent have shown it to be absolutely stable at all times and extremely low in turbidity. The excellent quality of the final effluent is attributed to the good quality of the tank effluent, and to the method of dosing the filter. The volume of effluent is usually four or five times the flow of the stream into which it discharges. At no time has there been any objectionable odor or any appearance of putrefaction in the stream. The stream bed is absolutely free from all indications of organic growths characteristic of sewage-polluted water.

It is the writer's opinion, judging from his observa-





THE PLANT CONSISTS OF A ONE-STORY SEPTIC TANK, DOSING CHAMBER AND SPRINKLING FILTER

tions of the working of municipal plants, that many plants in this country could be greatly benefited by the adoption of the short-cycle scheme of dosing. The practice, which is common, of constructing deep filters, and assuming the capacity to be in direct proportion to volume irrespective of the depth of the filtering material, is not consistent with the writer's experience. A filter of 4- or 5-ft. depth may be so designed and operated as to secure more perfect nitrification if operated at a rate of not to exceed 2,000,000 gal. per acre per day than can be obtained by the use of filters ranging in depth from 6 to 10 ft., as usually operated.

The sludge at Fort Myer is of unusually good quality, being thoroughly digested, as is evidenced by the fact that it dries rapidly. It is free from odor, does not attract flies, and is alkaline in reaction. All sludge has been disposed of by discharging it into shallow trenches excavated in the low ground near the plant. It dries quickly, notwithstanding the denseness of the soil and other unfavorable conditions.

During the period of maximum population the tank has a gross holding capacity of approximately 12 gal. per capita, and during the period of minimum population about 17 gal. per capita. The first compartment might be termed the "seeding" chamber, the second compartment the digestion chamber, and the third compartment digestion and sedimentation. Scum forms in a heavy mass in the first compartment, also of considerable depth in the second, and very lightly in the third. The action which takes place in the tank may be described as that of "division and transfer." The partially disintegrated matter in the first compartment is carried into the second compartment by the velocity resulting from the limited space between the scum and the sludge, and in the second compartment is again split up into a more finely divided condition. The finer particles are carried into the third compartment, where further division and sedimentation take place.

The effluent resulting from this action is in a better condition for oxidation in the sprinkling filter than that resulting from plain sedimentation, as nearly all of the matter carried in suspension is in a mineralized state. Analyses show that the nitrification is practically complete, and the effluent as it leaves the filter contains an unusually high percentage of dissolved oxygen.

Although complete data have not yet been received from many of the later plants of this type, it is anticipated that equally good results will be obtained as soon as sufficient time has elapsed for the tanks and filters to become thoroughly "ripened."

Keeping Track of Construction Plant at Hog Island

Condition of Every Piece of Equipment Known From Records Revised Daily—Precise Accounting System

By R. E. Roesler
Philadelphia, Penn.

MANAGERS and engineers building the Hog Island shipyards knew the character, condition and location of the hundreds of items of equipment employed as well as the good business man knows the contents of his desk. A highly systematized equipment department made this practicable. Summarized briefly, the duties of this department were: To know the exact location of each item at any time; to furnish information to various departments in various ways, concerning any equipment; to know what was idle and the reason for the idleness; to have on hand special, classified and full inventories; to pass on or void all orders to the purchasing department; to receive and identify all accessories and assign permanent numbers; to keep a record of work done by all equipment rented and contracted for; to anticipate future requirements, and to perform all clerical work required. No claim is made that the methods employed are the only possible methods, but the principle is sound and can be applied to almost any construction work.

Physical control is the manner of handling *physically* all equipment from its receipt until it becomes obsolete. Ordinarily, equipment is received at one point and can be passed through a single service station. This is the preferable arrangement, but at Hog Island it was impracticable, since there were several points of receipt.

An area approximately three miles long and one mile wide, about 900 acres, was covered by the yard. The three miles were along the river front and this front was divided into 50 shipbuilding ways and a wet basin. As the construction of the ways was assigned to five different contractors, five construction zones existed. The wet basin was considered a sixth zone, and the strip at the extreme rear of the island was made the seventh zone. Only the five construction zones are considered. Each of these was divided into five districts and these districts were designated by the letters A to Z.

A force of 35 men checked and reported receipt of all equipment. These were assigned as follows: One man in charge of each district, or 25 men in all; a zone foreman in charge of each five districts; three general foremen supervising the zone foremen and reporting to the supervisor of equipment, who reported to the superintendent of equipment. The total force was thus 35 men checking and reporting material.

When a piece was received the district man marked it, by brush and paint, with a temporary number, preceded by the letter of the district. On his list, under the assigned mark, he then recorded what the item was, whence it came, the number of the car or truck or the name of the boat which delivered it, the shop number, horsepower, size, etc. His lists, turned in to the zone foreman each night, were sent to the office and there checked up with the purchase orders, and the proper accounting records were made. The office assigned a permanent number in place of the temporary number and returned the lists to the district man, who substituted the permanent number for his original temporary mark.

Besides the force checking and recording receipt as described, there was a force of yard men, under the

storage yard man, who collected all available equipment, placed it in the storage yard, had it repaired if necessary, and thus kept the jobs clean of all idle equipment. These men increased the yard force to 75 men.

To control the activities of the yard forces, the office was divided into six departments:

1. The order department, which took care of all requisitions, purchase orders, expediting, and order and correlated files.
2. The receiving department, which looked after equipment received, identifications, special reports, permanent numbers and assignments.
3. The transfer department, which looked after all equipment in use, and kept a record of all transfers made, all available equipment reported and all reported for repairs.
4. The rental and contract department, which kept track of the receipt, identification, transfer, working records and return shipments of all equipment rented or contracted for.
5. The locomotive-crane department, which kept track of all locomotive cranes, recording work done, shut-downs, etc.
6. The inventory department, which made periodical statements.

In addition to these primary departments, there were an expediting and a car-record division and a filing department. The car-record division prepared the records for tabulating the information needed when cars arrived in the yard. By the work of the expediting division an effort was made to follow up the orders for equipment, from the time it was ordered until it was received, so that the status of any shipment could be known at any time. The duties of the filing department were to collect and deliver work and look after office equipment and supplies.

Clerks were assigned to the several departments according to their relative volumes of work. Each department force was headed by a "leader." The office was then divided into three divisions, with a chief clerk over each, to whom the leaders in his division looked for orders. The chief clerks reported to the superintendent of records, who in turn reported to the superintendent of equipment. When the work had been fully organized and the men had become trained, an office force of 80 men handled everything efficiently. This force added to the yard force of 75 men made an equipment organization of 155 men.

Accounting Separated Into Two Operations

Accounting consisted of two distinct tasks: (1) Accounting for equipment ordered, and (2) accounting for equipment received.

When equipment was ordered a requisition was issued by the stores department, after approval by the superintendent of equipment, on the purchasing department. One copy of this document was sent to the party initiating the order, one to the equipment department and one to the purchasing department. On receipt of its copy of the requisition, the equipment department made two copies for filing, one according to number and one according to classification. As soon as the purchasing department placed the order a copy of the purchase order was sent to the equipment department, which made six copies, one for each of the office divisions except the locomotive-crane division. Each division handled and filed its order according to its own particular needs; the procedure will be outlined very briefly.

In the order division, after checking the purchase order against requisitions, the order went to the numerical file clerk, who made out a sheet for each item and filed these sheets numerically; then to the ledger record clerk, and finally to the correlated file clerk, who entered the items on sheets which he filed according to classification. The receiving division received two copies of the purchase order and filed one according to classification of equipment and the other according to classification of shippers. The inventory department used its copy of the purchase order to check against equipment receipts.

Card Has Complete Record of Each Item

The work of the transfer department began by making up a transfer record card for each item shown on the purchase order. The transfer record card carried more or less complete information of each item, with additional columns for transfers to and from. These cards were filed according to the division of the yard—that is, by zones, districts, etc. A separate file was also kept for all equipment reported available or in repair shops, or obsolete. On receipt by the rental and contract department of its copies of these purchase orders they were separated and filed according to orders issued for contracts or orders for equipment rented or bought outright. Entries were also made on loose-leaf forms devised for the purpose of keeping each contractor's equipment separate. Entries were also made for equipment under contract and rented, on working records, giving a daily tally of the work done, the hours worked, the causes of shut-downs, etc. In this way a record was kept of performance, according to classification and according to contract.

No purchase orders went to the locomotive-crane department, as the work of this department consisted mostly of keeping records of crane performance. Requisitions for crane work went to this department, and cranes were assigned. A work-order card went with each crane assigned; on this card the engineman recorded his time, returning the card to the office when the work was finished. About 30 cranes were in use, and by this system a record was available, at any time, of the work done by any crane.

Methods of accounting on orders only nave been considered in the preceding description. On receipt of the equipment another set of accounting operations ensued. As previously described, the yard man turned in daily lists of equipment received. These receipts were registered on the equipment register and the lists were then checked against purchase orders. The original as returned to the yard, and a copy was sent to the record division, where proper notations were made on the various records. In turn the list went to the transfer and inventory departments, and, so far as equipment contracted for or rented was concerned, to the rental and contract departments, for the various records which they kept.

Chicago Water-Works Intake Crib Tilted Level With Screw Jacks

Lopsided Appearance of New Superstructure Corrected by Unique Engineering Operation—Instrumentman on Center Tower Controlled Moves by Means of Twenty-Four Leveling Targets

TILTED 18 in. out of level, the 1400-ton ashlar masonry ring forming the superstructure of Chicago's newest water-intake crib was recently blasted loose from its base, mounted on 300 jacks and restored to level partly by blocking up and partly by revolution. Using light charges of dynamite, a ring of concrete was removed from its place directly under the lower course of masonry. Only one stone in the entire 70-ft. ring was cracked. Expert house-movers operated the jacks, tilting the ring a fraction of an inch at a time, while an instrumentman checked each change of level and gave the foreman of the jacking crew the data by which he controlled the operations of his jack-men. Thirty days was the elapsed time from the start of operations to the finish of the underpinning. Scarcely a crack or an appreciably open joint was visible when the work was completed.

CONCRETE BLASTED OUT IN SECTIONS REPLACED BY SCREW JACKS

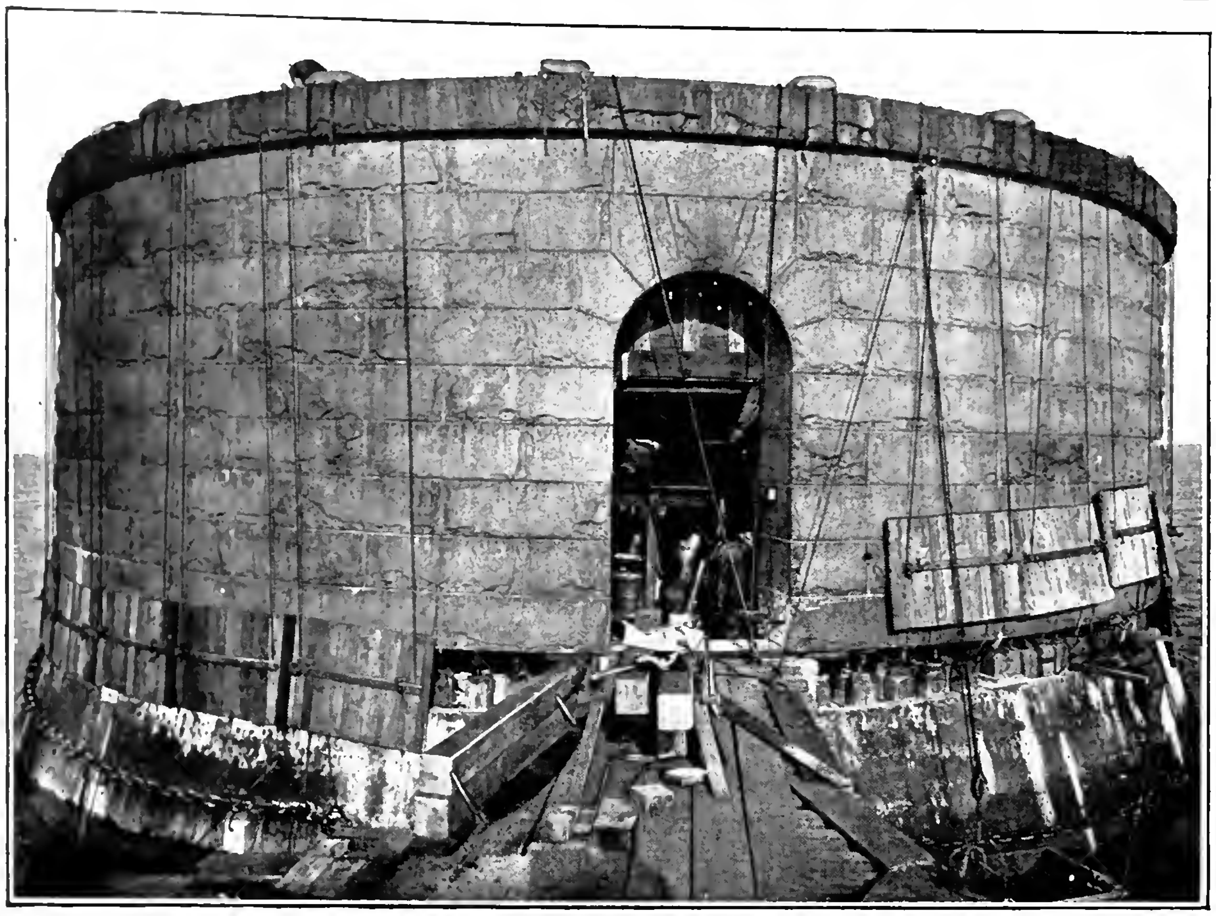
A—Inclined struts set on screw jacks prevented lateral movement of masonry ring. B—Bracing between inner and outer steel shells of caisson. Three rows of jacks set under masonry ring—concrete blasted out to cut ring loose.

Construction of the Wilson Ave. intake crib involved first the sinking of a caisson consisting of two concentric steel cylinders filled between with concrete, as described in *Engineering Record* of Jan. 23, 1915, p. 104. This caisson had an outside diameter of 70 ft. at the top and 90 ft. at the bottom. The inside diameter was 40 ft. On top of the caisson was erected a granite ashlar ring 70 ft. in outside diameter. Inside the caisson is the downtake shaft capped with screens and inside the granite walls is the housing for the crib tender and the appurtenances for crib operation.

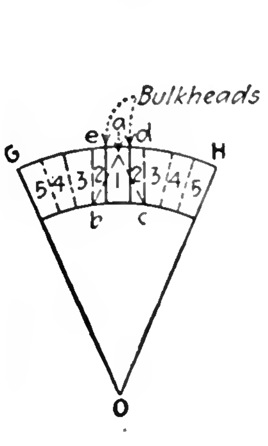
In the sinking of the caisson it tilted about 16 in. out of level, presumably because of varying density of the clay subsoil. This occasioned no concern, and after the inclined top was leveled up with concrete the masonry ring was built. Shaft sinking was then begun by the contractor inside the pumped-out caisson. This shaft was constructed by sinking cast-iron lining rings for a portion of its depth. Below this lining the usual wooden curbing was employed. The sides of the shaft swelled, and considerable more material was excavated than the volume of the shaft called for. When the shaft had been completed, it was discovered that the caisson had again tilted so that the top of the masonry ring was 18 in. out of level. It was decided to rectify the position of the masonry ring. Two methods of procedure were possible. One was to take down and reconstruct the ring after leveling up the caisson top with concrete; the other was to cut the masonry loose from its base, level it up and underpin it. The second procedure was adopted. It was also decided not to raise the low side the whole distance BE, as indicated by the sketch, but to revolve it on the axis YY so as to lower the high side from A to C and elevate the low edge from B to D.

To loosen the masonry from its concrete seat and to provide space for the jacks by which it was to be tilted level, a ring of concrete had to be cut out entirely around the crib. Blasting was the method adopted. As shown by the lettered view, this blasting had to be performed between the braces tying the inner and outer steel shells, and, of course, underneath the masonry ring, and it had to be performed so carefully that the masonry should not be cracked and the outer steel shell should not be broken through. The procedure was as indicated by the sketch. Between two sets of shell braces OG and OH, blasting under the ring was begun by drilling holes ba and ca and taking out a wedge cut. This cut was enlarged by removing wedges 2 and 2, and then three jacks were set and screwed up to a bearing. To protect the jacks, plank bulkheads were erected and cuts 3 and 3 were blasted, then cuts 4 and 4, and so on. These cuts were about 1 ft. wide, and as their removal made room, sets of three jacks were inserted. In this

manner the full circle of concrete was cut away and replaced with 300 jacks, as indicated particularly by the exterior view. Experiment determined the safe spacing for holes and the size of the charges. For each cut three 1¼-in. holes were drilled one above another. Each hole was charged with a half stick of 60% dynamite, and the three charges were fired by delay exploders. One jackhamer and one tripod steam drill did the drilling. A steam boiler and a locomotive air compressor furnished the power to operate the drills. After any portion of the ring had been cut through, protection of the men and the jacks from the wash of the waves was necessary. This was accomplished by plank shutters arranged as shown by the exterior view. When the shaft had been mounted on the jacks, preparations were made for the tilting operation. The interior bracing to prevent lateral shifting of the ring has been mentioned. A possible weak point in the ring was at the doorway. To guard against failure there the bottom of the opening was first spanned by a plank against which the jacks bore. Just above these planks, three anchors were set in the bottom course of blocks on each side of the door; these anchors were then connected across the opening by rods with turnbuckles. Finally, side posts were set on the anchors, and on these an arch center was erected and wedged tight. With this preparation, no weakness developed in the ring on account of the door.



MOVABLE SHUTTERS PROTECTED JACKS FROM WASH OF WAVES



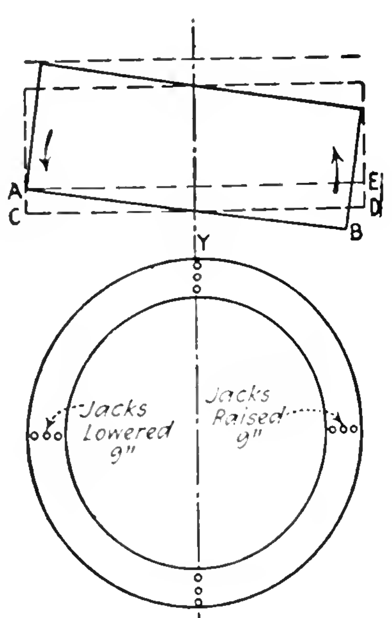
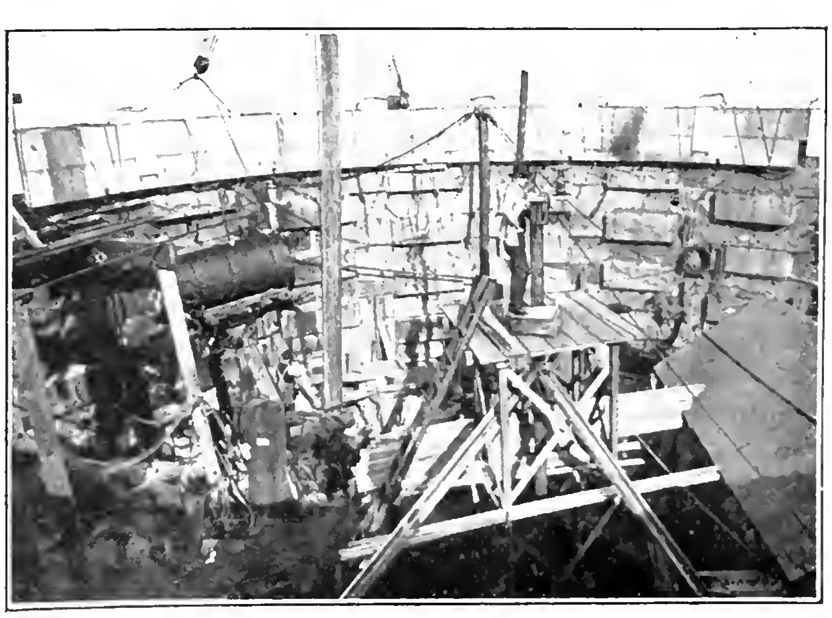


DIAGRAM SHOWING CRIB-LEVELING OPERATIONS

Preparation for instrument control of the jacking operations was made by erecting a pipe tower on the inner structure to carry the level, and building an observer's platform on independent supports. Around the inner edge of the masonary ring were set 24 targets at 15° intervals. On each target a top and bottom line marked the total change in elevation required at that point. These spaces were each divided into 100 equal parts. By this arrangement the instrumentman, swinging his telescope around, could check at sight the exact progress at each target. Down below, where the jack foreman stood, was a similar set of targets, so that as the observer called the figures above they could be noted below, and the foreman could speed up or slow down on any group of jacks, as conditions required. By this means no part of the jacking operations could get out of step more than a fractional part of an inch.

Twelve men operated the 300 jacks. These men were expert movers furnished by L. P. Friestedt Co. Referring to the sketch plan, it is seen that the jacks on the line of the neutral axis YY remained stationary, while those to the right were raised and those to the left were lowered in tilting the ring. The travel of the jacks varied from zero at the neutral axis to 9 in. at the points 90° from this axis.

When the ring had been jacked to level, brick underpinning masonry was substituted for the jacks, and the restoration was complete. The entire job took 30 days, and was carried out by city day labor under the direc-



INSTRUMENTMAN ON CENTER TOWER CONTROLLED JACKING BY SIGHTING ON RING OF TARGETS

tion of John Ericson, city engineer, and H. W. Claussen, assistant city engineer. Ernest Stromback was the engineer in local charge of the work.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

In Defence of the New Canadian Formula for Steel Columns

Sir—As a member of the committee responsible for the draft of a "General Specification for Steel Railway Bridges," published in the December *Journal* of the Engineering Institute of Canada, I desire to explain, in reply to Dr. Waddell's letter in *Engineering News-Record* of Jan. 16, p. 155, that the formula 12,000—0.3 $(l/r)^2$ was derived primarily from our interpretation of the published tests made by the Special Committee on Steel Columns and Struts, assuming 16,000 lb. per square inch (or one-half of the elastic limit) to be the proper unit-stress for tension members. If it should finally be decided to adopt a greater unit stress for tension members, the values in the column formula would be correspondingly increased; for it is, naturally, our aim to produce a specification which will result in structures of uniform strength, so far as practicable.

We obtained what we considered to be proper working values by taking the average of all the ultimate strengths of the solid columns for the several ratios of l/r, and dividing by 3, which figure is approximately the factor of safety on the ultimate strength of riveted tension members designed for a unit-stress of 16,000 lb. per square inch. These working values, as well as values derived from the formulas

$$12{,}000 / \left[1 + \frac{(l/r)^2}{36{,}000}\right] \text{ and } 12{,}000 - 0.3(l/r)^2$$

and 16,000 — 70 l/r, the latter used with a maximum of 14,000, are given in the table below:

l/r =	20	50	85	120	155
Working values	11,825	12,066	10,200	9,366	8,200
$12{,}000/\left(1+\left[\frac{(l/r)^2}{36000}\right]\right)$	11,900	11,230	10,000	9,580	7,200
$12{,}000-0.3\,(l/r)^2$	11,880	11,250	9,820	7,680	4,780
$16{,}000-70\,l/r$ .... (Max. 14,000)	14,000	12,500	10,850	7,600	5,150

In the above table, it will be noted that the Gordon formula,

$$12{,}000 / \left[1 + \frac{(l/r)^2}{36{,}000}\right]$$

agrees most closely with the working values derived from the Special Committee's tests, and may thus be considered as a safe guide in investigating the strength of existing structures; but the unit-stresses for ratios of l/r exceeding 85 are too high for practical reasons in new designs. Our parabolic formula 12,000 — 0.3 $(l/r)^2$ agrees very closely with the working values up to l/r = 85, and gives safe values when greater ratios are used, even to the limit of 200; moreover, its use is no more troublesome than use of straight-line formulas.

We are strongly opposed to limiting the ratio l/r to 100, as this restriction is not only a needless extravagance, but encourages the use of flimsily designed columns of fictitious strength.

There is nothing either radical or unusual in our column formula; the parabolic curve was proposed many years ago in this connection by the late J. B. Johnson, and many prominent bridge engineers in the United States are in favor of a much lower limit for compression in short columns than the allowed unit-stress for tension members. In this connection, the very valuable paper by J. R. Worcester on "Safe Stresses in Steel Columns," and the able discussion thereon, are recommended for careful study (See "Transactions" of the American Society of Civil Engineers, Vol. LXI, p. 150). The maximum unit-stresses for columns therein advocated by Mr. Worcester and others are, Worcester, 12,000; Prichard, 13,000; Seaman, 13,200; Emmons, 12,500; Horton, 10,666.

The American Railway Engineering Association's column formula is 16,000 — 70 l/r, with a maximum of 14,000 lb. per square inch. In the Quebec Bridge specification, compression members of carbon steel are limited to 14,000 lb. per square inch in conjunction with unit-stresses of 18,000 lb. per square inch for riveted tension members, and 20,000 lb. per square inch for eyebars, both of carbon steel.

R. S. Foulds, in an interesting article entitled "Column Tests and Formulas," published in *Engineering News-Record* of Aug. 9, 1917, p. 260, points out that the average strength of full-sized members in tension is about 54,000 lb. per square inch, net area; and in compression about 36,000 lb. per square inch gross area; that the elastic limits average about 30,000 in tension, and about 21,000 lb. (reduced) in compression. He claims that the J. B. Johnson parabolic formula 36,000 — 0.7 $(l/r)^2$ for ultimate strength is the most rational of all practical formulas, and that it corresponds to the average end conditions of bridge columns. Assuming the unit-stress of 16,000 for tension members, and taking into consideration the relative elastic limits of full-sized members in tension and compression (30,000 and 21,000, respectively), Mr. Foulds demonstrates that a working formula for columns of equal strength to that of the tension members should be: 11,000 — 0.214 $(l/r)^2$; or he would work to two-thirds of the elastic limit in both cases, using 20,000 lb. per square inch on the net section in tension, and 14,000 — 0.272 $(l/r)^2$ on the gross section in compression.

Finally, the Special Committee on Steel Columns and Struts, whose opinion cannot be ignored, recommends in its final report a working stress of 12,000 lb. per square inch for columns up to a slenderness ratio of 80; and 8000 lb. per square inch for columns having a slenderness ratio of 120, with interpolated values between these two ratios. Our proposed formula conforms practically to these recommendations for values of 0 and 120, but differs in using a curved line to connect these points, rather than a bent one.

Dr. Waddell refers to his formula 16,000 — 60 l/r, in comparison with ours, from which he concludes that compression members generally have either been overstressed by 15 to 25% or that the adoption of our formula would result in a corresponding waste of material. But the American Railway Engineering Association's formula, the one in most general use in recent years, is

16,000 — 70 l/r, with a maximum of 14,000; and the greatest difference between this formula and ours is 2250 lb. for $l/r = 28.5$, or about 16 per cent., whereas there is no difference when $l/r = 100$.

Referring to the so-called inconsistency between the formula 16,000 — 200 l/b for the compression flanges of beams, and our formula for columns, it is well understood that the two cases are by no means analogous; for the web of a beam provides continuous lateral support, and the empirical formula limiting the compressive unit-stress is provided to prevent the use of unreasonably narrow flanges.

Replying to the editorial comment in the same issue of *Engineering News-Record*, I would suggest that the compression members of a bridge are not of necessity properly proportioned, or of equal strength to the tension members, simply because they have shown no signs of weakness. No indications of weakness should be expected in a column as long as the stresses therein are within the elastic limit of the metal; and, with our liberal allowances for impact and for reversal of stress, few compression members, if proportioned by any of the recognized formulas, are likely to be subject to stresses of greater intensity than one-half of the elastic limit.

We all desire uniform strength throughout in our structures; and, taking into consideration the probability of increased loads in the future, together with deterioration from corrosion, a factor of safety of 2 on the elastic limit does not seem excessive for bridges.

W. CHASE THOMSON,
Consulting Engineer.

New Birks Bldg., Montreal, Can.

An Appreciation of Roosevelt

Sir—I have been very glad to note the appreciation of Col. Theodore Roosevelt in your Jan. 9 issue. As one who had the honor of meeting him in a more or less casual but still continuous way for 40 years, I have naturally come to know something of his interest in invention and engineering. This dated back to the time when, as a Harvard undergraduate, and through my humble intervention, he made his first acquaintance with the marvels of the Edison phonograph and the Bell telephone, to the accompaniment of music furnished by an organ built by his uncle, Hilbourne Roosevelt, one of the great organ builders of his time and a master of sound and mechanics.

During one of the intervening years, I had the honor of getting Governor Roosevelt to open by wire our electrical exhibition in New York City and discuss once again topics in the forefront of engineering. Some years ago, I was member of a committee on behalf of the engineering societies to ask President Roosevelt to open our splendid engineering building in New York City. He did this by message but not in person because, unfortunately, owing to complications in Washington, he could not leave; and, as he said jokingly in an aside, he "really was too busy to go chasing all over the country opening buildings for Carnegie;" but the protest was almost apologetic, and he was very much in sympathy with us. He had just declined to open a Carnegie building in Pittsburgh.

At another time I had the privilege of being, as the editor of the *Electrical World*, one of the four technical journalists invited to sit in at the first conservation congress in Washington, to which you refer so admirably. The conservation movement, as I sized it up, had begun with Richard Watson Gilder and Robert Underwood Johnson, editors of the *Century Magazine*, but President Roosevelt was wholly caught up in the spirit and enthusiasm of the movement; and from that time to this a new realization has existed in America of the value of our natural resources and of what the engineer is doing. Our whole civilization is an engineering exhibit, but conservation remains abortive; and it is amazing that after these many years, since the historical conservation conference at the White House, Congress is still allowing the water-powers of the country, then emphasized so strongly, to linger in wasteful neglect.

As one who frequently differed from his policies and practices, but who found him ever sympathetic to all the larger ideas of life and an intense admirer of the genius of our great inventors and engineers, I trust I am not exceeding the bounds of propriety in adding this little tribute to the memory of one of our noblest Americans.

THOMAS COMMERFORD MARTIN,
Secretary, National Electric Light Association.

New York City.

The Durham Land Colony

Sir—The article in *Engineering News-Record* of Dec. 5, 1918, describing the land colony at Durham, Cal., treats of an interesting and valuable experiment in land colonization. There are, however, a few points to which additional attention should be directed.

First, the real estate "shark" and his commissions were *not* eliminated. This fact was not known to the general public at the time when the land was originally sold nor, probably, was it known to the Land Settlement Board. Since that time, however, the two men who engineered the deal got into a dispute over the division of profits. In the suit that followed it was disclosed that their admitted profits on their options were considerably larger than the usual real estate agent's commission on sales of that size.

Second, the article makes a comparison between the overhead expense of $5918, for the first year of the project, and an assumed cost of selling alone, under private development, of $75,000. No analysis of the latter estimate is possible, but it might be stated that the amount is much greater than the selling costs per acre on several private projects of a similar character. With regard to the former sum, a simple mental operation shows that it amounts to a little less than $500 per month. A study of the statement of the amount of work performed during that time would indicate that some over-enthusiastic adherents of the plan of colonization have fallen, perhaps unwittingly, into the old error of public-ownership bookkeeping, and have made no proper distribution of the salaries and other expenses of state officials who devoted part of their time to the project. There is much to be said in favor of the proposition that the taxpayers of the state as a whole should help support the project, since its success will benefit the state as a whole, but the taxpayers should be apprised that they are doing so.

These notes have been written not with the intention of belittling the importance of the Durham experiment,

which I consider a step in the right direction, but rather because too fulsome praise of many a good plan has, in the end, militated against its success. Basing my opinion on my own experience as engineer for several colonization projects in California, I would say that the lessons so far to be learned from the Durham experiment are as follows: (1) Colonists should be carefully selected, not taking any man who happens to have the money for the first payment on the land, but rather selecting them partly for financial resources and mainly for experience in farming, for industry, and for general ability, to the end that every colonist should have a reasonable chance of success; (2) they should not be turned out on raw land to sink or swim—usually the former—but should have done for them at least part of the work of establishing an improved farm; (3) they should have the advice of experts, particularly during the first few years after settling on the land. Private colonization companies throughout the West are becoming cognizant of these facts, and many of them are acting upon this knowledge. It takes large capital, however, to do these things, which is one point where the state has an undoubted advantage over the private concerns, in the lower interest rates and better credit generally.

Disregarding the bookkeeping "camouflage" already mentioned, there is no doubt that, with the large amount of free advertising and the free administrative services of the able men on the Land Settlement Board as well, this first state colony is being handled more cheaply than would be possible on a private project. It remains to be seen, however, whether the total cost per acre of taking the raw land in large holdings and delivering improved farms to the colonist will in general be any less on a state-administered than on a private project.

A. T. PARSONS.

420 Market St., San Francisco, Cal.

[Mr. Parsons' letter was submitted to Dr. Mead, whose reply follows.—EDITOR.]

Sir—The letter of A. T. Parsons, commenting on the article on the state land settlement at Durham, printed in *Engineering News-Record* of Dec. 5, 1918, p. 1014, concedes that it puts into actual practice what he regards as the three essentials of successful settlement. The further statement might have been made that by doing this Durham has done more to improve the methods and practices of private colonization enterprises than all the legislation of the past ten years. Example is proving a better educator than precept.

The criticism that the article makes a better financial showing for Government action than the facts justify, and that the taxpayer is footing a larger part of the bill than it stated, is evidently due to a lack of knowledge of one of the most important features of this legislation. This needs to be cleared up. Mr. Parsons suggests that the real explanation is errors in public-ownership bookkeeping, and that the taxpayers of the state are paying the difference between the sum stated in the article and the actual cost. This is not the case. The amount of administrative expenses to be charged against this undertaking *was not fixed by the Land Settlement Board, but by the accountants of the State Board of Control.* If the cost had been larger that board would have said so, and, if they had fixed it at ten times the sum, this extra cost would not have fallen on the taxpayers of the state but would have been paid by the settlers *because the law requires all expenses of every kind to be so paid.* It is a self-supporting enterprise in the full sense.

The Department of Public Accounting in its report of this board's operations gives the following services as having been rendered without cost to the Land Settlement Board:

The University of California, salary of Dr. Elwood Mead and the use of an office in Agriculture Hall, Berkeley; Division of Soil Technology, University of California, soil surveys; United States Bureau of Roads and Rural Engineering, preparation of plans for irrigation and drainage works; State Department of Engineering, preparation of settlers' house plans; Attorney General, legal services; Board of Control, installation of accounting procedure. (To these might be added the services of the members of the board who have no salaries.)

It will be observed that the first three of these free services are rendered by agencies paid by the state and Federal Governments to promote the success of agriculture and to advance rural civilization. If the educational value of the work done at Durham was equal to work which might have been done elsewhere, and which would have been done elsewhere at public expense, then the Board of Control was correct in not charging this particular enterprise with any part of the salaries. All of the traveling and living expenses of officials that worked there were charged against the settlement.

The chairman of the board performed his duties in addition to his university work. The time given to constructive planning there has taught the state what successful settlement requires, more effectively than by talking about principles in a classroom. The Division of Soil Technology is making a soil survey of California as a foundation for the scientific agriculture of the future. It is a work that ought to be done, but some of the soil maps already made are now gathering dust. The soil map made for Durham was put to immediate and practical use. The settlers know why the acreage price of land was varied. Some of them speak with a sort of awe of the fact that they can trace in their crops the lines of the soil map. In other words, the science of soils has got a grip on the people of that settlement that it ought to have on the whole country, but which it is too often slow of securing. The settlers were not charged with the cost of that soil map, because the maps are everywhere made at public expense.

The Bureau of Rural Engineering has for years been giving to anyone who asked free advice about irrigation and drainage, which sometimes was labor thrown away because the advice was not followed. Here they had the inspiring opportunity of preparing a plan that they know would be carried out.

The professor of sanitary engineering was able here to create a mosquito-abatement district and thus forestall any possible malarial troubles. Usually he is not called in until illness has made remedial measures unavoidable.

The help rendered by the State Department of Engineering was given during a season of the year when

it could be done by people paid annual salaries, without any interference with other duties. It is of course admitted that there might be times when such free services could not be rendered, but if that had been the case it would have been charged and the settlers would have paid it, not the taxpayer. The services rendered by other departments were valuable, but not costly, and are rendered to all other public agencies, so that the decision of the State Accounting Board that they should not be charged here was in accordance with the general practice of the state.

The important point is not that the Durham colony was established at a small expense, but that the most efficient use of agricultural leaders was made there. This is a fact of great significance. The United States now spends more than any other two nations of the world for education in agriculture and to promote rural progress. Valuable as are the services now rendered, no one can study rural conditions without believing that, if experts were more widely used to create right conditions, as they were used at Durham, far more valuable results would be obtained. At present their work is largely corrective and not creative. They help to reform evils after becoming serious, but they allow others to arise without hindrance. At Durham the opportunity to build a rural neighborhood as it ought to be built, and in doing this to show how clearly they understood the problems of rural life, was given to the experts. Such use of them is the best use, and is destined to grow. California has not only formulated a plan which gives to poor men broader opportunities to obtain a home than they had before, but it has introduced an idea into education that is destined to have large application in the future.

No legislation can eliminate the real estate "shark," but, as the article truly said, the "shark" was eliminated in this case in selling the land to settlers. They knew what they were getting and they paid no commissions.

With regard to the saving to settlers which resulted from absence of commissions on sales, the article was conservative. The investigations of the Rural Credits and Land Settlement Commission of California, made in 1915 and 1916, showed that commissions of colonization agencies range from 10 to 30%. The State Land Settlement Board sold to settlers $744,928 worth of land. At the lowest commission this would be nearly $75,000. The average would have been more than this.

ELWOOD MEAD,
Berkeley, Cal. Chairman, Land Settlement Board.

The New York Central Train Wreck

Sir—I presume readers of *Engineering News-Record* will be interested in the wreck on the New York Central near Batavia, N. Y., on Sunday morning, Jan. 12, as observed by a passenger on Train No. 11 which crashed into No. 17. I was engaged in the rescue work for two or three hours following the crash.

The rear coach of Train No. 17, which was telescoped, is described in the Associated Press dispatches as made of steel. This may be true, but I have serious doubts. If it was a steel car it was of old design, for the exterior resembled that of a wooden car of old-fashioned type. The wreckage at the end of this car smouldered considerably but did not burn with much vigor, indicating that there must have been wood in it; furthermore, the fireman who came down from Batavia on the engine which was to assist Train No. 17 told me that the car had a wooden frame. If the roof of the telescoped car in some way had become dislodged it is conceivable that it might have been telescoped by the car ahead, but this is more or less improbable. I was on both sides of the wreck and up and down the track on both sides, and did not notice the roof of the telescoped car lying about.

It seems to me that if the rear coach of Train No. 17 had been of modern steel construction, such as the coach which telescoped it, there would have been almost no loss of life, if any at all. Unquestionably, we would all probably have been shaken up more than we were, but the loss of life was due entirely to the telescoping. Practically the entire force of the shock of the collision was taken up in the telescoped car, for not a single truck left the tracks.

If my supposition as to the use of wood in the construction of the demolished coach is correct, I believe that something should be done to make it a high crime to permit the use of even steel-lined cars on these fast trains.

HARLAND BARTHOLOMEW,
Engineer, City Plan Commission.
St. Louis, Mo.

More Comment on Engineers' Salaries

Sir—I note with interest the following advertisement in your issue of Dec. 19:

"Wanted—Transitman on stadia topography and location of property lines in Southern mountains, to live in isolated district in camp. Long job for desirable man. Salary $90 per month with maintainance in camp. In answer state age, school experience, if married and date available. Only preferred applications will be answered. ————" I omit the name of the firm, for obvious reasons.

It is possible some young engineer more anxious for a job than for what it is worth may take it at that price, but to advertise for men competent to do the work outlined and offer only $90 per month is an insult to the engineering profession. Here in Minnesota common, unskilled labor is getting more than that.

I have on my table at this minute a daily paper commenting on the fact that boys of school age had skipped school and earned $50 per week. This last item was from Philadelphia. My vocabulary is inadequate for further comment.

D. C. WASHBURN.
Elk River, Minn.

Corrects Statement of Levelman's Pay

Sir—In your issue of Jan. 9, p. 106, appears a letter signed "E. N. Gineer," which reads in part: "This is in striking contrast to $35 a month received by a leveler on a line now owned by the Baltimore and Ohio R.R., with $15 added for board."

I wish to say that this is undoubtedly a misprint, as our standard salary for a levelman is $145 per month and expenses over and above $25 when away from headquarters.

R. REIMANN,
Assistant Engineer, Baltimore & Ohio Railroad.
Baltimore, Md.

HINTS FOR THE CONTRACTOR

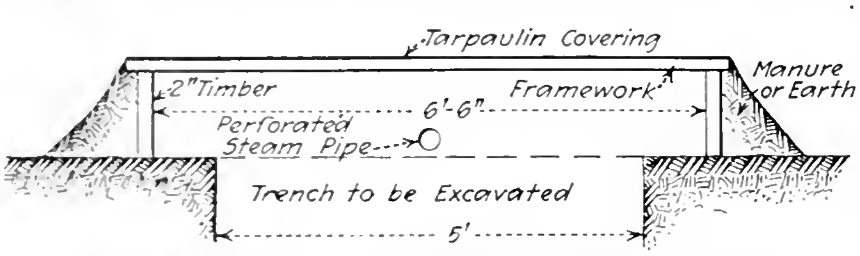
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Steam Thawing Box Reduces Winter Cost of Trench Excavation

By L. McLaren Hunter

Engineer Main Drainage, Ottawa, Ont.

FOR thawing frozen ground over the line of trench where a large sewer was to be constructed, the method shown by the sketch was successfully used. Steam was supplied by the derrick boiler. The thawing



STEAM BOX FOR THAWING FROZEN GROUND

apparatus was placed in position in the morning for the next day's work, and the steam was kept on continuously for the 24 hours. When the box was lifted forward we were able to excavate with ease without the use of picks. This method brought the cost of the work down almost to the level of what it was in summer.

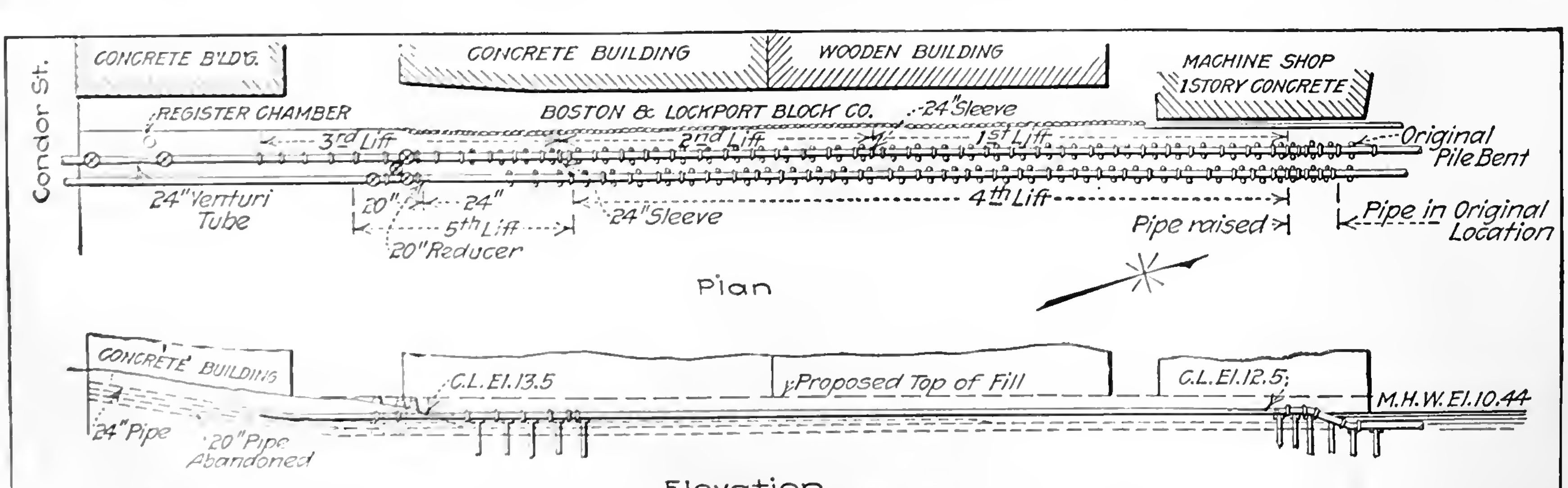
Raising Two Lines of 24-Inch Water Main Seven Feet

By Fred J. Sauer, Jr.

SCREW rods operating through timber cross-blocks supported on piles were recently used to lift to a new position two lines of 24-in. cast-iron water main at Boston. The work was done by the Boston & Lockport Block Co. in connection with an extension of its plant. Land was purchased from the City of Boston, subject to an easement for two 24-in. Class D water mains belonging partly to the City of Boston and partly to the Metropolitan Water District and connecting a tunnel under Chelsea Creek with the system supplying East Boston.

The pipes are 9 ft. c. to c. and enter the yard at an angle of about 10° with the horizontal and at an elevation considerably above high water. They originally continued at this angle for a distance of about 120 ft. From this point northerly the pipes were nearly horizontal at an elevation of from 4 to 6 ft. below mean high tide, the change in direction being made up in the joints. Approximately 700 ft. of pipe was partly exposed, being supported on piles at about the level of the flats. The remaining 250 ft. had been filled to a maximum cover of 14 ft. The grade of the Boston & Lockport Block Co.'s yard is about 11 ft. above the top of the pipes, so that in order to fill the newly acquired land to the existing grade without making the pipes inaccessible it was necessary to raise the pipes 7 feet.

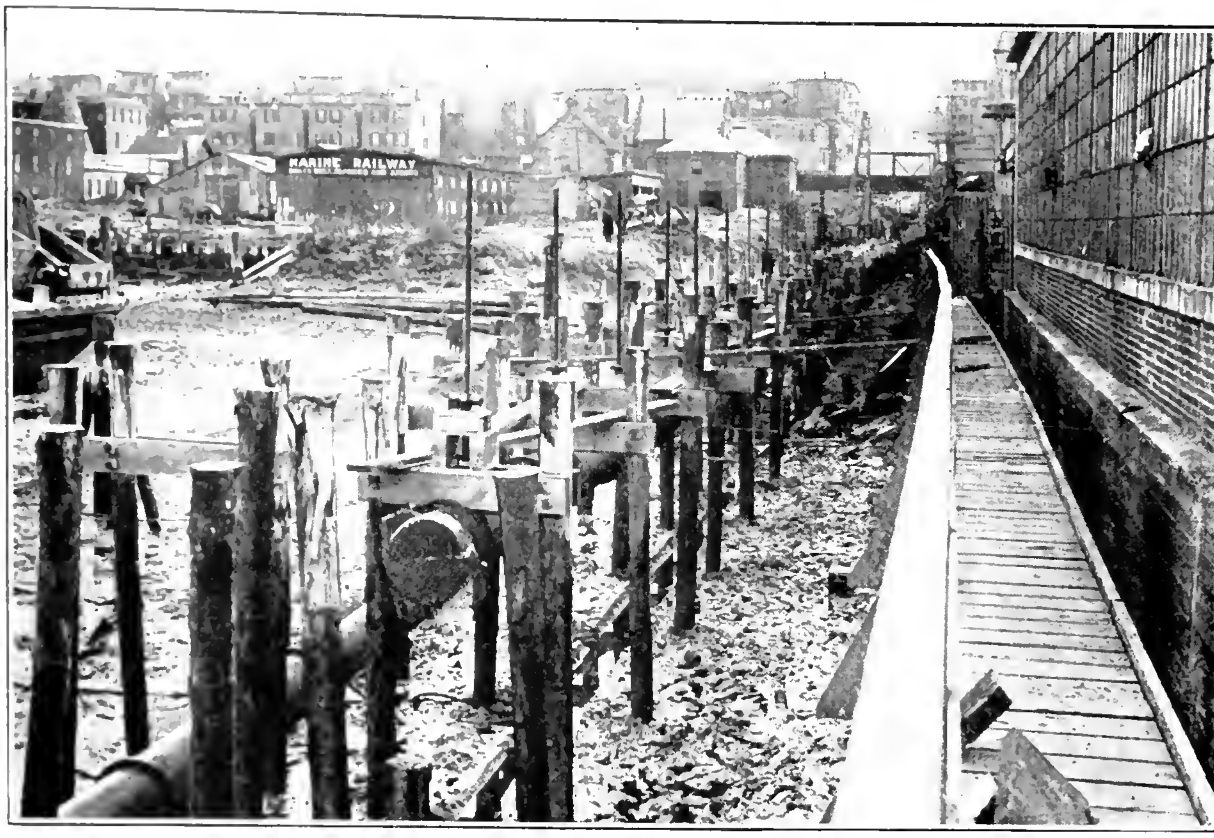
The piles and caps supporting the present pipe were in poor condition, having been exposed between the tides for nearly 50 years, and the soft mud in which the pipes were located made impracticable any system of raising from underneath. For the pipe that was exposed, or only covered to a depth of 3 to 4 ft., the method adopted consisted of driving 10-in. spruce piles on both sides of the pipe about 5 ft. c. to c. across the pipe and about 2 ft. behind each bell. The tops of the piles were left at least 10 ft. above the top of the pipe. The caps consisted of two 6 x 12-in. timbers, leaving a 6-in. tenon. These caps were used both to raise the pipe and as its final support and were designed to carry the weight of the earth fill and a heavy street load. For raising, the caps supported a 14 x 14-in. cast-iron bearing plate, through the center of which passed a screw which was raised by turning a threaded nut in a similar manner to the operation of a hand capstan. The screws were 2½ in. in diameter and lifted ½ in. for each complete revolution of the nut, the maximum lift without blocking being about 6½ ft. Wire-rope slings were used around the pipe. After the pipe



PLAN AND ELEVATION OF TWO LINES OF CAST-IRON WATER MAIN LIFTED TO HIGHER ELEVATION

The dotted lines on the elevation show the original level, and the full lines the level of the pipe as raised.

was raised to grade the caps were set under the pipe, and the piles were cut off at the top of the caps in their new position. The piles varied from 20 to 40 ft. in length, leaving from 10 to 30 ft. below the surface of the mud. No spur piles or bracing were used. The driving was done while the pipes were carrying water under 60 lb. pressure, the driving being done partly from a lighter and partly from a land machine. The lighter drew 30 in. of water and, as the pipes were only covered by from 4 to 6 ft. of water at mean high tide it was not possible to stay over the pipes for more than three hours each tide. The raising in fill was complicated by the local formation, a loose fill having been placed over the mud to a maximum depth of 14 ft., forming a very treacherous bank. The westerly pipe, which was 24 in. for its entire length, was not cut at the southerly end. The pipe was uncovered for a distance of about 24 ft. south of the point where it reached the proposed new grade, and as the pipe was raised the joints adjusted themselves to the new alignment, each joint being pulled out $\frac{1}{2}$ in. at the bottom. This straightening forced the whole section ahead 6 in., although the actual shortening of the line was only about 2 in. The raising was done in a manner similar to that described, except that no piles were driven, the bearing plates resting on long timbers that stretched across the trench to a firm bearing on either side.



ONE LINE OF PIPE HAS BEEN RAISED AND ONE IS IN ITS ORIGINAL POSITION

The easterly pipe, which at the southerly end reduces to a 20-in. line, was cut beyond the second gate. It was not considered economical to salvage the pipe beyond this point, as the city authorities were not willing to leave any of the pipe with the original cover. It was agreed that from this point to the street the easterly line should be replaced by a new pipe to be furnished and placed by the City of Boston.

At the southerly end were four gates. One of these was on a cross-over between the two mains, by means of which the flow of both lines was normally passed through a venturi meter. As it was necessary to maintain the flow through one line while the work was in progress, this gate had to be removed and reconnected after the lines had been raised.

The pipe was raised in five sections, the longest being 330 ft. It was found possible, with one man at each screw and one screw to each length of pipe, to raise at a rate of 1 ft. per hour, after the mud suction had been eliminated. With one screw for two lengths of pipe, it was necessary to provide three men at each screw, and the pipe was not so easily kept in good alignment.

The outer connections were made up of two $\frac{1}{16}$ bends and 15 ft. of straight pipe. On account of the difficulty of working in the soft mud, they were placed from a lighter, a connection being made up on the deck and hoisted into place as a unit.

The work was done in a period of 10 weeks, most of the delay being on account of the difficulty of obtaining labor. In using the figures on cost it must be borne in mind that labor conditions were acute owing to war demands as well as the influenza epidemic.

The cost of the work, excluding engineering, was about $8000, or $8.50 per linear ft., distributed approximately as shown in the following table:

	Quantity (Approximate)	Cost per Foot of Pipe Raised	Cost per Unit	Total Cost
Excavation	500 cu.yd. (200 cu.yd. wet)	$1.06	$2.00 cu.yd.	$1,000
Piles furnished and driven	142 piles, 4,700 lin.ft.	2.48	$0.50 lin.ft.	2,350
Lumber and hardware		.84	Y. P. 6x12 in. $80 per M. Hardware 7c. per lb.	800
Pipe connections		.74	Pipe specials 7c. per lb. lead 10c.	700
Gate chambers	4	.37	$87.50 ea.	350
Carpentry	144 sets of caps	1.06	6.95 per set	1,000
Backfill	500 cu.yd.	.32	.60 cu.yd.	300
All other work, including raising, setting, slings, and screws, etc., for 950 lin.ft. pipe		1.58	....	1,500

William Jackson, formerly city engineer of Boston and engineer for the Boston Water Board, in his report for 1886 describes the raising of 1870 lin.ft. of 48-in. main, the maximum distance raised being 18 ft. No costs are given. In *Engineering Record* of June 20, 1903, John L. Howard, division engineer of the Metropolitan Water-Works, describes a similar job of raising 36-in. mains, in which the cost is given as $11.03 per foot.

The piledriving and capping were done by the Aberthaw Construction Co. The jointing and connecting were done by the maintenance division of the Metropolitan Water Department, under the direction of S. E. Killam. The work was subject to the approval of the Metropolitan Water Board and the City of Boston, and was under the immediate supervision of the writer, who was advised by C. W. Sherman, of Metcalf & Eddy, consulting engineers, Boston.

NEWS OF THE WEEK

New York, January 30, 1919

Bills For Employment on Public Works

Two Measures Introduced in Congress to Promote Municipal and Governmental Projects

Two bills looking to the appropriation of money for public works construction of all kinds are now before Congress. One of them, introduced by Senator Kenyon of Iowa, was briefly described in last week's issue of *Engineering News-Record*. The other was introduced by Representative Kelly of Pennsylvania and provides for the creation of a United States Construction Service.

Under the Kenyon bill there would be established a United States Emergency Public Works Board, consisting of the Chief of Engineers of the United States Army, an officer of the Department of the Interior, an officer of the Treasury, and two citizens to be appointed by the President. The board would have direct supervision over all public works of the Federal Government in the present emergency, and for those works $100,000,000 would be provided. All agencies of the Federal Government would have to report to the board, within 30 days after the passage of the act, the construction plans they are contemplating.

In addition, the act would authorize the War Finance Corporation, for a period of one year, to make loans to the various states in order that emergency public works might be undertaken. Loans might be made by the War Finance Corporation for the work of counties and municipalities, but the Federal Government's relations would be with the state and the state would have to arrange for the advancement of the money to its local subdivisions.

In every case, whether for Federal Government or other public works, expenditures may be made only after there has been filed with the board a certificate of the Secretary of Labor stating that extraordinary unemployment exists in the particular community or vicinity in which the proposed works are located. The inspection of the work done with funds advanced by the War Finance Corporation would be made by officers of the Corps of Engineers.

Representative Kelly's bill would authorize the appointment of a National Emergency Board for Soldier Employment, consisting of the Secretaries of Labor, Agriculture and the Interior. This board would undertake the organization of a body of workers to be

(*Concluded on p.* 258)

Will Devastated France Be Rebuilt?

Credit Conditions and Other Economic Factors Will Greatly Retard Work and Be a Barrier to Aid From America

Readers of this article will find a detailed summary of the destruction in France, and of the reconstruction plans, on page 218 *of this issue.*—EDITOR.

"Why should we rebuild the ruins?" is the question in the minds of industrial and financial leaders in France. A complete change in the manufacturing layout of the country, due to the shifting and the taking root elsewhere of the industries formerly in the devastated areas, the necessity for preserving, with the limited means available, the existing industries that have expanded under war-time demands, and the financial conditions that will make the forming of commercial credits a slow process after the Governmental credits disappear with the signing of peace—all tend to delay greatly the reconstruction process and make the offering of help from the United States, either industrial or engineering, a difficult problem. This is the burden of a message brought from France to the manufacturers, engineers and contractors of this country by Pierce C. Williams, commercial attaché of the American embassy in Paris. On the other hand, he says, the large iron and steel plants in the areas occupied by the Germans where only a minimum amount of fighting was done can be put on a working basis in a comparatively short time, and the German plants in the recovered territories of Alsace and Lorraine are immediately available, so that France herself will be able to produce an amount of steel products almost, if not quite, equal to the necessities of her industries.

The rebuilding of the totally destroyed sections, if considered at all, will be subject to a number of important factors. The destruction included a large portion of the French coal industry that will, of course, have to be revived, but it also comprises several hundred miles of totally deserted farmlands so badly torn up by shell fire that it probably will never again be cultivated, but will probably be given over to pine forests. This area was dotted with towns and villages, as well as with many populous cities, some of which were considered among the most important industrial centers of France. Their industries included mines, blast furnaces, steel, textile and chemical plants and electric-power stations. But with the precedent in mind, that areas devastated in former wars were never rebuilt, and considering the fact that the inhabitants of these cities, towns and farms, are either dead or widely scattered, it is thought probable that these regions may also remain as they are.

Restoration Slow and Difficult

The sugar industry was also located in this section, the sugar beet having been raised nowhere else in France, but the mills are totally destroyed, having been, among others, a special target of German destructiveness. The beets were raised on small farms, and the buyers from the mills went among the peasants and bought up their raw material in small lots. Should these people return, the mill owner will ask, "Why build a mill when there are no beets?" and the peasant will ask, "Why raise beets if there is no mill to take them?" And, as pointed out by Mr. Williams, the synchronizing of these two branches of this industry will be a slow and difficult process.

The rebuilding of the iron and steel plants in the totally destroyed area presents another phase of the matter, with further difficulties. In the first place, the coal mines, flooded and otherwise damaged, must be restored and, second, the mills will have to be built according to local ideas and customs, since that part of the world has its own

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

Division of Engineering, United States Employment Service, 29 South La Salle St., Chicago, Ill.

Professional and Special Section, United States Employment Service; George W. Kirchwey, state director, 16 East 42nd St., New York City.

ideas to which it will be necessary to conform.

Until the final retreat of the Germans certain of the coal mines lying well within the battle lines were kept in more or less continuous operation, but just before the departure of the enemy he destroyed the hoisting apparatus and power plants and blasted out the concrete lining of the shafts as far down as possible. The top soil in this part of France consists of sandy silt very similar to the "muck" familiar to many of the tunnel builders and miners of our own country. This was held in place by concrete shaft-lining. The destruction of this not only flooded the mines with surface water, but precipitated down the shaft an avalanche of water-soaked sand and silt, together with the wreckage of the head works, thus making it impossible even to estimate the amount of damage that has been done. One representative mine in the Vimy Ridge battle ground, the location of which is now indicated only by a heap of bricks, twisted pipe and bits of machinery, was worked in five levels and had a shaft 1500 ft. deep. The owners told Mr. Williams that the water now stood within 50 ft. of the surface, and that they were unable even to predict when coal could be mined in paying quantity. Before that is possible, or even before coal-extracting machinery can be purchased, the owners point out, the coal mines must be entirely cleared of water. This, they say, will take from one to two years. The French officials and engineers responsible for organizing the work of "reconstituting" the coal mines are now assembling pumps, hoists, gas engines, and electric motors, etc., in order to begin the work as soon as possible. But not until this is well under way will there be any means of predicting when coal can once more be produced in large enough quantities to make feasible the rebuilding of the iron and steel plants, or even the mining villages and surface works. Since, as pointed out by Mr. Williams, the industrial plants depend on this supply of coal, there being no hydraulic or electric power available as a substitute in that part of France, delay is inevitable.

Outside Aid May Not Be Needed

On the other hand, outside assistance may not be needed to any great extent, because the French did not develop their iron and steel industries as completely as possible, preferring to export large amounts of the raw ore to Belgium and Germany, and they will probably export again. Furthermore, the iron and steel works in eastern France suffered only from pillaging. The steel and iron men told Mr. Williams that the warning sent out by President Wilson against wholesale destruction in their retreat was undoubtedly heeded by the Germans, and such operations were definitely checked. Of all of the iron mines only three were damaged to any

(Concluded on page 258)

Urge Passage of Bill for Hudson River Vehicular Tunnel

The Merchants' Association of New York City has asked Governor Smith to support the project for a vehicular tunnel under the Hudson River, between New York City and New Jersey, which provides that the estimated cost of $6,000,000 shall be paid equally by the States of New York and New Jersey. Bills for this purpose are now before the two state legislatures, since Congress has virtually refused Federal financial support. The association's letter to the Governor urges that an appropriation of $1,000,000 be made for immediate use.

"Careful consideration was given by our committee to the possibility that such a tunnel might have the effect of diverting to New Jersey industries which would otherwise locate or continue their location in New York. We do not believe that this would be the result, but, on the contrary, think that the benefits would be mutually reciprocal," the letter says. It states that there is a strong tendency at present to divert business from the port of New York to points where the port charges are less and that it becomes important that economies should be effected wherever possible in port charges.

Large Road Appropriation Combined With Post Office Bill

An appropriation for $200,000,000 for roads has been added to the House Post Office appropriation bill by the United States Senate Committee on Post Offices and Post Roads. The original bill as it came from the House provided for an expenditure of $357,-782,000. The amended bill provides for $50,000,000 this year and $75,-000,000 each in 1920 and 1921.

State-Insured Highway Construction Contracts Suggested

Consideration of a system whereby a state may provide its own insurance for the completion of highway contracts is suggested by Edwin Duffey, state highway commissioner, in his annual report to the New York legislature. The plan, if adopted, would eliminate the present practice of requiring contractors to furnish bond through one of the many surety companies. It has been the custom of these companies to furnish certified checks guaranteeing the execution of the contract, and bonds for the performance of the work, and this has been done for inefficient contractors, with little if any capital. This has resulted in poor performance. The undesirableness of this procedure has been emphasized by the abnormal conditions due to the war and by the refusal of the surety companies to take over and complete the contracts promptly.

In reviewing the inconvenience and loss thus produced, the report states that large amounts have been paid to the bonding companies by contractors, and, through their contracts, by the state, since the highway system was begun. In this time the companies have lost little money, but now that an emergency has arisen, the responsibilities which were assumed when the premiums were paid are disclaimed on the grounds of abnormal conditions.

The state carries its own fire insurance on state buildings and its own compensation insurance. In concluding, the report says:

"It would seem that a plan could be evolved by which the state could insure its own contracts and thus receive the protection for which payment is made; and the attention of the legislature is directed to this subject for such consideration as it deems advisable."

American Society Will Discuss Railroad Situation

Francis Lee Stuart, lately chairman of the Budget Committee of Eastern Railroads, will address the New York meeting of the American Society of Civil Engineers Feb. 5 on the national railroad situation today and a suggested basis for legislation.

Proposed New Water Law for State of Idaho

A proposed new water law for the State of Idaho was the principal engineering subject discussed at the joint conference of the Idaho Society of Engineers, the Idaho Irrigation Congress, and other associations interested in the agricultural development of the state. The conference was held at Twin Falls, Idaho, Jan. 13-17. The draft of the text, written by a committee of the Irrigation Congress appointed for that purpose, is based on the laws of Oregon and Washington, and also on the present Idaho law. A bureau of water rights is proposed, consisting of three men appointed by the Governor for terms of nine years each, one member to be appointed each third year. The members would be paid not less than $4000 and not more than $7500 a year. The bureau would take over the duties of the present state engineer as regards the distribution of water and the approval of plans for irrigation-district work; also the duties of the State Land Board in connection with its Carey act irrigation project; it would also make adjudications of water rights, subject to confirmation by the court. It is felt that the last-named change would save much of the expense and delay incident to the court's procedure as now carried out.

The act provides for changes in the methods of selecting and paying water masters on the various streams of the state, which changes, it is thought, would materially increase the efficiency of these men. In the selection of members of the proposed new board, the intent of the act drafted is to secure men of experience in the control of water resources, and to see that at least one member of the bureau is an engineer of ten years' experience.

Bills Provide Employment on Public Works

(*Concluded from page* 256)

known as the United States Construction Service, which would act under the general supervision of the Director of Soldier Employment. Employment in such service would be entirely voluntary. The works that the United States Construction Service would undertake would be the reclamation and preparation of agricultural lands, the establishment of logging operations and sawmills, the development of coal lands, and the building of roads, waterways and general public improvements that would aid or advance the projects of land settlement, forestry or mineral development which would be undertaken. All agricultural lands would be leased to settlers, not sold. The act would carry an appropriation of $500,000,000, said money to be raised for the Treasury by means of an issue of certificates of indebtedness bearing 3% interest.

Workers joining the United States Construction Service might be those who have been in civilian occupations, as well as discharged soldiers and sailors.

Provision is made for coöperative contracts with the various states for land settlement, forestry and mineral developments, the Government's contribution in such cases not to exceed 75% of the total cost of the projects.

Interstate Commission Overrules Director General's Rates

The Interstate Commerce Commission Jan. 20 in a decision written by Clyde B. Aitchison, formerly a member of the Oregon State Railroad Commission, overruled the rate on lumber products in the Pacific Lumber Co. case against the Northwestern Pacific Railroad Co. and others. It decided that the present rates charged for the transportation of lumber and other forest products from Humboldt Bay points to destinations in defined territories east of Denver, Colo., are unreasonable in that they exceed the rates contemporaneously in effect for California coast group points to the same destinations. The defendant railroads named in the case include virtually all the great lines in the Federaly-controlled systems from coast to coast, and the order issued by the commission notifies them to cease before May 15, 1919, from publishing, demanding or collecting present lumber rates, as covered by the decision, and to file new rates in accordance with the terms of that decision.

The new Director General of Railroads, Walker D. Hines, on Jan. 21 issued a formal statement in which he acknowledged the right of the Interstate Commerce Commission to review any of the rates initiated by the Director General, and denies that the latter has thought of contesting the right of the commission to make such a review of rates. He said the Federal control act places the power of review specifically in the hands of the Interstate Commerce Commission, and that at no time since the Government took possession of the railroads has there been conflict in jurisdiction between the commission and the Director General.

Form National Highway Association

Delegates from 37 highway associations, each having a trail of over 500 miles, touching at least three states, met at Kansas City, Mo., last week, and formed a permanent organization to be known as "The Associated Highways of America." Representatives from every state in the Union, except Massachusetts, were present, and 48 different organizations applied for membership. Of these, 37 were found eligible.

Nashville Engineering Association Publishes Strong Appeal

In a full-page advertisement in the Sunday *Nashville Tennessean* the Engineering Association of Nashville, Tenn., on Jan. 18 made the following strong appeal, addressed as an open letter to the members of the sixty-first General Assembly of Tennessee:

"The Federal Government realizes that this period, immediately following the close of the war, is beset with grave dangers from the social and conomic unrest, resulting from the increasing surplus of labor. The Department of Labor has created a new division, with the object of stabilizing these conditions and hastening the return of normal peace-time prosperity.

"This division has made careful investigations, and has arrived at the conclusion that the one industry which will most quickly start the wheels of progress is the building industry. Secretary Baker, realizing that private enterprises could not be expected to advance when the Government enterprises are stopped, says:

" 'We strongly urge that all public improvements be advanced to absorb labor; we ask that you use all influence with the state, county and municipal authorities to this end. Preliminary steps should be taken, in order that necessary authority may be secured in time for operation upon the opening of the construction season.'

"The Engineering Association of Nashville has already started such a campaign, and has the vigorous indorsement of the Department of Labor, and it asks you, Mr. Legislator, to take immediate steps to have all contemplated state work, such as buildings, bridges and roads, ready to start when the season opens.

"Granting that the cost may be more than at a later period—though there is little justification for such a belief—is it not better to spend this extra cost and get needed improvements than for our entire citizenship to suffer immeasurably more on account of idleness?"

Devastated France

(*Continued from p.* 256)

extent, and they not irreparably. It is evident, then, that no great amount of assistance will be needed in this industry. These mines, as well as those in German Alsace-Lorraine, will be worked to capacity to take care of the demobilized soldiers and assure a supply of raw material as soon as possible.

The coal necessary for their immediate operation, as well as the operation of other industries throughout France, that cannot be supplied by their own mines, will be drawn from other countries.

As to supplying needed material throughout the rest of France, Mr. Williams states that it is necessary that everything that can possibly be manufactured in France should be turned over to the French factories. While there has been enormous destruction of industrial capacity in the north of France, there has been in many lines a counterbalancing expansion in the center and southwest of France, particularly among factories that could produce any sort of munitions of war. These factories will be unable to guarantee jobs to demobilized French soldiers unless they are assured of orders growing out of the restoration of the devastated region. It is the task of the new Ministry of Industrial Reconstruction to see that these factories are converted into plants for peace as soon as possible; therefore it is safe to assume, says Mr. Williams, that the factories will receive every opportunity to make reconstruction goods. So pressing is this need that machinery, in the partially destroyed and other parts of France, that would be ordinarily scrapped, with the buying of complete new plants, will be repaired as quickly as possible and put into commission.

Supplies Needed by France

Hence a call will be made for such supplies as France does not produce, including machinery packing, greases, leather belting, and other things needed to put machinery into commission as soon as possible. There will also be a demand for railway supplies and specialties, small tools, some farm implements and semi-steel products. As the new Ministry of Reconstruction takes hold and starts the various factories to work there will undoubtedly be an impetus in the demand, but Mr. Williams warns against assuming that when this demand arrives the big reconstruction era, the time to rush large supplies and solicit contracts for the work, has come.

He says, furthermore, that even if, on account of the record made by the American forces in France and the large amount of construction machinery already there, the French officials might let contracts in the United States, the American contractors would experience great difficulties in carrying out their contracts. Not the least of these difficulties, says Mr. Wil-

liams, will be the small French contractor, who will demand a share of the work and, when obtained, will do it, or wish to do it, in his own way and not the ways of the American contractor.

Credit, however, says Mr. Williams, is the predominating factor of the whole situation, and many of the bankers of this country and France state that it presents the most serious problem. After the signing of peace there will be no Government credit, and the formation of commercial credit will be a slow process. As has already been pointed out, the reconstruction period will be fully two years long, and probably more. It will be impossible for the French people to pay their debts until they can produce enough goods to sell. Take, as an example, a steel man who wishes to place an order for, say, $200,000 worth of machinery or equipment. It will be impossible for him to pay for this material until his steel works are bringing in a return. This will vary from two to two and a half years, and no business house in this country will be able to assume such long-time paper. It will be necessary, then, for this steel man to offer notes that will be guaranteed by the French Government, but such long-term notes will not conform to the rules of the Federal Reserve system in this country. One of the ways, then, that might be used to finance this trade would be the formation of a syndicate in this country which would take over these notes and issue bonds of their own, meanwhile holding the French notes. On the surface, this seems to be a simple process, but the bankers point out that the social unrest and Bolshevism now threatening all the countries of Europe, and the more attractive financial possibilities elsewhere in the world, will make American financiers very slow to take up such proposals.

Must Supplement French Efforts

Concluding, Mr. Williams says: "America's part in the reconstruction of devastated France therefore will be to supplement French efforts. It will be necessary for us to supply French factories with only such raw materials as are not produced in France, and we shall doubtless be called upon to fill in certain gaps which at present exist in French industries. There are, or will be, many kinds of equipment which the French manufacturer will probably find it more economical to have made elsewhere, since it will be difficult for him to make them in his own plants, which for more than four years have specialized in the production of something very different. If American manufacturers can demonstrate to the French industrialists the advantage of having certain machines or parts of machines made in the United States, while the French concentrate on things for which their industries are especially adapted, a business alliance permanently beneficial to both nations will result. It is highly necessary, then, for the people of the United States to have great patience in the situation in France. At present, the business is not there, and until it develops the American manufacturer, engineer, and contractor must gather the facts bearing on the French problem and concentrate on the creation of an effective export, selling, or construction organization, in anticipation of the call which France may ultimately make upon our coöperation."

Engineers Decorated with Distinguished Service Cross

MAJ. GEN. WILLIAM S. SIBERT
Director of Chemical Warfare Service

MAJ. GEN. S. M. FELTON
Director General of Military Railroads

Government Will Sell Large Amount of Equipment

Ten million dollars' worth of equipment owned by the United Spruce Production Corporation is to be sold. Sealed bids will be received by the sales board appointed by Brigadier General Brice P. Disque, commanding officer.

The equipment, which consists of everything from picks and shovels to complete railroads and mills, capable of producing stock from the huge tree in the forest, to the finished product ready for shipment to the airplane factory, is in excellent condition and much of it, because of the abrupt ending of the war, was never used.

The corporation believes this to be an opportune time for the sale, on account of the reconstruction and adjustment, during which many large projects will probably be put under way very soon. This will require a large amount of machinery and equipment such as is to be sold, and will enable its absorption with the least possible disturbance of the markets and to the best advantage to the Government and the trade.

The equipment has been stored at Vancouver, Wash., where it may be inspected by interested persons, upon proper certification by the board, in the Yeon Building at Portland, Ore. Bids will be received at the same address up to and including Feb. 15.

Highway Traffic Association To Discuss Truck Regulation

A conference on regulations covering the speed, weight and dimensions of motor trucks will be held under the auspices of the National Highway Traffic Association at the Automobile Club of America, 247 West 54th St., New York City, at 8 p.m., Jan. 31. The discussion will be opened by the members of the Committee on Motor-Truck Regulations, which is composed of prominent men from all parts of the country. It is requested that highway officials, engineers, manufacturers and owners of motor trucks present their views freely, and thus aid in the solution of a problem which vitally affects the development of highways and motor transportation.

Testing Materials Society Joins Engineering Council

The American Society for Testing Materials has accepted an invitation to become a member of the Engineering Council.

All necessary formalities having been completed, this society is now in full membership, and its representative is expected to take his place at the annual meeting of the Engineering Council Feb. 20.

The present member societies of the Engineering Council are now the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials and the United Engineering Society.

Russian Railway Corps Still in Siberia

Awaiting Military Guards and Necessary Labor to Make Possible Any Progress in Work

The Russian Railway Service Corps, organized in 1917 to rehabilitate the Russian railway from Vladivostok to Petrograd, met from the outset with obstacles which prevented any headway being made in the direction intended. Upon arrival at Vladivostok the members of the corps were not permitted to land, the Bolsheviki having taken possession of the city. Some of the members went to Nagasaki, where they remained until about three months ago, at which time they managed to get into Manchuria and Siberia. There are about 200 of the corps awaiting developments there. They have been denied military guards and the labor with which to carry on the work, two conditions which make going ahead impossible.

Capt. J. D. Rogers, who returned to this country last June, stated that on the docks at Vladivostok there were about 500,000 tons of material held for months awaiting transportation facilities. He said that from Vladivostok to Petrograd the roadway, bridges and tunnels were in comparatively good condition, and that American engineers could, without difficulty, bring the railroad to a good working basis in a short time for the whole 6000 miles of track.

The corps was developed under the direction of S. M. Felton, director of military railroads, and is in charge of Col. George Harrington Emerson, former general manager of the Great Northern R.R. In an interview with the Washington representative of *Engineering News-Record* Mr. Felton said that the corps had been the victim of difficult circumstances and had therefore been unable to accomplish anything substantial, and that the length of the stay of its members in Russia is problematical. They will probably remain indefinitely. All expense of maintaining the corps is assumed by the Russian Government.

Government Will Dispose of Surplus Lumber Stocks

The second conference of the Government bureaus which have surplus building material to dispose of was called Jan. 20 by Richard L. Humphrey, director of building materials of the War Industries Board. At this meeting it was announced that all building-material industries had signified their approval of the plan of procedure that was outlined at the conference on Jan. 8, which was noted in *Engineering News-Record* of Jan. 23, p. 205. At this second conference the main subject discussed was lumber.

The Government surplus lumber stock will be purchased by various lumber interests in various parts of the United States at market prices, less a reasonable amount to pay for handling. The contract which was made will apply to lumber at any given point in amounts of 2,000,000 ft. and more. The purchase is to be completed on or before Aug. 1, 1919, with a further option to purchase lumber, as offered to the Government, in amounts less than 2,000,000 ft. at any given point on or before May 1, 1919. The conference announced that the surplus stock probably will not exceed 150,000,000 feet.

Committee Appointed To Study Automatic Train Control

The creation of the Automatic Train Control Committee of the United States Railroad Administration was announced Jan. 14 by C. R. Gray, director of the Division of Operation, as follows:

C. A. Morse, chairman; W. P. Borland, C. E. Denney, H. S. Balliett, Henry Bartlett, J. H. Gumbes, R. W. Bell.

The committee will make a study of the automatic train-control devices now undergoing test upon various lines of railroad or available for test, and report recommendations for the installation and further practical test of devices made available for that purpose, which they may consider practicable and reasonably conforming to the purposes to be accomplished. Their conclusions upon the mechanical or economic features of such of the devices as they may find available for practical use are also to be reported.

Government of Manitoba Appoints Drainage Commission

The Manitoba Government has appointed a drainage commission to investigate the problems of reclaiming by drainage large areas of land. The commission consists of J. G. Sullivan, chairman, formerly chief engineer, Canadian Pacific Ry., Harry Grills, of Sanford, and John A. Thompson, of Winnipeg.

Cornell Engineering Schools May Merge

At a dinner for the engineer graduates of Cornell University held in New York Jan. 17 announcement was made by President Schurman of the university that a committee of the board of trustees was considering a proposal to merge the College of Civil Engineering and Sibley College, in which mechanical, marine and electrical engineering is now taught. The schme—which in all likelihood will go into effect within a year, or perhaps two—contemplates one college of engineering in which all branches of engineering will be taught. President Schurman, Dean Haskell of the College of Civil Engineering, and Dean Smith of Sibley College, all enthusiastically advocated the merger.

Over 425 Cornell engineers were in attendance, the program including remarks by returned Army and Navy officers.

Under-River Water Conduit Contract To Be Relet

The contract for duplicating the Jersey City water-supply conduits where they cross under the Hackensack and Passaic Rivers was declared defaulted by the authorities of the city in December. Slightly amended specifications were adopted by the City Commission on Jan. 23, and invitation for bids was ordered. Michael I. Fagen is director of the Department of Streets and Public Improvements.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Feb. 17-20, New York.

The North Carolina Society of Civil Engineers will hold its first annual meeting at Raleigh Feb. 8. A prominent place in the program will be given to a discussion of the social status of the engineer and to consideration of state legislation regarding the licensing of engineers. Affiliation with national societies will also be discussed. Among the papers to be presented are "Coöperation Among Engineers," by H. W. Keuffner; "The Social Status of the Engineer and How It May Be Improved," by Dr. W. C. Riddick; "Importance of Testing Materials for Construction," by Ira B. Mullis, and "Bridge Engineering and Its Future," by W. L. Craven.

The Engineers' Club of Philadelphia will hold a regular meeting Feb. 18. Maj. Nevil Monroe Hopkins, Technical Research Branch, Ordnance Department, U. S. A., previously of George Washington University, will present a paper, illustrated with lantern slides, on "The Spirit and Outlook for Research and Invention," with reference to Germany's methods of fostering research, in the past, as compared with those of this country. A special meeting of the club will be held Feb. 15, at which H. F. Moore, professor of experimental engineering, University of Illinois, will read a paper on "The Fatigue of Metals," illustrated with lantern slides and motion pictures. At the weekly luncheon Feb. 4 the club will be addressed by William S. Twining, director of the Department of City Transit, Philadelphia, on "Financing City Improvements."

The Topeka Engineers' Club held its first meeting Jan. 25. The officers of the club are: President, J. E. Williams, county engineer, Shawnee County; secretary, L. B. Smith, chief engineer, Topeka Bridge Co., and treasurer, H. S. Putney, president of the Road Supply and Metal Company.

The New Jersey State Association of County Engineers held its annual meet-at Trenton, Jan. 21. The state-aid specifications, the result of a year's study and research by members of the association, to be recommended to the State Highway Commission, were approved. The following officers were elected for the year: President, Garwood Ferguson, Passaic County; vice-president, Thomas J. Wasser, Hudson County; secretary, Alexander H. Nelson, Atlantic County, and treasurer, Alvin B. Fox, Middlesex County.

The Kansas Engineering Society will be addressed by Lieut. K. P. Cecil on "With the Artillery at the Front," and by Capt. L. R. Tillotson, on "With the Engineers in France," at the annual meeting to be held at Topeka Jan. 30-31, noted in these columns last week. Among the other subjects to be discussed are: "New Methods in Engineering Education," "Geological Engineering in Kansas," and "Some Highway Troubles, Their Cause and Cures," by S. E. Fitch, New York State Highway Department. Papers will also be read on concrete, brick and bitumen roads.

The Illinois Association of Members of the American Society of Civil Engineers Jan 20 elected the following officers: Maj. H. J. Burt, president, and Charles B. Burdick, vice-president. A brief discussion on the work of the development committee was entered into by the 25 members present. Edgar S. Nethercut is secretary-treasurer.

The North Dakota Society of Engineers will be addressed by W. B. Stevenson of Fargo on "The Relation of the Engineer to Reconstruction Work," at the annual meeting to be held at Valley City, Jan. 30-31, mentioned in these columns last week. On the first day of the meeting a report of the committee on legislation will be presented. Other committee reports include those on roads, bridges and drainage. On the second day of the meeting inspection trips will be made to the Valley City light plant and water-works and to the Northern Pacific high bridge. The papers to be presented before the meeting include the following: "Range Spotting by Aëroplane," by L. B. Dale; "Members of the Society in the War," by E. F. Chandler.

The Montreal Branch of the Engineering Institute of Canada will hold a meeting Feb. 6 at which the following papers will be read: "Some Problems in Ocean Transportation," by A. W. Robinson, and "Manufacture of Nitro-Benzol and Aniline Oils," by G. J. Caron.

The Engineers' and Architects' Association of Southern California held a meeting Jan. 31 at which Dr. Albert L. Shiels, superintendent of the Los Angeles schools, spoke on Bolshevism. At a second session of the meeting Leroy C. Bishop gave a talk on the use of the acousticon and the dictograph.

The Albany Society of Civil Engineers held a meeting Jan. 28, and was addressed by Dr. A. T. Lincoln, professor of chemistry, Rensselaer Polytechnic Institute, on "Service of Chemistry in the War," with particular reference to explosives and gas warfare.

The Oregon Society of Engineers will hold its annual meeting at Portland, Feb. 3.

The Chicago Chapter of the American Association of Engineers elected the following officers, at the recent annual meeting: President, Paul Augustinus; vice-presidents, A. M. Van Auken, William J. Strong, Robert W. Shelmire and L. O. Wolf; secretary, Walter M. De Berard, and treasurer, L. G. Reed.

The Detroit Engineering Society was addressed Jan. 24 by Lieut.-Col. G. M. Barnes, Ordnance Department, U. S. A., who spoke on "Long-Range Artillery in War." Colonel Barnes' paper included special reference to railway artillery and was illustrated with stereopticon views.

The Rochester Engineering Society will meet Jan. 31 and will be addressed by Virgil M. Palmer and F. A. Collins, Jr., who will speak on "Fatigue Study," with reference to the factory worker.

Personal Notes

JOHN H. GREGORY, consulting engineer, New York City, has been appointed professor of sanitary engineering, Johns Hopkins University, Baltimore, succeeding Capt. Grandville R. Jones, Sanitary Corps, U. S. A., who recently died in the service. Professor Gregory has been engaged in consulting engineering practice in New York City for several years, specializing in water-supply work. After his graduation from the Massachusetts Institute of Technology in 1895 he entered the service of the Metropolitan Water Board of Boston as office assistant, engaged in the design of the Wachusett aqueduct. Later, for several years he was associated with Allen Hazen on various water-supply projects. In 1902 he became division engineer for the Jersey City Water Supply Co. on the 50,000,000-gal. daily water supply, in charge of the construction of the conduit from Boonton to Jersey City. In 1903 he became principal assistant engineer for the Commission on Additional Water Supply for New York City. In 1910 he was appointed engineer for the Metropolitan Sewerage Commission of New York. Several years later he became associated with Rudolph Hering, under the firm name of Hering & Gregory, consulting engineers, New York City, which firm was dissolved in 1917.

Readers who are returning to civil life from military, naval or other Government service are strongly urged to send in items about themselves and about their friends who are in similar situation. Items should give former position, describe character of military or other service and state the civil work to which the engineer or contractor in question is going. In the case of those with service abroad, information regarding the activities of the units to which they were assigned is especially desired.

JOHN F. STEVENS, head of the American Railway Commission to Russia, is to become chief administrator of the Transsiberian Ry., from Porgranichana to Omsk, a distance of 3000 miles, with General Horvath as co-director, according to recent dispatches from Vladivostok concerning the allied control of the Transsiberian line.

E. LOGAN HILL, secretary of the United States Shipping Board Commission on Port and Harbor Facilities, resigned recently to become associated with Heyl & Patterson, Inc., contracting engineers, Pittsburgh. Previous to his appointment to the Shipping Board Mr. Hill was assistant general manager of the Erie R. R. He will be attached to the New York office of the company, and will specialize in freight-handling problems.

MAJ. EUGENE W. STERN, Engineers, U. S. A., who was superintendent of roads in Base Section 2, with headquarters at Bordeaux, American Expeditionary Forces, has returned to the United States and has been discharged from the Army. He is at his home in New York City, where he was formerly chief of the Bureau of Highways, Borough of Manhattan. In his military service, Major Stern had charge of the construction and maintenance of roads near Bordeaux, and in that capacity built 35 miles of new road, resurfaced 45 miles, and maintained 100 miles. This work involved the handling of something like 100,000 tons of road stone, part of which was

produced under Major Stern's supervision.

A. H. KROM, director of the Division of Engineering, United States Employment Service, Chicago, has returned to the American Association of Engineers as assistant secretary. Since the division was organized in July, more than 5000 engineers have been placed in positions.

LIEUT. COL. H. W. HODGE, Engineers, U. S. A., recently returned from overseas, has received his discharge from the service and has returned to his office in New York City.

W. WALKER, acting division engineer, Grand Trunk Ry., Eastern Lines, has been appointed division engineer, succeeding Maj. F. C. L. Bond, promoted to be chief engineer of the system, with headquarters at Montreal, as noted in *Engineering News-Record* of Dec. 26, p. 1202.

LIEUT. COL. SANFORD E. THOMPSON, Ordnance Department, U. S. A., who has been in charge of the Estimates and Requirements Division of the Ordnance Department in Washington, has been discharged from the Army and has returned to Boston to resume his consulting practice.

CAPT. E. E. HOWARD, Engineers, U. S. A., who was commissioned last October, has received his discharge from the service and returned to his work with the firm of Harrington, Howard & Ash, consulting engineers, Kansas City, Mo.

WARREN WORTHINGTON, general superintendent, in charge of engineering and erection, Donner Steel Co., Buffalo, N. Y., has resigned to become special engineer in charge of steel-mill construction and equipment for the American Steel Export Co., New York City.

CAPT. WARD S. ROBINSON, recently discharged from the Personnel Branch, Office of Procurement Section, Operations Division, General Staff, formerly with the Illinois State Civil Service Commission, has been made head of the Middle West zone of the Division of Engineering, United States Employment Service.

GEORGE W. OSGOOD has been appointed engineer of the Tacoma, Wash., Port Commission, of which Frank J. Walsh has been appointed consulting engineer, as noted in these columns last week.

H. N. RODENBAUGH has been appointed engineering assistant to the Regional Director, Southern Region, United States Railroad Administration.

CAPT. H. C. MCCORMACK, Engineers, U. S. A., has received his discharge from the service and returned to the Koppers Co., Pittsburgh.

M. O. LEIGHTON, consulting engineer, Washington, D. C., who has been chosen as chairman of the newly formed National Service Committee of the Engineering Council, mentioned last week, p. 206, has made a particular study of hydro-electric development in this country. He testified before the Congressional committee on the possible commercial development of navigable rivers and streams in forest preserves, indicating also to what extent canalization of navigable streams would result in improvements to navigation as well as in water-power possibilities. He has made a study of the application of water-power to many uses, including industry, central stations, and electrochemistry and especially to railroad electrification. Mr. Leighton was born in 1874 and was graduated from the Massachusetts Institute of Technology in 1896. He engaged chiefly in hydraulic work, and in 1906 was appointed chief hydrographer of the Geological Survey. He continued in this office until 1913, when he took up consulting work. He has been a member of a number of Government commissions to study waterways.

Chairman of National Service Committee

M. O. LEIGHTON

BRIG. GEN. AMOS A. FRIES, Engineers, U. S. A., who was in charge of the Chemical Warfare Service of the American Expeditionary Forces, has returned to the United States and is now assigned to duties in Washington, D. C.

F. E. BONNER, assistant engineer, Forest Service, Washington, D. C., has been appointed acting district engineer for the Forest Service at Denver, Colo.

MAJ. WILLIAM M. ACHESON, Engineers, U. S. A., who was superintendent of roads for the American Expeditionary Forces, has returned to the United States and, since his discharge from the Army, has returned to his home in Syracuse, N. Y. He was formerly division engineer of the New York State Highway Department, at Syracuse.

D. C. NEWMAN COLLINS, engineer and architect, until recently associated with the Emergency Fleet Corporation, has returned to his office at 14 John St., New York City.

ARTHUR BONIFACE, JACOB SIEBERT and WALTER H. FEDERLEIN have become associated under the firm name of the Boniface Construction Co., engineers and contractors, with office at 52 Vanderbilt Ave., New York City.

FRANK W. WARD, formerly of Ridgville, Penn., has become city engineer of Niles, Ohio, succeeding H. W. Turner, resigned.

OBITUARY

LT. COL. HOWARD L. BODWELL, D. S. O., C. M. G., Croix de Guerre, assistant director of light railways, Canadian Military Area, France, died at St. John, N. B., a few days after his arrival from France. He was a graduate of the Royal Military College, Kingston, and had been connected with railway engineering in western Canada. He had also served two years in China on railroad work. At the outbreak of the war he went overseas as second in command of the Canadian Battalion, and subsequently won the decorations noted above.

COL. ROBERT S. LOW, of the contracting firm of Bate & McMahon, Ottawa, Ont., died Jan. 16. He had been engaged in war construction work, including the construction of Valcartier Camp and Camp Borden, and was afterward engaged in reconstruction work at Halifax.

JONAS F. YOUNG, locating engineer, Lehigh & New England R.R., died recently in Buffalo. He was born in 1847, and was graduated from Rensselaer Polytechnic Institute, Troy, N. Y., in 1868, taking the degree of C. E. in 1872. His first railroad work was for the Buffalo, Rochester & Pittsburgh. He afterwards became associated with the Lehigh Valley R.R., for which he served as division engineer for several years. Later he became division engineer, Chicago, Milwaukee & St. Paul Ry., on double-track work in Iowa.

MORLEY L. SMITH, director of engineering of the Technical School, Toronto, died Jan. 18, at the age of 37. He was graduated from Toronto University in electrical engineering in 1912.

Bridge Builders Report 27 Per Cent of Capacity Taken

The records of the Bridge Builders' and Structural Society, as collected by its secretary, show that during December, 1918, 29% of the entire capacity of the bridge and structural shops of the country was contracted for. During the entire year 1918 the new business placed amounted to 56% of capacity.

New Light-Weight Shovel That Can Be Converted Into Crane

In order to meet the wider range of usefulness that, according to manufacturers, will be demanded of construction machinery, a light portable steam shovel has been produced. It may also be converted into a crane, with a working radius of 25 ft. and able to handle a ½-yard clamshell bucket, by adding an auxiliary shaft carrying two drums, and the substitution of a longer and lighter boom.

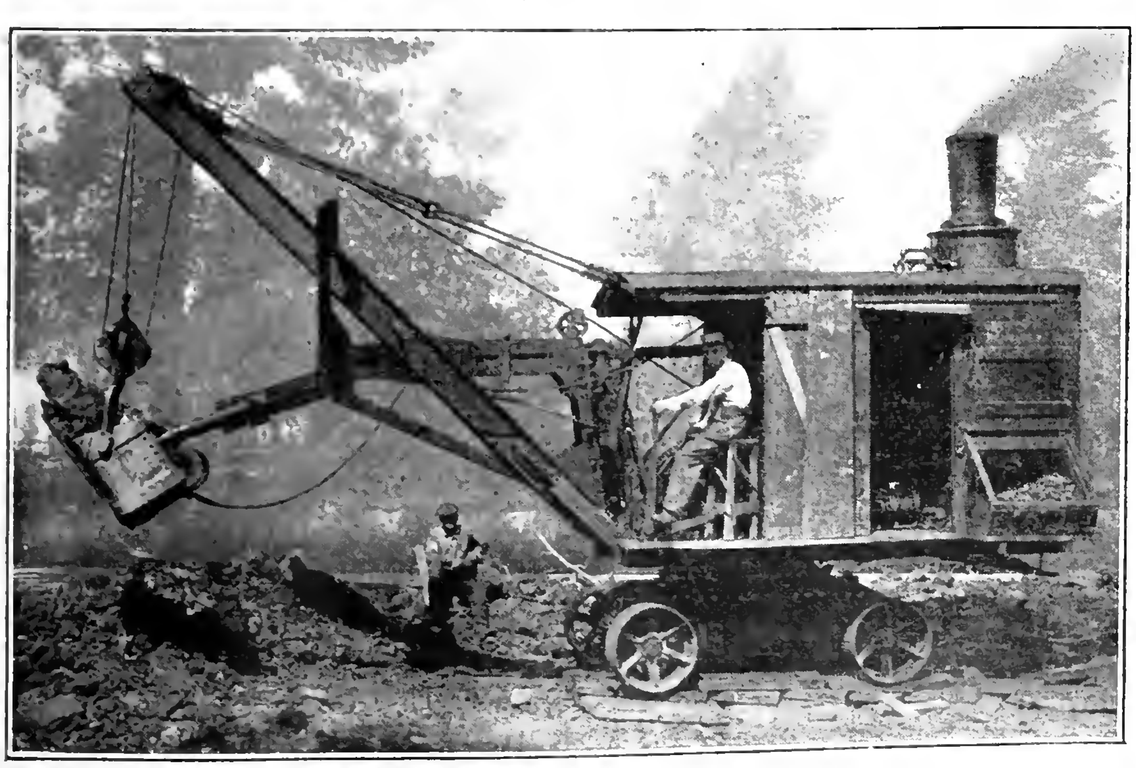
It is so designed that, with minor changes, it may be equipped for steam, electric or gasoline operation and the change from one form of power to another can readily be made in the field, at reasonable expense.

When equipped for electric or gasoline motor, this auxiliary shaft controls the dipper crowding motion, so that the only change from shovel to crane lies in the exchange of booms. All drums are power-driven, and the machine is adapted to clamshell or drag-scraper service.

Independent double reversing engines are employed for hoisting, crowding and swinging when the power is steam, and for electric and gasoline service a single motor is used, operating at constant speeds. The various motions are controlled through reversing frictions.

When equipped as a shovel the machine is regularly mounted upon a truck with wide-tired traction wheels, with both hand and power steer. It is self-propelling at speeds approximating 1½ miles per hour, and is designed primarily for the lighter classes of work to be undertaken by a shovel of this size. It weighs 14 tons and regularly uses a ½-yd. dipper. It has handled clay, earth or thoroughly blasted material at a rate of approximately 300 cu.yd. per day.

The shovel is manufactured by the Thew Automatic Shovel Co., Lorain, Ohio.



STEAM SHOVEL MAY BE FITTED GASOLINE OR ELECTRIC POWER

National Builders' Supply Association Elects Officers

At a convention held last week in Indianapolis, Ind., the National Builders' Association elected officers for the ensuing year. Arthur E. Bradshaw, of the Indianapolis Mortar and Fuel Co., was elected president; Charles M. Kelly, of Providence, R. I., vice-president, and John J. Voelkel, of New Orleans, La., treasurer. A board of directors to serve two years was also appointed.

Following the decision of the executive committee, the convention was conducted wholly as a business session, with discussions of questions of vital interest to the association. A resolution was passed and forwarded to Washington urging the Federal Government, through its proper departments, to make a speedy investigation, and an announcement, regarding the stability of the present market valuations, with the object of creating confidence in the industries represented by the association. The latter are being held back by statements regarding the possibility of an early decline in present valuations. These statements the members believe to be misleading.

Total 1918 Foreign Trade but Slightly Below That of 1917

Heavy December shipments brought the total exports for 1918 to $6,150,000,000, a decrease of but $83,000,000 from the 1917 total, according to an announcement by the Bureau of Foreign and Domestic Commerce. Imports for the year totaled $3,031,000,000. Imports for the previous year were $2,952,000,000.

Exports for December, the first full month after the signing of the armistice, reached a total of $566,000,000, a decided increase over the $522,000,000 recorded for November, although not up to the high mark of $600,000,000 for December, 1917.

Imports for December, however, at $211,000,000, were low as against $251,000,000 for November and $228,000,000 for the month of December of the previous year.

Business Notes

The Superior Portland Cement Co., Seattle, has purchased the plant of the Washington Portland Cement Co. at Concrete, Wash., adjoining the Superior plant. John C. Eden becomes president of both concerns.

Francis C. Bagby has succeeded J. F. Weiss as district manager for the Kansas City district of the Corrugated Bar Co., with offices at 1505 Waldheim Bldg. Mr. Bagby, who is a member of the American Society of Civil Engineers, was formerly manager of the St. Louis and Detroit offices of his company.

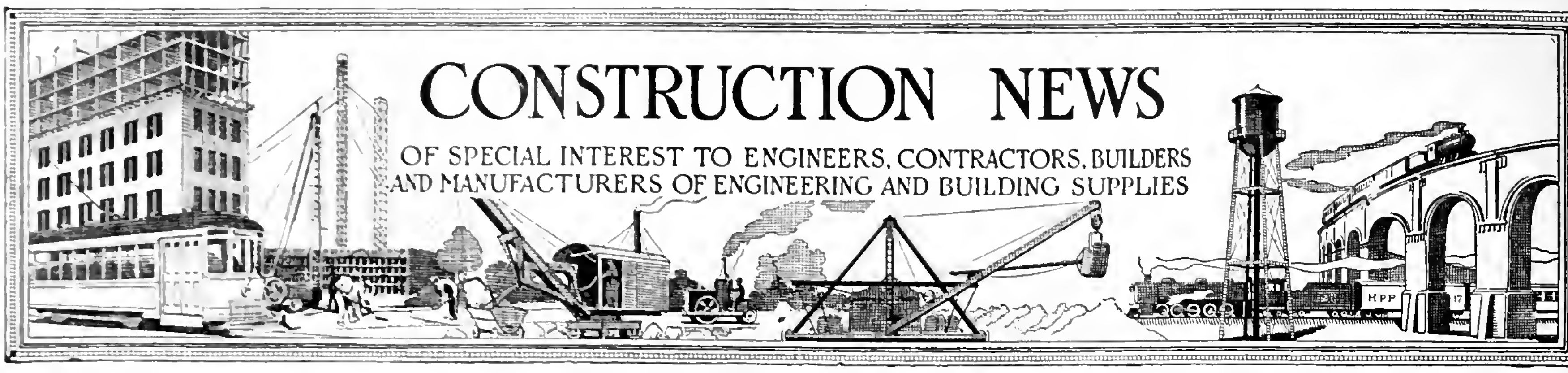
W. W. Cochrane, formerly in the purchasing department of the Chain Belt Co., Milwaukee, Wis., has been appointed manager of excavator sales by the Pawling & Harnischfeger Co., Milwaukee, Wis.

Trade Publications

"The Road to Peace" is the title of a recent 42-p. 11 x 14 book, in pamphlet form, showing in full-page half tones, pictures of war work in which the products of the Lakewood Engineering Co., Cleveland, Ohio, were used.

The McKenna Co., 1851 E. 38th St., Cleveland, Ohio, has issued Catalogue A, describing its bar-bending machines. It illustrates and describes five types of power bending machines, one hand bending machine, stirrup formers and steel shears, all of which are used in the handling of reinforced-concrete steel.

Drill sharpeners and stationary and portable air compressors of various types are the subject of four bulletins, 6 x 9 in., issued by the Sullivan Machinery Co., Chicago, as follows: Drill sharpeners, 24 pp.; simple straight-line compressor, 12 pp.; simple compressor with two-stage air cylinders, 12 pp.; small belt-driven compressors, 12 pp.; portable mine-car compressors and "rotator" hammer drills, eight pages.



PROPOSALS

For Proposals Advertised See Pages 47a to 49 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Feb. 3	Cascade, Mont.	Jan. 30
Feb. 3	Kingfisher, Okla.	Jan. 30
Feb. 3	Maple Heights, O.	Jan. 16
Feb. 11	Poughkeepsie, N. Y.	Jan. 30
Feb. 18	Jersey City, N. J. Adv. Jan. 30.	Jan. 30
Feb. 25	East Chicago, Ind. Adv. Jan. 30.	Jan. 30
Feb. 28	Clarksburg, W. Va. Adv. Jan. 30.	Jan. 30

SEWERS

Feb. 3	Ford (Wyandotte P. O.) Mich.	Jan. 30
Feb. 5	Appleton, Wis.	Jan. 30
Feb. 5	Portvue, Pa. Adv. Jan. 16, 23 and 30.	Jan. 16
Feb. 8	Granite City, Ill.	Jan. 23
Feb. 25	St. Louis, Mo.	Jan. 30

BRIDGES

Feb. 3	Charlotte Harbor, Fla. Adv. Dec. 19, 26, Jan. 2 and 9.	Jan. 2
Feb. 3	Oswego, Kan.	Jan. 30
Feb. 6	David City, Neb.	Jan. 30
Feb. 11	Oglethorpe, Ga.	Jan. 30

STREETS AND ROADS

Feb. 1	Atlanta, Ga.	Jan. 30
Feb. 3	Clarksdale, Miss.	Jan. 30
Feb. 3	San Antonio, Tex.	Jan. 30
Feb. 3	Santa Barbara, Cal.	Jan. 23
Feb. 3	Indiana	Jan. 23
Feb. 3	Wichita, Kan.	Jan. 9
Feb. 4	Indiana	Jan. 23
Feb. 5	Indiana	Jan. 23
Feb. 5	Hartville, Mo.	Jan. 23
Feb. 5	Indiana	Jan. 9
Feb. 5	Grand Island, Neb.	Jan. 30
Feb. 7	Norton, Kan.	Jan. 23
Feb. 10	Fayetteville, W. Va.	Jan. 16
Feb. 10	Idaho	Jan. 30
Feb. 11	Indiana	Jan. 23
Feb. 11	Moulton, Ala.	Jan. 16
Feb. 14	Oswego, Kan.	Jan. 30
Feb. 17	Phllippi, W. Va. Adv. Jan. 23.	Jan. 23
Feb. 17	California	Jan. 30
Feb. 17	Tulsa, Okla.	Jan. 30
Feb. 18	Indiana	Jan. 23
Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 20	Hamlin, W. Va.	Jan. 23
Feb. 20	Rumson, N. J. Adv. Jan. 23.	Jan. 23
Feb. 24	Middlebourne, W. Va. Adv. Jan. 30.	Jan. 30
Mar. 4	Ripley, W. Va.	Jan. 23

EXCAVATION AND DREDGING

Feb. 3	Madisonville, Ky. Adv. Dec. 5, 12 and 19.	Dec. 12
Feb. 3	Lewiston, Ill.	Jan. 30
Feb. 10	St. James, Minn.	Jan. 30
Feb. 15	SouthBend, Ind.	Jan. 30
Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 19	Albany, N. Y. Adv. Jan. 23.	Jan. 23

INDUSTRIAL WORKS

Bids Close		See Eng. News-Record
Feb. 3	New York, N. Y.	Jan. 30
Feb. 3	New York, N. Y.	Jan. 23
Feb. 18	Albany, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 25	New York, N. Y.	Jan. 30
Mar. 4	Thiells, N. Y.	Jan. 16
Apr. 1	Sioux City, Ia.	Jan. 16

BUILDINGS

Feb. 1	Irvington, N. J.	Jan. 23
Feb. 3	Melbourne, Fla.	Jan. 9
Feb. 3	St. Paul, Minn.	Oct. 31
Feb. 3	Leavenworth, Kan.	Jan. 23
Feb. 5	Portland, Mich.	Jan. 23
Feb. 5	Washington, D. C.	Jan. 30
Feb. 6	New York, N. Y.	Jan. 30
Feb. 10	New York, N. Y.	Jan. 30
Feb. 11	Lusk, Wyo.	Jan. 23
Feb. 14	Brooklyn, N. Y.	Jan. 23
Feb. 19	Brooklyn, N. Y.	Jan. 30
Feb. 21	Phillipsburg, O.	Jan. 30
Feb. 24	Norwood, O.	Jan. 23
Feb. 24	Cincinnati, O.	Jan. 30
Mar. 1	Cloquet, Minn.	Jan. 30
Mar. 1	Mountain Iron, Minn.	Jan. 30
Mar. 1	Duluth, Minn.	Jan. 23
Mar. 3	Rockport, Ind.	Jan. 23
Mar. 15	Culver, Ind.	Dec. 26
Apr. 2	New York, N. Y.	Jan. 23

FEDERAL GOVERNMENT WORK

Feb. 3	Dredging — Spec. 3579 — Ft. Lafayette, N. Y.	Jan. 16
Feb. 3	Kitchen Equipment—Spec. 3730—Chelsea, Mass.	Jan. 16
Feb. 3	Water Tower, Pump and Tank House Equipment—Spec. 3682 — Philadelphia, Pa.	Jan. 16
Feb. 3	Hangars, Pavement and Beach—Spec. 3432—Galveston, Tex.	Jan. 30
Feb. 4	Boilers—Memphis, Tenn. Adv. Jan. 9.	Jan. 9
Feb. 4	Turbine, Pump set, etc. — Memphis, Tenn. Adv. Jan. 9.	Jan. 9
Feb. 5	Tank and Tower—Ft. Mifflin, Pa.	Jan. 30
Feb. 10	—Metal and Glass—Baltimore, Md. — Adv. Jan. 16.	Jan. 16
Feb. 10	Portland Cement — Denver, Colo.	Jan. 23
Feb. 10	Refrigerating Plant Equipment—Spec. 3749—Ward's Island, N. Y.	Jan. 30
Feb. 10	Steel Stock and Storage Shed—Spec. 3736—Boston, Mass.	Jan. 30
Feb. 10	Laundry Equipment—Spec. 3665—Ward's Island, N. Y.	Jan. 30
Feb. 10	Chimney for Boiler Plant—Spec. 3606 — New York, N. Y.	Jan. 30
Feb. 10	Coal and Ash Handling Equipment — Spec. 3300—Hampton Roads, Va.	Jan. 30
Feb. 10	Tanks—Spec. 3628—Quantico, Va.	Jan. 30
Feb. 10	Coal and Ash Handling Equipment — Spec. 3607 — New York, N. Y.	Jan. 30
Feb. 11	Bridge—Washington, D. C. Adv. Jan. 16.	Jan. 16
Feb. 12	Elevator, etc. — Ft. Worth, Tex. Adv. Jan. 23.	Jan. 23
Feb. 15	Laboratory — Washington, D. C. Adv. Jan. 23.	Jan. 23
Feb. 17	Piping and Circulating System — Spec. 3416 — Portsmouth, N. H.	Jan. 30
Feb. 17	Small Boat Basin and Bulkhead—Spec. 3776—Indianhead, Md.	Jan. 30
Feb. 17	Railroad Extension—Spec. 3727—Ft. Mifflin, Pa.	Jan. 30
Feb. 17	Equipment, etc.—Spec. 3328 Hampton Roads, Va.	Jan. 30
Feb. 20	Surgical Dressing Room—St. Louis, Mo.	Jan. 30
Feb. 21	Dredging, etc. — Norfolk, Va. Adv. Jan. 23.	Jan. 23
Feb. 24	Fuel Oil Storage Plant—Spec. 3631—Mare Island (Vallejo P. O.)	Jan. 30
Feb. 25	Jetty Work—Sabine Pass, Tex. Adv. Jan. 23.	Jan. 23
Mar. 1	Foundation and Rip Rap—Baltimore, Md. Adv. Jan. 16.	Jan. 16
Mar. 1	Dredging—Superior, Wis.	Jan. 16
Mar. 3	Barracks — Spec. 3728 — Fire Island, N. Y.	Jan. 30

MISCELLANEOUS

Feb. 3	Crib—Casper, Wyo.	
Feb. 3	Dam—Los Angeles, Cal.	Jan. 9
Feb. 5	Chlorine, etc.—New York, N. Y.	Jan. 30
Feb. 11	Boilers and Piping, etc. — Utica, N. Y.	Jan. 23
Feb. 13	Refrigeration Equipment—Iroquis, N. Y.	Jan. 30
Feb. 13	Road Oil, Asphalt, etc., Montclair, N. J.	Jan. 30
Feb. 14	Additional Window Guards —Bedford Hills, N. Y. Adv. Jan. 23.	Jan. 23
Feb. 14	Pier—Philadelphia, Pa. Adv. Jan. 23.	Jan. 23
Feb. 19	Gantry Crane — Seattle, Wash. Adv. Jan. 2 and 9.	Jan. 2

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

N. Y., Central Islip—State Hospital Comn., Albany, applied to State Legislature, for appropriation of $25,000 for water supply at Central Islip State Hospital.

N. Y., Dannemora—State Prison Comn., Albany, applied to State Legislature for appropriation of $10,000 for new reservoir and extension of water supply system.

N. Y., Poughkeepsie—State Hospital Comn., Albany, applied to State Legislature, for appropriation of $30,000 to improve water supply at Hudson River State Hospital here.

N. J., Newark—City will sell $500,000 bonds Feb. 6 for water supply system in Wanaque River watershed and $300,000 bonds for extending water supply system in Pequannock River watershed. M. R. Sherrard, city engr.

W. Va., Elkins—City plans to install filtration system.

Fla., Ft. Lauderdale—City plans election to vote on $30,000 bonds for improvements and extensions to water system.

Wis., Milwaukee—City plans to drill artesian wells in various parts of city. About $50,000. G. Staal, city engr.

Minn., Manganese—City soon lets contract building water-works system. I. C. Dimmic, clk.

Minn., St. Paul—City plans to build stand pipe in Dale St. to increase water pressure. About $10,000. O. Claussen, city engr

A Consolidation of Engineering News and Engineering Record
McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 NEW YORK, THURSDAY, FEBRUARY 6, 1919 Number 6

Taking the Gamble Out of Garbage Disposal Contracts

BALTIMORE is not only to become the largest American city to have its garbage disposed of by feeding to hogs, but it has also made a step forward in taking the gamble out of garbage-disposal contracts. In the first place, the contract is for disposal only, thus eliminating the manifold collection risks. Then, and of great significance, the price which the contractor pays the city for the garbage is based on the selling price of live hogs in Chicago—and it is into live hogs that the contractor is to turn the garbage. This is a long step in advance.

No Engineer in Evidence

BUSINESS stands excused in large measure for subordinating the engineer, because of the engineer's own indifference to business affairs which affect his interests. Over 400 business men and public officials met last week in Chicago to combat a proposal by the Railroad Administration to increase freight rates on sand, gravel, crushed stone, and slag. This proposed increase in freight charges, as is pointed out on p. 306 and as was discussed editorially in *Engineering News-Record* of Jan. 30, p. 213, means a material curtailment of public work and an enormous additional burden of expense for work which must be carried through. State legislatures sent delegates to protest against the proposed action; public-works officials, commercial and industrial organizations an individual manufacturers came forward with statistics and argument to demonstrate that the action was unwise. There was not a speaker who represented the engineering profession, nor one who represented the contracting business.

Direct Locations for Trunk Highways

FEDERAL and state highway officials are already studying proper locations for through highway routes, and more of them will be doing so if the expected boom in highway building materializes. Heretofore it has been the custom to select a route with the idea of touching all the principal centers of population along the line, often at considerable increase in distance. With the increasing evidence that these routes will become parts of a connected freight-transportation system, it is a question whether one of the controlling economic factors will not be the shortest distance between the most important centers of population, as suggested by our correspondent on p. 299. No doubt, selection on this principle would, in the initial stages, cause a great amount of complaint from those not living on the main route, and from politicians who wished to use the roads as political capital to influence the voters in their districts. But such opposition subsides when the cities off the direct route realize the advantage of having the wear and congestion of through traffic removed from their streets. The State of Delaware has adopted this principle of location with excellent results, and with satisfaction to the public. We are on the eve of a tremendous development of the highways for freight transportation. Broad vision divorced from property and political interests will be necessary if these highways are to be located to the best advantage.

A Treaty to Develop the Port of New York

A TREATY between the States of New York and New Jersey is to be introduced in the legislatures of both states and, if adopted, will establish a "port authority" which will have jurisdiction over the entire port district at New York City included within the two states. The treaty has been framed by the New York-New Jersey Port and Harbor Development Commission, an interstate body created by the legislatures of the two states two years ago with authority to study the needs of the entire port and prepare plans for its further development. The commission has found what has been evident to many engineers and others who have studied the needs for transportation, sanitation and other necessities of this great center of population at the mouth of the Hudson, that the first essential for successfully treating these problems is that the needs of the district shall be considered as a whole without regard to the state boundary which bisects it. Few outside the engineering profession realize how frequently the development of great public works is hampered by the conflicting jurisdiction on different sides of state boundaries. But the Palisades Interstate Park Commission of New York and New Jersey has acquired and developed lands representing a value of some $9,000,000. If these two states can now establish a single authority for the entire port of New York, they will provide a further precedent of great value in encouraging similar joint state action by other commonwealths.

British National Aid To Highway Building

NATIONAL aid in road-building to the extent of £10,000,000 has been granted for 1919-20 through the Road Board to local authorities in England. This means the resumption of the help which was given annually for some years prior to the war. The action was

taken on account of "the desirability of stimulating employment on useful work at the present time," which is one of the leading arguments for an immediate increase in Federal-aid road work in the United States. Highway officials here who have watched their roads go to pieces under war-time trucking will find some comfort in the fact that the British national aid is to be used, so far as possible, on the important roads and bridges where heavy trucking is probable or has taken place during the war. This aid will not be granted to a local authority unless it agrees to carry on as extensive a road program as was finished in the year immediately preceding the war. The significant thing about this action, to American engineers, is the official recognition given in the first post-war road announcement to the fact that roads must be built for the traffic, and traffic should not be regulated to fit antiquated roads. Of course, it is ridiculous to allow one or two heavy vehicles to ruin a road fit for all other travel which uses it; but where motor trucks are useful it is sound economy to build roads for them and not force the people to pay needlessly high transportation charges, by severely restrictive traffic regulations. The war has brought motor trucking to the front, and with it the same sort of new problems which arose when motor cars came into use. The British authorities, conservative as they were in changing their road methods to fit the automobile, have shown no sign of conservatism in the new situation that faces them. But what are we doing?

Judgment and Calculation in Fixing Working Stresses

WORKING stresses for use in the design of engineering structures require to be fixed by means of technical judgment of remarkably high type. Many factors are involved, relating to present and future service as well as to quality of material; and few of them are amenable to calculation. It is therefore not possible to apply precise methods to the determination of these stress values; judgment must be the chief reliance in evaluating the factors of influence. Yet attempts are frequently made to fix working stresses by a process of calculation. Several such attempts are engaging attention just now, and it is of value to consider them, as an understanding of their nature will tend to prevent misconceptions of the meaning of their results.

Three different methods of calculation have come to light as having been used in arriving at allowable working loads on steel columns. Their results, curiously enough, are identical, though the starting points and the methods of procedure employed differed considerably.

According to the report of the American Society of Civil Engineers' Committee on Steel Columns and Struts, now discharged, the committee fixed the loading which it recommended as the limit of safety by comparison with tensile-stress practice. It considered that both in tension and in compression 50% of the elastic-failure load might be used as working load with safety, this view agreeing with ordinary practice as to tension members. The committee then reported that its tests showed the elastic limit (or "useful limit") of columns to be 24,000 lb. This value of 24,000 was reached by a unique process; it is the average value determined from a large number of tests, in turn averaged with the lowest single value of all those obtained. Evidently the committee believed that the figure of 24,000 lb. per square inch thus found represents a strength that may with reasonable certainty be counted on under all conditions. The manifold influences that separately affect column resistance were not considered in detail, but these effects were pooled in the committee's judgment as described, and the line of safety was, so to say, put at the edge of the middle third.

A different explanation of the 12,000-lb. column-load limitation has been given by an engineer of note who formerly belonged to the committee. His view is that 40,000 lb. may be accepted as the ultimate limit of tensile value, characterized by elastic failure of the steel; and that 30,000 lb. is to be taken as the limit of column strength, a value maintained with fair reliability throughout a large range of conditions. The same proportion of both, then, should be taken as safe working load. Since the commonly used tensile stress of 16,000 lb. is 40% of the tensile value, the limit of column load is to be fixed at 40% of 30,000, or 12,000 lb. per sq.in.

Rather higher factors of safety were adopted by a committee of Canadian engineers in devising a new column formula, embodied in recently published bridge specifications of the Engineering Institute of Canada. This committee determined one-third the average strengths of various groups of test columns, using the same tests studied by the American committee. This value of one-third was taken to be coördinate with a stress of one-third the ultimate strength for riveted tension members. Again the basal figure for column loading was found to be 12,000.

It is hardly possible to contemplate these different procedures, all yielding the same result, and feel any great confidence in the merit of the calculations. In fact, the conclusion cannot be escaped that the three calculations are nothing other than methods of judgment, whose thin veneer of figures has little meaning. Whatever virtue resides in the recommended working stresses, then, is due to the excellence of judgment of the men who offer them, and not to the excellence of the analysis presented.

The use of calculation in fixing stress limits, where the real decision is made by judgment, is harmless when the true state of affairs is appreciated. It may easily have a misleading effect, on the other hand, when the calculation is regarded as producing exact results.

There is a tendency, moreover, to regard working stresses, and, for that matter, specifications, as laying down boundary lines between safety and danger. This is apt to prove a particularly harmful view when working stresses backed apparently by mathematical deduction are expressly stated to be limits of safe loading. The fact is, of course, that no stress limits afford complete protection againt unsafe design; yet this truth is often forgotten when the question of working stresses is approached from the standpoint of safety. The controlling consideration with regard to all broad rules of design practice is the proper utilization of the material,

a matter demanding quite as much care to avoid waste of material as to avoid overstress. This is preëminently a field for the exercise of judgment, and the appearance of calculation applied to the subject tends to interfere with successful use of judgment rather than to promote it.

Are You Doing Your Share To Start Construction?

CALAMITY howlers are never popular. The world loves a cheerful optimist. But there are times when a considered pessimism is necessary, because it demands a looking forward and a seeking for remedies which never enter into the program of those who hold that everything is well in this best of all possible worlds. Today construction work is in so low a state as to demand an active pessimism that can be translated into the kind of results which optimism only passively hopes for.

Six months or a year ahead of us lies a period of unprecedented industrial activity. This must be so. A world starved for four years of everything but bare necessities must be fed, clothed and amused by producers made measurably fewer by the ravages of war. Plants and utilities and structures left for years to take care of themselves must be restored to an economical working basis. Normal increase in producing capacity must be regained. Construction, next to agriculture the basic industry, will absorb growing numbers of men and quantities of material and vitalize all industrial life.

Meanwhile, there is today a dearth of construction work. In spite of certain widely circulated reports of unprecedented activity in all kinds of building—reports based on a kind of whistling courage—every contractor and engineer knows that never before in the memory of the present generation has a February come with so little actual business in prospect or on the books. In consequence this reservoir to provide against unemployment and to restore confidence—for agriculture will not begin to absorb labor for some months—is empty and shows no signs of immediate filling. And soldiers and munition workers are coming back toward industry by the millions.

Why is construction holding off? Because it costs so much? No; because it is hoped that six months from now it will be cheaper. Because no man wants to spend $2 today for that which he expects to be able to buy for $1 tomorrow. Millions of dollars of work would start immediately if there were assurance that the cost of such work would be the same next year or even next summer. We are in a condition where individual timidity is outweighing mass confidence. Every prospective builder, be he the president or director of a railway, the mayor of a city or the owner of an industrial plant, is drawing into his own shell of self-protection and betting on his own personal preservation in the general cataclysm of panic which is bound to follow continued inactivity. Everyone is counting on not being the hindmost in the devil's drive which he hopes against his better judgment will not come.

One of the most misunderstood laws in the world is that of supply and demand. How often is it quoted as inevitable! How often is it forgotten that the essence of inevitability is time! Demand controls supply—but not immediately, and in the intervening days, or months, or years can happen all sorts of things that confuse the law and serve to destroy or impair its natural results. Everyone is sitting back and waiting for the obvious demand of the world's needs to adjust the elements of his part of its supply to his liking or to his expectancy.

What is going to be done about it? The necessity in the case of public works is obvious. In spite of costs or prices, it is the solemn duty of every public agency to start immediately all of the necessary construction activities which have been delayed for the past year or two. What if the cost is greater; charge it up to insurance. Unless economics and common sense and statistics are all equally wrong, we are fast approaching a period of unemployment with accompanying social distress far more expensive to the body politic than any possible increase in cost of construction due to present conditions. Let those bright optimists of the do-nothing type take what comfort they can from their self-satisfaction. The world is in ferment. He who runs may read.

The obligation is just as great on all of the private interests that go to make up a piece of finished construction. Personal selfishness must be forgotten now just as it was in the nineteen months of war. Every element—the owner, the contractor, the material man and the laborer—must be prepared to give up something. As it stands today, no one will concede anything. The material man wants his full price, labor wants its wartime wage, capital must be assured of its full investment profit.

Cannot a scientific method of preparing for the emergency be devised? Cannot an agreement be reached between the various parties to a construction operation whereby future adjustments in prices will be cared for? The fear of a lowering of prices after the work is started and paid for is holding up more construction than fear of the high prices themselves. Why cannot every new construction contract be written on a delivery basis? It would be merely a modification of the Construction Division's form of contract, by virtue of which the owner would pick a responsible contractor at a graduated but limited fee and then pay for his labor and material at the price they commanded when used. The contractor wants work to keep his organization intact; he should be willing to make some sacrifice in his normal profit. The material man must dispose of his stock if he expects to keep in business; cannot he contribute something in the way of reduced prices? Labor must live; may its contribution not be an efficient performance which all employers say will alone make possible the high wages demanded to meet increased living costs? The owner gets an approximation of full future value in the adjusted costs, and the difference is what he pays toward the common good.

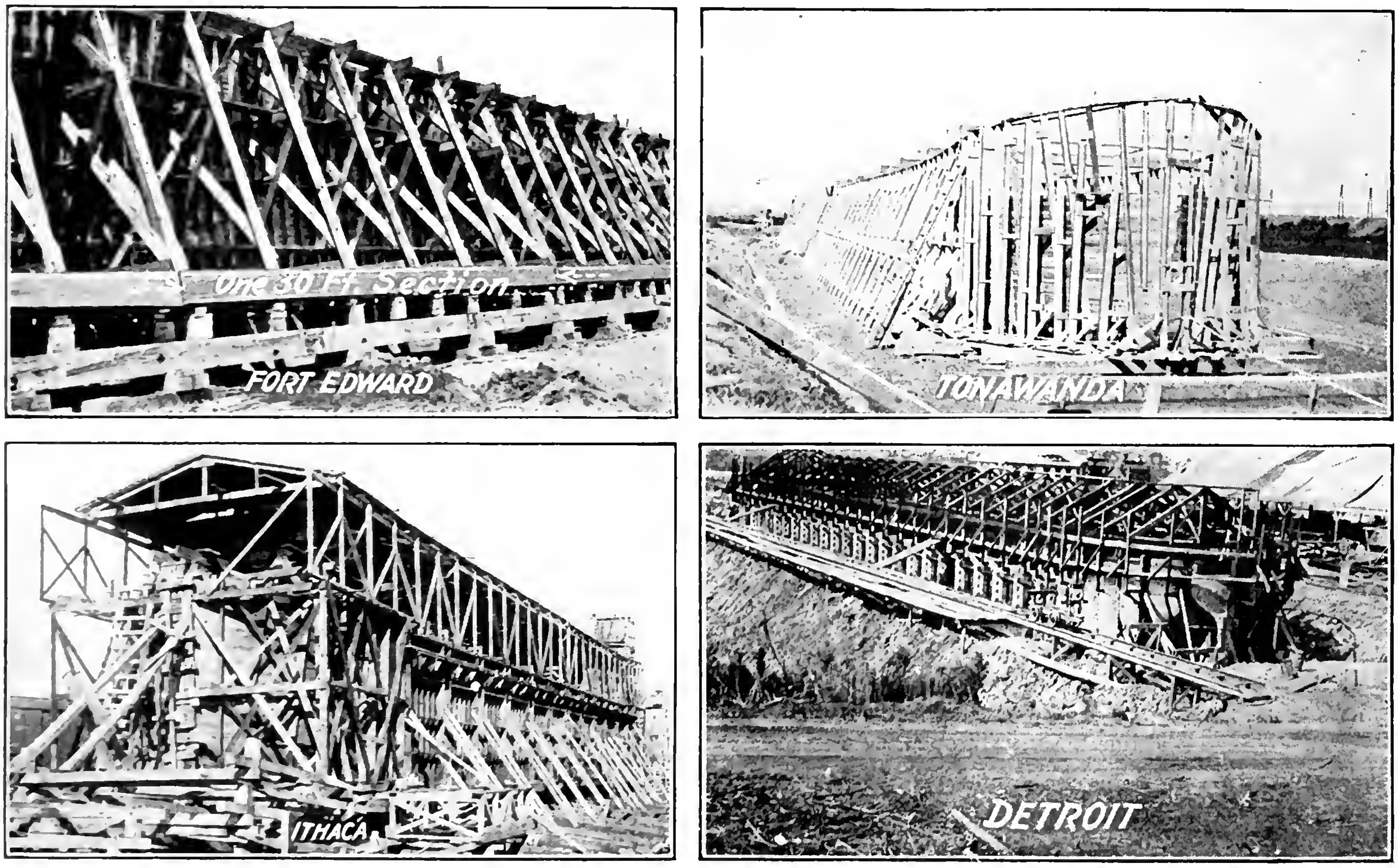
This is a time for coöperation based on a lively sense of impending common danger. Optimism for the future is justified to the extent that prompt present action is taken. Ahead of us lies a wonderful and growing prosperity. Must we pass through a slough of depression for lack of united action and individual sacrifice? Did patriotism go out of business on Nov. 11?

How the New York Canal Concrete Barge Is Being Built

In Four Yards Independently at Work on Same Type of Boat Differences May Be noted in Yard Layout, Launching Schemes, Form Construction and Steel Placing

EXCEPTIONAL opportunity to study methods of concrete-boat construction is afforded by the simultaneous building in four different yards of the 500-ton barge designed by the Emergency Fleet Corporation for the Railroad Administration, and to be used on the New York State Barge Canal. While the general operation in building these barges is supervised by the engineers of the Concrete Ship Section of the Fleet Corporation a free hand in plant layout and construction details is allowed the contractor. It happens that site conditions and individual initiative are so various in the four locations that many contrasting solutions of problems that are essentially the same are available.

The design of the New York State canal barge was described in *Engineering News-Record* of Aug. 8, 1918, p. 271. The boat is 150 ft. long, of 21-ft. beam, and 12 ft. deep. It is of the simplest open-box type, with frames 5 ft. on centers, a 3-in. shell, cantilevered side decks and an open hatchway crossed with deck beams every 15 ft. The bottom is flat except for a 2-ft. quadrant curve at the bilge. Contracts were let for 21 of these barges last summer, it being provided in the advertisement for bids that the barges be built at such locations that they could be towed to the New York canal system. Accordingly, the contracts were let to the Holler-Davis-Flood Co., for eight to be built at Fort Edward, N. Y., which is on the Hudson River some 60 miles north of Albany; to the Caldwell-Marshall Co., for four to be built alongside of the Ellicott Creek canal at Tonawanda, N. Y.; to the Cummings Structural Concrete Co., for four to be built on the inlet which makes in from the south end of Cayuga Lake at Ithaca, N. Y., and to Thomas E. Currie (the Grayhaven Shipbuilding Co.), for five to be built on the Detroit River, Detroit, Mich. Several boats have been completed at each of these yards, and all will be delivered to the Railroad Administration in time for the opening of navigation on the canal next spring.

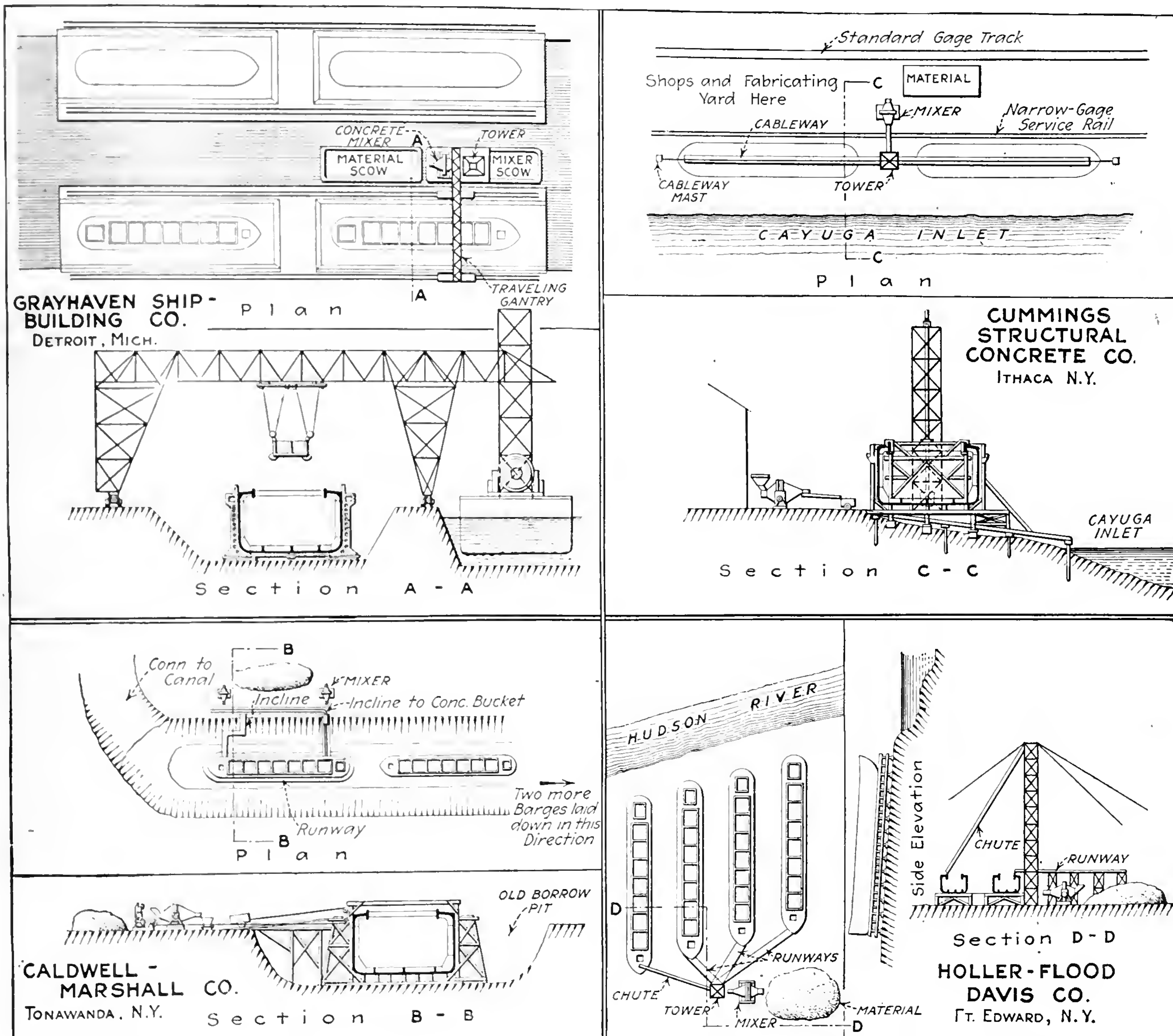


NEW YORK STATE CANAL CONCRETE BARGES UNDER CONSTRUCTION AT FOUR DIFFERENT YARDS

A primary difference is seen in the adoption by each of the four yards of a different system of launching, which reflects in the layout of the yard. A sketch of each of the four layouts is shown. At Detroit there is the remarkable dry-dock arrangement described in *Engineering News-Record* of Jan. 2, 1919, p. 21. In brief, this consists of four concrete-floored docks, two on each side of a lagoon leading into the Detroit River. The boats are built directly on these concrete floors in the dry; when they are completed the gates of the dock are opened, water is allowed to flow into the dock, and the boats are lifted from the base by hydraulic pumps and floated out into the lagoon. At Tonawanda advantage has been taken of a long borrow pit left in adjacent railroad construction. This pit is immediately alongside of the Ellicott Creek canal and separated therefrom by a narrow dike of earth. Each of the four barges contracted for here is provided with its own supports,

ranged in line along the borrow pit, as shown in the sketch, and launching is taken care of by a lock with about 4-ft. drop which lowers the barges into Ellicott Creek, a branch of the New York State Barge Canal, after they have been floated in the borrow pit. Provision is made for intermediate cross dikes so that the first barge completed, the one nearest the creek, can be floated out before the others are finished.

shop in the nearby city. The Detroit yard, on the other hand, is laid out for future shipwork of various sorts, and has full shop and mill equipment. At Fort Edward the contractor is also building wood barges, and has a large yard with self-sufficient shops and mills. The Ithaca yard, too, though designed for the present work, is well provided with shops and equipment. It is so located that one of the Barge Canal terminals can be



LAYOUT OF FOUR YARDS WHERE NEW YORK STATE CANAL 500-TON CONCRETE BARGE IS BEING BUILT

At Ithaca two side-launching ways are provided, dropping the barges into the inlet. Two barges will be built on each of the two ways. At Fort Edward there are four end-launching ways leading diagonally into the Hudson River. On each of the ways there will be built two of the barges contracted for. We have, therefore, two different types of float launching, an end-launching system, and a side-launching layout.

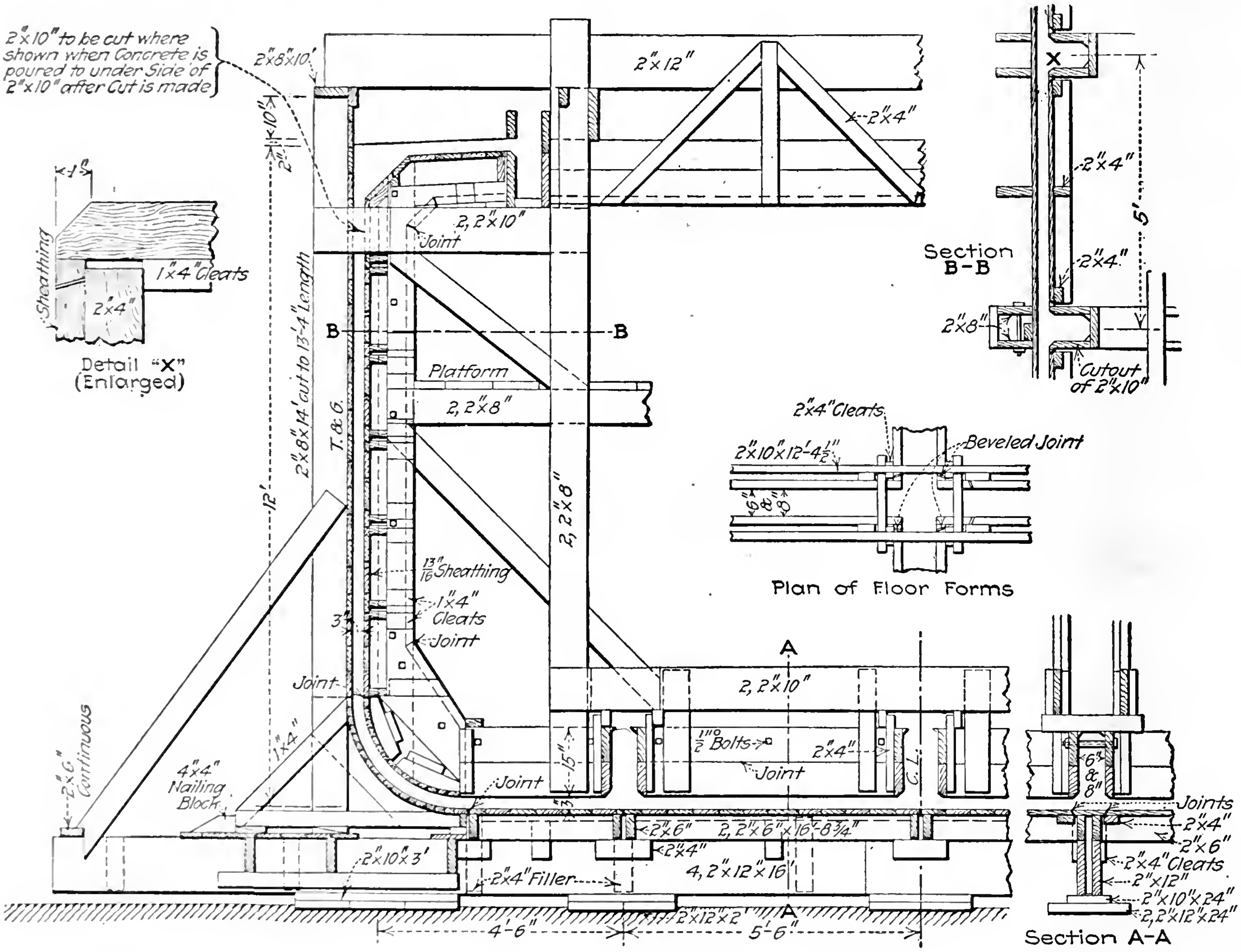
Yard equipment varies in the four yards. The Tonawanda plant is frankly temporary, laid out only for the four barges under contract. Its equipment is mobile and scanty. Carpenter work, both for forms and fitting out, is done, in so far as possible, by contract at a

utilized as a fitting-out dock, and the carpenter shop is placed alongside this dock.

The Government required that the barges be poured in one operation. This did not put any great burden on the concreting plant, because only about 120 yd. of concrete is involved, but it did make it necessary to set up a complete set of forms before any concreting was started. The yards, then, had the common problem of providing a complete form structure, comprising (1) supports or launching ways; (2) outside forms for the floor and for the shell—which latter included the warped surface forms for the bow and stern, and (3) inside forms for the frames and shell. These forms had to

be so arranged as to interfere as little as possible with the process of concreting, to be readily removable and re-usable, and to be of such design as to permit their removal clear of the barge when launched. In all cases, the barges were poured complete, the forms stripped for re-use in from one to two weeks, and the barge was launched in from two to four weeks after pouring commenced.

Supports or Launching Ways and Outside Forms—In all except the Detroit yard, where there is a concrete floor on which the barge is laid directly, the supports are timber frames on mudsills varying in design to suit the conditions of launching. In each case, the supporting frame extends far enough outside the barge itself to take the outside form posts and braces, when moved out away from the poured shell. On the supports rest the outside floor forms, so designed as to permit their ready removal.

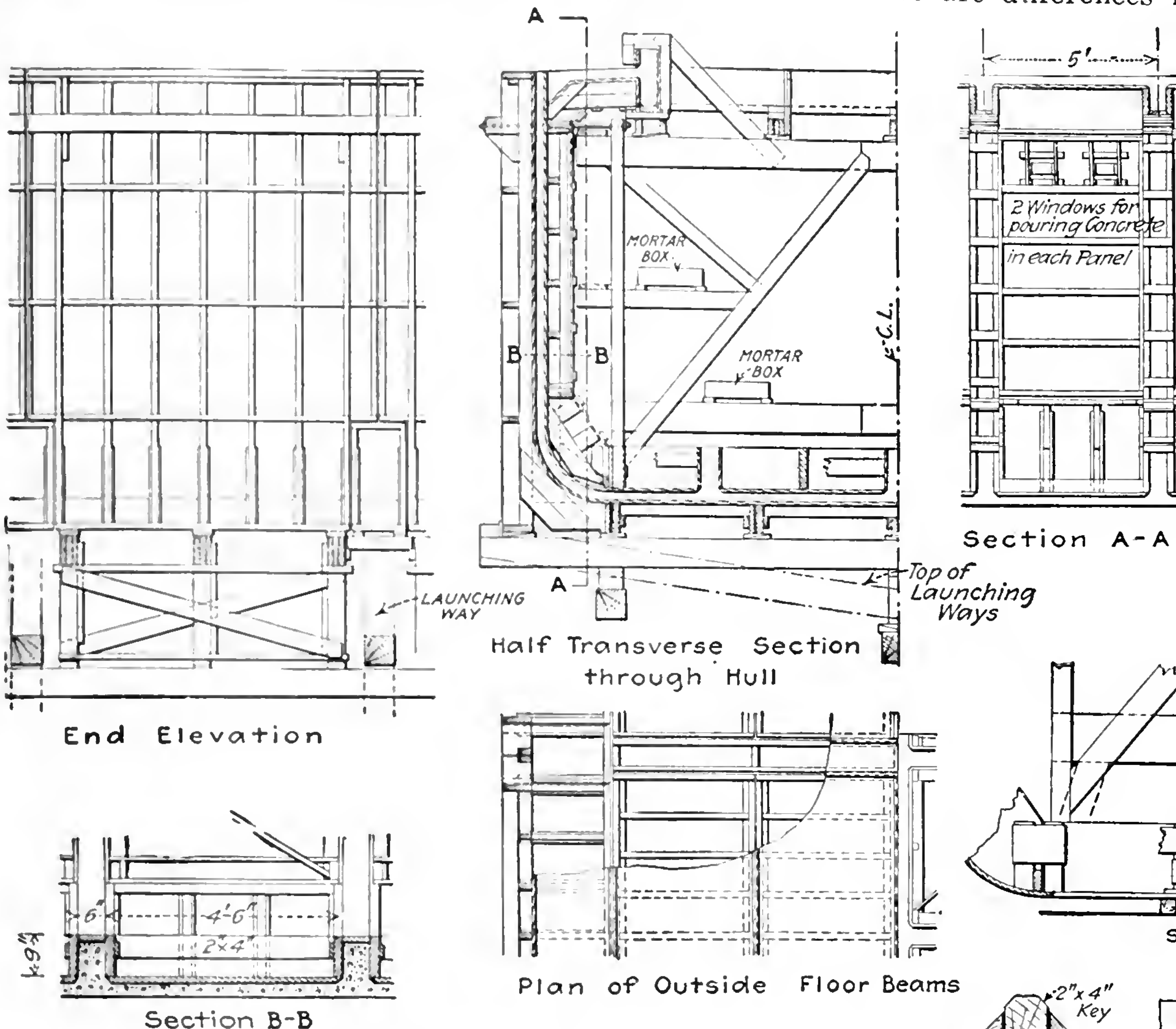


AT TONAWANDA, CALDWELL-MARSHALL CO. IS BUILDING CONCRETE BARGES ON STATIONARY SUPPORTS IN OLD BORROW PIT

In the Tonawanda yard, as shown in one of the drawings, longitudinal wooden sill footings reinforced with cross-beams on the ground carry transverse 2 x 12-in. planks under each of the frames extending to the floor. The bottom floor forms are in panels between the keelsons and the floor frames, and are held in place by cleats nailed to the transverse 2 x 12's. After the barge is complete these cleats are knocked out, and the bottom floor panels are dropped down and pulled out from under the boat, leaving 2 x 12's with the small piece under the frame. These latter are taken out piece by piece, and the boat is strutted up to the ground. The outside forms in the Tonawanda yard are in one piece, extending the whole straight length of the barge—that is, about 120 ft.; the tongue-and-groove lagging is carried on frames 5 ft. apart, as shown, which rest on wedges propped up from the ground. In stripping the forms these wedges are knocked out, thus dropping the whole outside form on its outward face and pulling it away from the concrete about 7 in. at the top. It can then be lifted out before launching by flotation takes place.

At Fort Edward an end-launching system is used, and longitudinal ways carry the whole boat during construction. The floor is supported, as shown in the drawing, on transverse 2 x 10's which are cantilevered out from the outside jack frames to meet at longitudinal stringers under the center keelson. There is one of these jack frames every 5 ft., and they are tied together in panels of 30 ft. The cantilevered floor-beams are bolted together when they meet at the center, to hold the whole floor in place during construction. The side frames which carry the lagging for the outside forms of the shell are propped up on wedges from above a transverse roller skid. When the boat is to be stripped the wedges are dropped from under the frames and floor, and

the whole frame in 30-ft. panels, with its cantilevered floor, is slid outward a sufficient distance to clear the outside launching way. The cradles are placed in this 30-ft. length, and the barge is supported on them. The process is continued along the whole length of the boat before it is ready for launching. The barge is built normal to the ways.

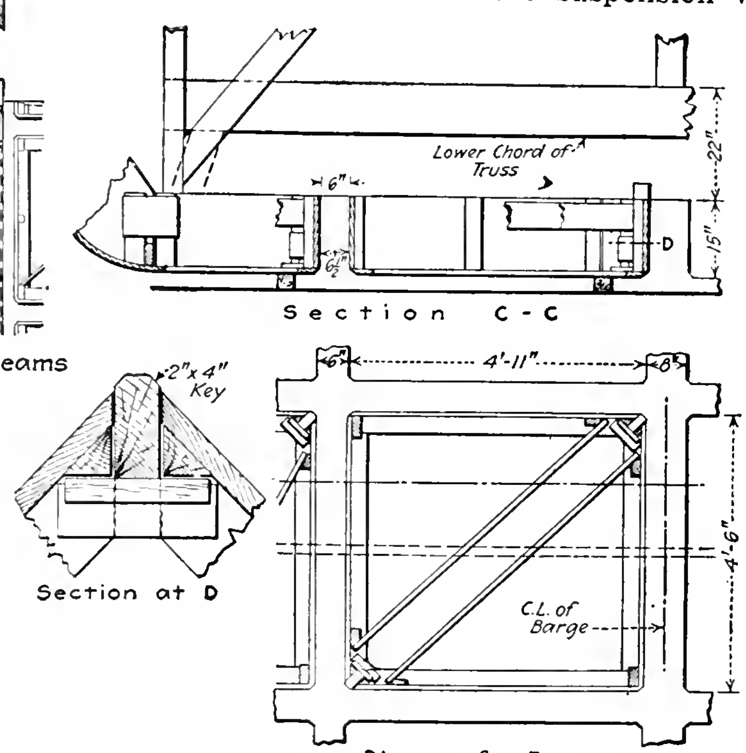


SIDE-LAUNCHING WAYS AT ITHACA

In the Ithaca yard the level floor of the main supports is strutted up from the sloping side-launching ways, and carries the bottom floor forms in panels of simple design. A separate drawing shows these forms in detail The panels are boxes with longitudinal stringers resting on wedges on the supports and carrying closely spaced transverse stringers on cleats. To dismantle, the wedges are drawn and the box is dropped. Outside shell forms are of different types for the shore and the water side. Because they have to be moved entirely out of the way before the barge is launched, the waterside outside forms were made in easily handled 10-ft. sections, with special panels at the bilge curve to permit the introduction of the launching cradles. In the first barge a similar design was used for the shore outside forms, because it was expected that the launching ways would extend shoreward of the forms, and provision was made to permit their placing. It was later decided that the ways need not extend so far, and the second set of shoreward forms was made in one piece for the whole straight length of the barge and was moved out bodily. The shore forms built for the first barge were used for waterside forms on the other way, and two sets of complete-length outside forms were made so that there were two full sets of forms available for the four barges.

In Detroit, as described in the previous article, the whole outside straight shell form is one piece backed against concrete frames, and is dropped by wedges and moved out bodily.

Inside Forms—There is a similarity in the design of the inside form framing in all of the yards, although there are differences in the method of taking care of the inside shell panels. In all the designs the inside forms are one structure, built up in its entirety before any concrete pouring is started. They consist of transverse timbers or trussed frames, every 5 ft. resting in the outside frames or studs and carrying by a dependent framework the floor-frame, side-frame and cantilever deck forms. Some of the designs intended that these forms should be at all times suspended from the upper truss work, but in construction the suspension was used merely as a stiffener, and the load of the forms was transferred by means of interposed concrete blocks, small pieces of stone, etc., to the floor steelwork, which in its turn was held a proper distance away from the bottom floor forms by similar pieces. The short cantilever deck was held everywhere by cross-frames extending out from the suspension structure and fastened also to the vertical frame forms, but at Fort Edward deck forms as well as the steel reinforcement were held in place by wires from the beams across the boat.



INSIDE FLOOR FORMS AT CUMMINGS YARD

According to specifications, each yard had some overhead framework on which tarpaulins or planks, for cover in inclement weather, could be placed. At Ithaca the whole framework is enclosed and steam pipes within keep the temperature fit for concreting even when the outside temperature is very low.

The inside floor panels vary somewhat in detail, though in each design there is used a form box between the keelsons and the frame. At Detroit this box is built up with wood screws and in the stripping

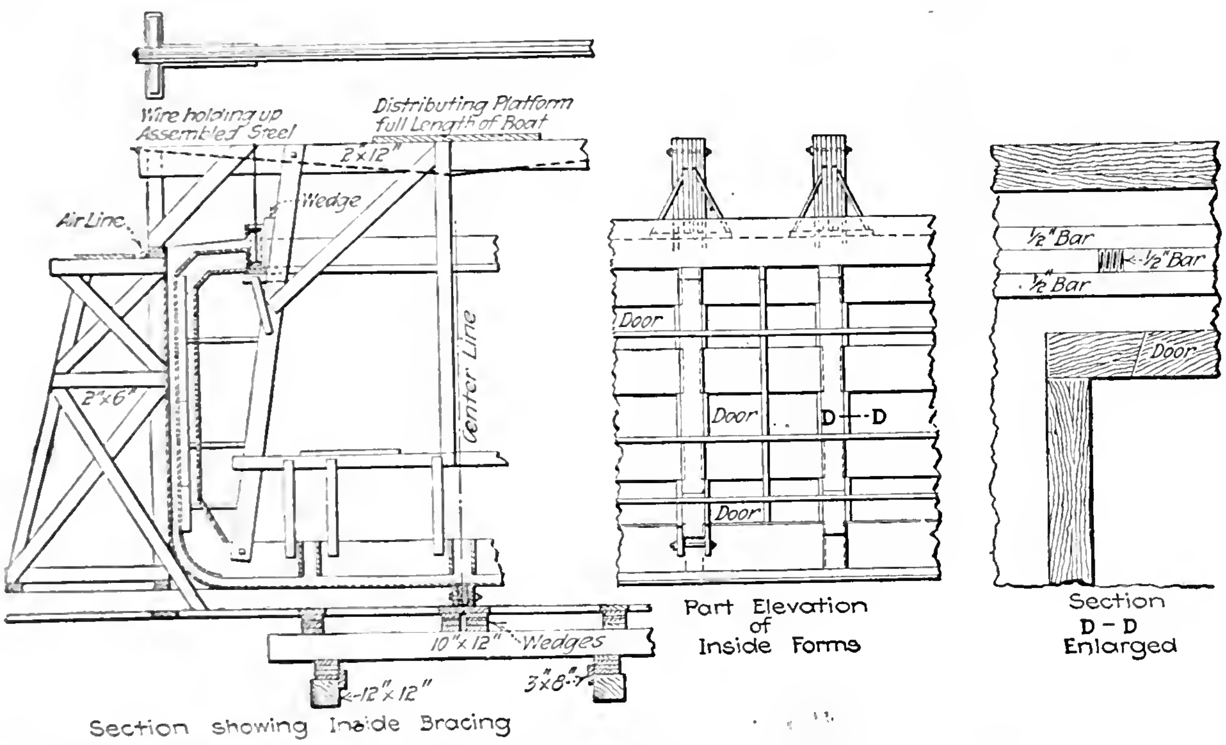
it is taken apart by unscrewing the fastening. At Tonawanda the four corners of the boxes are cut on a beveled joint, and the box is held to the true square by overhead 2 x 4's used as spacers. In stripping, the 2 x 4's are knocked out and the boxes knocked apart on their beveled joints. At Ithaca the boxes have a special corner key, shown in one of the drawings. This is knocked out, and the form falls apart. The Fort Edward yard uses a hooked system of box forms in all of the demountable panels. In the floors, for instance, the four sides are connected with ordinary door hooks at the corners and are demounted by the knocking out of the hooks.

Inside Shell Forms—Shell frame forms in all cases are of heavy planks held in place by braces from the inside form framing and serving as guides for the shell forms. In Detroit part of the side planks were left permanently in place as the nailing strips for the barge lining. In these yards the face form of these frames was continuous, but at Fort Edward there were windows left in the form for the concrete, on account of the method of pouring.

The inside shell forms have to be designed so as to permit openings up the side of the shell as the concrete is poured. It is manifestly impracticable to pour the 3-in. shell from the top, with assurance at the same time that the forms will be filled clear around the bottom of the bilge curve. In all cases, the bilge curve outer form is a part of the outside forms—a solid section tacked to curved studs attached to the jack frames—and the inner form is made up of lagging attached to a segmental form hung from the inner frame. This lagging is of narrow slats laid longitudinally.

In two of the yards, at Detroit and Tonawanda, the inside shell forms are in panels 2 ft. deep extending between the frame forms, and sliding against the bearing of these forms, as shown in the drawings. There is one less panel in the section between frames than is required to fill the full height, and in the beginning of the pouring the opening 2 ft. wide is left just above the top of the bilge curve. When the concrete reaches the top of the bilge curve the panel next above is dropped down flush with the top of the bilge curve, leaving the 2-ft. opening then in the next panel above. The process is continued until the entire shell is poured. The two drop-panel systems differ somewhat in detail, as shown in the drawings.

In the Ithaca yard the inside shell form is built in an integral panel extending the whole depth of the boat and the distance between frames. Small windows are then cut in the form at regular intervals, with an inside bevel on the joint. The wood window is then removed while the concrete is being poured, and as soon as the pouring reaches the bottom of the opening the gate is put back and buttoned tight against the standing part of the form. The sides of these forms are beveled, to permit their removal, but it proved to be difficult to take them out, even with this provision. At Fort Edward panels 2 ft. in depth and frame spacing in width are provided for the whole depth of the shell. These are buttoned on against one another, to resist the movement toward the outside of the boat, and held with door hooks to the studs, to resist an opposite movement. Panels are taken out one at a time as the concrete pouring rises in the shell.



AT FORT EDWARD, N. Y., HOLLER-DAVIS-FLOOD CO. BUILDS CONCRETE BARGES ON END-LAUNCHING WAYS

Outside and inside shell forms are all tongue-and-groove material, but matched lumber is used for the inside for the warped surfaces.

Four different systems of outside end forms are used. Both bow and stern of the canal barge are curved, the stern having a warped curve for its full height, and the bow being warped only up to the top of the bilge line, above which the only curve is the one in the horizontal plane. Complications of these curves, however, forbid the continuation of the regular system of forms. In Detroit, mortar molds are used for both ends of the boat. These molds, as described in the previous article, are divided into three parts, and are slid out on the jack frames to be used over again in other boats. At Fort Edward an attempt was made to cover the curve studding with surfaced lagging and a tin form. This did not prove entirely satisfactory, because the tin was wrinkled by hickeys while placing steel and left a wrinkled surface on the concrete simulating too vividly the mold from which it was formed. At Ithaca narrow lagging was bent around the templet-formed studs, the slats being made of quarter-sawed cypress. Similar bending of slats was used at Tonawanda, but oiled elm was used for the lagging. In both these cases the fitting of the studs to the proper curve and the bending of the lagging made a nice piece of carpentry. Inside end forms in all cases were small boxes cut to the varying curves of the ship and fitted in between the frames.

Placing Steel—In all the boats, the floor steel was laid first and the side shell steel tacked into place on

the outside form, wired together, and then braced out from the outside form with small concrete spacers. At Ithaca, however, in the later boats, special clipped spacers with protruding hooks at proper locations for the longitudinal steel were attached against the side of the boat, and the longitudinal steel was dropped into these clips. The clips were allowed to remain in place. The strips against which they were nailed were removed when the forms were taken down, and the opening was plastered up. In some of the boats, longitudinal rods were welded by spot welding. In others, they were overlapped and wired. In three of the boats, the steel frames were prefabricated, and lifted or carried into place in the boat. At Fort Edward the stirrups on the frames were electrically welded, but in the other yards they were wired. In the Tonawanda yard all the frame steel was erected and fabricated in place in the boat.

A—Oiled Elm Bent Around Frames at Tonawanda

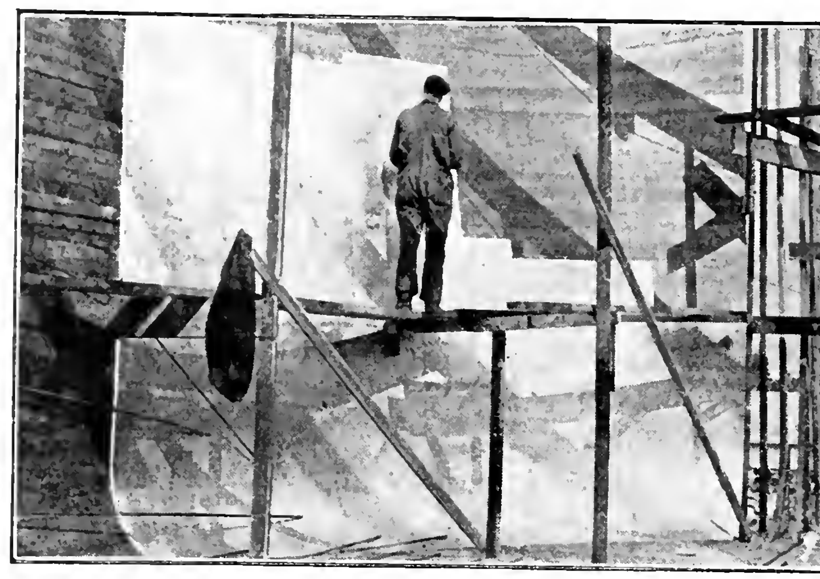
END FORMS DIFFERENT IN THREE YARDS

Concreting Plant—The problem in concreting one of these barges was not in producing the concrete, nor even in getting it to the boat. Both of these processes will, in general, be held up by the difficulty in placing concrete in the narrow forms, congested as they are with steel and difficult of approach through the forest of supporting framework. As described in the previous article, the Detroit yard has a special gantry crane, traveling over the boat, which drops the concrete, where required, from a bucket. All the other yards use a buggy wheeling system to get the concrete to the place of deposition, although in the first boat poured at Fort Edward a chuting system, shown in one of the sketches, was used. This did not prove satisfactory, and for further boats there were built from the concrete mixer trestles over which the buggies were wheeled to the boats themselves. At Ithaca the concrete mixer is located immediately alongside of the material pile between and just off line of the two ways. The material enters the yard by rail, is dumped alongside the mixer, feeds through the mixer into a car, which is pushed under the tower and elevated to runways extending out along the center line of the barge from the upper deck level to the tower.

At Tonawanda an extremely simple plant is used. Two concrete mixers under a canvas cover are moved along the bank of the borrow pit as required, the materials being dumped alongside of them as they move from boat to boat. The timber runway runs alongside the dump end of each mixer to an incline up to the platform along one side of the barges. The concrete is dumped into an ordinary concrete barrow and pulled up the incline with a line leading through a spool on the barge back to the mixer.

In every yard but Ithaca, where a center runway was used, there was a runway at deck level around the outside of the boat. All the boats had runways on the top of the floor frames, but in Detroit these were used only for the men themselves to work on, the concrete being chuted to the bottom from a runway half way up the frame, on which runway were mortar boxes receiving concrete direct from the gantry bucket. In the other boats, however, the buggies or boxes—and at Tonawanda mortar boxes on small industrial dollies—were kept on the bottom runway and were filled from chutes from the upper runway. The men then shoveled from the boxes into the floor and lower side forms. In all cases, as the shell concrete rose, the midway runway was used. These midway runways were all supported from the inside frames, except in the case of Fort Edward, where the midway platform was hung by bent reinforcing rods, improvised for the occasion, to the trusses across the boat. In all cases, one form or another of portable hopper, made up either of straight pieces of wood or of bent galvanized iron, was used to facilitate the pouring of the concrete into the side forms.

C—Quarter-Sawed Cypress Matched on Frames at Ithaca



B—Tin Tacked on Lagging at Fort Edward

In general, the order of pouring was as follows: Bilge curve, floor frames, keelsons, floors, side shell and deck. The principle followed was to lead the concrete into the open, getting the benefit of the course of air flowing ahead of the concrete. Pouring began at the top of the bilge curve, and when the concrete began to tail out on the floor, it was reasonably certain that the curve was filled. Likewise, when the floor frames were poured, concrete tailed out onto the floor.

Following the general practice on the Emergency Fleet concrete ships, mechanical hammers were used to vibrate the sides of the forms and agitate the concrete so that it would run around the curves of the bilge and into the frames. At Detroit and Tonawanda electric hammers were used. In these cases, the whole inside framework of the boat was wired with plug outlets into which either hammer connections or electric-light connections could be placed. At Ithaca and Fort Edward compressed air was available, and air hammers were used. No difference in the effect of the two types has been noticeable.

At Fort Edward the keelsons and floor frames were

BENDING STEEL WITH BULLDOZER AT FORT EDWARD

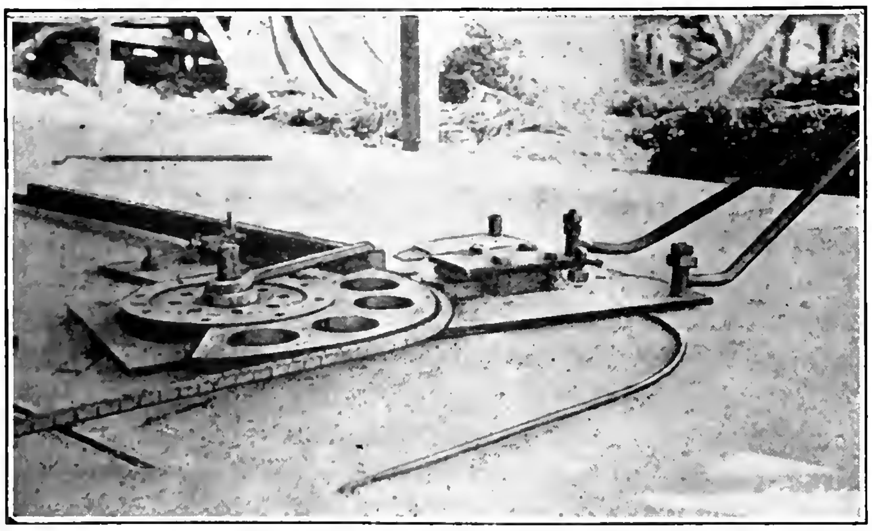
first poured, then the bilge curve, and then the side frames through the windows noted above. The contractor here felt that he could not be sure that the vertical side frames would be completely filled by pouring in the shell forms, as at the other yards.

Hand work predominates in handling the materials in all of the yards. At Detroit the transverse moving gantry is available, and floating derricks alongside can be used for heavy material, and are used in the placing of the transverse steel frames. At Ithaca two hand-operated cableways have been installed. These cableways operate between the central tower where the concrete mixer is, and two gin poles are set up at either end of the adjacent boats. The cable is continuous around the large spool at the base of the tower, up to the top of the tower, across over the boat, down to the bottom of the pole and under the boat and back to the spool. It is controlled by hand movement on the spool, and it carries an ordinary triplex block, also hand-operated. In the other two yards there is only gin-pole control of the heavy material. All of the boats are left open at the end as long as possible, so as to permit the ready horizontal transference of material into the boat during construction.

In all the yards aggregate of the same size—under ¼ in.—is used in a mixture which becomes 1:2 mortar. At Detroit a Detroit River gravel is brought in by a barge. At Ithaca a Ludlowville gravel is brought down via the lake. Niagara grit is used at Tonawanda, and at Fort Edward iron-ore tailings brought from the mines at Port Henry. The latter are somewhat dark in color, but make a concrete which tests very high in strength.

Bending and placing is the most laborious operation in the barge-construction steel. Small pieces are bent by hickeys either on the field or on the boat, but for the 1-in. steel bending different devices have been developed. At Detroit the bender with its main reaction against a cast-iron segment of the proper curve has been set down into a concrete floor. At Fort Edward bulldozers are used which crimp the steel around the curve

RADIAL FRAME AT ITHACA MARKS LIMIT OF BENDING



AT DETROIT, BENDER FOR LARGE BARS IS SET IN CONCRETE FLOOR

step by step. The work is very slow and not particularly satisfactory. At Ithaca a crimp bender is also used, but a chord system of bending has been developed which makes the work quite rapid. On the outlying radius, beyond the bender, there has been set up a light frame on which are marked the steps of bending for every inch on the rod at the crimp. One man stands at the bender, moving it along inch by inch, while the other man pulls the end of the rod around to its proper mark on the circumferential frame. At Tonawanda a heavy cast-iron grating made up of 2-in. pieces with 2-in. openings has been set tight into a bending table. On this grating is marked the proper curve, and the bending is done by hand by dropping dogs into the openings in the grating as the bend proceeds. This simple device works admirably.

What Shall Be Done About The Railroad Question?

Francis Lee Stuart Reviews the National Railroad Situation and Proposes Return to Private Ownership

After reviewing the facts which led up to Federal control of the railroads, Francis Lee Stuart, lately chairman of the Budget Committee of Eastern Railroads, proposed before the New York members of the American Society of Civil Engineers, Feb. 5, the return of the roads to private ownership as soon as enabling legislation can be passed. In reply to the question, "What shall the Government do with the railroads—Government ownership, or Government control for five years, or return to private ownership as soon as possible?"—he made the following statements:

Politics has no conscience, business morals or responsibility, and the danger to our methods of government from the political control of the railroad employees, possible and probable, under Government ownership prohibit its serious consideration.

From an engineer's standpoint, this country is young, and its natural resources have hardly been scratched, and an experiment in Government ownership would be extravagant, unfortunate, and undesirable on any basis, but primarily because it destroys the reward for initiative and sound judgment in the greatest field necessary for the proper development of our country and our national prosperity.

From the public's point of view, Government ownership throttles competition, which is a necessary incentive for proper service to the people in every part of the country and every city in the land.

On Control for Five Years

Some of the things which were ordered with propriety during the war, which should be undone at once and not five years hence, are:

The traffic departments of the various railroads, which were dispersed, should in great part be reassembled and rehabilitated at once.

An immediate abandonment as a national effort of an attempt at standardization of all manner of railroad necessities and methods. Such standardization, while it has a certain apparent first-cost economy when applied to quantity productions in the scheme of things in this country, tends to inefficiency, and should be a local question only in a limited locality. Our tools and methods are so crude that the national efforts should be to improve, not to standardize.

The horizontal raise in railroad wages of the entire country in one order which was necessary during the war is a pernicious destroyer of individual discipline, and debauches and atrophies the ambition of the men receiving such increase, and should be abolished in time of peace for responsible bargaining between employers and their own employees, as soon as possible.

The discomfort of the public, some of which was necessary during the war, should give way to even better facilities than offered before the war, the direct tax of an increase of passenger rates should be reduced to a minimum, even if an indirect tax of increased freight rates is necessary to pay the bills. The movement of the people freely around and about our country should be encouraged as increasing happiness and social-well-being, and tending to a unity of spirit which is good for the body politic.

The terminal problem, which was made so acute by lack of ships and storage facilities, is largely one of changing our commercial methods, pooling facilities, and providing for the prompt unloading of cars. Belt railroads are needed and should be built in many places, but the matter is a local one peculiar to each community, and best handled as a financial policy of such community and not by the Federal Government.

We have great national efforts to make in world affairs, and the sooner we put the vim of an owner's interest back of the largest business interest in the country the better.

Return to Private Ownership

This country is so young and undeveloped that the railroad should exist and be encouraged primarily for the development of our material welfare—and, for the good of all, the railroads should be returned to their owners as soon as possible, so that their growth will naturally follow the normal business needs of the country, tested by business standards, and not directed into any predetermined course which would be determined by a centralized Governmental agency.

Returning the roads to their owners under old conditions would mean financial chaos in the country, and some legislation, with certain Governmental controls, is absolutely necessary.

The normal growth of our country requires that the railroads spend in the next five years at least $4,000,000,000 for improvements, betterments, and normal growth of our transportation service, and a continuing and enlarging amount thereafter to meet our growing needs. While the Government finds it necessary to put out varying issues of Liberty Bonds, it seems best that they buy the securities of the railroad as needed until the public regains confidence enough to take the investment out of their hands. This will require a possible advance of from $1,500,000,000 to $2,500,000,000, for which the railroads could be charged a high enough annual interest charge, over and above the cost of the money to the Government itself, to pay off the debt within 20 or 25 years.

The principle of a fixed financial policy and the control by the Government necessary to carry out such policy under all ordinary business cycles should be made a law by Congress. The control should be of an enabling nature and not more restrictive than is necessary, and might at the present time well consist of:

1. A control of rates initiated by the carrier. The rate question is largely an artificial issue and little understood by the public. The shippers of the country are chiefly interested in rate relationships, and the ultimate consumer in the amount of the rate, as he really pays the bill. We hear of the shippers through their lawyers, but the ultimate consumer is rarely heard, because his indirect tax due to the rate alone is so very small. There are possibilities in a more logical rate structure for settlement of most of the misunderstanding between the public and the shipper, and between the shippers themselves, for which the railroads usually

"hold the bag." In connection with the control of rates, the Government should have an unbiased economic study made for a more logical application of rates than at present.

2. The wage question of the railroad employee, like other inflations of the war, will be settled sensibly by public opinion. It does not seem a proper Governmental function to settle wage scales, and it is for the best continuing interest of labor itself that such questions should be returned as soon as practicable to be settled between employers and employees. It is necessary, however, that the Government take cognizance of such matters in the control of rates.

3. A control of unproductive expenditures required by the public, and particularly as to the grade-crossing elimination question, which threatens to be of serious financial importance in the near future, so that due cognizance may be taken of such expenditures.

4. A control of issue of securities for improvements and consolidations, and of the necessary railroad accounts. Generally, the weak lines should be consolidated with the strong, and the large lines prevented from becoming so large that they eliminate competition from any section of the country.

5. A control in safety matters.

6. A recognition that for the continuing solvency of the properties the voice of the general public, whose welfare is at stake, and the voice of the owners of the properties, should be heard with that of the shippers and representatives of the employees.

Principles for Legislation

In my opinion, the proper principles for legislation for a fixed financial policy should be based on an average railroad efficiently operated, receiving, as a minimum, a fair profit for the transportation it has to sell, and that fair profit must include: (1) An adequate going return on the investment over the cost of proper service to the public; (2) a return for such money as is borrowed for improvements required by the growth of the country, which will include the cost of the money plus an added equity to the corporation in compensation for extending their credit and brains as collateral for such money; (3) the further right to build up such surplus as this class of business, wisely conducted, should have in reserve for emergency.

With the principles of a policy fixed, and controls whereby it may be made effective, the means for carrying out the purpose could be more flexible and could consist of a number of commissions with some coördinating force, all safeguarded in certain cases by right of appeal to proper courts.

The entire matter is of such importance to the whole country that, if this session of Congress cannot settle the question, then an extra session should at once be called for this purpose.

Courses in Industrial Hygiene and Medicine

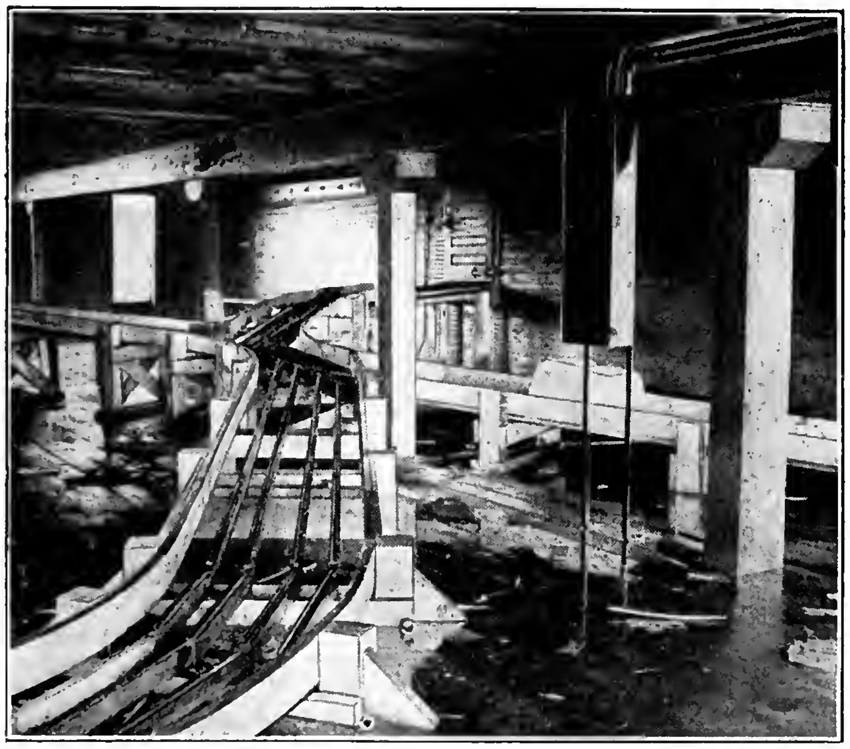
A course in industrial hygiene and medicine was recently given at Yale University under Prof. C.-E. A. Winslow, and a similar course is to be given at Ohio University, according to a statement issued by the Working Conditions Service, Department of Labor.

New Car-Icing Plant Accommodates Twenty-Eight Cars

Modern Ice-Handling Machinery Operated by Electric Motors—Three-Deck Platform Is More Than 1000 Ft. Long, With Conveyor Service

By E. F. Ackerman
Assistant Engineer, Illinois Central Railroad, Chicago

At Waterloo, Iowa, the Illinois Central has replaced its old car-icing plant, erected 32 years ago, by the largest plant now operated by that company. Modern ice-handling machinery inside the building, gravity conveyors, and three-deck platforms over 1000 ft. long, make the new plant far superior to the one it replaces, as 28 cars can be spotted and iced in one and one-half hours without moving the train, whereas only nine cars could be supplied by the old plant, and it required four hours to ice a train. Instead of hand labor, the new plant uses electric motors for mechanical handling; loss from melting in the new plant is practically nil, because it is built like a refrigerator with insulated walls and air-tight openings. The plant is located on the main line between Omaha and Chicago, for the purpose of re-icing the refrigerator cars loaded with fruit and meat on their way to Eastern markets.



INCLINES TRANSFER CAKE ICE TO OUTSIDE PLATFORM

The new plant consists of three separate units, combined in one large building which has a ground area of 59 x 282 ft. At either end of this building is a storage room 55 x 124 ft. and 35 ft. high in the clear, each with a capacity of 5000 tons of ice. Between the storage rooms is a three-story building 30 x 55 ft., known as the ice-handling room. The first floor is the receiving room, the second floor is used in taking cake ice from the storage room, the third floor is the crusher room and salt-storage room.

Along the side of the building is a three-deck platform which extends beyond each end, to a total length of 1008 ft. The first deck is the receiving deck, and is built on an incline, so that ice taken from the cars slides down onto two conveyors, each 123 ft. long and with a capacity of 24 full cakes per minute. These con-

ICING STATION WITH OUTSIDE PLATFORMS 1008 FT. LONG FOR ICING 28 REFRIGERATOR CARS

veyors push the ice to the receiving room, in which slides are built which convey the ice by gravity to the combined elevating and lowering machines, of which there is one for each storage room. These elevating and lowering machines have a capacity of 16 full cakes per minute, and are arranged so that ice can be taken from the receiving room and elevated to any level in the storage room. They can also be reversed, to take ice from the storage rooms at any level and convey it to the different floors of the ice-handling room. Each of these machines has two motors; one operates the hoist and the other operates the brake, which is so connected that when the power is cut off from the hoist motor the power of the brake motor is automatically turned on, and this in turn applies the brake.

Conveyors Can Be Reversed

On the second floor of the ice-handling room slides are built which take the ice from the elevating machines and deliver it by gravity to two conveyors, which run to each end of the second deck of the platform and are 484 ft. long. Ice can be taken from these conveyors at any point along the platform. They have a capacity of 18 full cakes per minute, and can be reversed so that the ice not used is run back into the storage room.

On the third floor, or crusher room, ice is taken from the elevating machines and by gravity runs down inclined slides into two Creasey ice crushers. These crushers have a capacity of 60 tons of ice per hour, and are located on an elevated platform so that the crushed ice can be dumped into carts which are then hauled by men onto platforms and dumped into a movable chute; this runs on rails along the entire length of the third deck, and conveys ice into the hatches on top of the refrigerator cars.

In the ceiling of this crusher room is built a large hopper-shaped salt bin of 30 tons capacity, with a gate in the bottom to deliver the salt into cars which are hauled on the top deck of the platform to hoppers placed at every third post. Under the receiving platform is a concrete hopper with a concrete chute, into which salt is dumped from cars and run by gravity into buckets bolted on an endless belt. This conveys the salt into salt bins in the roof of the crusher room.

The entire building is built as a refrigerator room, the walls being double and consisting of two thicknesses of ⅞-in. sheathing nailed on 3 x 10-in. studding, with heavy roofing paper between on the inside, and one thickness of ⅞-in. sheathing and 6-in. No. 115 lap siding with heavy roofing paper between, nailed on the outside between the sheathing and the studs. Granulated cork is packed to a height of 10 ft., and above that fine shavings are used to the under side of the rafters.

The roof is double, the under side of the rafters being sheathed tight with ⅞-in. sheathing, and the top of the rafters is sheathed with 1⅛-in. sheathing open at the eaves, where a small monitor is built at the peak of the roof the whole length of the building. This forms an air passage between rafters and keeps the under side of the roof cool.

The wall and floor foundations are of concrete, the floor being built of 4 x 4-in. cypress sleepers, upon which 2 x 6-in. rough cypress planking is placed 1 in. apart, to form an air passage and allow drippings to run off into the sewer. All the doors to the storage room and crusher room are double refrigerator doors.

Construction Under Severe Conditions

The erection of this plant was accomplished in one of the most severe winters ever known, work being carried on in temperatures as low as 12 deg. below zero, and material being shipped from the East in the worst snowstorm. The cars with machinery were stalled in the snow for months, and the first ice had to be stored with the aid of a steam engine and an inclined conveyor.

The work required a total of 2616 cu.yd. of excavation, 640 cu.yd. of concrete, and 320,000 ft. bm. of lumber. The plant was planned and designed in the office of F. R. Judd, engineer of buildings, Illinois Central R.R., and the writer was locally in charge for the railway company. The construction work was done under contract by the J. W. Zitterell Co., of Webster City, Iowa, with H. Bearman as superintendent.

Surveyed 38,136 Square Miles Last Year

Detailed soil surveys covering 38,136 square miles were made during the fiscal year 1918 by the Bureau of Soils of the United States Department of Agriculture. Prior surveys of 445,825 square miles make the total 483,961 square miles. Twenty-two states and four bureaus of the Federal Government are now actively coöperating in this soil-survey work.

Operating an Employment Bureau for Civil Engineers

How a Technical Society Conducts a Registration Office—Tries Also to Place Employed, But Not Satisfied Men

BY C. S. RINDSFOOS
Chairman, Registration Bureau, Cornell Society of Civil Engineers, 30 E. 42nd St., New York

UNEMPLOYMENT in the engineering profession threatens to become serious in the near future, so that greater interest than ever before is being displayed by the various Governmental and society employment bureaus which have operated, until recently, in a most perfunctory manner. How the Registration Bureau of the Cornell Society of Civil Engineers is now being conducted may therefore prove of interest to many other similar societies that have such work under way or in contemplation.

The writer believes that—important as is the question of assisting the unemployed, in which class discharged soldiers and sailors would fall—there is one possibility of service, on the part of such bureaus, of much greater and abiding importance; namely, the shifting of the man who is doing unprofitable, uncongenial or unsatisfactory work into work that he can do to better advantage—in short, in helping the "misfits." Nothing is more sad than to see a man doing work for which he is not fitted. Many a man starts on the wrong path or becomes sidetracked and, being burdened with a family or other private responsibilities, lacks the time, capital, ability or nerve to change to that position where his native talents have a chance to display themselves. At this juncture a helping hand, pointing the way to greater opportunities, is a fine thing not only for the man but for his profession and society in general, tending to efficiency and greater productiveness.

EVERY MAN CATALOGED

Keeping this in mind, the bureau took the first step in its plan by cataloging every man who had ever attended the college, whether he was satisfactorily employed or not; whether he was a beginner or a man of high attainments. A questionnaire with inquiries of every sort necessary to a knowledge of a man's capabilities was sent to every Cornell civil engineer, some 2000 in number. The idea in cataloging all the men was, first, that in no other way could it be determined how many were desirous of a change; second, that any man at any time might become a candidate for a new position; third, that every man, practically speaking, will consider a change if offered sufficient inducement either in salary, responsibility, or chance for service, and fourth, that the sympathy and help of the satisfied men was necessary to the bureau and that they would support a bureau more readily if they were a part of it and received the notices sent out from time to time.

These questionnaires are four-page, letter-size, and are filed by number (without reference to the alphabet). All correspondence with reference to a man's record received subsequently is filed with the questionnaire, so that the questionnaire becomes a folder with complete data, up to date, and immediately available. Follow-up cards are sent from time to time to keep the records up to date, and these also go into the questionnaire folder.

A card index (size 3 x 5 in.) is maintained to go with the questionnaires, arranged alphabetically, each card containing the name of the man and his number—nothing more. By means of this index, given a man's name, his number can be immediately determined and from the number his questionnaire is located.

Another card index (size 3 x 5 in.) is maintained and arranged by classes. This index is divided into two main groups, labeled "satisfied" and "not satisfied." Unemployed men are filed in the latter group until employed, when their cards are transferred to the "satisfied" group. Should a man become dissatisfied with his employment, his card is transferred from one group to the other, without disarranging the regular files.

Each of the two main groups is subdivided by salaries. For example, cards of all men who place a value on their services of, say, $250 per month are placed between the tabs 200 and 300. Men who value their services at, say, $350 have their cards placed between the tabs 300 and 400, and so on. Should a man's value increase so that his subsequent reports show that, whereas at one time he would consider a $250 position and his card was so filed, he now would consider nothing less than $350 his card is simply transferred, without deranging the regular files.

Each salary group is further subdivided by symbols which indicate whether a man is a candidate for an "executive," "administrative," "engineering," "sales," "clerical," "commercial," etc., position. The card is so ruled that the symbol and salary may be changed from time to time, so that a clerk, without even knowing what the symbols mean, can place the card in the right slot with a maximum of speed and accuracy. For example, if the last symbol on a card is 1-450-NS his card belongs in the "Not satisfied" group, subdivision 400-500 (salary) sub-subdivision 1 (executive).

Suppose an employer calls for a man to fill the following position: (1) Superintendent of construction; (2) salary, $450 per month; (3) age wanted, 30-40; (4) type of work, factory building, reinforced-concrete, pile foundation. It requires a moment to pick the group of cards classified "administrative—400-500." The corresponding questionnaires are then taken from the questionnaire file and those selected which represent men of about the age and professional attainments required. Any special requirement such as "married man preferred," "man capable to design as well as construct wanted," etc., can be determined from the questionnaire. An exact copy of each questionnaire of each logical candidate is then sent to the employer, and the original is returned to the file. A metal signal is then placed on the card of each man recommended, for purposes of follow-up. A notice is also sent to each man, telling him he has been recommended for the position.

It will be seen that every effort is made to serve the employer by only sending "logical" candidates. If no man seems available, the inquiry is referred to one of the other college bureaus, which reciprocate in like manner.

Many other forms and devices for follow-up purposes, for obtaining inquiries from employers, and to save dic-

tation in correspondence, are used, but it is thought the part here explained gives the gist of such features as are novel. The plan was evolved after a careful study of many other systems, and it is believed that by combining desirable points from several with ideas of our own a good workable system has resulted.

Loss of Head in Sewage Sludge Pipe at Toronto, Ontario

Experiments Made on 12-Inch Cast-Iron Sludge Main After Five Years of Use Give Value of n = 0.0168 to 0.0181

By T. H. Nevitt

Superintendent of Sewage Works, Toronto, Ont.

Owing to the necessity of obtaining some data as to the loss of head due to pumping sludge through pipes, an experiment was made at the main sewage-disposal works, Toronto, on the 12-in. cast-iron sludge discharge main. The data were required for use in a report on sewage disposal.

The sludge experimented with was obtained from the sedimentation tanks, and was not more than 10 days old. This sludge was released from a tank through four 8-in. valves situated at the apex of the bottom hoppers, and flowed through a 10-in. cast-iron pipe, on a 2% grade, to a sludge well in the pumping station. Here it flowed into an 8-in. centrifugal pump and was raised about 35 ft. and discharged through 400 ft. of 12-in. cast-iron pipe and some 200 ft. of 10-in. spiral-riveted pipe to the sludge lagoon.

After leaving the pumping station, the pipe is supported on posts at a distance from 10 to 6 ft. above the ground, and turns down just below surface level in the lagoon, where it discharges. The pipe was laid some five years ago, on a grade of 1 in 80, which it still retains, although, through the action of frost on the supporting posts, the alignment is not so good. Pump tests show that this grade is sufficient to carry the sludge away by gravity.

As the pipe ordinarily does not flow full, it was necessary to cause it to do so, and this was done by making a siphon at the discharge end, the height of which was a little greater than the loss of elevation due to the grade of the pipe.

For the purpose of the experiment, a length of 12-in. pipe south of the station was selected which was unaffected by either valves or bends. In fact, no obstruction to the flow occurred within 12 ft. of either end of this test length, which was 240.5 ft. long.

To measure the loss of head, two ¼-in. holes were drilled through the cast-iron pipe on its horizontal diameter, one at each end of the section selected, and, to insure the entrance being square and sharp, these holes were cut with a sharp drill running at high speed. The pipe was then counterbored half way through its wall and tapped to take a ¼-in. water pipe. At the north end, the ¼-in. pipe was turned down and then run horizontally to a point 6 in. north of the middle of the test length, while at the south end the pipe turned north and ran horizontally to 6 in. south of the middle. At this point, a mercury U-tube was inserted and connected to the ¼-in. pipe by rubber tubing. Quarter-inch gate valves controlled the pipe at the north and south ends

OBSERVATIONS ON FLOW OF SEWAGE SLUDGE THROUGH 12-INCH CAST-IRON PIPE AT TORONTO

Head in Pipe										
Loss of Inches of Mercury	Feet of Water	Feet of Water per 100 Ft. of Pipe	Discharge, Cu. Ft., per Sec.	Area of Pipe, Sq.Ft.	Velocity in Pipe, Ft. per Sec.	R	S	C	n	Hazen & Williams' Formula. C for Observed Loss of Head
3¼	3.41	1.415	5.00	0.785	6.36	0.25	0.0141	108	0.017	115
3	3.15	1.306	4.92	....	6.26	....	0.0131	110	0.017	118
3¼	3.41	1.415	4 90	....	6.24	....	0.0141	106	0.017	113
3¼	3.41	1.415	4.88	....	6.21	....	0.0141	105	0 018	113
2¾	2 89	1.199	4.81	....	6.12	....	0.0121	111	0.017	122
3	3.15	1.306	4 79	....	6.10	....	0.0131	107	0.017	115
3¼	3.41	1.415	4.77	....	6.07	....	0.0141	103	0.018	110
3	3.15	1.306	4.72	....	6.01	....	0.0131	104	0.018	114
2¾	2.89	1 199	4 70	....	5.98	....	0 0120	109	0 017	118
3¼	3.41	1.415	4.69	....	5.97	....	0 0141	101	0 018	108
3	3.15	1.306	4.67	....	5.94	....	0.0131	104	0.018	112
3	3.15	1.306	4.65	....	5 92	....	0 0131	104	0.018	112
3	3.15	1.306	4.62	....	5.88	....	0.0131	103	0.018	111
2¼	2.89	1.199	4.55	....	5.79	....	0.0120	105	0.018	113
2⅞	3.02	1.253	4.50	....	5.73		0.0125	102	0 018	109

and ¼-in. pet-cocks at the center. The scales on the U-tube could be read to ⅛ in. and estimated to $\frac{1}{16}$ inch.

The volume of sludge was measured by a 12 x 6-in. venturi meter and register indicator recorder of the latest type. The indicator has a uniformly divided scale which can be read very accurately.

Before the experiment was started, the ¼-in. piping was carefully filled with clean water and all air was expelled; the watches of the two observers and the recorder clock were regulated as to time. Readings were taken at 5-min. intervals. At the end of an hour the observers changed places, and the experiments were continued for another hour. Some difficulty was experienced in reading the U-tube on account of the continual fluctuation of the mercury column, but the reading at the 5-min. interval was that recorded. The fluctuation was fairly uniform until a discharge of 4½ sec.-ft. was reached, below which it became very erratic. In consequence, these results were neglected. This was for two reasons: (1) On account of the small differential an error of ⅛ in. in the reading made a large percentage error, and (2) the flow had become turbulent due to choking in the sludge pump from heavy sludge and also the low discharge.

The value of n was determined by substituting in Kutter's formula for C and solving for n in each case. The results show a variation from 0.0168 to 0.0181, which is probably accounted for by variations in the density of the sludge. For comparison, the value of C in Hazen and Williams' formula was worked out on the slide rule. The results show that for Toronto conditions the addition of two years to the age of the pipe permits the Hazen and Williams' tables for water to be applied very closely.

Pint samples of sludge were taken every 10 min. at the discharge end of the pipe, and collected in a pail. At the end of the experiment, these were stirred thoroughly and a sample was taken for analysis.

The sludge analyzed as follows: Specific gravity, 1.01; moisture, 95.9%; solids, 4.1; percentage of dry solids which are volatile, 50.5; ash, 49.5%. The temperature of the sludge was 54° Fahrenheit.

The experiment was carried out under the general supervision of R. C. Harris, commissioner of works for the City of Toronto, G. G. Powell, deputy city engineer, and W. R. Worthington, assistant engineer in charge of sewers, and under the writer's immediate direction.

Structure and Strength of Overheated Rivet Steel

Failure of Long-Grip Rivets Led to Study of Overheating, Annealing and Forging—Microscopic Grain Structure and Strength Properties Investigated—Embrittling Effect of Overheating Made Clear

By S. H. Graf

Professor of Experimental Engineering, Oregon State Agricultural College, Corvallis

RECENTLY, in the construction of a steel building in Portland, Ore., it was necessary to rivet together a number of plates such that the thickness of the member thus built up was about 5 in., the rivets being thus rather long. The heads of some fifty of these rivets snapped off after cooling. It seemed that the manipulation had been little if any different from the usual practice, and the cause of this failure was therefore somewhat of a mystery. It was thought by some that the cause lay in inferior or defective material. A microscopic examination of the body as well as the field head of one of the failed rivets was made, and revealed in the body of the rivet the peculiar broken structure shown in Fig. 1. The head showed a very different structure, as shown by Fig. 2. Those familiar with work of this nature would recognize the structure in Fig. 1 to be that characteristic of badly overheated steel, while that in Fig. 2 more nearly represents the normal structure.

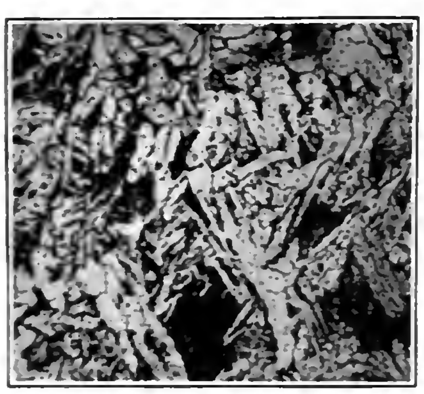


Fig. 1. Body rivet (x200)

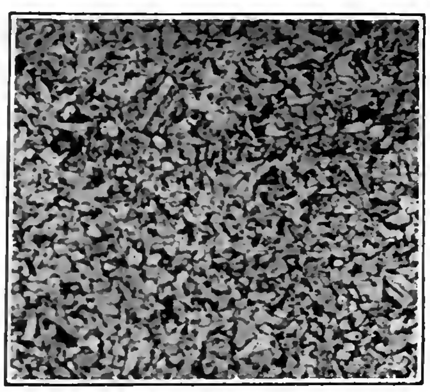


Fig. 2. Field head (x200)

STEEL STRUCTURE IN ONE OF THE RIVETS THAT FAILED

It is quite generally known that the overheating of steel causes a coarsening of its structure and a deterioration of its qualities. However, cases where this is of practical importance are uncommon enough to be interesting whenever they do occur.

To make conclusive the evidence of overheating as the cause of failure of the rivets in question, it was decided to conduct a little laboratory research, imitating conditions which might under different circumstances obtain in practice, and then to make studies of the steel structures and physical properties resulting from these various treatments. It was further desired in this study to determine, if possible, why, under most conditions, apparently no damage is done by a given treatment, while in other cases failure results from what is apparently the same mode of manipulation.

Rivet steels may contain from 0.05 to 0.25% carbon, according to the strength required. Ordinarily, the carbon content is in the neighborhood of 0.12%. For the purpose of the proposed microscopic tests, two ½-in. round bars were selected, differing in grade of steel, one containing 0.11 and the other 0.23% carbon. The first of these is similar in grade to the rivets which failed in the instance referred to, while the other represents rivets of the highest carbon content customarily used. Fig. 3 shows the normal structure of the first of these, and Fig. 8 that of the second.

Pieces of both of the test bars were subjected to the following manipulations:

(a) Held at 2100° F. for 10 min. and air-cooled.

(b) Heated in the forge until sparks began to be thrown off, and held at this temperature for two minutes.

(c) After treatment b (same specimens), refined by heating to the upper limit of the critical range plus 100° F. for 15 min. and air-cooled (1700° Fahrenheit).

(d) Using a fresh piece of the bar 2 in. long, treatment b, followed by upsetting the piece to one-half of its original length and forging out to about ¼ in. square.

Micrographs are shown in Figs. 4—7 and 9—13 of the results of these various treatments. All of these are to a magnification of 400 diameters, with the exception of Fig. 11, which is to only 100 diameters, the structure in Fig. 10 being so coarse that the entire photograph does not show one whole grain. The following table shows the grain size (in grains per square millimeter) resulting from the various treatments. The counts are necessarily only approximate in some cases, owing to the broken structure.

CHANGES IN GRAIN SIZE OF STEEL PRODUCED BY HEATING AND FORGING CONDITION AND TREATMENT OF STEEL

Carbon Content	Normal	(a)	(b)	(c)	(d)
0.11%	15,500	4,100	680	10,900	6,800
0.23%	7,100	3,200	168	17,500	12,400

These figures indicate quite startling changes. The soaking for ten minutes at 2100° F. has, in both cases, increased the grain size quite materially, and even the short heating at a sparkling temperature (about 2500° F.) has increased the grain size enormously, and in addition to this has considerably altered the character of the structure itself. Treatment c has resulted in a wonderful refining of the grain. In the case of the higher carbon content the grain is even finer than it was in the original steel. The forging treatment (see Figs. 7 and 13) has resulted in a very material grain refining, especially in the case

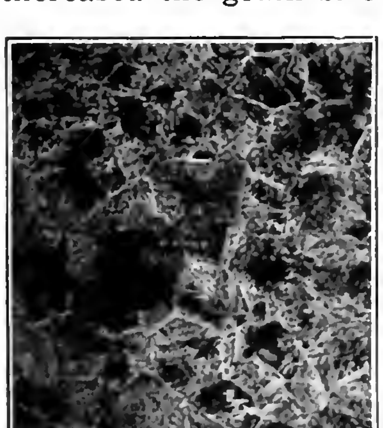
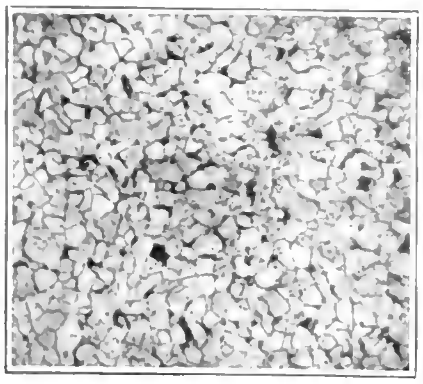


FIG. 11. STRUCTURE OF OVERHEATED STEEL OF 0.23% CARBON

Magnified 100 diameters (same as Fig. 10) but lower magnification used because structure is so coarse that Fig. 10 does not show an entire grain.



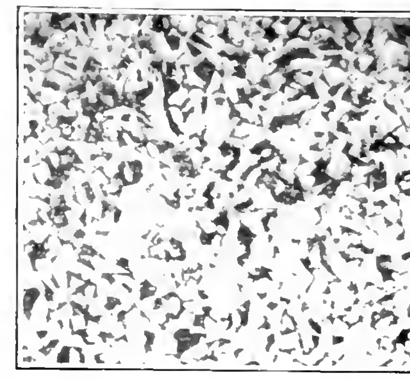


FIG. 3 FIG. 8

Normal Structure

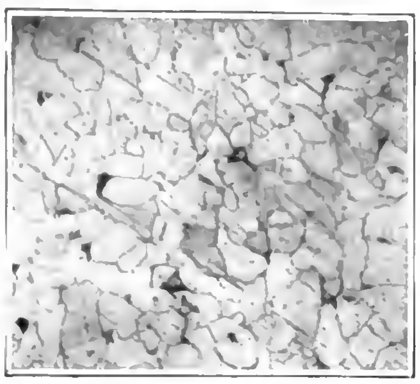
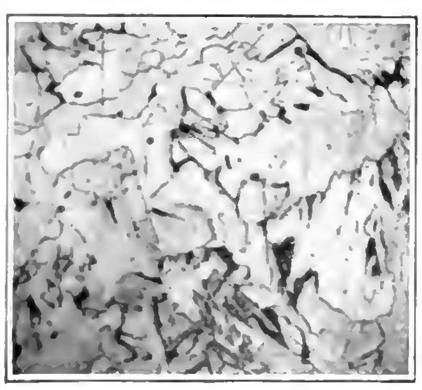


FIG. 4 FIG. 9

Held at 2100 for 10 minutes and air-cooled



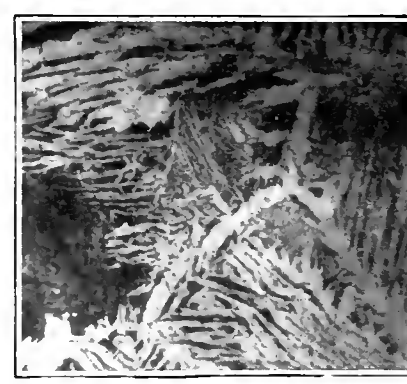
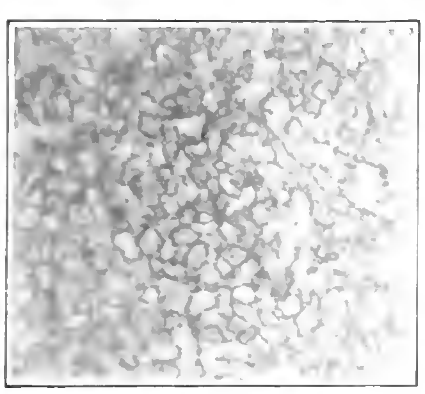


FIG. 5 FIG. 10

Overheated



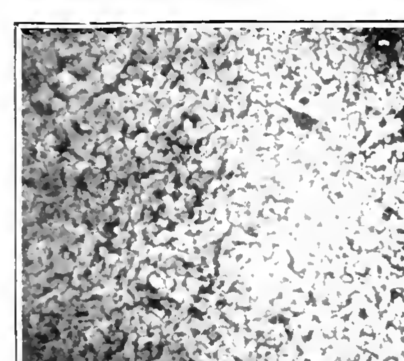
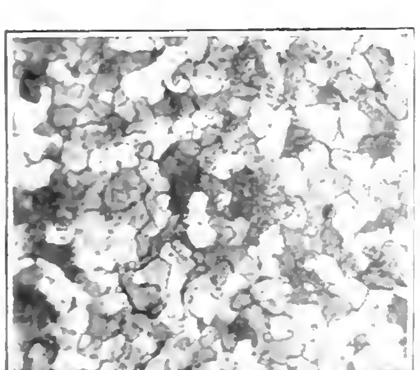


FIG. 6 FIG. 12

Overheated Specimen Refined by Heat-Treatment



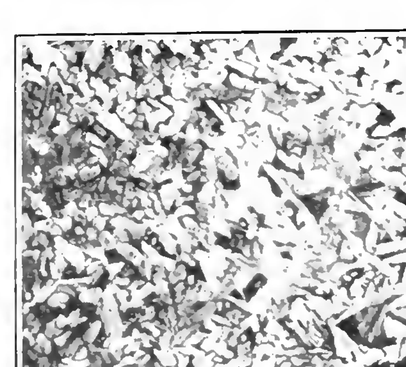


FIG. 7 FIG. 13

Overheated Specimen Refined by Forging

STEEL OF 0.11% CARBON

STEEL OF 0.23% CARBON

(Reproduced one-half linear size of original microphotographs)

of the higher carbon content, where the grain has been rendered somewhat finer than it was originally.

Contrasting Figs. 5 and 10 with 7 and 13 shows why the structure in the head of a rivet may be normally fine, while that in the body (especially in a long rivet) may be extremely coarse. The head has been forged and thus refined. The body has simply cooled from a very high temperature, just as was the case here in treatment b. A thermal refining of the grain, as accomplished by treatment c, is of course not possible with rivets, but is practicable in the case of forgings, and is always applied to high-grade steel castings.

The micrographs already referred to show beautifully the changes in structure resulting from the different in structure far beyond the point reached by the specimens in these experiments, so that the ductility may be reduced to almost nothing. In the case of such long soaking, there may also be an absorption of carbon from the fuel in the forge, such as takes place in casehardening. This effect was looked for in the present study, but was very slight, if not entirely absent.

It is often thought—and the statement is sometimes made in case of a failure exhibiting a coarse crystalline structure—that the material has "crystallized" in service. The latest research has shown—at least in the case of ordinary low-carbon steels—that there is no such change of grain size, and that the coarse structure was there originally in the fabricated article, caused by some

EFFECT OF HEATING AND FORGING ON THE PHYSICAL PROPERTIES OF STEEL

TABLE I—REPEATED-STRESS TESTS

Condition	Alternations of Stress 1	2	Ave.
Normal bar	350	379	364
Overheated bar (treatment B)	183	61	122
Overheated and heat-treated bar (treatment C)	283	316	300
Overheated and forged bar (treatment D)	244	255	249

TABLE II—TENSILE TESTS

Condition	Yield Point Lb. per Sq.In.	Ult. Strength Lb. per Sq.In.	Ductility, %	Reduction of Area, %	Character of Fracture
Normal bar	45,600	65,100	31.5	72.2	Very fine silky
Overheated bar (treatment B)	70,700	71,400	4.0	10.8	Coarse crystalline
Overheated and heat-treated bar (treatment C)	47,800	66,200	17.5	55.8	Fine silky

treatments, but the question arises, Just what physical properties correspond to these different structures? In order to answer this question, repeated-stress tests were made on samples of $\frac{3}{8}$-in. rivet steel, in carbon content lying between the two steels which were studied microscopically. The tests were made by means of a Landgraf-Turner alternating impact testing machine; the results are given in Table I.

The alternating-impact test is quite a severe one, and yields comparative results which measure primarily the toughness of the material. An inspection of the results shows that the structure represented by treatment b and Figs. 5 and 10 is very brittle and unreliable. Either heat-treating or forging very largely restores the original qualities of the material so far as toughness is concerned.

Tensile tests were made in a 50,000-lb. Riehlé testing machine on the same material as used for the repeated-stress tests. The results were as given in Table II.

These tests show quite conclusively what happens. In the overheated specimen the yield-point is raised so high that it closely approaches the ultimate strength. The ductility and reduction of area are reduced to a small fraction of what they are normally. The coarse crystalline nature of the structure is also in evidence. The heat-treating greatly improves the material, bringing it back nearly to its original good quality. The very low ductility in the case of the overheated specimen shows why rivet heads may snap off when such material cools from a high heat to atmospheric temperature. The contraction on cooling under these conditions, especially with long rivets, is sufficient to stress the rivets beyond the elastic limit of the material, so that if the ductility of the metal is much reduced the rivets will actually be pulled in two by the contraction.

It must be understood, too, that rivets allowed to soak in a forge for a considerable time may be coarsened error or accident in manipulation either in the production of the steel or in its subsequent treatment.

In conclusion, it may be said that this study of rivet steels shows clearly the danger of overheating rivets (and steel generally), either by holding at a very high temperature for a short time or by long soaking even at temperatures ordinarily considered safe.

Shipbuilders Encouraged to Think at McDougall-Duluth Yard

Two new features have been introduced in the McDougall-Duluth Co.'s shipyard, Duluth, Minn., to increase coöperation between the men and the management. Most novel of the two is an Invention Division, which the yard monthly, the *Riverside Review*, says has just been established by the company to give legal and technical assistance to any employee of the company who may have an idea worth patenting. S. G. Stevens, patent attorney of Duluth, has been retained to give advice.

Any employee can obtain Mr. Stevens' assistance through the industrial department of the shipyard. The service is intended to assist in (1) developing an idea to the form of a patentable invention; (2) comparing it with prior patents that conflict or that may be helpful, and (3) bringing out its commercial possibilities. A plan for financial assistance in developing and patenting inventions for its employees is under consideration by the company.

Revival of the suggestion box is another means by which the company aims to enlist the coöperation of the yard workers. The box was established more than a year ago, in the early days of the yard, but during the building and great expansion of the new plant it ceased to exist. Now A. Miller McDougall, general manager, has reëstablished the suggestion box and will take personal supervision of it.

Keeping Economy of Operation Paramount in a Shipyard Layout

Despite Cramped Quarters Moore Plant on San Francisco Bay Adhered to Standards for "After-the-War" Basis—Ways Served by Derrick Towers—Transportation on Zone System—Ordering Methods

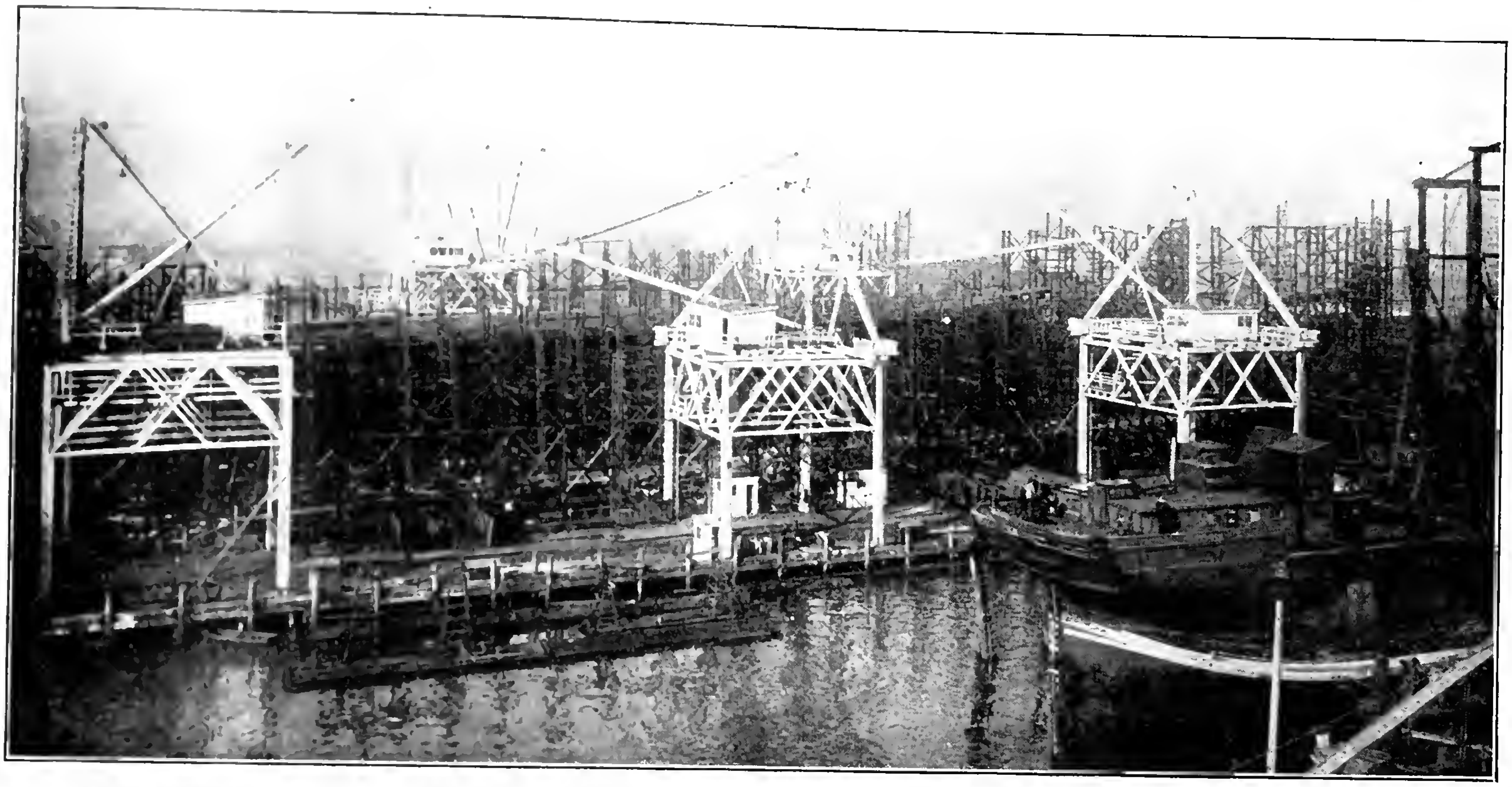


FIG. 1. MOORE SHIPYARD USED DERRICK TOWERS INSTEAD OF TRAVELING CRANES FOR BERTH SERVICE
Material is delivered to wide storage spaces alongside the ways by locomotive cranes. The latest derrick towers are 70 feet high.

LIMITATION of yard space at the Moore shipyard on San Francisco Bay called for careful attention to layout, in order that material could be handled economically. Studies of the material-handling methods were continued while the yard was in operation, and as it expanded improvements in the system continued to be made. By the time the plant had grown from two ways to ten, there had been developed the slogan of "economy of operation on after-the-war basis," and efforts were consistently directed toward adhering to that standard. Expansion on both sides of the original plant and the fortunate selection of main building sites for the early development are factors without which this would have been impossible.

Important steps in attaining the desired economy of operation are the zoning of locomotive-crane travel and the card-index and requisition systems used for recording and ordering out plates and shapes. There has been constant effort to avoid interference in delivery and fabrication and to find storage space, particularly along the ways, where material ready for the boat could be located most conveniently. Elbow room in the fabrication yard has been insisted upon, and continual attention is given to plate-shop organization.

It is also notable that because of the delays and difficulty attendant upon getting delivery from Eastern factories some of the shop equipment and several cranes were designed and built in San Francisco.

The machines in the angle yard are set up under "umbrellas" consisting of four piles supporting a central roof and four radial jib cranes. The booms of these cranes are I-beams hinged to the four corner piles; they constitute an important feature in time-saving in the angle yard. The booms carry differential chain blocks and a workman can swing the boom by one hand with the same movement that draws the block along to the desired point. These "umbrellas," developed in the San Francisco Bay region, illustrate the simplicity of device and economy of construction notable in many of the Western yards. Their open construction indicates how the climatic advantage favors this region as a shipyard location. In winter or summer the slight shelter afforded by the umbrella is sufficient protection for the workmen

Raw Steel Card-Indexed—The angle yard is laid out to handle steel shapes up to 80 ft. long, weighing 20 lb. per foot. Here, as well as in the plate yard, materials are classified for storage according to size; there is no attempt to segregate material for any particular hull. Coupled with this plan is a card-index system whereby each piece of steel, as it is received from the mill, is recorded on a card. The card (Fig. 4) has a space for the mark by which the piece has been ordered, the number of the hull for which it is intended, the size and thickness of the piece, the date received into the yard and the number of the order under which it goes out of the yard to the shipfitters. There is also a space for entering the sheet number in the list of material which is kept separately for each hull. By the use of this system it is possible to draw material for any hull

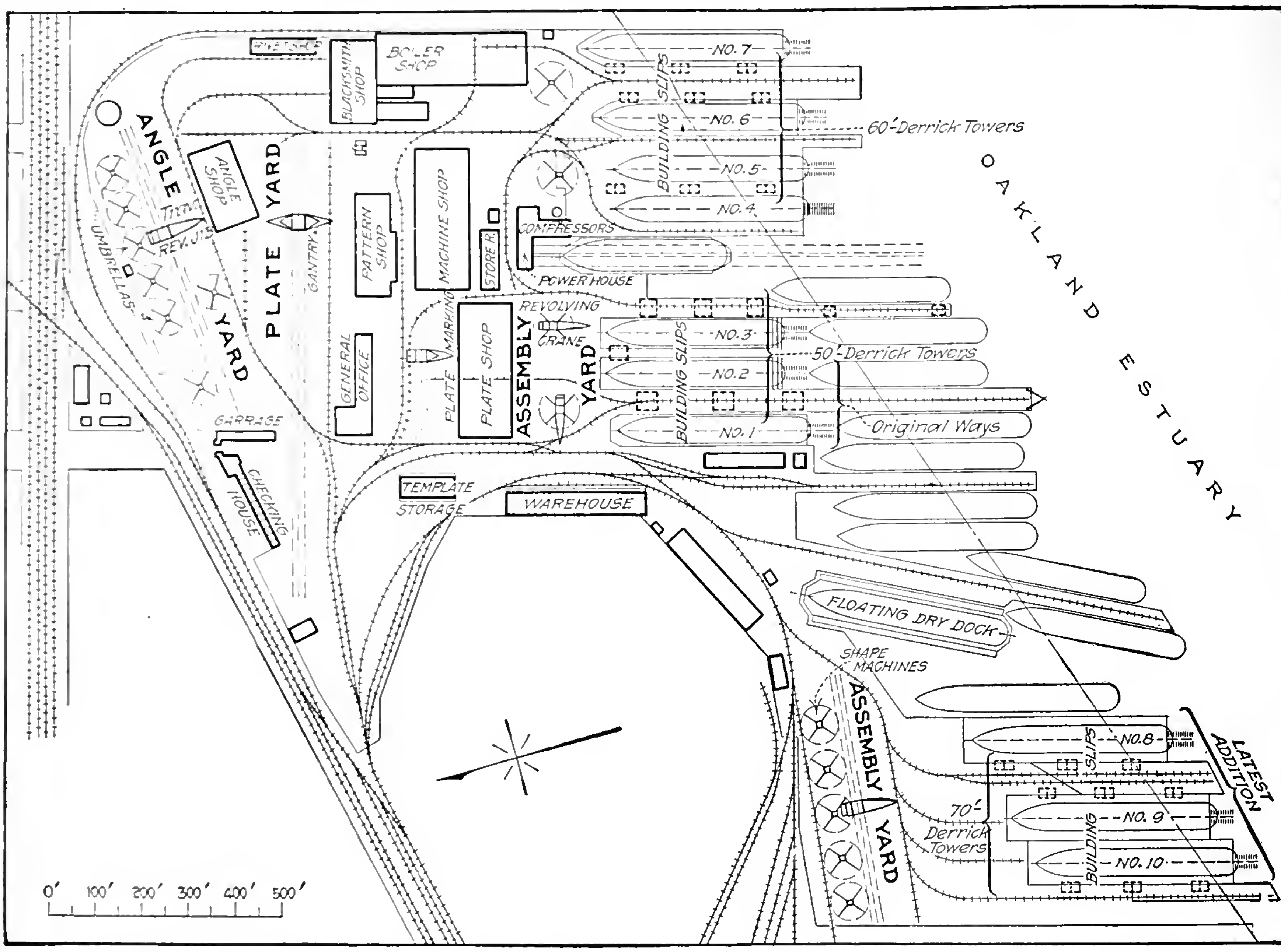


FIG. 2. SPACE LIMITATIONS RESPONSIBLE FOR IRREGULAR PLAN OF SHIPBUILDING AND DOCK COMPANY'S YARD

from the general stock supply without complicating the records, and yet there is convenient record of how such material was used.

The angle shop has equipment for cold and hot bending of angles and shapes, including two 9-burner 50-ft. oil furnaces for heating the longer pieces. Realizing that bent shapes are the greatest source of trouble in the erection of vessels, particular attention was devoted to the equipment of the angle shop, and careful study has been given to its arrangement and method of operation.

Yard Crane Equipment—Cranes for service over the material yards were not to be had in time from Eastern plants; therefore, three traveling cranes with revolving booms and two stationary revolving cranes were built to special design, and a cantilever gantry (Fig. 3) for the plate-storage yard was rebuilt from material already on hand in the old yard. Each of the revolving cranes has a 90-ft. counterbalanced boom, and as auxiliaries four jib cranes, one on each corner of the main tower. The jib cranes, hinged to swing through an angle of about 150 deg., are found exceedingly useful, particularly on the stationary cranes in the fabrication yard. (See view, Fig. 7.) Eight locomotive cranes are used at the Moore plant, seven 15-ton and one of smaller capacity. Because of the long haul from end to end of the trackage, it has been found economical to limit the travel of cranes to certain zones; that is, to each crane is assigned a section of the trackage beyond which it does not operate except under special orders. Under this plan loss of time in rehandling from crane to crane is actually very little, cer-

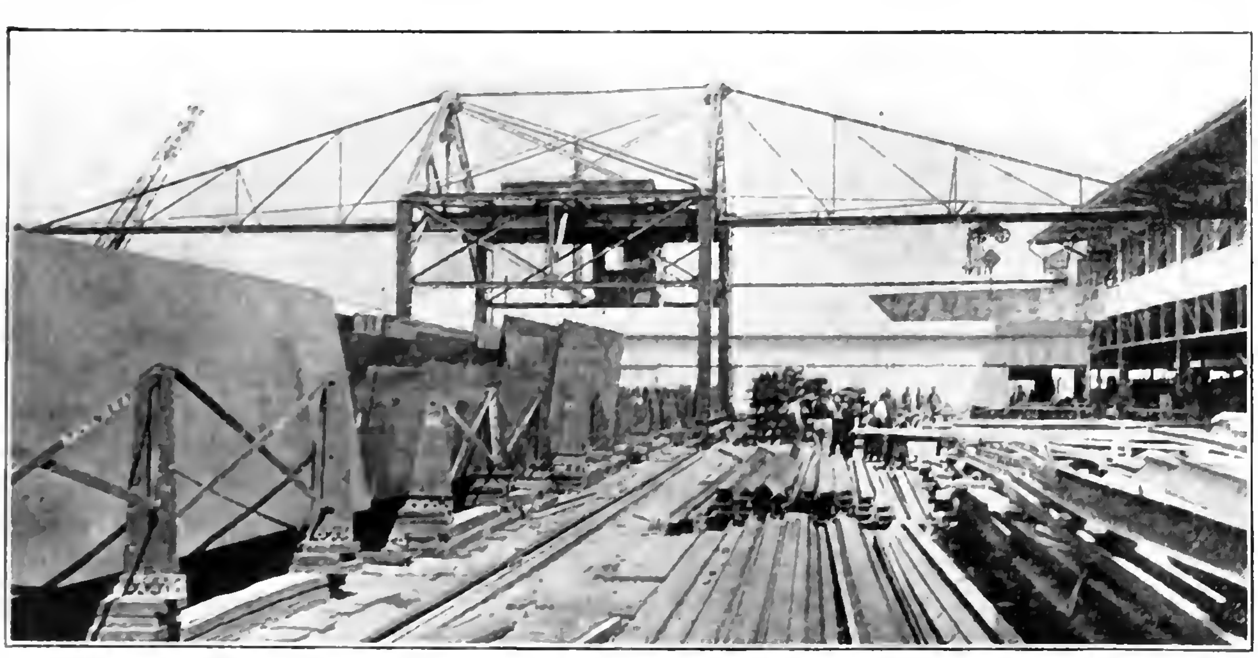


FIG. 3 CANTILEVER GANTRY IN PLATE YARD WAS BUILT FROM MATERIAL ON HAND

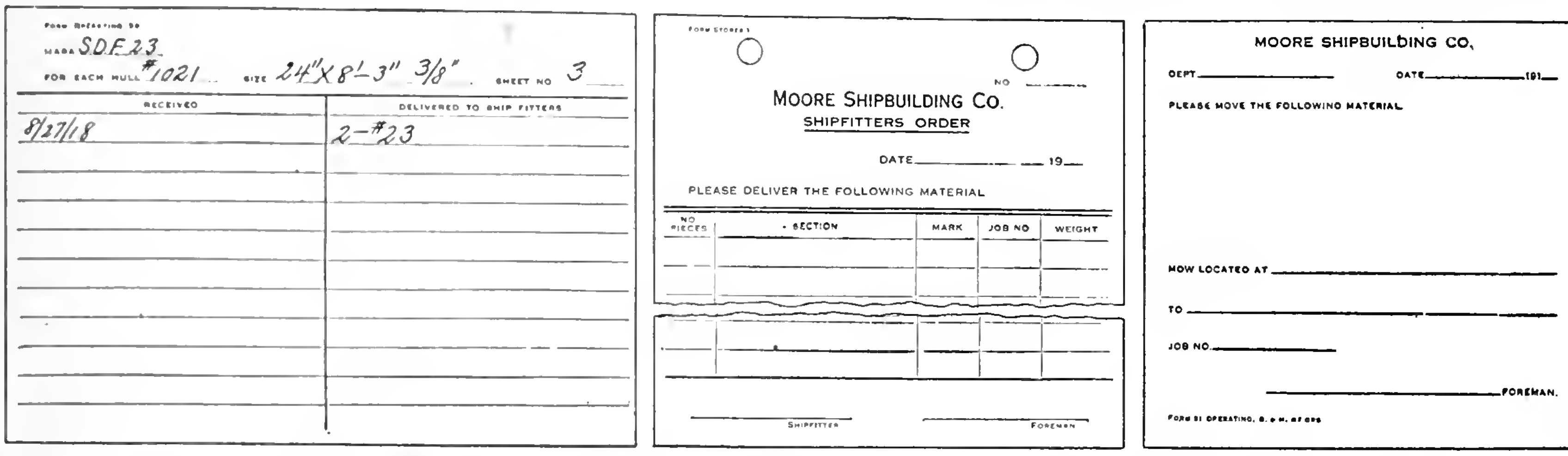
tainly much less than that resulting from waiting for right-of-way past a crane in another zone. The plan has been made most effective by endeavoring to select as far as possible zones which are between natural terminals—as from plate storage to assembly yard, or between any other two points where rehandling would ordinarily be required. The time of the locomotive cranes has been still further conserved by the use of eight one-ton Ford tractors which reach all parts of the yard and the storage along the ways. These handle all small material and relieve the locomotive crane of many minor errands.

Ordering Material and Transportation—Material is taken from the storage yards on a "shipfitters' order," signed by the shipfitter and the foreman, Fig. 5. This order indicates the number of pieces and the exact kind of material required, and gives the number of the hull on which it is to go. The locomotive-crane foremen turn these slips in daily to the material superintendent's office. From them, together with the checked invoices on incoming freight, the stock records are kept up to date. Shapes and plates are recorded in separate card indexes, the cards being filed alphabetically by "mark," which is the designation by letter and number on each material shipment received.

A very simple plan which has saved much time and confusion in this yard is the scheme of using a foreman's requisition for ordering material moved for a special purpose. Formerly, it was necessary to find the superintendent of the material-handling department or one of his assistants and get permission to have a locomotive crane do the special moving job. This is now unnecessary; all foremen are authorized to fill out and sign a special form, about 4 in. square, which, when presented to the nearest craneman, authorizes him to move the specified material as requested. On this form, Fig. 6, there are filled in the date, the description, the present location and the destination of the material, and the number of the hull for which it is needed. These slips, turned in daily by the locomotive-crane men, give a check on the time and the hull number to which the special service should be charged.

Derricks Serve Ways—The ways are served by derricks on stationary wood towers. On the first ways these were made 50 ft. high, on later ways a 60-ft. height became standard and finally, in order that troop ships could be served easily, new ways were equipped with 70-ft. derrick towers. By using stationary derricks with long booms the maximum of undisturbed storage was made available in the limited space between ways. The ways in the original plant had two derricks per tower with three towers between ways. In later additions the plan has been changed to single-derrick stationary towers, three to each way. The towers are of wood. The booms are 105 ft. long and can place 12½ tons at a 65-ft. radius, which is enough to reach beyond the center of the ship.

An assembly or fabrication yard at the head of the slips is used for building up heavy work such as transverse units, pillars, hatch girders, etc. This yard, shown by the view, Fig. 7, is served by two 3-ton revolving cranes which deliver to the derricks at the forward ends of the ways or to flat-cars for the derricks farther down the ways. Near the three new ways in the far end of the yard a storage space is provided for finished shapes and plates. From this storage a traveling crane with a revolving boom will deliver the material to flat-cars, from which it will go to the storage alongside the way. The policy is to keep the storage along the ways always as near capacity as possible. As soon as the final plates for the ship have been taken from one section of the pier storage, material for the next boat is assigned to that space. As the first boat nears completion as much material as possible is stored on the pier for the one that is to follow.



FIGS. 4, 5 and 6. MATERIAL INDEX CARD, WAY ORDER, AND TRANSPORTATION ORDER FORMS

Fig. 4. Each piece of steel received is recorded on a card like this, the cards being filed according to the piece mark. Fig. 5. This form with two signatures is needed to authorize delivery of material from storage yard. Fig. 6. Foremen get locomotive crane service with this order; the order slip system avoids verbal requests and allocates charges for crane time.

In the plate shop, as in those of other Pacific Coast yards, there is a notable absence of multiple punches or other heavy equipment which could have come only from Eastern factories. Nevertheless, material is put through at high speed. The plate shop and the angle shop in this yard, with a total area of about 50,000 sq.ft., average almost 12,000 tons of finished metal per month.

The Moore plant has installed its own rivet shop, so as to have an independent rivet supply. The bars for making the rivets are always available from the coast mills. Much of the steel for this yard comes from the Gary plant of the Illinois Steel Co., although shapes and bars are frequently allotted from the San Francisco and Seattle mills of the Pacific Coast Steel Company.

The cost-plus contract under which this yard operated at first has been revoked to put the yard on a lump-sum basis. The latter, with provision for protecting the yard on advances in materials or labor cost, is con-

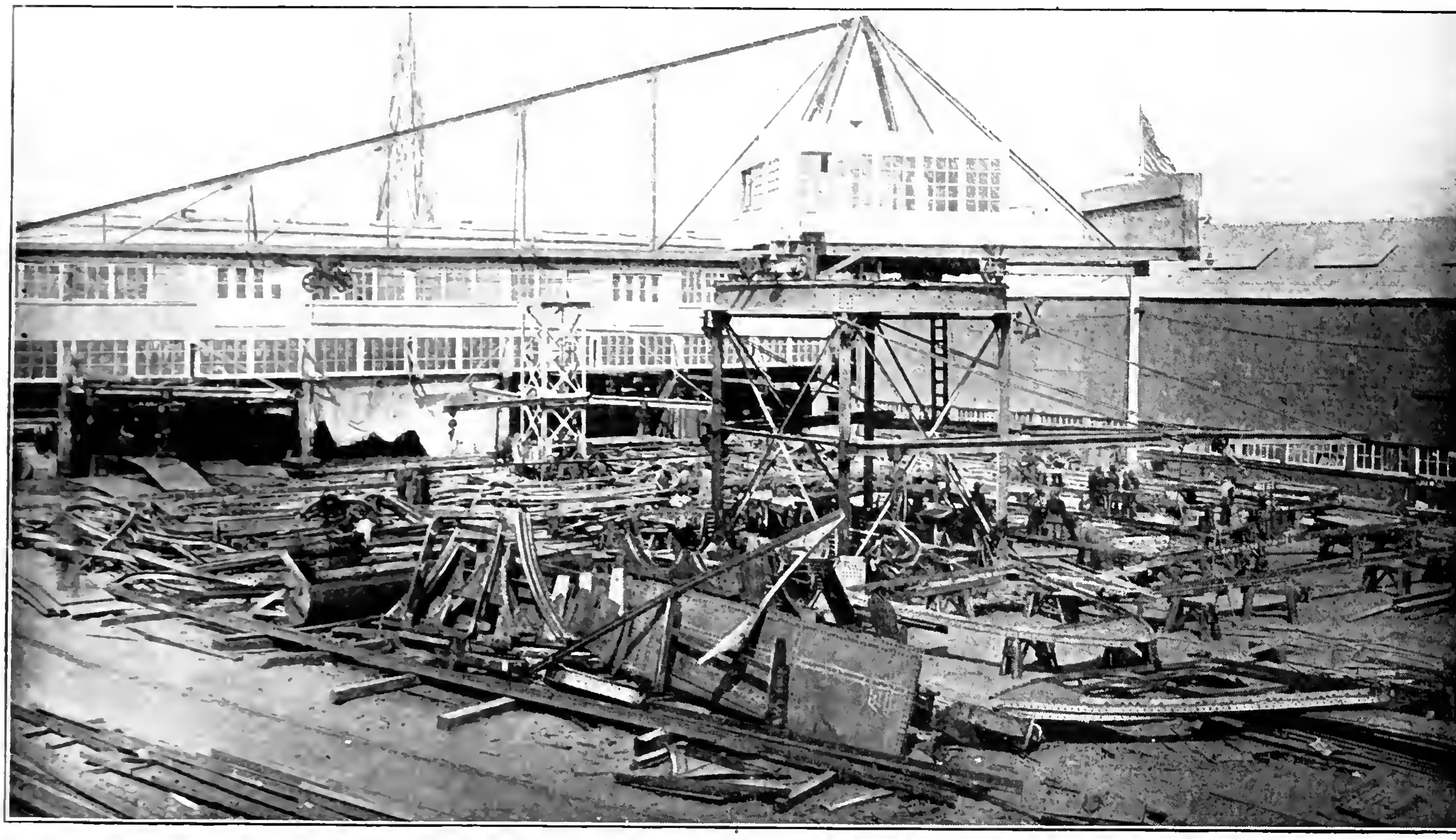


FIG. 7. ASSEMBLY YARD AT HEAD OF WAYS, LOOKING TOWARD PLATE SHOP
The crane is one of the home-made revolving cranes which do much of the yard service at the Moore plant

sidered much more satisfactory. At present the yard is working on 9400-ton refrigerator boats; after their completion twelve 10,000-ton tankers are to be built. The plant employs about 8000 men in all three shifts.

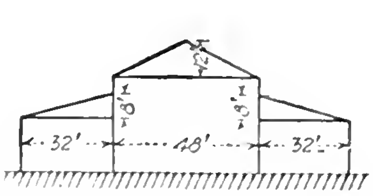
George A. Armes is president and general manager of the Moore Shipbuilding Co., Andrew Moore is first vice-president, and J. A. Moore is second vice-president and general superintendent. Leland S. Rosener, consulting engineer, has laid out the extensions and has designed cranes and other equipment that were built locally.

How Define the Pitch of a Roof?

By R. Fleming
American Bridge Co., New York

The pitch of a roof is defined, in many a dictionary, handbook and textbook, as the proportion obtained by dividing the height by the span. In most dictionaries of the English language the term is classified as architectural, and the definition is often followed by an explanatory note such as, "If the rafters exceed in length the width of the building the roof is said to be of the Elizabethan or knife-edge pitch; if they are equal to the width the pitch is Gothic; or if two-thirds the width the roof is said to be of a true pitch, or of the Roman pitch; a roof still flatter than this is the Grecian pitch."

The definition is at once seen to be ambiguous in the case of a lean-to or shed roof. If the pitch of the roof over the center aisle is $\frac{1}{4}$, what is the pitch of the roofs over the side aisles, in the accompanying diagram? The inclination of the rafter with the horizontal is sometimes expressed in degrees. But for ordinary slopes this method is cumbersome—a rise of 6 in. to the foot indicates an angle of 26° 33′ 54″. Again, the pitch has been interpreted as the quotient of the rise divided by one-half the span. This is at variance with the commonly accepted definition, but has the same ambiguity. The writer is of the opinion that the term "slope" should be adopted in structural engineering, and suggests the following definition: The slope of a roof is the natural tangent of the inclination with the horizontal, and is best expressed in inches of rise to one horizontal foot. There is no ambiguity in the definition, and the slope is easy to lay out. The mental gymnastics necessary to interpret such sentences as, "the pitch for tar and gravel roofs shall preferably be from $\frac{1}{32}$ to $\frac{1}{24}$," would be avoided. A specified slope of $\frac{3}{4}$ in. to 1 in. per foot would convey at once a picture of what was intended.



TYPICAL ROOF OUTLINE WITH DIMENSIONS

Suggestions and Complaints in Railroad Operation

According to the annual report of Director General W. G. McAdoo, the Bureau of Suggestions and Complaints of the Railroad Administration, established Sept. 3, 1918, received in all 10,424 "initiatory letters" containing 11,666 suggestions, complaints, and commendations. Those commending employees for courtesy and loyalty exceeded the complaints of discourtesy by nearly two to one. In all, some 1328 communications were received, as against 714 letters complaining of individual discourtesy or incompetence. The commendations received have been noted upon the records of the employees and will receive due consideration. In addition, 128 communications commended the railway service rendered by particular lines.

Baltimore Garbage Will Be Made Into Pork

Contractor Will Pay City Three and a Half Times as Much Per Ton as Chicago Top Price for Market Hogs, Thus Eliminating Gambling Risk to Both Parties—Change from Disposal by Reduction

BY WALTER E. LEE
Water Engineer of Baltimore, Md.

A FEEDING contract for the disposal of garbage was awarded by the City of Baltimore on Dec. 21, 1918, for a period commencing May 1, 1919, and ending Dec. 31, 1923. Under it the contractor will pay the city an annual estimated sum of $31,500. Barging and towing costs will reduce this by $15,000, leaving an annual net return of $16,500.

The writer, in a report of Jan. 28, 1918, to Mayor James H. Preston, recommended that garbage be disposed of by reduction in one central plant; ashes by filling ravines, low marshes and swampy ground along the water front for reclamation of land; and rubbish by incineration of the combustible portions, except the recoverable merchantable articles, in three municipal incinerators. (See *Engineering News-Record* of Mar. 14, 1918, p. 522.)

The history of garbage disposal in Baltimore has been, successively, dumping on the ground, reduction and, finally, feeding. From 1882 until 1901 the garbage was barged to a point six miles below the city by a contractor and there spread over the ground as a farm fertilizer.

A contract for 10 years was awarded, commencing Oct. 20, 1902, at an annual payment to the contractor of $147,300, for the collection, removal and disposal of garbage. An Arnold-Edgerton reduction plant was erected in the heart of the city near the water front, to which the collection carts of the contractor made a direct haul. Complaints of the noncollection of refuse became so numerous, and objections to the odors from the reduction plant were so strong, that the city terminated the contract on Jan. 1, 1908, purchased the collection equipment and reduction plant from the contractor for $372,888, and placed directly under the Commissioner of Street Cleaning the collection and removal of garbage from residences.

A second reduction contract was awarded in 1908 for 10 years, terminating Dec. 31, 1917, at an annual payment to the contractor of approximately $75,000. A new company was organized, and the reduction machinery was leased from the city at an annual rental of $10,000. At the expiration of this contract it was extended for a period of one year, until Dec. 31, 1918, at the request of the city. Under this extension no rental was paid for the use of the city's machinery, so that the cost of disposal amounted in effect to $85,000.

FIRST OF THREE CALLS FOR BIDS IN 1918

The first specifications for disposal by reduction, in furtherance of the recommendation of Jan. 28, were advertised in March, and bids were opened Apr. 17, 1918. Proposals were asked on the basis of a lump sum yearly payment to the city under an 11-year contract, the city to deliver to the contractor all garbage produced within the city.

The specifications defined garbage as being every accumulation of animal, fruit or vegetable food waste, containing not more than 5% by weight of other refuse, generated by or resulting from the decay, deterioration, storage, preparation or handling of animal or vegetable matter in any place or at any point where food is prepared for human consumption, including all kitchen and dining-room refuse.

The contractor was required to receive the garbage at the water-front dumping stations provided by the city, and convey it on his own scows and by his own power to the site of the reduction plant.

The specifications provided that the garbage should be handled and disposed of under a "closed" system of reduction, so as to prevent the emission of offensive odors of any kind while being handled, treated or reduced, and that the process, machinery and apparatus be thoroughly sanitary in effect and the plant so conducted as not to cause conditions which would be detrimental to the public health or comfort, or in any way constitute a public nuisance. All gases carrying odors which were produced or resulted from the operation of the process, machinery or equipment used were to be confined and, before being liberated to the atmosphere, were to be thoroughly deodorized. All water flowing from the plant was to be inoffensive, free from nuisance or any matter dangerous to the public health or to the oyster beds in Chesapeake Bay or its tributaries. It was further specified that the city should have the option of purchasing the plant and equipment from the contractor at the expiration of the contract, and that the reduction site should contain not less than five acres, situated on at least one railroad or above high tide on a navigable waterway.

Under this specification a flat offer of 35c. per ton was received from a bidder who proposed to employ the Cobwell process of reduction, but the city failed to secure the approval of the Capital Issues Committee for the necessary stock issue for the erection of a plant of a capacity of 350 tons per day, and the bid was subsequently released.

A second specification was advertised on Oct. 2, with bids to be opened Oct. 16, 1918, under which the city obligated itself to do the same things as in the previous specifications and asked for alternate proposals on disposal by reduction or by feeding. The reduction contract proposed was for 16 years and offered to the prospective bidders, without charge, the use of machinery which the city owned in the existing plant, for reërection and operation in a temporary plant until the end of the war, after which a permanent plant was to be erected. The contract for feeding was for five years. No bids were received under either plan.

A third specification was advertised on Dec. 6, and bids were opened Dec. 18, 1918. Under this specification the city undertook the delivery of garbage from the water-front stations to the contractor's disposal

site, as the city realized that the collection and removal of garbage from its water-front dumping stations was simply an extension of the collection and removal from the residences, and a matter in which the contractor has no primary interest. The towing of garbage was a proper function for the city to undertake, for when any contractor is required to undertake it the public at large is not always satisfied with the way in which the work is done; but when it is done by the city the public always has the proper remedy for getting a quick and adequate response to its complaints of the accumulation and nonremoval of garbage from the water-front stations.

An act of the Maryland legislature prohibits the erection of a garbage-reduction plant within a nine-mile radius of Lazaretto Light, a shore light in Baltimore harbor, and consequently any possible site for such a plant would involve a barging distance of 16 miles from the water-front dumping station in the city and four hours of towing either way.

Alternate proposals were again asked on disposal by reduction or by feeding. The term for reduction was 16 years, and a flat price per ton was requested—with an adjustment, to be stated by the bidder, in cents per ton for every upward or downward fluctuation in the market value of grease from a basic price of 8c. per pound, as the city felt that it should share this risk with the contractor so that all elements of gambling in making a bid should be entirely removed. The term for feeding was five years, commencing May 1, 1919, and bids were requested on an annual flat payment to the city for each ton of garbage delivered to the feeding site.

No bids were received for reduction, and only one bid for feeding. The contractor operating the present reduction plant made no formal offer.

A contract was awarded Dec. 21, 1918, for disposal by feeding. The price to be paid to the city for each ton of garbage delivered is 3½ times the price per pound of live killing hogs on the Chicago market, as determined by averaging the top prices for each month. The scales for weighing the garbage are located at the feeding site, and all garbage is drained before weighing.

Until May 1, 1919, at which time the piggery shall take the full quantity of garbage produced, the city with its own forces will temporarily dispose of its garbage by burying it in shallow trenches 18 in. deep and 5 ft. wide, in which the garbage is placed 12 in. thick and covered with 6 in. of sandy soil. There will be 17,000 lin.ft. required to accommodate this temporary disposal of garbage. The cost of the temporary disposal is 85c. per ton against a former cost of $1.06 per ton under reduction, the towing cost being included in both figures.

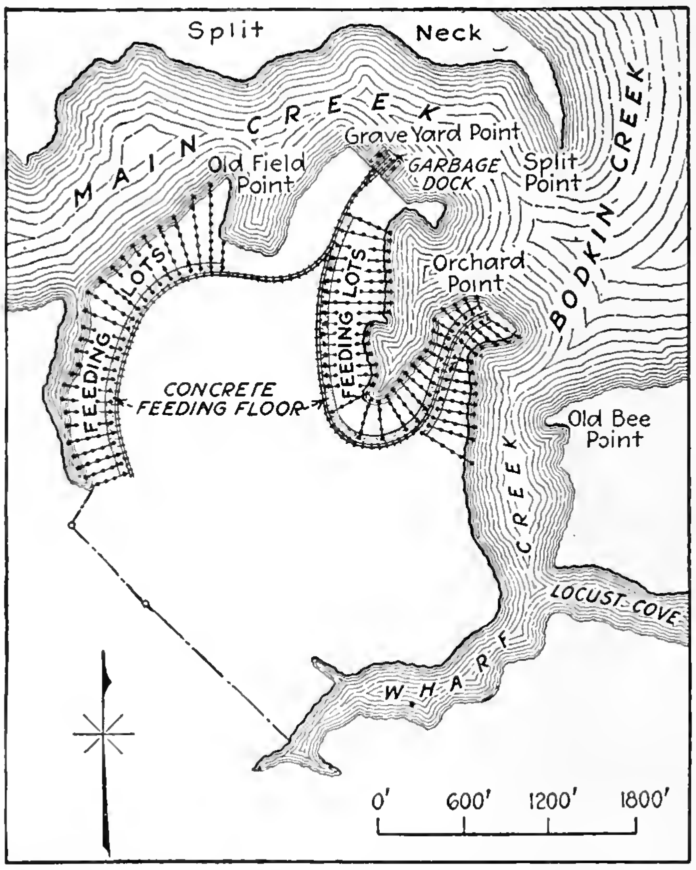
City Delivers Garbage to Feeding Plant

The contractor pays for all household garbage delivered and for those portions of market refuse derived from an animal source, but not for that from a vegetable source or for any packing-house refuse.

The city obligates itself to enforce good primary separation and to deliver the garbage in as fresh a condition as possible to the feeding site, with not less than four deliveries per week in summer and three deliveries per week in winter.

The contractor is given the privilege of using the empty city scows, without charge, on their return trip to the city, for the transportation of the products of the piggery.

The 160-acre farm on which the feeding operations will be conducted is almost level and has sandy soil, insuring good drainage with considerable water through an extensive shore line. Scrub-pine, chestnut and oak timber affords protection from the summer heat. The farm is owned by the city and was purchased at an average price of $140 per acre. It is situated on a point on the opposite side of the tributary of the Chesapeake Bay on which the existing garbage-reduction plant is



FROM SCOWS GARBAGE WILL BE DELIVERED BY SHORT RAILWAY TO CONCRETE FEEDING FLOOR

situated, and this proximity to a plant which has been operating 11 years without any formal complaint or restraint will insure a like freedom for the piggery.

The specifications require that the piggery shall be operated subject to the general and local public laws and under the supervision of such veterinarian and sanitary officers of the county and state as have proper jurisdiction. The city will also employ a veterinarian who will have continual supervision and inspection over the work of the piggery. The garbage which is unfit for feeding or not consumed shall be removed from the feeding platforms, which shall be cleaned at least once a day, and shall be disposed of by the contractor through sale or by plowing under the soil.

The area of Baltimore is 80.5 square miles and the estimated population, with the recently annexed territory, is 720,000. The quantity of garbage produced and the seasonal fluctuation are shown in the accompanying tables. (See the following page.)

It is estimated that 15,000 hogs will be required to consume the maximum amount of garbage that is produced during the summer peak; this will probably rep-

TABLE I.—YEARLY COLLECTION OF GARBAGE AND DEAD ANIMALS, IN TONS, AT BALTIMORE, MD., 1908 TO 1918

Year	Garbage Production, Tons	Number of Dead Animals	Estimated Population
1908	54,000	13,754	569,000
1909	46,900	11,637	576,000
1910	44,500	17,790	559,000
1911	48,300	19,792	565,000
1912	49,200	20,498	568,000
1913	54,400	16,561	573,000
1914	59,100	15,993	578,000
1915	61,500	14,459	583,000
1916	62,400	17,419	588,000
1917	62,300	20,178	593,000
1918	51,324	16,464	670,000

TABLE II.—MONTHLY FLUCTUATION IN GARBAGE PRODUCTION AT BALTIMORE FOR 1917 AND 1918

Month	1917, Tons	1918, Tons
January	4,566	3,272
February	3,089	2,081
March	3,594	3,030
April	3,334	3,081
May	4,979	4,570
June	5,475	4,207
July	7,577	5,570
August	7,399	5,267
September	6,886	4,904
October	7,096	6,657
November	4,517	4,392
December	3,719	.....
	62,261	*51,324

*Estimated from eleven months' collection.

resent the largest piggery in the world, and Baltimore will be the largest city of the United States which has adopted this method for its disposal of garbage. Young shoats, vaccinated with cholera serum, will be purchased in the open market and shipped to the feeding station, where approximately 100 animals will be placed in feeding lots 70 x 250 ft. in area.

Garbage will be unloaded from the city's scows at the feeding site by the contractor, by the use of a locomotive crane with a 1-yd. grab bucket. The garbage will be dropped into steel rocker double-side dump cars of 10-yd. capacity, each on an adjacent track, and hauled by an oil-burning locomotive directly down a lane between the feeding lots, as shown by the accompanying map.

The end of the feeding lots adjacent to the railroad will have a monolithic concrete feeding floor, from which the animals will be excluded by wide gates when the garbage is being dumped from the rocker side-dump cars.

When the train has traveled to the full length of its trip, the garbage will be spread on the return trip to the wharf by a spreader from the rear end of the train, after which the gates will be opened and each lot of hogs allowed to enter on the concrete feeding floors.

Disposal of garbage by feeding involves a relatively small capital investment, which can be quickly and almost wholly liquidated at the expiration of the contract, and in this respect differs from all other garbage reduction plants, in which the machinery is of little use for any other purpose and possesses only a scrap value.

Feeding is a reliable method, and one which offers the highest financial returns to a municipality. It is absolutely essential, however, that the responsibility of the bidder be determined beyond the shadow of a doubt, which condition is usually met when there is sufficient training in animal husbandry and practical experience by the bidder in piggeries that have previously been managed successfully.

Road Building Materials Supply Solved by System

Wisconsin County Eliminates Delays and Demurrage—Contractors Selected for Past Record—Cost-Plus-Profit Contract

By Walter J. Driscoll
Assistant Commissioner of Highways, Outagamie County, Wisconsin

Sand, stone and cement are delivered f.o.b. cars at the nearest railway station to all contractors for concrete road work in Outagamie County, Wisconsin. This system has helped greatly in expediting the work, but, to make sure of efficient handling of the contracts, the county highway commission selects the contractors only after careful consideration of their past performances, instead of accepting the lowest bid. Coupled with a special contract insuring a definite profit to the contractors, this arrangement has simplified the war-time difficulties of road construction and assured steady progress in the county's road-construction program. In fact, since the plan has been in operation there has not been a single delay of moment due to nondelivery of materials, and the season's output of finished road has been increased one-half.

Present Outagamie County road practice has developed by steps. The first was education of the citizens to the need of spending money for improved roads. Then, a season's work was undertaken under the old-style itemized-bid contract awarded to the lowest bidder, and the operation of the plan was studied. Revision of the plan to that outlined above was the outcome of this study. Trial of the new plan proved satisfactory, and

OUTAGAMIE COUNTY HIGHWAY COMMISSION

Date 5/21/18

We have this day shipped you

Car Number 71787

Initial C

Point of Shipment Waukesha, Wisconsin

Shipped to—Station New London

Weight or No. Cu. Yds. 110,000

Kind of Material Gravel

WAUKESHA LIME & STONE CO.

By RS

NOTE—Please make neat, clear figures.
These cards (a card for each car shipped) must be made out DAILY and NIGHTLY, put in an envelope and MAILED to the Office of the Outagamie County Highway Commission, Court House Appleton, Wisconsin. All cards must reach this office the morning following shipment of cars.

OUTAGAMIE COUNTY HIGHWAY COMMISSION

Name of Road Appleton New London

Car No. 71787 Initial C. N. W.

Kind of Material Gravel Marked Capacity of Car 100,000

Name of Station New London

Date Arrived May 24,

Date Spotted " 25

Date Unloaded " 25

Name of Foreman J. N. Briggs

IMPORTANT NOTICE. MAKE GOOD CLEAR FIGURES. Foreman should fill out this card very accurately and carefully and nightly must put all cards of the cars unloaded this day in envelopes and nightly mail to the office of the County Highway Commissioner, Court House, Appleton Wis. Failure to properly send in records of each and every car unloaded daily, will result in a Penalty of $1.00 assessed against the man neglecting to render such report

DEALER'S SHIPPING AND FOREMAN'S UNLOADING REPORT CARDS

its details were improved until the practice described hereinafter was adopted.

Outagamie County is the first in the State of Wisconsin in which a proposition to issue bonds for road construction has been carried by popular vote. Ordinarily, the bond issues throughout the state have been small and have been made by action of the county boards. The electors of Outagamie County in the spring of 1916 approved a bond issue of $700,000 for the construction of a county system of concrete highways. More than 60 miles of these roads have been completed at the present time, and so pleased are the people with the results that in the autumn of 1917 an additional bond issue of $272,000 was voted further to extend and complete the system.

During the first season, little actual construction was accomplished. Contracts were let to the lowest bidder, the only requirement being that the contractor must be able to obtain a sufficient and approved bond. By this contract, also, the contractors themselves furnished all construction materials. Actual construction was begun about July 1, and the next thing realized was that it was Oct. 1 and little of the road had been completed. A few of the contractors had done fairly well while some had failed miserably. The result was that some of the main trunk highways were blocked during the winter, and the people began to evince dissatisfaction.

Partial failure of the first season's program prompted reflection, and the winter of 1916-17 was devoted to study of possible reforms. One conclusion appeared inevitable—a radical departure in plan from the usual methods of road construction in Wisconsin was necessary. It was decided that the county must and would exercise a more rigid choice in the selection of contractors who were to carry on future road work, and would also abolish the practice whereby the low bid was the sole basis on which contracts were awarded. Nothing promotes general satisfaction with and creates a favorable sentiment toward road improvement like the execution of a contract in a minimum length of time. Nothing arouses greater dissatisfaction than to have one of the main roads of a community closed to travel for a long period. Consequently, it was decided to confine future business to contractors who had demonstrated their ability to execute their contracts systematically, and who were equipped to execute their work successfully and in the shortest practicable time. The execution of this plan called for a new form of contract.

Contractor Assured of Reasonable Profit

Assurance to the contractor of a reasonable profit was the basis of the contract adopted. All equipment is provided by the contractor, and he gives the work his personal direction for a fixed sum per mile. Labor is hired and paid directly by the contractor, who is reimbursed twice a month by the county. Time is kept by the county inspector. Also, the county commissioner has power to set the maximum wages and to discharge unfit or incompetent workmen.

Attached to and forming a part of the contract is a preliminary estimate by the county commissioner of the labor cost. If the contractor keeps the actual cost below the estimated cost he receives a percentage of the saving. Also, if he permits the actual cost to exceed the estimated cost he pays a percentage of the excess. Both bonus credits and penalty charges are on a sliding scale, so fixed that the contractor's bonus or penalty increases as the saving or the loss increases. The contract for a county road known as the Seymour South highway illustrates the sliding-scale arrangement. Labor cost per mile was estimated at $4298. Below this sum, to $3998 per mile, the contractor's bonus was 20% of the decrease; below $3998 to $3700 it was 40%, and below, $3700 it was 50%. If the cost increased over $4298, the contractor paid 20% of the increase to $4598; 40% of the increase from $4598 to $4896, and 50% of all increase above $4896.

Besides paying all labor costs, the county purchases and delivers all construction materials to the nearest railway station. Experience with the first season's contracts indicated that delay in the supply of materials had been a prime cause of hindrance. All materials had to be shipped in by railway from plants and quarries situated from 50 to 100 miles from the work. Certain contractors seemed able to obtain materials—at times even more than they required to meet current consumption—and would accumulate stocks, while other important jobs would be shut down for lack of one kind or all kinds of materials. For example, important jobs on the outskirts of the City of Appleton, which is the county seat, were tied up for lack of material, while less essential roads, from the standpoint of service to the whole county, were receiving more material than was needed to maintain progress. Coördination of materials supply, considering the road work as a whole, was lacking. Obviously, the remedy was to be found in selecting a single head who would direct and control the supply and distribution of materials for all the road work of the county. Naturally, the most appropriate head was the county road commissioner.

OUTAGAMIE COUNTY HIGHWAY COMMISSION

CEMENT CARS RECORD

Name of Road ____________ Date ____________

Contractor ____________

We hereby report that this day we have received and unloaded the following cars of cement, consigned to Outagamie County.

Car No.	Initial	No. of Bbls.

Signed ____________

IMPORTANT NOTE. Contractors must mail in these cards **nightly** of the day cars are unloaded. Failure to receive these cards promptly results in the loss to the County of discount for prompt payment from the Cement Companies, so therefore discount losses to the County, through Contractors failure to nightly fill in and return the correct car records, will be charged against said contractor or dealer and deducted from his contract.

CONTRACTOR USES THIS POSTAL-CARD REPORT FOR CEMENT UNLOADED

System Eliminates Delays

For two years the county has furnished contractors with all cement, sand and gravel f.o.b. cars at the nearest railway station. The contractor hauls the material to the work and includes this expense in the labor cost. This plan has its disadvantages, but its success, on the whole, has been great. During the period in which the plan has been in operation, there has not been a single delay of moment in the supply of material,

and the season's work has been increased 50%. Contractors were at first a little skeptical, perhaps, of the innovation, but today it is doubtful that a single contractor would vote to return to the old plan.

Success in supplying and distributing materials by the county has been the result of the system. Each company from which material is bought sends to the county commissioner daily a notification card for each car shipped. This card is of a form devised and furnished by the county, so that there may be uniformity of reports. When the notification card is received it is placed in the live-card file. The card bears the car initials and numbers, kind of materials, weight, destination of car, etc., and is filed under the name of the road on which the materials are to be used and the name of the station to which the car is shipped. For each car an unloading report card is made out and sent to county headquarters by the foreman at the point of unloading. This card differs in color from the notification card and bears car initials and number, weight, date received, date spotted and date unloaded. The form of these cards is shown in an illustration. When the latter card is received from the foreman, it is checked with the corresponding notification card and inserted behind it in the live-card file. When the freight bill is received it is checked with the cards on file, and then the three are indexed and filed in the permanent file under the job name. This gives for quick reference a history of every car of materials. A special postal-card report form is provided, as shown in another illustration, for the contractor to use in reporting cement unloaded.

Report Cards Alone Not Enough

Report cards, however well devised, are alone not sufficient to control shipments. Regularity in making out and forwarding the cards must be assured. To make certain that the unloading foremen do not fail to make reports promptly and regularly, they are first supplied with stamped and addressed envelopes. Whether they have to report one car or a dozen, they must mail the report the night when cars are received, and, if they do not, a penalty is imposed. Once a foreman thus learns that his instructions mean what they say, little trouble is experienced in getting prompt reports—and promptness is essential if materials are to be routed and distributed accurately.

Each morning, at a certain time, the agent of each station at which shipments arrive is called by telephone, and from him is obtained a list of the loaded cars on track at his station. Having these lists and the card reports previously mentioned, and having also the report of the inspector on each job for the previous day, as to how much material was received and how much was used, the companies supplying materials are called by telephone, and orders are given for destination and routing of the day's shipments. Also, means can be taken if necessary to divert cars in transit to new destinations. If one job happens to be shut down, the material is diverted to that other job where it is most needed. If trucks break down or cars pile up, or for any reason it is apparent that material cannot be handled at one point, it is diverted to another point where it can be handled.

Recapitulated, the force employed comprises the assistant highway commissioner, who purchases and directs distribution; the county road inspectors, who report daily the amounts of materials received and used on the jobs; the unloading foremen, who report daily on the cars received and unloaded, and one office clerk. One-half of the assistant commissioner's salary and expenses is charged to materials management, since half his time is devoted to general supervision and inspection of construction. All of the office clerk's time is charged. The county inspectors report on materials as a part of their regular duties. Since they would be employed and receive the same pay whether or not the county supplied materials, no charge is made for their services. Also, since the unloading foremen are the contractor's regular foremen and the daily report which they make is incidental to their regular work, no charge is made against materials management for their services.

Based on the past season's work, from May 1 to Sept. 1, inclusive, during which period there were used in construction 1410 carloads of sand and gravel and 210 carloads of cement, the charges for materials management were:

Assistant commissioner (one-half time)	$600.00
Office clerk (full time)	320.00
Telephone charges	94.90
Printing, stationery, postage, etc.	102.90
Total	$1117.80

These figures are the true and actual records, and may be verified by the accounts and vouchers on file in the office of the county highway commissioner. They permit the following deductions:

Number of cars handled	1620
Average cost per car, cents	69
Number of cars sand and gravel	1410
Cost per car (1410 x 69c.)	$972.90
Contents of cars, cubic yards	54,990
Cost per cubic yard, cents	1.77
Carloads cement handled	210
Cost per car (210 x 69c.)	$144.90
Barrels of cement	42,100
Cost per barrel, cents	0.344

Briefly, then, by the plan described, the county has eliminated demurrage and kept cars moving. In two years there has been no delay in construction due to lack of materials. The cost has been moderate.

Cement Production Falls Off

Statistics and estimates of the production of portland cement in 1918, compiled under the direction of Ernest F. Burchard, of the United States Geological Survey, Department of the Interior, shows a marked decrease in the total output; in fact, the output was the lowest since 1909. The estimated shipments of portland cement in 1918 amounted to 71,645,000 bbl., valued at $113,910,000, compared with 90,703,474 bbl., valued at $122,775,088, in 1917, a decrease in quantity of 21% and in value of 7.2 per cent. The estimated production in 1918 was 71,632,000 bbl., compared with 92,814,202 bbl., in 1917, a decrease of 22.8%. The stocks at the mills increased from 10,462,822 bbl. in 1917 to about 10,594,000 bbl. in 1918, or 1.3 per cent. The exports of hydraulic cement from the United States for the first 11 months of 1918 amounted to 2,025,178 bbl., valued at $5,257,285, or $2.59 per barrel. The exports for the whole year 1917 were 2,586,215 bbl., valued at $5,328,536, or $2.06 per barrel. The export trade also therefore fell short of that for 1917.

The Economic Duties of the Engineer

By W. R. Ingalls
Editor, "Engineering and Mining Journal," New York

In the presidential address before the Mining and Metallurgical Society of America, Jan. 14, 1919, W. R. Ingalls presented a discussion of the present duties of engineers in relation to the economic problems of the immediate future. The portions of this address which concern civil engineers most directly are here reproduced. After emphasizing the great fundamental economic laws, he analyzes the distribution of wealth in this country and asserts that labor gets what is left after taxes, rent, interest and profits have been paid, and that "what it gets is what it produces." Hence follow the necessity and value of greater production, especially in view of the increased alertness and intelligence being applied to methods of production in Europe. The need for promotion of human welfare by the engineer, and his obligations in this direction, are insisted upon. Of the trinity of production—labor, capital and talent—Mr. Ingalls asks who among the talented are so eminent as the engineer, and closes with an indictment of engineering societies and a strong appeal for an awakening to economic duty.—Editor.

SUPERIOR to all industrial and political principles are economic laws, for it is those laws, which are laws of nature, that create and determine principles and practices. One of the greatest of economic laws is that of the survival of the fittest, which exhibits itself in competition, and from that is derived the classic economic doctrine that labor is the residual claimant upon the produce of industry. After the shares of the state, the landlord, the capitalist, and the *entrepreneur* have been deducted, all the rest goes to labor, and here is what is mystifying to many—to wit, rent, interest, and profits are limited by competition, and of them the laborer can get neither the share of the landlord nor of the *entrepreneur* by any economic means, while, as for interest, the residual claimant is benefited by every payment on account of capital used in the production of wealth, and is better off when a high rate of interest is being paid than when a low rate is paid. We may apply the principles to the concrete case of the United States.

The wealth of the United States at the end of 1916 was estimated at about $250,000,000,000. The production of things was about $50,000,000,000. These are very rough figures, as they are bound to be. Estimates relating to this subject vary considerably. I have mentioned the highest that I have seen. There is reason to suppose that the higher figures are more nearly correct than the lower. Anyhow, I am going to use the highest only to give an approximate idea of proportions. This was before the United States entered the war, and, according to the United States Bureau of Labor, we had 40,000,000 workers. Let us assume that rent, interest, and profits averaged 4% of the wealth of the nation, which would hardly be extravagant. That would account for $10,000,000,000 out of the total product, leaving $40,000,000,000 for labor, or $1000 per worker. Two million railway workers and 250,000 iron and steel workmen received about that sum. Those figures are specific expressions of two whole industries. The workmen in some other industries earned more; in some they earned less.

That labor does not get increased wages at the expense of capital (unless capital be confiscated, in which event the increased wages will not long endure) is illustrated by the experience with the railways in Great Britain and America. The Governments guaranteed the bond and stock holders their average return for a series of pre-war years. In the United States this was $1,000,000,000 per annum, or just about 5% on the capital as reported by the Interstate Commerce Commission. The increase of $800,000,000 in wages has been paid by the public in higher freight and passenger rates. To have left the roads in private hands, compelling them to pay higher wages without permission to make higher charges, would have resulted, first, in impaired service and finally in the state having to take over the lines and supply the deficit in order to have any service at all, just as has happened with some of the street-railway lines in Massachusetts. Thus, what is virtual confiscation aids the wage earner only slightly and only temporarily.

But, apart from confiscation, the winning of increased wages by one group of labor is obtained only at the expense of other groups. The inequality in the distribution of wealth is not between the capitalist and the laborer, but rather is it among laborers themselves. There is ample ground for the surmise that the professional, clerical, shop-tending, and similar classes, and the salaried classes generally, have suffered especially at the hands of the railway operators, mechanics, artisans, builders, and miners, but the farmers and the factory folk have not been immune.

I am not going to enter upon any fine analysis of the very rough statistical data that I have given, and shall point out merely that after the state, the landlord, the capitalist and the *entrepreneur* have got their taxes, rent, interest and profits, of which the last three are severely limited by competition, labor gets all the rest, and what it gets is what it produces. The only way it can get more is to produce more.

It is unfortunate that the only way of expressing production is in terms of money. If it were possible to express it in terms of goods, there would be less misunderstanding. However, it is clear that if the total goods and the total population remained the same, it would not matter if the money value of the goods

fell from \$50,000,000,000 to \$30,000,000,000—i.e., it would not matter at all if money wages fell from \$1000 per annum to \$600, as, indeed, they would fall inevitably. On the other hand, if commodity prices remained the same, and the value of products should rise from \$30,000,000,000 to \$50,000,000,000, labor would get so much more, for it would be producing more goods. This is the only way that the war scale of wages can be maintained, and it is a problem of capital, labor and talent to coöperate in accomplishing it, for only by coöperation can it be done.

Classic Economic Doctrine

This is no preaching of capitalism as commonly understood, but is simply classic and proved economic doctrine. The workman who wastes time and material, the farmer who lets himself be led astray by foolish agrarian policies, the small miner who is similarly misled, the manufacturer and the railway company which fail to adopt efficient methods, the interests large and small which create monopolies or enter into agreements to exact noncompetitive prices—all of these are counteragents to progress in human welfare, although in varying degrees. Probably, on the whole, there is more intelligence among the great corporations than there is among the labor unions, and a better understanding of economic principles, but there are some labor unions whose leadership is bright and some corporations whose management is stupid, while of both there are many that are only mediocre. My thesis is rather that the only way whereby the condition of the mass of the people can be improved is for it to produce more, and the loss of capital and life that has been suffered during the last 4½ years makes it particularly essential now to give attention to increased production, to accomplish which we shall undoubtedly need to develop new systems and new methods. This is what I mean by the necessity for reorganization, rather than readjustment, after the war. And it is in such reorganization that the engineer must play a great part. England is already making her plans, and unless we are careful she will get the start of us. Thus, I recently noted the following paragraph in a letter from an observant American traveling abroad:

"England is knitting together for work. The directors of capital and the organizers of labor were never more together. There have been no strikes in England against capital, only against Government wages or failure of Government to equalize matters as between war bonuses and high cost of living. England is studying efficiency and is preparing for the overseas competition of the future. Forty-six English factories, without trade union or labor opposition, have adopted scientific management, but no stop-watch can be used in any factory controlled by the United States Government, nor is it allowed by the labor unions to make studies in time or motion, or to compile records to promote individual efficiency."

Now, more than ever, should labor in this country be taught that its real interest is to produce more, which is to earn more, and employers should not attempt to diminish labor's residual claim by abolishing competition among themselves or artificially enhancing profits by other means. And just as it is the interest of labor to earn the maximum, so is it the duty of the employer, which means that he should ever be alert to improve his methods of production. Wide differences of plant efficiency, administration, etc., are really the inspiration of social unrest among workers, rather than conditions that are intentionally designed to be evil. The social reformer, who does not understand production, is a far less important person in the promotion of human welfare than the engineer, who does.

America and Great Britain may be in no danger of either political or industrial socialism—the results of the recent elections in each country are reassuring as to that—but, nevertheless, some of the virus has got into us, and, anyhow, our affairs are bound to be affected by the back-wash from the revolutions in Russia and in Germany. Those adversities come on top of the direct destruction by the war in the countries that have preserved their stability. You may mark my words that the engineer is going to have from now on such obligations as he never had before. How he will live up to them remains to be seen. Certainly he will live up to them best if he knows what they be. I can do no more than state them as I see them. Perhaps I see only a few of them. Without any doubt I fail to see all of them.

Study Sound Economic Doctrine

First of all, what I see is that the engineer should saturate himself with sound economic doctrine. This is just as much the basis of his professional work as are the sciences of physics and chemistry; and the fundamental laws of economics are just as immutable as are the laws of gravitation and indestructibility of matter. The engineer-economist cannot possibly be a socialist, or a semi-socialist, nor even an industrial democrat; for it is his business to produce, and socialistic tenets do not tend toward production.

The engineer must be not only a counteragent against the destructiveness of the proletariat, but also must he direct himself against the sluggishness of tortoise-like capitalists. One of the cardinal principles of American engineering during the last 20 years has been the exchange of information and the promotion of publicity about everything—technical processes, business relations, corporate affairs. We have seen America forge ahead largely owing to the absorption of this idea, while Great Britain lagged behind and almost went asleep at the switch. She is wide awake now. Let nobody forget it. But we ourselves have got to go further in publicity than we have gone heretofore. Publicity has been a favorite word among us, especially among mining engineers, who have created more openness in the affairs of their profession and their corporations than exists anywhere else. In reading one of Hobson's treatises not long ago I found a word that struck me more emphatically than publicity. He spoke about transparency, and said that "Perfect transparency of industrial operations, perfect fluidity of labor and of wealth, would effect incalculably great economies in the production of commercial wealth." And he said further: "No fact bearing on prices, wages, profits, methods of production, etc., merely concerns a single firm or a single body of workers." The more you think about that the more will you be impressed by its truth and its merit. Further

effort toward perfecting the transparency of industry is, then, another of the economic duties of the engineer for the promotion of the production of wealth.

Must Harmonize Labor and Capital

I have just quoted from Hobson's work on the "Evolution of Modern Capitalism." In an addendum to that book, written in August, 1916, he outlined post-war economic problems in a way that was prophetic. Let me quote one paragraph: "After the war, the task of economic reconstruction will compel the adoption of bolder experiments, both in public and private enterprise, than had hitherto been thought possible. To realize the enlarged productivity, more pacific coöperation between capital and labor, employer and employed, is a first essential. The immediate peril of an economic situation in which labor seems liable to a sudden fall of wage from the artificially inflated war level will evoke conscious efforts to find ways of harmonizing the interests of capital and labor. The issue is one of devising adequate and reliable stimuli to draw from the workers a larger and more regular output of productive energy, a greater willingness to adopt and apply new mechanical and business methods, and, in general, to coöperate more effectively with the other factors of production."

There was real vision in that forecast of 30 months ago. I may be captious in my criticism of it for its reference to capital and labor, which antithetical representation of two parties alone is always irritating to me. Even some of the socialistic writers recognized many years ago that it was necessary to consider the talented classes as well as the laboring and capitalistic; and recently Lenine and Trotzky, appreciating that the confiscation of capitalistic wealth would not reduce Russia to a dead level of equality so long as they allowed talent to exist, logically began the massacre of the intelligentsia. Labor, capital and talent are a trinity, which one of our rough-and-ready philosophers not long ago represented as a three-legged stool. Among the talented, who are so eminent as the engineers, and whose is more clearly the duty of devising the new stimuli that must be provided?

But while devising stimuli for the workmen let us not forget the need for opening the eyes of the employer to his own defects, and I do not mean defects in his human relations, but rather his economic defects. For an employer may be a generous and lovable captain, whom those working for him may affectionately call "the old man," and yet he may be their worst enemy, an economic impediment, owing to his ignorance and backwardness. Just as there is a class of no-rent lands which determine the price of agricultural produce, so is there a class of no-profit employers who determine the rate of wages.

Sometimes we see the backward manufacturer stirred to new and better things by the threat of imminent extinction through the advent of a new competitive process. Thus, about 20 years ago the contact process of making sulphuric acid promised to displace the classic chamber process, and abolish millions of dollars invested in plant, but the chamber-process men bestirred themselves, improved their practice, and held their own. Right now we see in the electrolytic process of zinc extraction a dire threat against the distillers, and the probable dislodgment of some of them. There will not be an extinction of them as a class, but there will be a case of the survival of the fittest; and those will be the fittest who first improve their practices in ways for which there is room, but which they will not take until necessity drives, necessity in this case being the danger of losing all of their capital tied up in plant.

We have seen how in antebellum days Great Britain practically lost important metallurgical industries, such as zinc smelting and copper smelting, in which she was once preëminent, and we see her now keenly studying and introducing improvements that will rejuvenate her and not unlikely put her ahead of us if we do not look out. Similarly in France, Spain, and other countries, where important steps are already being taken. But few people here appreciate the alertness and intelligence with which the Europeans are entering upon a new program, for the simple reason that they know they have got to do it. It is one of the immediate economic duties of American engineers to see that our own industries do not become blind to the reorganization that is being started elsewhere and ought also to be considered here. I am not now thinking in terms of individual enterprises, many of which may be, and doubtless are, very efficient; but rather am I thinking of industries as a whole.

And just as we must think of industries as a whole, so also must engineers think and act as a whole. The individual, no matter how superior he may be, cannot alone make very much of an impression. Indeed, his influence may be greater abroad than at home, and may be more to the advantage of foreign people than his own if he be unsupported by a body of colleagues at home, as witness the influence of Orville and Wilbur Wright in aëronautics.

Indictment of Engineering Societies

I think it is an indictment of the engineering societies of this country that they have made no general efforts for the advancement of economic conditions. Their meetings have been pleasant social functions, the benefit of which is not to be decried. Their printed transactions have been the repositories of valuable technical papers, which are useful for reference and guidance. But in their practical indications, in their practical push toward better things, they have been insignificant in comparison with the splendid efforts of the American engineering press, respecting which we may proudly say, *"Ne plus ultra."* Pray forgive any impropriety in my expressing this, for of course I have not in mind my own trifling part in what hundreds of papers have done with the coöperation of the industries and professions that they represent.

The Mining and Metallurgical Society of America is one of the few professional organizations that have aimed to improve economic conditions by active concerted pressure representing the consensus of professional opinion. Its efforts have naturally been confined to its own industry. In spite of its small membership, which smallness is, after all, inconsequential, so long as there is the right quality of membership, this society undeniably did most in recent years to improve the transparency of the mining industry. With equal assurance may it claim the credit of giving the impetus to the movement for greater

safety for miners. And also may it claim the crystallizing of the movement for a reform of our archaic mining laws upon new lines, as to which the mining industry is in almost unanimous agreement, the actual drafting of the new legislation having been delayed by the advent of the war. It is exactly such kind of work, now with regard to some broad economic principle, now with regard to some plans for new legislation, and at other times, at the present time, with regard to purely technical questions such as the status and particular problems of the copper, lead, zinc, or iron mining industries, that mining and metallurgical engineers must act unitedly through a body like this, if we are going to achieve the right reorganization in this country. And what we do in our particular field, so must the civil, mechanical, and electrical engineers do in theirs.

Engineers' Services in the War

With the entry of the United States into the war, the engineers of the country, like everybody else, enthusiastically offered their services to the Government. I think that the engineers were particularly eager, for they knew from the previous experience of our allies that it was an engineering war. Our own members, and those of other societies, and engineers generally, entered the services and undertook duties at Washington and elsewhere in great numbers. Now, far be it from my thought to minimize their accomplishments. The job was done, the war was won, sooner than we expected and more victoriously than anybody ventured to prophesy; and that was the principal thing. We performed some marvelous engineering feats in building cantonments, in repairing the German ships, in organizing and equipping a great army and transporting it to France, in building shipyards and ships, in feeding our allies and supplying them with materials. I cannot hope to enumerate all the praiseworthy things that we did, largely through the instrumentality of our engineers. Yet I cannot overlook that according to General Pershing's official report, made after the armistice, his armies had fought with French guns, British tanks, and French and British airplanes, although 19 months had elapsed since the United States entered the war. Nor can I forget the coal famine, and other industrial troubles in this country, and consider that the engineers of the country did all that they might. It was not their fault that they did not. They wanted to do everything in the best way, anyhow to give the best that was in themselves. The engineering societies did loyal and effective work in so far as they were asked or permitted. Yet is seems to me that the delay in starting shipbuilding, the subsequent airplane fiasco, the mess about making the 75-millimeter guns, and some mix-ups in our own industry, show that our engineering bodies did not exercise the pressure toward prompt and successful accomplishment that they might have done. Sometimes, when we knew that things were going wrong, we let ourselves be swayed by emotions and by condonations that anyone of us would have regarded as short of his duty to an individual client.

The wicked war is now ended, thank God, and the hurly-burly of doing thinks quickly, without counting cost, is past. We are entering upon an era not merely of reconstruction or readjustment, but of reorganization, in which it will be many years before we shall be able to form much of an idea of what the result is going to be. There is every probability that engineers are going to be called upon to play a great part in this, and now, fortunately, they will be able to give more deliberate consideration to the study of problems and the formulation of plans than they could during the war. They will have to work individually and also concertedly through professional bodies like this. If they fail to do so, they will be derelict not only in their economic duty, but also in their duty as citizens of the Great Republic, whose welfare must not be permitted to suffer during the coming period of competition and elevation among our friends and rivals.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Association Seeks Better Pay for Railway Engineers

In its campaign for fair play for railway technical engineers, the American Association of Engineers has issued a circular giving schedules of monthly pay recommended by three leading chief engineers as follows:

	A	B	C
Division engineer	$300 to $400	$325 to $350	$320
Assistant engineer	250 to 300	224 to 240	225
Instrumentman	175 to 200	$175	190
Rodman	75 to 90	145	125
Tapeman	60 to 75	120	90
Draftsman	130 to 175	150 to 200	175
Chief draftsman	200 to 250	250	250

This circular also announces a plan for financing the campaign, by setting aside half the receipts from new railway members during January, and by soliciting subscriptions from present members and engineers who are not members. This fund will be used to make a study of the wages paid to technical engineers in railway service, and to present the results to the Board of Wages and Working Conditions of the United States Railroad Administration.

Participator Gets Greatest Benefit From Serving Societies

That the benefit of society work and the return is of most value to the member who participates, is one of the points too many young engineers are inclined to forget. The return is prompt and positive, said Charles B. Burdick, president of the Western Society of Engineers, at the recent annual meeting. His further views along the same line follow:

"He educates himself in presenting his message to others. It is no doubt true generally that none receives a greater benefit from an engineering paper than the man who prepares it. Those who miss the opportunity thus to benefit from the society lose one of its chief advantages.

"But we are not all benefited to an equal degree, nor is the gain equal from year to year. Some will reach

a time when perhaps their duties are of such executive nature that they get out of touch with pure engineering, and some may feel that society work is too great a burden, and the *unthinking* may reach the point where he questions its value because he personally does not feel the need of it. If so, then it is well to remember that the society represents all grades of membership, that there are others less fortunate who need to keep abreast of the engineering times, and who need the acquaintance that comes from contact in the work of the society. From the standpoint of earning capacity, the engineer has no better asset than to be well and favorably known among engineers. This is true regardless of the engineer's position, whether he is engaged in purely scientific or commercial endeavor, whether depending on fees for a livelihood or working for a small salary."

Mr. Burdick's positive statements with reference to compensation will cheer the young man. He said, "I believe the society is justified in proper efforts looking toward better compensation for engineers, but anything savoring of trade unionism would be the most positive detriment. The engineer's best stock in trade is his absolute loyalty to the job. It opens fields of unlimited possibilities that would be closed, and properly so, by any evidence of a tendency to coerce, or to standardize service.

"But there are many things we *can* do that would be in the interest of the individual engineer and the public; no doubt more than we have done in the past. We can use our influence to see that technical men are appointed to public positions requiring technical skill, and that remuneration is provided sufficient to attract men of capability. We can help to educate the public to better appreciation of engineering and the necessity for adequate compensation. We can increase our facilities for solving the question of unemployment, particularly among our members."

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Ratio of Tensile to Compressive Unit Stress Should Be Increased

Sir—I have noted with interest Dr. Waddell's suggestion, in your issue of Jan. 16, p. 155, that riveted truss bridges of 100-ft. span be tested by the Bureau of Standards at Washington. Such tests should be an advance over the present methods of testing columns and tension members, and would add to our knowledge. A very great advance was made in our knowledge when full-size tests replaced specimen tests.

The writer believes, however, that the tendency in the American Railway Engineering Association to alter the relation that has existed between compression and tension working stresses is rational and in the right direction. Column tests made some years ago showed that the same proportion existed between the elastic limits and ultimates of full-sized columns, and of full-sized tension members.

Engineers can hardly be said to be hasty in altering the working stresses. The writer believes that safe working stresses in bridge columns could be represented by the formula $14{,}000 - 0.272\,(l/r)^2$, corresponding to safe working stresses in tension of 20,000 pounds per square inch.

There is no denying that if this new tendency is correct much metal has been wasted in tension members of bridges. A similar reasoning leads one to believe that much metal has been wasted in tension flanges of girders—for, as Dr. Waddell points out, consistency requires lower unit stresses in compression flanges than are now used, or higher unit stresses in tension flanges. It would seem that the latter course is safe. The writer further believes that present specifications require altogether too many web stiffeners.

A series of tests of riveted truss bridges would certainly settle the question of relative compression and tension stresses. It would add much to our knowledge of the behavior of members in actual structures.

ROBERTS S. FOULDS.

229 Fourth Ave., Phœnixville, Penn.

Rapid-Transit Construction Should Be Separated From Regulation

Sir—I have seen little or no comment, in either *Engineering News-Record* or any other paper or magazine, relative to the very drastic and pertinent recommendations made by Governor Smith in his message to the legislature of New York, on Jan. 1, 1919, concerning the reorganization of the Public Service Commissions of the state. It does not appear that this matter is receiving the attention that its importance to the city and state demands.

The Governor proposes to take away from the Public Service Commission of the First District all control and supervision over rapid-transit construction work in New York City, and to place it under the control and direction of a rapid transit commissioner, who would devote his entire time to the completion of the construction work. In this recommendation the Governor goes to the very heart of the trouble that has afflicted rapid-transit work from its very inception. If, in the beginning of the work on the dual systems, a single commissioner with full powers had been put in charge, it is more than probable that—even including delays incident to the war—all work under the dual system contracts would have been completed months ago.

With a commission composed of five members, all with equal powers, responsible collectively but not individually, it could easily have been foreseen that delays in carrying out the work would follow inevitably. With such a commission, whose personnel was continually changing in whole or in part almost yearly—new commissioners coming in with new ideas—it was difficult if not impossible to formulate any policy that was likely to stand for any length of time. This has led to end-

less delays and much confusion in the rapid execution of the work.

In addition to its supervision of rapid-transit construction work the Public Service Commission has its primary function to perform, the regulation of public utilities. Therefore, its full time and energy could not be devoted to the construction work. The commission has been handicapped from the very beginning by the method provided by law for handling the work; the method and not the commission is mainly at fault. A great deal of the criticism that has been raised against the commission, on account of the delays in completing rapid-transit construction work, is in many instances both unfair and unjust; it seems to be conceded that the commissioners generally have endeavored to carry out the work both honestly and faithfully; the failure of the commission to function properly must to a very large extent be set down to the mistake that was made in providing a method of supervision that was both cumbersome and inefficient. This appears to be the opinion of most of those who have given the matter much thought.

One of the great object lessons of the war has been that, if results are to be obtained along any line of endeavor, responsibility must be fixed by giving to a single qualified executive full powers and purisdiction. This was demonstrated also in the construction of the Panama Canal; if General Goethals had not had full authority in connection with all construction, it is more than probable that the canal would not be finished yet. The proposal of the Governor to place rapid-transit construction work in the hands of a single commissioner, with full power and responsibility, is sound and is dictated by the hard-learned lessons of past experience.

To engineers especially, and to all those who are interested in the early completion of the rapid transit systems in this city, this is a matter of vital importance, and it would seem that every effort should be made by engineers and the public generally to aid the Governor in obtaining the necessary legislation.

If the statements in the public press are to be believed, it is the intention of the Governor to appoint an engineer as rapid-transit construction commissioner, if the necessary legislation is enacted. This is also to be commended as sound policy and very essential if the work is to be brought to rapid completion.

The Governor has further recommended other radical changes in the organization of the Public Service Commissions of the First and Second Districts. He proposes to do away with the present five-headed commissions and to substitute therefore, in each district, a single commissioner with four deputies; this appears also to be a step in the right direction, as it will not only fix responsibility on a single individual, but will tend toward increased efficiency.

If the commissions are organized along the lines proposed, and the public service commission act is amended so that power is given to the commissioner to enforce his orders without undue delay, much of the discontent and dissatisfaction now existing will be very materially modified.

The legislation proposed by the Governor appears to be so necessary and essential to the welfare of the public generally that I believe the greatest publicity should be given the matter. I have therefore taken this opportunity of writing you at length. ALFRED LUDWIG.

103 West 54th St., New York.

More Comment on Engineers' Salaries

Sir—The letter of Professor Barnes in your issue of Dec. 26, under the caption, "Why Offer Such Low Government Salaries?" reminds me of a recent request addressed to the writer by the wife of a mechanic here in Toledo. She said:

"Please secure a job for my husband at the Air Nitrate plant which will pay as much as the night engineers are receiving there; viz., \$9.15 per night, or nearly \$300.00 per month, as they are on duty every night."

It looks as though Uncle Sam were penalizing the man who possessed both theoretical and practical knowledge, and favoring him whose training is strictly practical. I wonder why this is so? W. J. SHERMAN,

Toledo, Ohio. Consulting Engineer.

Sir—I have read with interest the criticisms which have recently appeared in your columns of the low remuneration earned by civil engineers in America, and as a member of the profession, not an American, but merely a visitor, it would seem to me these criticisms are entirely justified.

I recall an interesting incident which occurred on my first arrival in this country to complete my technical education—a conversation I had with a man who was painting my room. He inquired what course I was studying, and on my replying, "Civil engineering," it was evident that he regarded me as either an ass or an imbecile. Then he asked me if I intended to settle in America. I replied in the negative, on which he remarked it was a good thing, as, if I did, I should starve. He cited the harrowing experience of one of his nephews who had striven hard for a technical education, had been graduated as a civil engineer, and, after working for the munificent salary of \$10 a week for a couple of years—this was before the war—had thrown the calling over in disgust and turned to something else.

There is something radically wrong somewhere with the organization of engineers, and members of the profession must wake up and help themselves, since it is waiting for the millennium to expect others to help them. Is it not a disgrace that those who are supposed to possess organizing ability in a peculiar degree should evince so little of this talent in the protection of their own interests? If civil engineering societies serve no purpose other than to provide opportunities for their members to read voluminous papers on professional subjects, then it is time for engineers in America to decide whether they do not fall short of their proper function.

Engineers must be brought to realize that in furthering their pecuniary interests they are doing something neither unprofessional nor derogatory to their self-respect as individuals. Staunch coöperation secured for the medical fraternity their present recognized status, and only similar effort on the part of engineers can

better a state of affairs which all of the calling, I think, are agreed is nothing short of disgraceful. As a first step in this direction, it would be a good thing if engineers agreed to admit to membership only those able to furnish satisfactory evidence of professional competency, examinations to be instituted to determine the latter qualification. The second step would be for engineers to decide precisely what constitutes civil engineering, to press for the enactment of legislation making compulsory the employment of civil engineers in the supervision of all activities falling within this definition, and to refuse to work with or employ anyone not properly qualified as a civil engineer. A. E. GOLDING.

New Haven, Conn.

RATES OF PAY FOR DRAFTSMEN AND COPYISTS, AWARDED BY DECISION OF THE SHIPBUILDING LABOR ADJUSTMENT BOARD

Oct. 1, 1918

Class	Rates Per Hour	Day	Week	Month	Year
Second-class copyist......	$0.40	$3.20	$17.60	$76.27	$915.20
First-class copyist........	.50	4.00	22.00	95.33	1,144.00
	.60	4.20	26.40	114.40	1,372.80
Draftsman, Grade C......	.65	5.20	28.60	123.93	1,487.20
Draftsman, Grade B......	.75	6.00	33.00	143.00	1,716.00
	.90	7.20	39.60	171.60	2,059.20
Draftsman, Grade A.....	1.00	8.00	44.00	190.60	2,288.00
	1.20	9.60	52.80	228.80	2,745.60
Charge man.............	1.25	10.00	.55.00	238.33	2,860.00
	1.50	12.00	66.00	286.00	3,432.00

EXPERIENCE REQUIRED

Class	Previous Experience	Education
Second-class copyists,	None	No special.
First-class copyists,	6 months	or 6 months' technical.
Draftsman, Grade C,	2 to 3 years	or technical school graduate.
Draftsman, Grade B,	4 years	or technical gradute with some experience.
Draftsman, Grade A,	5 years	or technical graduate with 1 year's experience.
Charge man,	5 years	or technical gradute with 2 years' experience.
	7½ years	or technical graduate with 4½ years' experience

Sir—In *Engineering News-Record* of Dec. 26, p. 1192, I noticed a letter from Prof. A. F. Barnes, dean of engineering, New Mexico College, discussing the low rates of pay offered to draftsmen by the Navy Department. He also quotes from a civil service announcement that "the department is finding some difficulty in obtaining, for the rates of pay it has to offer, men with the qualifications necessary to meet its requirements." He also discusses further the low rates of pay offered to engineers in general by the Government departments.

The answer to the Navy Department statement may be found in the decision by the Shipbuilding Labor Adjustment Board of Oct. 1, 1918, in Section XVII of which rates of pay for draftsmen are authorized. The decision is quoted below:

"In response to the request of the Navy Department and the Emergency Fleet Corporation, of representatives of the employees affected, and of many of the shipbuilding companies, we have held hearings and made a careful study of the compensation and privileges enjoyed by draftsmen, with a view to standardizing these conditions in the shipyards under our jurisdiction. On the basis of this study we direct that in all shipyards building vessels under direct contract with the Navy Department, or the Emergency Fleet Corporation, the compensation, hours and conditions of employment of draftsmen and copyists conform to the following regulations, to be made effective in such shipyards with the pay periods beginning on Oct. 1, 1918, or immediately thereafter.

"First: Draftsmen and copyists are to be subdivided into the following defined classes, and are to receive the compensation indicated:

"*Charge Man*—Man who is in responsible charge of the drafting work on one or more ships and who is supervising its execution. Must have had five years' experience in marine drafting, or be a graduate of a technical school in the course in engineering or architecture, and in addition have had two years' experience in a shipyard. Rate per hour $1.25 during the first six months' service in this class and to increase 5c. per hour at the end of each six months' period to a maximum of $1.50 per hour.

"*Draftsman, Grade A*—Man laying out and developing work completely from specification. Must have had two years' experience as draftsman in Grade B, or five years' drafting or equivalent experience outside of a shipyard, or be a graduate of a technical school in the course in engineering or architecture, and, in addition, have had one year's experience in a shipyard. Rate per hour $1 during the first six months' service in this grade, and to increase 5c. per hour at the end of each six months' period to a maximum of $1.20 per hour.

"*Draftsman, Grade B*—Man designing details. Must have served one year as draftsman in Grade C, or be a graduate of a technical school in the course of engineering or architecture, with some shipyard experience, or have had four years' drafting or equivalent experience outside of a shipyard. Rate per hour $0.75 during the first six months' service in this grade, and to increase 5c. per hour at the end of each six months' period to a maximum of $0.90 per hour.

"*Draftsman, Grade C*—Man handling details under supervision. Must have had two years' experience in a shipyard, or three years' drafting or equivalent experience outside of a shipyard, or be a graduate of a technical school in the course in engineering or architecture. Rate $0.65 per hour.

"*First-Class Copyist*—Man who alters tracing to agree with work or sketches of work, or man starting to do detail work. Must have had six months' experience in a shipyard, or in a drafting room, or in a technical school. Rate per hour $0.50 during the first six months' service in this grade, and to increase 5c. per hour at the end of each six months' period to a maximum of $0.60.

"*Second-Class Copyist*—Man who traces from original work. Rate $0.40 per hour."

In the first paragraph of this section, you will note that "all shipyards building vessels under direct contract with the Navy Department" are directed to follow this decision.

Also, Section XXVI gives the application of this decision and is quoted below:

"This decision shall apply on the Atlantic Coast, Gulf and Great Lakes to shipbuilding and ship-repairing plants, and plants engaged in installing equipment in ships under direct contracts with the Navy Department or the Emergency Fleet Corporation, or the United States Shipping Board, to work performed by subcontractors in such plants or upon such ships being built or repaired under such contracts and to shipyard construction or extension in this district, the expense of which is borne entirely by the Navy Department or the Emergency Fleet Corporation; provided, that rates and

working conditions in connection with such yard construction or extension for building occupations are to be the prevailing rates and working conditions in the building trades in the locality in which the shipyard is situated."

The above quotations are from the decision in Atlantic Coast, Gulf, and Great Lakes shipyards. Section XVII is identical in the decision for Pacific Coast yards.

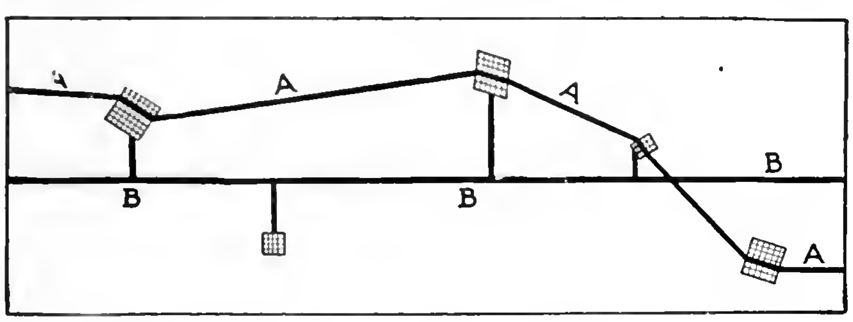
Herewith I have tabulated the rates of pay for different periods, and minimum experience required to qualify for these rates of pay.

I believe that this information should have the widest circulation among engineers, and that this can be secured through publication in *Engineering News-Record*.

Philadelphia, Penn. LLOYD W. WEED,
Concrete Ship Section, Emergency Fleet Corporation.

New Locations for Through Truck Routes

Sir—In the present literature of motor highways more attention is given to construction than to location. It seems to me that, for great highways not chiefly intended for traffic between any two cities, marked advantage would result by such location as would avoid passage of through traffic over the congested streets of the intermediate cities. Such roads would be located



THROUGH ROUTES SHOULD FOLLOW LINE B

not through cities on the route, but near them, to the advantage both of the through traffic and of the intermediate cities and towns. Such location would shorten the distance, and, by giving wider choice of location, could secure more favorable grades and curves.

The sketch illustrates the above thought. Of the two locations, A and B, for a trans-state or transcontinental highway, line B would seem to serve the purpose of freight transportation and through traffic better than line A. At the same time, the streets of the intermediate cities would not be congested with the through traffic. FRANKLIN BACHE.

Philadelphia, Penn.

Labor and Bolshevism

Sir—Your editorials on humanitarian subjects prompt me to submit the following reflections:

So much has been written regarding social conditions throughout the world today that it has seemed strange to the writer that no reference has been made to the wonderfully prophetic poem, "The Man With The Hoe." About 18 years ago Edwin Markham wrote this poem, after seeing Millet's painting of the same name. When the poem was published in the San Francisco *Examiner* of Jan. 8, 1901, there was considerable criticism of it, on the ground that it was an affront to manual labor. That this view was wrong one may easily see by even a casual reading of the poem. The great poet saw that the day would come when the relations of mankind in certain portions of the world would undergo a change. In proof of this I submit the last stanza:

> "O masters, lords and rulers in all lands,
> How will the Future reckon with this man?
> How answer his brute question in that hour
> When whirlwinds and rebellion shake the world?
> How will it be with kingdoms and with kings—
> With those who shaped him to the Thing he is—
> When this dumb Terror shall reply to God,
> After the silence of the centuries?"

We all are too prone to get our cause and effect oriented to suit our own particular viewpoint. The oft repeated words of caution regarding the necessity of guarding against Bolshevik tendencies in our country are due to lack of discrimination between cause and effect. The conception of the painting which inspired this poem was foreign. The poem does not refer to American conditions, political hodge-podgers and Socialistic teachers notwithstanding.

Albany, N. Y. E. W. WENDELL.

Waterproofing Bridge Floors With Burlap

Sir—The writer has read with much interest the very interesting article written by H. T. Welty, engineer of structures of the New York Central R.R., on the waterproofing of railway-bridge floors. In regard to the materials to be used, special emphasis has been laid, in this article, on two points which in the writer's opinion might be subject to some qualifications, and as in the present instance the qualifications are based on practical experience, they may not be uninteresting.

It is stated that the fabric used in the membrane should be thoroughly saturated, and that a cotton drilling so saturated would probably prove to be the best material to be used. It is also stated care should be taken not to overheat the compound used with the fabric.

In 1911-12 the waterproofing of about 50 bridge structures involved in the construction of the New York, Westchester & Boston R.R. was under the care of the writer. On a number of the structures the two conditions above mentioned were purposely violated, and the results have not shown that any defects were produced by this violation. In these constructions a membrane was used composed of a single ply of open-mesh untreated burlap and two coats of a special compound. It was conceded at the time that in many instances burlap which had been used with the ordinary tar and asphalt compounds had, when taken out after several years' use, appeared to be almost burned up. Chemical investigation of this phenomenon had, however, demonstrated, as far as could be judged, that this disintegration was due to the sulphur content in the coal-tar pitch, and many of the grades of asphalt used. The material used in the present instance did not contain sulphur, and such confidence was felt in the above analysis of the cause of disintegration that burlap was used without fear.

As to saturation: One of the chief needs for saturation appears to be the securing of a thorough bond between the fabric and the compound. In the present case, the compound used had such an adhesive quality that the chief difficulty in using it was to prevent it from adhering not only to the burlap but to anything

else with which it might come in contact. There would, therefore, be no difficulty as regards the bonding. Saturation of the fabric before application was thought not to be necessary with the compound used, because, if a thorough bond were obtained and the compound were thoroughly waterproof and really elastic, no water could get into the fabric, and its primary function was merely to hold the compound in place while the cover was being placed. It was also believed that with the compound used partial saturation would actually occur in the field, due to the fact that it was possible to heat this compound material to a very high temperature and apply in a very liquid form—and this leads to the second admonition in Mr. Welty's article, in regard to the question of overheating.

It was quite frankly acknowledged at the time, with the asphalt and tar compounds available, that overheating would destroy them, and this was believed to be due to the driving off by heat of the volatile solvent used in them to obtain plasticity. With the material used, however, the plasticity was not obtained by the use of a volatile solvent, and the material was heated in some instances until it was burning, and was as liquid almost as water.

Now as to results: As far as seven years' service can show, the floors have proved to be remarkably water-tight. A section of the membrane was taken out after four years' service, and has been on file in the office for two more years. The burlap has shown absolutely no evidence of any disintegration of any sort, and is in as perfect condition as on the day it was installed. The compound is bonded to it absolutely, and the burlap, if not quite saturated, has sufficient coating to prevent any possible entrance of water into it. It might be added that the compound itself has remained adhesive and elastic. A. H. RHETT.

320 Fifth Ave., New York City.

Minute Concrete Mix Subject To Some Doubt

Sir—In *Engineering News-Record* of Nov. 28, 1918, p. 966, there was an editorial under the heading "Minute Mix Justified By Extensive Tests," in regard to which the writer, who is familiar with the report that was the basis of this editorial, desires to comment.

Professor Abrams, in the introduction to this report, rightly states that this report must be considered merely preliminary to any comprehensive investigation covering the performance of concrete mixers, but in his conclusions he makes some strikingly general deductions which are emphasized in your editorial.

From tests of a similar nature made at the Bureau of Standards and from extensive observations of field concreting operations, the writer is of the opinion that the conclusions, especially in regard to 1 min. being the most efficient period of mixing, are too general and broad in application. This the writer believes for the following reasons:

First, the results reported in Professor Abrams' paper deal only with concretes in which sand and gravel are the aggregates, and the question of the possible effect on this problem of using aggregates of different character (i. e., crushed stone) is not taken up.

The accompanying table, which includes results of

TESTS ON TIME OF MIXING CONCRETE

Mixer: Chain Belt No. 145

Each result average of 3-8x16 cylinder. Stored in damp closet.

Composition of Concrete (Parts by Volume)	Water, %	Time in Mixer	Compressive Strength Lb. per Square Inch, —Age in Weeks— 2	4	8	13	Average of All Tests
1 part Portland cement, 2 parts Cow Bay sand, 4 parts crushed trap rock ($\frac{1}{4}$ to 1 in.)	8.06	45 sec.	1300	1865	1965	2992	2030
		2 min.	1850	2335	2710	3697	2648
1 part Portland cement, 2 parts Cow Bay sand, 4 parts Cow Bay gravel ($\frac{1}{4}$ to 1 in.)	6.90	45 sec.	1285	1755	1795	3060	1974
		2 min.	1300	1675	1920	2832	1932
1 part Portland cement, 3.15 parts Cow Bay sand, 5.42 parts crushed limestone ($\frac{1}{4}$ to 1 in.)	12.2	45 sec.	....	840	1060	1900	1267
		2 min.	....	1285	1785	2542	1871

The consistency used may be described as a "quaking" consistency, and probably closely resembles what Professor Abrams considers the normal consistency.

some tests made at the Bureau of Standards, indicates that Professor Abrams' deduction as to the proper period for mixing is applicable to sand and gravel concrete, but not to concrete in which either crushed trap rock or crushed limestone is the coarse aggregate.

Second, in this report of Professor Abrams, the facts are evident that the increase in strength due to longer mixing becomes greater as the size of the largest particles decreases. From the writer's observations, made on mixing in the field a rich concrete in which the particle of maximum size was ½ in., it is believed that the increase in strength due, say, to mixing 2 min. rather than 1 min., would be even greater in a 1:2 concrete than in the 1:5 concrete series given in this report, in which the size of the largest particle is varied.

Third, it has been observed that where an effort has been made to approximate 1-min. mixing in the field with a 1:2 mixture, with the largest particle ½ in., there is a distinct tendency for dry balls to appear in the output of the mixer. These are sometimes 3 or 4 in. in diameter, and indicate plainly that the concrete has been imperfectly mixed. In this connection it might be stated that these dry lumps might be easily broken up in molding the test pieces, and no reduction in strength result from their presence, while a quantity of such dry unmixed concrete might be a serious source of trouble in the actual work.

Finally, it is the writer's opinion that it is impossible so to coördinate the operations of filling, mixing and discharging a concrete mixer as to give the materials one full minute in the mixer and approach very near the batch-a-minute output. Where the batch-a-minute performance is accomplished, it is obtained only by greatly decreasing the actual time of mixing. From observations on the operation of some 15 different types of mixers at present on the market, it was noted that practically all of the mixers tried out required at least 30 sec. to dump a reasonable amount of their batch (in this case a 1:2 mortar).

Therefore, the writer believes that, in specifying the proper time of mixing, the mix to be used, the character of aggregate, and at least the type of mixer likely to be employed, should be considered, and a minimum time specified for all the material to be mixed in the drum, and a limit fixed on the number of batches permitted for a given period of time.

Philadelphia, Penn. HERBERT A. DAVIS,
Concrete Ship Section, Emergency Fleet Corporation.

HINTS FOR THE CONTRACTOR

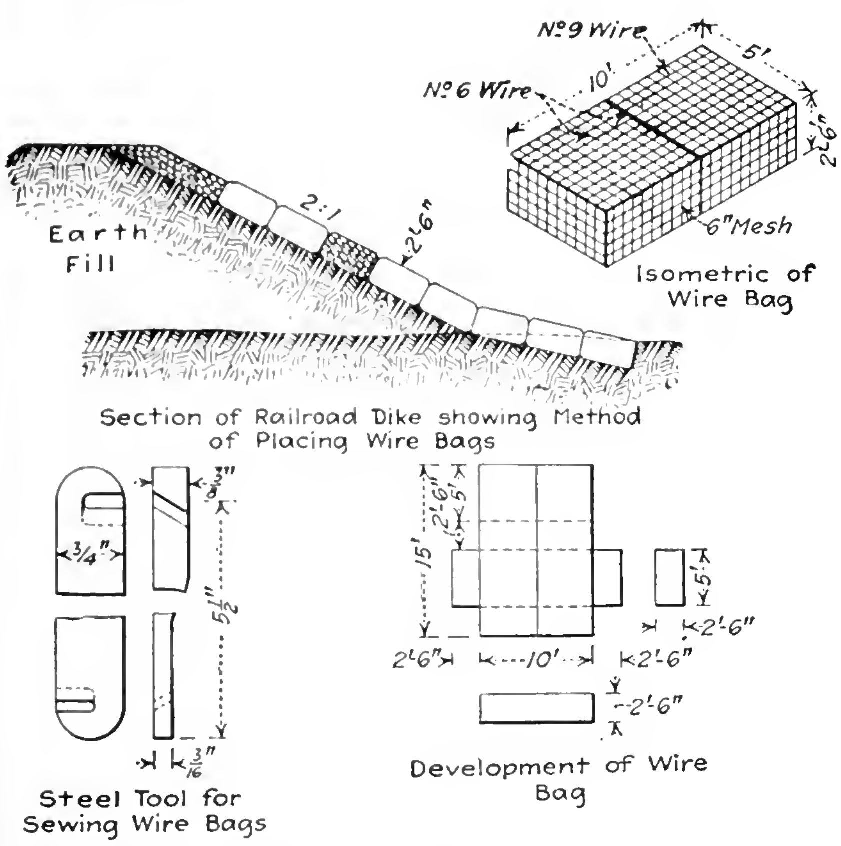
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Weaving Wire Bags To Hold Riprap on Earth Embankment

EARTH embankments at Lake McMillan, on the Carlsbad project of the United States Reclamation Service are protected by wire bags full of riprap, where the velocity of the current is higher than 5 cubic feet per second.

L. E. Foster, project manager, describes the making of the wire bags, in a recent issue of the *Reclamation Record.*

The bag material, of No. 9 galvanized wire mesh, was cut and sewed in the shop into the developed form shown in the drawing, then folded together flat, and hauled to the work. The bags were then sewed into rectangular



WIRE-MESH BAGS HOLD RIPRAP TO PREVENT SCOUR ON EARTH EMBANKMENT

form with the lid loose. The bags were set in a horizontal row in place and they were filled directly from the rock wagons.

The labor of filling the bags proved to be less than to lay riprap of the same thickness. Care was taken to have all rock next to the wire mesh of greater dimensions than 6 x 6 in. Since this is a relatively small-sized rock, much rock is available for bag work that would be otherwise considered too small for use in riprap.

After the bags were level full the top was closed down and sewed securely on the front and two sides. The bags were also tied to each other along these edges, thus forming a continuous mat.

The tool shown in the drawing was used in sewing together the bags. The ties were placed at 6-in. intervals. Each 5 x 5 x 2½-ft. bag weighed 70 lb. empty and carried 4.63 cu.yd. of riprap.

Other Articles in This Issue of Interest to Contractors:

How the New York Canal Concrete Barge is Being Built — Page 268

Road Building Materials Supply Solved by System — Page 289

On the basis of 259 bags the detail costs of the work are as follows:

Material required per bag:
- 31 lin.ft. of 60-in. wire mesh;
- 11 lin.ft. of 30-in. wire mesh;
- 5 lb. No. 12 tie wire.

Cost:

Cost per square foot, including tie wire	$0.0229
Weight per square foot, including tie wire, pound	0.38
Weight per bag (182.5 sq.ft.), including tie wire, pounds	75.4
Cost per bag (material only)	$4.20

Detail costs:

Material for bags	$4.20
Manufacture of bags ready for placing	.905
Placing and filling bags	1.125
Closing bags and sewing	.446
Total unit cost per bag	6.676
Cost of rock hauling for bag work per cubic yard	0.17
Cost of wire bag work per cubic yard	1.681

Swing Pipe Saves Hose Changes on Concrete Highway Work

By H. H. Edwards

Highway Laboratory, University of Illinois, Urbana, Ill.

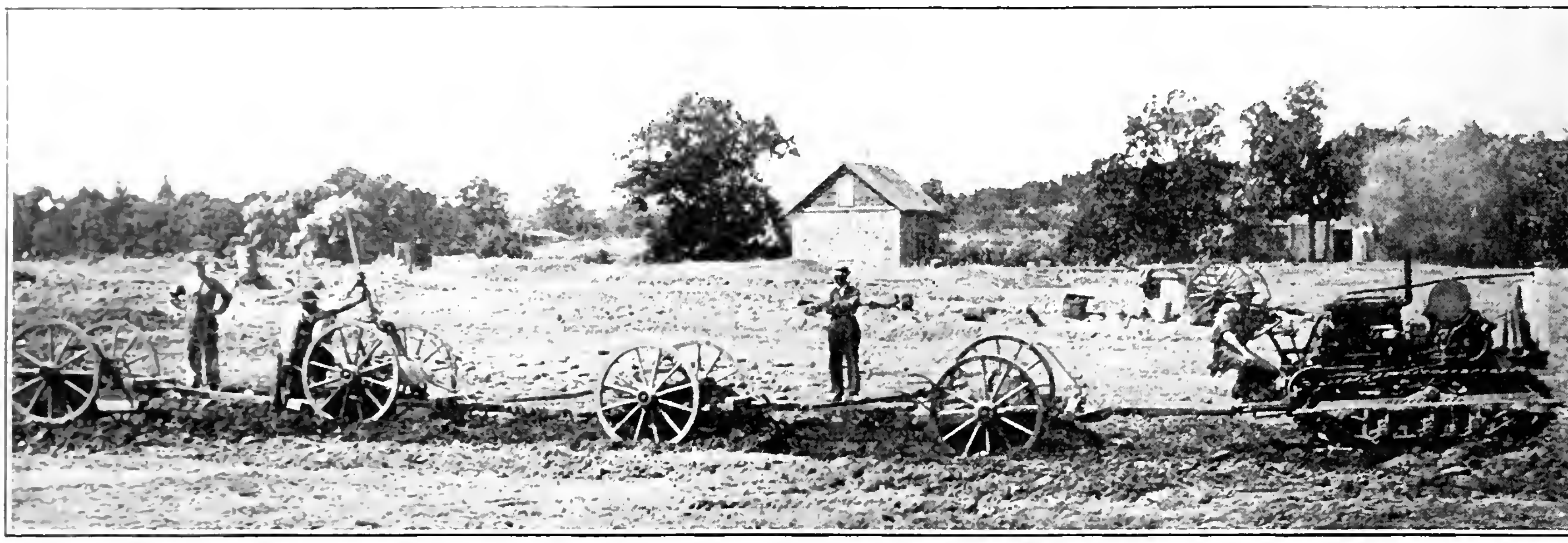
CONSIDERABLE saving of time and labor in the operation of a mixer on highway concrete construction is effected by fitting a swing joint and one or two lengths of pipe to the tee in the water line. Such an arrangement will reduce by one-third the number of times the hose has to be changed, without using an unusual length of expensive hose, which means an added saving.

As seen by the illustration, a nipple and elbow are screwed into the tee, a couple of lengths of pipe are coupled, and the mixer hose is attached to the end. If the length of hose were such that the tees on the main line could be placed 160 ft. apart, by using the 20 ft. of iron pipe as above it would be possible to place the tees 200 ft. apart, thus reducing the number of changes. The length of pipe is first turned toward the mixer from the tee, and, as the mixer moves down the road past the tee, the pipe is flopped over and laid in the other direction.

SWING PIPE REDUCES NUMBER OF HOSE CHANGES

One Tractor Operates Six Wheeled Scrapers

SIX wheeled scrapers coupled together in train were loaded and hauled by a gasoline tractor last summer in mining molding sand near Burlington, Wis. The haul from the pit was $\frac{1}{8}$ mile to a bridge over the loading track where the scrapers dumped through a trap into cars. An evener was fitted across the back of each scraper, and the tongue of each was cut off about one-third. When coupled tongue to evener a space of 8 ft. was left between the scrapers. In operation, four to six scrapers were coupled in tandem, with the forward scraper coupled to a tractor geared to three speeds.



TRACTOR OPERATES TRAIN OF WHEELED SCRAPERS IN GRAVEL PIT

The train was hauled through the pit at low speed, and two men loaded the scrapers one after another. Travel to the dumping bridge was at middle speed, and return, unloaded, was at high speed. At the bridge, dumping devices automatically tripped and righted the scraper bodies. Travel to the dump was at a speed one-third faster than team haulage, and return to the pit was at twice the speed of teams. With a haul of $\frac{1}{8}$ mile and a force of four men, four to five coal cars of ordinary size, about 35 cu.yd. each, were loaded in ten hours. Previously, the same outfit of scrapers required from 15 to 18 men and three teams to accomplish the same task. The tractor scraper outfit was originated by the Walsh Sand & Gravel Co., Burlington, Wis. James Walsh devised the method of coupling the scrapers and also the automatic dumping devices.

Special Traveler Erects Frame of Large Railway Shop

ERECTION of a steel-frame machine shop at Logansport, Ind., for the Pennsylvania Lines West of Pittsburgh, was effected by the use of the double-boom steel traveler shown in the accompanying view. The building is about 475 x 195 ft., with a 250-ton, 90-ft. overhead electric crane in the erecting bay.

The traveler has a deck about 32 x 26 ft., carrying triangular side frames which are braced together and on which are mounted two 60-ft. booms. For each boom the rated hoisting capacity is 10 tons, but 15-ton loads have been handled. Each boom is served by a 30-hp. hoisting engine and boiler, these being mounted on the working deck, 3 ft. above the rails. The track consists of a pair of 80-lb. rails spaced 25 ft. on centers, each rail being laid on ordinary railroad track ties. There are three double-flanged wheels on each side, one at the rear and two at the front, to carry the load from the mast and boom. These are of 12-in. diameter on the tread and are $4\frac{3}{4}$ in. wide over the flanges.

This work is under the direction of Robert Trimble, chief engineer of construction, Pennsylvania Lines West of Pittsburgh. The Austin Co., Cleveland, Ohio, is the contractor, with J. E. Anderson as superintendent.

STEEL TRAVELER READY TO ERECT STRUCTURAL FRAME

Dry Dock Filled by Pumping

A graving dock of moderate size is to be built by a Swedish shipbuilding company at Ljusne, North Sweden, on land above water level, and will be filled by pumping. London *Engineering* says the dock will be 328 ft. long and of such size as to accommodate a 4000-ton vessel. The boat to be docked will enter a lock and will be raised and lifted into the dock by means of water from an adjacent water-power canal. By this arrangement the dock can be filled and emptied without the use of any extra pumping plant, and at low cost.

NEWS OF THE WEEK

New York, February 6, 1919

Proposed Modifications of the Federal-Aid Road Law

Despite agitation for a more extended road-building program, it is believed by many who are in touch with the situation in Washington that the most that can be obtained from the present Congress is represented by the following clauses inserted in the Post Office Department Appropriation Bill for 1919-20 by the Senate Committee on Post Roads:

Section II of the Federal-aid road law of 1916 is to be modified so that a post road is interpreted to mean any public road which is now used, or may be made suitable, for the transportation of the United States mails, excluding roads through places with a population of 2500 or more where the houses average less than 200 ft. apart.

The amount of Federal aid in the 1916 law is to be increased by $50,000,000 for the current fiscal year, $75,000,000 for 1920, and $75,000,000 for 1921. Honorably discharged soldiers, sailors and marines are to receive preference, other conditions being equal, when labor is hired for the roads on which these additional funds are used.

War material not needed by the War Department but suitable for highway improvement, is to be transferred to the Secretary of Agriculture at the discretion of the Secretary of War, and to be then distributed among the state highway departments for use in Federal-aid road construction and national forest roads, in the same manner as Federal-aid funds are now distributed.

Appropriations of $3,000,000 annually for the fiscal years 1920, 1921 and 1922 are to be made for coöperative or independent construction of roads in the national forests.

Public Service Engineers Reinstated

On Jan. 31 the Board of Estimate of New York City reversed its action in discharging nearly 400 employees of the Public Service Commission. The commission was authorized to reëstablish the roll in force on Dec. 31, and an appropriation was made to maintain this organization for February and March (the rest of the current quarter).

All those discharged, most of whom were engineers, have been reëngaged by the commission, with the exception of some who had taken positions elsewhere. The principal effect of the board's action of Dec. 31 (noted in *Engineering News-Record* of Jan. 9,

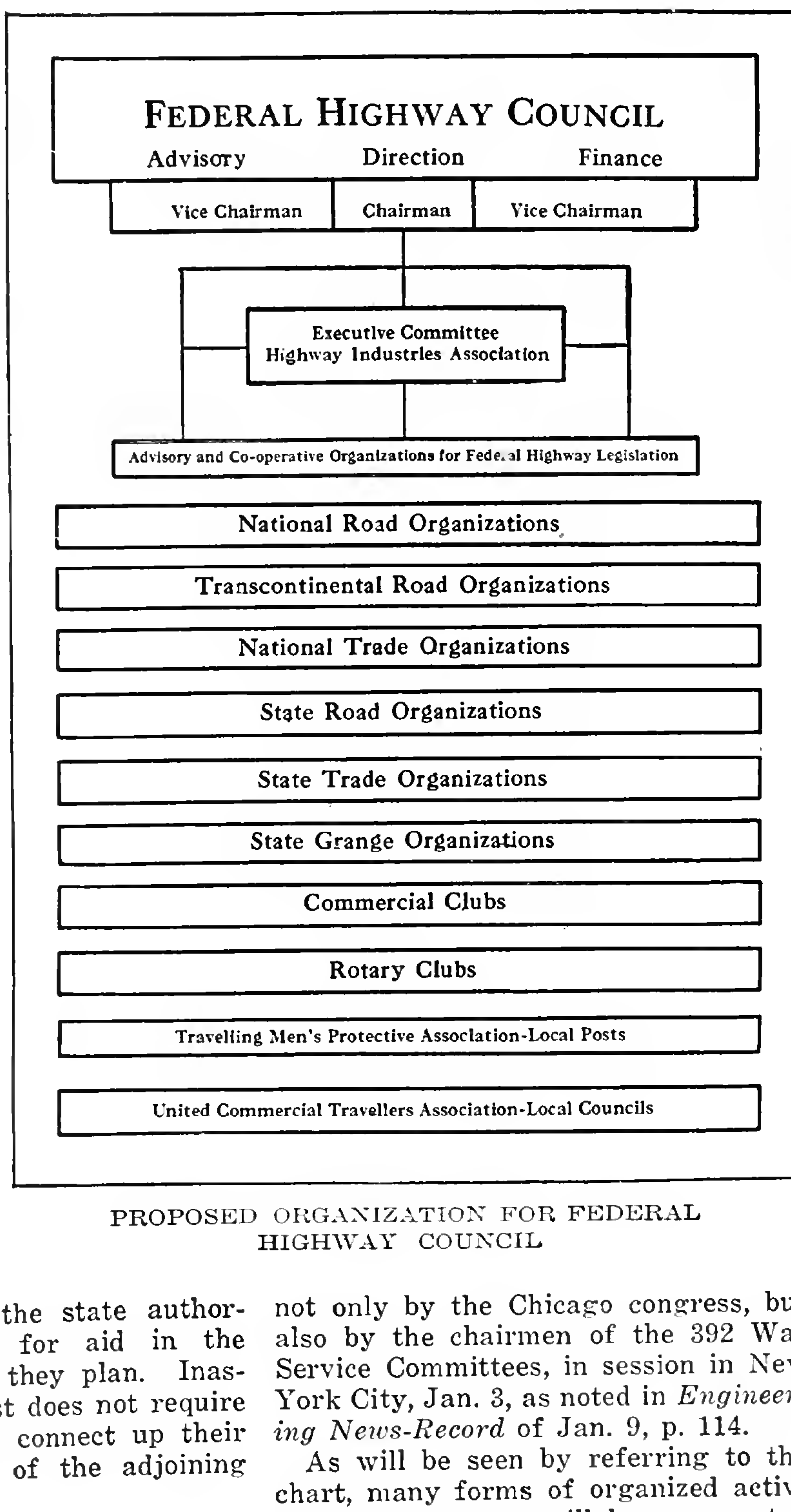
(*Concluded on page* 304)

Large Committee Will Promote Federal Highway Commission and System

Civic Organizations Throughout Country to Coöperate—Highway Industries Association Takes Leading Part

Formation of a Federal Highway Council, as outlined in the accompanying chart, is being arranged in order to promote, crystallize and mobilize sentiment throughout the country for a Federal highway commission to build a Federal highway system. The movement is an outcome of the great highway congress at Chicago last December, and the Highway Industries Association, which, with the American Association of State Highway Officials, called the joint convention, is taking a leading part in the organization of the new movement. It has been realized for some time that the present method of laying out roads under the Federal-aid, state and county plans could never produce anything but a disjointed system. The Bureau of Public Roads has not the power, under the present law, to originate work, but must wait for the state authorities to request it for aid in the road projects which they plan. Inasmuch as local interest does not require it, the states seldom connect up their systems with those of the adjoining states.

To overcome this condition, a Federal highway administration is proposed which will provide for the building of a system distinct from that of the states, while the Federal aid to the states will continue as before. Into the Federal system would be incorporated such present state and county roads as would meet the requirements of the system. Such a plan has been indorsed not only by the Chicago congress, but also by the chairmen of the 392 War Service Committees, in session in New York City, Jan. 3, as noted in *Engineering News-Record* of Jan. 9, p. 114.



PROPOSED ORGANIZATION FOR FEDERAL HIGHWAY COUNCIL

As will be seen by referring to the chart, many forms of organized activity in the country will be represented on the committee. Circular leters containing reports of the action taken by the two conventions were sent to the organizations designated and others, and more than 300 answers have been

received, giving approval and signifying a willingness to coöperate by sending delegates to assist in forming the organization.

The plan is to have one delegate from each national, state and local organization upon the main committee. These will elect the various chairmen, while the Highway Industries Association will act as the executive committee and work through the different members of its local organizations, which will in turn use their efforts to bring before the public in their particular localities the need for a national highway system.

Public Works Department Up at Washington

Congressional Committees Listen to Suggestions from Engineers for Its Formation

(Washington Correspondence)

Last week the long dormant subject of a Federal Department of Public Works became more or less a live issue at Washington. There is no prospect that anything definite will be done in the immediate future, particularly by the present Congress, which goes out of existence on Mar. 4 and which is far behind in its necessary appropriations and other legislative business. It is a fact, however, that the subject has been brought to the attention of at least two Congressional committees and that agitation on the part of a number of individual engineers and of the Engineering Council is in prospect.

Before the Senate Committee on Labor and Agriculture, which is holding hearings on the Kenyon bill providing for an emergency appropriation for public work (noted in *Engineering News-Record* of Jan. 30, 1919, p. 256), some engineers urged to the consideration of Congress the necessity for a department of public works. The Kenyon bill in effect provides an emergency department of public works made up of representatives of various departments, the Chief of Engineers of the United States Army, and two citizens to be appointed by the President. While the bill is supposed to be an emergency measure, it provides that the appointive members shall be designated, one to serve for two years and one for four years, and thereafter each member shall serve for four years, all of which would indicate that emergency in the mind of the author of the bill is not the same as temporary. The bill also provides that money shall be loaned to municipalities, counties and states, by the Federal Government at a rate not less than 5 per cent., to build public works, and that an officer of the Corps of Engineers, U. S. A., has to pass upon the practicability and usefulness of any state or municipal public work for which such an advance is asked. The Chief of Engineers, furthermore, is ordered to coöperate so far as is practicable with the state or local officers having in charge the planning, supervising, directing and executing of any such public work. This, it will be seen, practically puts the control of the emergency public works department in the hands of the Chief of Engineers of the Army.

The other committee before which the subject has been broached is the Senate Committee on Public Buildings and Grounds. In the course of testimony on an entirely different matter, General Marshall of the Construction Division had occasion to refer to the need for a department of public works. This seemed to interest the committee, particularly Senator Hardwick of Georgia, who was acting chairman, and the General, together with some members of his staff, and some representatives of the Engineering Council, which had later discussed the matter, were asked to appear before the committee to give their opinions of the necessity for a department of public works and possibly of a method for its operation. There has been as yet no public indication that the committee intends to bring in any particular bill for a Federal Department of Public Works, but the attitude of the senators who make up the committee and who are interested in Government construction probably more than any other senatorial committee, showed that the present is a live time for conducting among the legislators an educational campaign on the public works department idea.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

Division of Engineering, United States Employment Service, 29 South La Salle St., Chicago, Ill.

Professional and Special Section, United States Employment Service; George W. Kirchwey, state director, 16 East 42nd St., New York City.

Public Service Engineers Reinstated

(Concluded from page 303)

p. 112) is that the 339 discharged engineers were deprived of a month's pay, and that the rapid-transit construction work was temporarily checked and disorganized. A number of the men discharged remained at work through the month, however, and, according to officials of the commission, this proved of great assistance in carrying on the necessary office and field operations with the depleted force.

Seek Reasonable Motor Truck Requirements

Road Engineers and Manufacturers Consider Speeds, Weights and Sizes at Meeting

A spirit of coöperation marked the meeting of the National Highway Traffic Association at the Automobile Club, New York, Jan. 31, which was called to discuss the weight, size, and speed of motor trucks. In a discussion entered into by both highway engineers and representatives of truck manufacturers, there was evidenced by both sides a distinct desire to compromise on a reasonable basis. Truck limits were discussed in the light of general conditions throughout the country, and a resolution was passed to promote road building as a national undertaking.

In opening the meeting, A. H. Blanchard, president of the Highway Traffic Association, stated its purpose and announced that after hearing a few set speakers the meeting would be open for general discussion. Before opening the meeting he offered a resolution favoring a national highway commission, a national system of good roads, and greatly increased Federal aid. The resolution was unanimously carried.

George H. Pride, chairman of the Committee on Motor-Truck Regulation, the first speaker, dealt with the necessity of coöperation between the interested parties. As trucks are eminently utilitarian they must be fostered for the benefit of the country, which means the use of trucks of reasonable dimensions on adequate roads.

Since no set of figures can settle the proper thickness of road crusts, an arbitrary limit must be placed on the trucks until such time as experience supplies a working basis, according to W. G. Thompson, state highway engineer of New Jersey. Mr. Thompson maintained that at present highway design necessarily rests upon empirical rules, as there are so many unknown quantities. After pointing to the great increase in truck traffic and stating that New Jersey has as much as any state, he suggested the figures recommended by George M. Graham at the Chicago congress as a basis to start discussion. These call for a maximum truck load of 28,000 pounds. See *Engineering News-Record* of Dec. 19, 1918, p. 1109.)

Charles G. Bond, counsel for the Motor Truck Association of America, decried the tendency to include too many details in uniform traffic laws. He felt that details should be left to the local officials and that emphasis should be put on simplicity. In his opinion, the law should be limited to the regulation of dimensions, weights and speeds, leaving out such details as license fees, etc. Otherwise, there will be no possibility of getting the law adopted generally. He cited the New York State Constitution submitted a few years ago, which had so many details that everyone had something against it.

General conditions as they affect the problem were set forth by E. W. James, general inspector, Bureau of Public Roads. He gave statistics to show that the great porportion of roads receiving Federal aid are of types from ordinary earth up to water-bound macadam. Six-ton gross loads for bridges are about the largest that can be obtained in many states, according to Mr. James. From this he argued that before you can pass a uniform traffic law throughout the country you must secure uniform construction details. He believes that the truck of five-ton capacity is the heaviest feasible at present, and even this weight could not be borne by a large portion of the roads.

In arguing for a great campaign of education for the public, A. D. Williams, the retiring highway commissioner of West Virginia, stated that it was his belief that the United States should spend $20,000,000,000 for roads in the next few years. In answer to general discussion favoring unlimited motor-truck expansion, he said that the engineers stood ready to build roads which would bear any load, if the money is provided. Their greatest trouble is financial.

Charles M. Upham, chief engineer, Delaware Highway Commission, made a plea for definite assurance as to the maximum loads of the future, so that the engineer would have a standard to work with. Discussion brought out in this connection that the 28,000-lb. load suggested by George M. Graham is about the maximum that rubber tires will stand.

In closing the meeting, President Blanchard announced that a progress report of the Motor-Truck Regulation Committee will be made at a joint meeting with the American Road Builders' Association at its convention to be held in New York City Feb. 25-28.

Bridge Committee Discusses Road Crossings Over Large Rivers

Unification of bridge and road control under the same Governmental authority was advocated at the organizing meeting of the Division of Bridges, National Highways Association, held recently at New York. A resolution was passed expressing the opinion of the division that construction and maintenance of bridges should in general be in the hands of the same Governmental unit that builds and maintains the adjoining roads.

Active discussion developed on the subject of the present seriously inadequate provision for highway crossings over large streams, especially those forming state boundaries. Such instances were cited as the absence of all highway crossing over the Mississippi south of Memphis and over the Hudson south of Albany, and the existence of only three highway bridges across the Missouri within the State of Missouri, a length of 350 miles. The chairman pointed out the feasibility of adding a highway floor to a railway bridge at the time of its construction, and the meeting decided to promote all efforts of local authorities to obtain the construction of such joint bridges.

Recognizing the value of the work in improving bridges done by the various state highway departments, the meeting took note of the lack of similar care for problems of interstate river crossings, and resolved to coöperate in working out the problems of such crossings, when requested. The desirability of uniform requirements for bridges throughout the country was also discussed.

Another meeting of the division is to be held within 30 days. The members are: Chairman, Gustav Lindenthal, New York; Admiral H. H. Rousseau, Washington; Prof. George F. Swain, Boston; Frank C. Osborn, Cleveland; Prof. E. J. McCaustland, University of Missouri; Prof. Donald Derickson, Tulane University; Edward Duryea, San Francisco; R. D. McCarter, New York; F. E. Schmitt, New York; and Charles Evan Fowler, 25 Church St., New York City, secretary.

Illinois Engineers Will Assist In Legislation

Many General Measures for Regulation Indorsed by State Society at Bloomington Meeting

That state legislation is a means of promoting progress in engineering and technical development, is evidently the opinion of the members of the Illinois Society of Engineers, who attended the 34th annual meeting, held at Blooming-for Jan. 29-30. They indorsed measures for regulating vehicle loads and speeds, regulating housing conditions, promoting drainage and land reclamation, regulating the operation of sewage- and water-treatment plants, regulating the practice of engineering, and expediting the preparation of topographic maps of the country. Besides appointing a legislative committee, they arranged for engineering participation in the revision of the state constitution. They advocated the construction of municipal improvements and other public work as aiding in the solution of the problems of the reconstruction period, urged adequate salaries for school teachers, and also the lowering rather than the raising of railway rates on materials of construction.

Need of a state law to regulate housing conditions in order to promote health and vitality, to prevent disease and to protect the community, was presented in a paper by Charles B. Ball, of the Chicago Health Department. The housing bill now before the legislature was outlined by Senator Kessinger. As it appears that this applies to new structures, the suggestion was made that it should include the remedy or removal of existing unsanitary conditions. The engineer's part in the after-the-war reconstruction problems was reviewed by Prof. F. H. Newell, of the University of Illinois, while W. D. Gerber, of Chicago, reviewed the possibilities of engineering coöperation.

Prevailing unsanitary conditions of sewage-treatment plants was shown in a paper by M. C. Sjoblom, assistant engineer of the state Board of Health. These are due partly to ignorance and lack of understanding, but largely to neglect, plain and simple. As a remedy, Mr. Matte, chief engineer, presented a draft of a law giving to the board power to compel the abatement of nuisances and dangerous conditions, and also power to compel the employment of competent operators at both water- and sewage-treatment plants. The city water-supply system of Bloomington was described by C. D. Williams, superintendent, and a visit was paid to the pumping station, where a new concrete-lined well is being sunk.

Flexible paving for country roads, in the form of brick on gravel, macadam or lean concrete, was advocated by G. H. Reiter, of the Illinois Paving-Brick Bureau. A talk by Clifford Older, state highway engineer, on the program for road work under the Illinois $60,000,000 bond issue, produced a rapid-fire attack of questions concerning what work is to be done, and where and how.

Regulation of wheel loads and speeds on country highways was suggested in a report by J. G. Gabelman, of Chicago, as follows: Three-ton vehicles with pneumatic tires, 25 miles per hour; three to six tons, 20 and 15 miles per hour with pneumatic and solid tires; six to twelve tons, 16 and 12 miles per hour; 12 tons to maximum load, nine miles per hour; maximum wheel load to be five tons, with not more than 800 lb. per inch of tire in contact with the road; all steel-tired vehicles to be limited to six miles per hour. Formulas for regulating speeds of trucks were suggested by H. J. Fixmer, of Chicago, who also showed a new form of parabolic cross-section for streets.

Inland navigation as a possible accessory to river improvements was suggested by Prof. F. H. Newell in a paper on the water resources of Illinois, but he pointed out that the unknown factor is the economic feasibility; that is, whether the waterways would be used to such an extent or in such a way as to justify their cost.

Officers for 1919 were elected as follows: President, J. W. Dappert, drainage engineer; vice-president, F. W. DeWolf, Illinois Geological Survey; secretary, E. E. R. Tratman, Wheaton, Ill. The next meeting is to be held at the University of Illinois, Urbana, Ill.

Bowles To Leave Fleet Corporation

Announcement of the resignation of Francis T. Bowles from the position of assistant general manager of the Emergency Fleet Corporation was made by the Shipping Board Feb. 3. The resignation, tendered Jan. 25, is to take effect Mar. 15.

Proposed Raise of Rates Threatens Construction

Chicago Meeting Protests Against Increase on Sand, Gravel, Crushed Stone, and Slag

Road building will be seriously curtailed, and general construction will be retarded, if the increase in freight rates proposed by the Railroad Administration on sand, gravel, crushed stone and slag are put into effect—this was the opinion of state highway officials, producers and industrial associations voiced at a hearing held in Chicago Jan. 30, before the Central District Freight Traffic Committee. About 400 representatives of the industries affected by the proposed rate action attended the hearing.

The increase proposed is on a mileage scale, with excess for two-line hauls. The territory affected is roughly that south of the Great Lakes and north of the Ohio River and extending east from the Illinois-Indiana state line to include the western part of Pennsylvania.

Calls Proposed Rate Absurd

According to H. C. Barlow, who represented the Chicago Association of Commerce, with the present Federal direction of railways there is logically no such thing as a two-line haul, and the increased rate proposed over single-line haul is an absurdity. He said that present rates are excessive and unjust; they should be reduced and not increased. Other speakers condemned the mileage scale as a basis for fixing rates. Producers had established their plants and built up their markets on the old rate-making basis, and the change to a mileage scale would disorganize everything accomplished. Figures were presented by large producers showing that the new scale would increase the cost of shipments to their regular markets from 10 to 150 per cent. In some instances, it was asserted, the increase would completely exclude the producer from his best markets and might even force him to discontinue business.

Commissioner S. E. Bradt said that Illinois planned to spend $60,000,000 on about 4800 miles of hard roads, and if the increase under discussion went through, Governor Lowden would hesitate a long time before authorizing construction. To ship a ton from Janesville to Park Ridge, a distance of 98 miles, the price was 30c. until last June, when it was raised to 50c. and now it is proposed to make it 95c. Mr. Bradt continued:

"You can figure out how much that means in road construction when you estimate that 6000 tons must be used to each mile. With the increase in rates last June the cost of the Illinois road program was raised from $60,000,000 to $64,000,000. This proposed raise adds at least $4,000,000 more.

"Take a ton carried from Joliet to Springfield, 148 miles. The cost was 53c. until June, then 70c., and now it is proposed to make it $1.20. Another illustration is from Racine to Evanston, 52 miles. The increase was from 40c. to 60c. last June, and the proposal is for 85 cents."

The people of Michigan, according to J. H. Bateman, assistant commissioner, will be asked to vote at the spring elections on a $50,000,000 bond issue for good roads. It is planned during 1919 to spend $6,000,000. On the basis of the new rates, freight on a mile of 16-ft. gravel road will amount to $4000 and on a mile of 18 ft. concrete road it will amount to $5200. Quoting the specific example of the Detroit-Monroe road built last year, Mr. Bateman said: "The freight on the sand and gravel for this job cost $2400 a mile before June, 1918, when the cost was increased to $3200, and now it is proposed to make it $5200." If these higher rates were put in force it would he said, gravely, affect the disposition of the people of Michigan to enter on a broad policy of road improvement.

Resolutions of protest were formally presented by delegates from the legislatures of Ohio, Indiana and Michigan. The Ohio resolution, whch is typical of the others, respectfully but most urgently requests the President of the United States, Congress and the Railroad Administration to take such action as will immediately and effectively prevent an upward revision in the freight rates upon materials entering into the construction of public works.

"This proposition will throw a wet blanket over construction of public works," said John M. Glenn of the Illinois Manufacturers' Association. "Instead of encouraging activity, it will discourage it. The proposal is a serious error."

Other speakers were Dale F. Stansbury, assistant attorney general of Indiana; O. P. Gothlin, of the Indiana Public Service Commission, and B. F. Affleck, representing the National Federation of Construction Industries.

Michigan Engineers Suggest State Board of Public Works

Establishment of a state board of public works, affiliation of technical societies, and the passage of an engineers' licensing law, were all indorsed by the Michigan Engineering Society at its fortieth annual meeting, held in Flint, Jan. 21-23. About 120 members and visitors were registered. In connection with the encouragement of drainage projects a central authority was suggested. The suggestion developed into the idea of state supervision and assistance of public works in general. A resolution was adopted for the appointment of a committee to consider whether such a plan is advisable, and how it can be carried into effect.

C. E. Drayer, secretary of the American Association of Engineers, discussed the advisability of close coöperation of engineers and engineering societies. This led to a general discussion, which ended in the appointment of a committee to consider the coöperation or affiliation of all technical societies in Michigan.

A licensing law for civil engineers was submitted by a committee and approved, with some minor changes. The committee was then directed to have the bill presented to the legislature. The suggestion was made that the bill ought to apply to engineers in general, but the majority opposed it.

Prof. H. H. Atwell suggested changes in the present cumbersome drainage laws, including means for making the credit of the state available for large projects so that the cost could be spread over several years. He estimated that Michigan has 4,000,000 acres of land awaiting drainage. Reconstruction of small water-power plants was discussed by H. K. Holland. He referred especially to plants of 8- to 20-ft. head and 100 to 500 square miles of drainage area. Municipal work by day labor was described by E. C. Shoecraft, city engineer, Flint, Mich., where all sewer, paving and sidewalk work is done by the city forces, also the cleaning of streets. He said the results have been highly satisfactory. Sanitation in a military camp was the subject of a talk by the president, Maj. E. D. Rich, late director of the school of sanitary engineering at Camp Greenleaf, and limitations in the use of chlorine for water treatment were discussed by W. C. Hirn, assistant state sanitary engineer. Duties of the county engineer as both engineer and manager were outlined by E. E. Sours, who said that at present 31 counties in Michigan, where they act more or less as county managers, are employing county engineers on salary.

Delegation to France Returns and Will Address Engineers

The delegation of American engineers which sailed from New York Dec. 5 to attend the joint engineering congress in Paris, France (see *Engineering News-Record* of Nov. 28, 1918, p. 1003) returned Jan. 31, with the exception of the chairman, Maj. J. F. Case, who went to Italy. All members of the four national societies are invited to attend a meeting in the Engineering Societies' Building, New York, Monday evening, Feb. 10, when the delegates will describe informally the work of the congress and their impressions of conditions in France.

New Bills In Congress for Federal Aid to Hudson River Tunnel

Bills have been introduced in both houses of Congress, by Senator Calder of New York and Representative Eagan of New Jersey, for Federal participation in the construction of a vehicle tunnel under the Hudson River between New York and Jersey City. The Senate bill, offered as an amendment to the Post Office appropriation bill, would direct the Secretary of Agriculture to join equally with the two

states concerned in building the tunnel as a post route; the maximum participation is fixed at $6,000,000, and the sum is to be repaid from tolls collected from the traffic through the tunnel.

Indiana Engineers Seek License Law With Architects

State Body Holds Joint Meetings with Several Local and National Sections —Watches Proposed Road Laws

Good roads construction and cost-keeping, lessons from the war, the engineer's economic welfare, and license legislation largely occupied the attention of the hundred engineers attending the thirty-ninth annual convention of the Indiana Engineering Society, held Jan. 23-25 in Indianapolis. Coöperation with local engineering organizations was well worked out. Immediately prior to the first session, a dinner meeting was held by the Scientech Club, the reorganized Indianapolis Engineers' Club. An evening session was held jointly with the American Association of Engineers, and at another meeting the local section of the American Society of Mechanical Engineers participated. The annual dinner was also held jointly with the local sections of the national societies, and the Scientech Club.

Indiana's delay in its state highway work, due to the slowness with which the courts decided its state commission to be constitutional, means that more legislation is being considered. The engineers have a legislative committee carefully watching developments to insure, if possible, a practical working plan.

M. T. Calef, highway engineer, South Bend, exhibited a careful analysis of methods of unit-cost keeping, based on all factors and spread out over a 20-year period. Prof. R. P. Wiley, in a paper on "The Rational Method of Estimating Storm Water Run-off," gave essential points in sewer design, saying that the engineer's judgment is of far more importance than generally given credit. Camp sanitation at Camp Custer, as described by S. A. Greeley, indicated that during construction the strict regulations and attention to cleanliness and personal hygiene of the men had kept the influenza from gaining any headway. Knowledge of this fact enabled the contractor to maintain a full working force and attract all the labor he needed when other contractors were unable to keep a full force.

Prof. D. D. Ewing's paper, "Electrically Driven Pumps in Small Water-Works," included concrete examples of power requirements, costs and comparisons, and gives valuable reference data.

Public-utility problems were handled in six papers, four of which were on the fuel question and war experiences.

C. E. Drayer, secretary of the American Association of Engineers, spoke at the joint meeting on "Local and National Societies Coördinated," and W. W. DeBerard was substituted for W. H. Finley, president of the Chicago & Northwestern Railway Co., who was scheduled to talk on "The Relation of the Engineer to Social and Business Problems."

H. O. Garman discussed the proposed structural engineers' and architects' bill. In effect, this will require all civil engineers to apply for license. Initial registration for a six-months' period will cost $30, but subsequent licensing by examination will cost $50, and annual renewals $10. Danger of the Illinois controversy with the architects is avoided by putting the two professions together with separate licenses for each. Penalties range from $10 to $500 in fines. Concurrent with the bill is one proposed by the county surveyors' organization for the creation of a new office, that of county engineer, with proper qualifications and with salaries, based on populations, ranging from $1800 to $4500. It is hoped to raise the standard of the county surveyor, who is now an elective statutory official without other qualifications than being a voter, by providing that the county engineer be the surveyor if the latter is qualified for the engineer's position.

The society is supporting both bills, and also instructed its legislative committee to prepare one, on civil service for municipalities, which the business men of the state Chamber of Commerce requested that the society write and present. Prof. G. A. Young was elected president, Charles Cheney, vice-president, and Charles Brossmann secretary-treasurer.

Labor Department Will Take Up Safety Code Work

The Working Conditions Service, Department of Labor, announces in connection with its plans for safety work during the coming year that the following codes, among others, will be first taken up, with the coöperation of the Bureau of Standards, Department of Commerce:

Plant arrangement, including routing of material and product, design of buildings and layout of plant; yard entrance and exit gates, roadways and walkways, railroad tracks, material piles, clearances and illuminations; fire hazards, including fire-fighting equipment, water mains and hydrants; spacing between buildings as related to occupancy, and arrangement of yard material as related to occupancy of buildings.

Building equipment, including stairs and exits, skylights, ladders, railings, and toeboards (fixed), platforms and scaffoldings (fixed), illumination and window cleaning.

Fire prevention and protection.

Elevators, including shaftways and hatchways, shaftway equipment, cables, counterweights, guide rails and bumpers, landings, landing doors and gates, cars and car construction, machines, machinery and machine rooms, car and machine safety devices, control and signals, and escalators.

Cranes and derricks, including controllers and wiring, hoist mechanism and brakes, clearances, bridge, tower and gantry cranes, locomotive cranes and derricks, and hand-power cranes.

Conveyors and conveying machinery.

Head and eye protection, including protectors for chippers, riveters, calkers, for babbitting and similar operations, sealing, grinding and similar operations, dipping and brush coatings, sandblasting, oxyacetylene welding and furnace work, and electric-arc welding and cutting.

Lumber and wood-working machinery.

Organize the National Merchant Marine Association

As a result of the American Merchant Marine conference at Washington, Jan. 22-23, a new organization was created, to be known as the National Merchant Marine Association. Its purpose will be to carry on a nation-wide propaganda in advocacy of a large American merchant marine. R. Goodwyn Rhett, former president of the Chamber of Commerce of the United States, was elected chairman, and Winthrop L. Marvin, of Boston, secretary. The governing body of the organization will consist of the officers and a council of not less than 30 members, the nucleus of which will be members of the resolutions committee which recommended the creation of the new organization.

Strong opposition was made to the report of the resolutions committee by Rear Admiral Francis T. Bowles, in charge of the Emergency Fleet Corporation at Hog Island, who contended that the interests of the various parties engaged in shipping were well represented by the American Steamship Association. He said that he was of the opinion that it was inappropriate to attempt the organization of any body representing private interests when the nation's interests were at stake.

Assurance that the United States Navy would lend every aid to the new organization was made by Commander Charles Belknap, U. S. N., who stated that the Navy should train the men and officers of the merchant marine, and that they should then be made members of the Naval Reserve. J. J. Powell, vice-president of the Bethlehem Shipbuilding Corporation, said that the cost of building American ships was a barrier against any attempt to establish a merchant marine, unless the nation assumed the undertaking; the difference between the cost of a ship in Great Britain and that of one in this country was now $100 per ton, an increase from about $25 or $35 a ton before the war. A great part of this cost, he said, was due to the increase of the cost of labor.

Among the members of the resolu-

tions committee named by Chairman Ransdell were H. A. Wheeler, president of the United States Chamber of Commerce; P. A. S. Franklin, president of the International Mercantile Marine; J. H. Pruitt, president of the Masters', Mates' and Pilots' Association; F. L. Sanford, of the Southern Pine Association, and C. E. Grunsky, of San Francisco. J. Parker Kirlin, of New York, headed the committee on organization.

A. S. Baldwin President Western Society of Engineers

A. S. Baldwin, vice president of the Illinois Central R.R., has been elected president of the Western Society of Engineers. He was born at Winchester, Va., in 1861, and began his career as a railway engineer in 1879. After 14 years of service with the Louisville & Nashville R.R., he entered the employ of the Illinois Central R.R. in 1907 as principal assistant engineer. He was made chief engineer in 1905 and in 1918 he was made vice president. He was president of the American Railway Engineering Association in 1917. As a member of the Western Society of Engineers he has taken special interest in its development and in the management of its finances.

Public Service Commission Reports on Past Year

Rapid-transit lines aggregating 63 additional track-miles were opened to traffic in New York City during 1918, according to the annual report of the Public Service Commission for the First District, New York, and it is said that the end of the current year will see placed in operation 300 of the 341 track-miles of the system remaining to be completed. It is promised that early in 1920 the entire work will be practically finished. Since Jan. 1, 1918, the Interborough and the Brooklyn Rapid Transit Companies have spent a total of $48,000,000 for construction and equipment of new lines, while the city for construction alone has spent $19,000,000, in addition to $358,600 for improvements to the first subway.

It is stated that if the Board of Estimate will coöperate in granting the necessary funds, more than $20,000,000 of the remaining $25,000,000 worth of new work yet to be done can be let before the end of the coming summer. Under outstanding contracts there is upward of $20,000,000 worth of work, contract value, yet to be done to allow $80,000,000 of new lines to be placed in operation.

The report says that the gross increase in traffic on the city transportation lines during the past year was 56,670,090, which represents per capita riding of five more rides per person than in 1917. The total amount paid to the companies in fares was $97,394,225, an increase of $2,843,309, or 3 per cent over the preceding year.

Now that the war is over, the commission believes that the grade-crossing elimination work should be actively resumed, and the legislature is asked to appropriate $250,000 as the one-quarter share of the state toward $1,000,000 which is considered necessary.

At the end of 1918 the employees of the commission, including over 400 absent on war duty, numbered 1651, as against 1855 at the close of 1917.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

AMERICAN INSTITUTE OF MINING ENGINEERS; 29 West 39th St., New York City; Feb. 17-20, New York.

The Engineers' Club of Dayton, Ohio, was addressed Jan. 21 by Worcester R. Warner, vice-president of the Warner & Swasey Co., Cleveland, who delivered an illustrated lecture on Egypt and the pyramids. The first anniversary banquet, celebrating the dedication of the new clubhouse of the club, the gift of E. A. Deeds and F. C. Kettering, will be held Feb. 4. Representatives of all the national engineering societies will be present, and the subject of the furtherance of engineering coöperation will be discussed.

The Engineers' Club of Boston, Mass., celebrated its sixth anniversary, Jan. 23, at the clubhouse. Originally the resident membership of the club was limited to 500 and the nonresident to 200. The limit is now 750 resident and 300 nonresident, and there are 603 resident members and 287 nonresident, besides the 16 life members and four Army and Navy members.

The Hamilton, Ont., Branch of the Engineering Institute of Canada held a meeting Jan. 17 at which the subject of legislation in relation to the engineering profession was discussed. It was decided that since many Governmental questions, especially those dealt with by various commissions, are essentially engineering questions, the Engineering Institute should endeavor to obtain representation on such commissions, where the presence of one or more professional engineers is appropriate.

The New York City Chapter of the American Association of Engineers will hold an open meeting of New York engineers at the Machinery Club, 30 Church St., Feb. 10. W. H. Finley, president of the American Association of Engineers, will speak on "Engineering Organization and its Relation to Public Service." The meeting will be preceded by a dinner.

The Binghamton, N. Y., Engineering Society, at the annual meeting held Jan. 28, elected the following officers: President, C. E. Anderson, vice-presidents, Charles Van Amburgh, Burt E. Nelson and G. Fred Scharbach; secretary, D. M. Edgerton; treasurer, Frank J. Tillman; librarian, C. E. Beach.

The Houston, Tex., Engineers' Club held its regular monthly meeting Jan. 23. James Z. George, general manager of the Houston Chamber of Commerce, spoke on "The Opportunity and Responsibility of the Engineer in the Readjustment Period."

The Engineers' Club of Philadelphia, at its luncheon Feb. 11, will be addressed by Dr. William D. Lewis, principal of the William Penn High School, on "What the War Has Taught Us About the Educational Needs of Democracy."

The Manitoba Branch of the Engineering Institute of Canada, meeting at Winnipeg Jan. 20, decided that a close watch should be kept on all public works, provincial and Federal, which involve engineering problems. Among the matters discussed at the meeting were the development of national resources, highways, and drainage.

The Engineering Institute of Canada on Jan. 28 held, at the headquarters in Montreal, the preliminary session of the annual meeting.

The Utah Society of Engineers held a meeting in Salt Lake City Jan. 15, at which the initial steps were taken in a movement to consolidate all the engineering societies in Utah into one body, to be known as the Associated Engineers of Utah. The new society will comprise the Utah Society of Engineers and all other organizations of mining, civil, electrical, mechanical, and chemical engineers in the state. The recent meeting is an outcome of the one held Oct. 16, at which the proposition for the consolidation was put before the Utah Society, and a committee consisting of G. M. Bacon, H. T. Plumb, and Ernest Gayford was appointed to consider the matter. The committee has conferred with representatives of national engineering bodies and has proposed changes in the constitution of the Utah Society of Engineers which will permit that body to become the affiliating medium for all similar organizations.

The Montreal Branch of the Engineering Institute of Canada, at its regular meeting, Feb. 20, will be addressed by J. L. Busfield, whose subject will be "The Construction of the Canadian Northern Railway Tunnel, Montreal."

The Engineers' Society of Northwestern Pennsylvania, the Erie Chapter of the American Institute of Electrical Engineers, and the Erie Chapter of the American Society of Mechanical Engineers (Associated Bodies) will hold a joint meeting Feb. 11 in Erie. The lecturer of the evening will be Prof. Comfort A. Adams. His subject will be

"Arc Welding as Applied to Shipbuilding."

The Duluth Engineers' Club, at its meeting Jan. 27, decided to support energetically the project for a deep waterway from the Great Lakes to the Atlantic. Frank Hutchinson, Dwight E. Woodbridge and W. H. Woodbury were appointed a committee to obtain information. E. R. Lewis was elected to represent the club on the Minnesota State Joint Engineering board. Besides the regular representative, the Duluth club will be represented by two special delegates, Dwight E. Woodbridge and J. L. Pickles, at the annual meeting of the joint board, to be held at St. Paul on Feb. 12-14. A committee of the club was named to investigate prices of cement, at the suggestion of the Minneapolis Engineers' Club, that existing prices are too high under peace conditions.

The American Water-Works Association will hold its 39th annual convention in Buffalo, N. Y., June 10-14. The headquarters of the convention will be the Hotel Iroquois.

The San Francisco Chapter of the American Association of Engineers was tentatively organized Jan. 24, when 10 members of the association and six applicants met for the purpose of organizing the local chapter, discussing means for extending the influence of the organization and instituting a campaign for new members. A petition to the Board of Directors in Chicago for a charter for the chapter was drawn up and signed by all present, and a total of 20 signatures from California members was anticipated at an early date. J. H. Knowles was elected temporary chairman and A. G. Mott temporary secretary and treasurer.

The San Francisco Section of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the American Chemical Society held a joint meeting Jan. 24 under the auspices of the electrical engineers, at the Engineers' Club. The subject of the evening was "A Symposium on Engineering Education," and 15-min. talks were made by J. W. Beckman, representing the chemical engineers; John A. Britton, the mechanical engineers; C. L. Cory, the electrical engineers; C. D. Marx, the civil engineers, and T. A. Rickard, the mining engineers. A considerable number of those present participated in the discussion. There was rather general agreement as to essentials, which were that a most important function of the college course for the engineer is to equip him so that he will be able to take a broad view of the problems he meets later. It was considered that a grounding in fundamentals is more important than endeavoring to fit a man for some specialty.

The Tacoma Master Builders' Association, Tacoma, Wash., recently held its annual meeting, at which the following officers were elected: S. C. Erickson, president, for another term; John Biehn, vice-president; A. L. Sutterfield, secretary; Dick Ketner, treasurer.

The Engineers' Club of Seattle has established a clearing house for obtaining positions for returned soldiers or sailors who were formerly connected with the engineering profession. E. J. Bartells, secretary, is in charge of the work.

The Associated Engineering Societies of Seattle held a joint meeting Jan. 24 at Bagley Hall, University of Washington. The features of the program were furnished by the Puget Sound section of the American Chemical Society and the Seattle Association of Members of the American Society of Civil Engineers. John L. Hall, president of the Pacific Northwest Society of Engineers, spoke on "Engineering Education."

The American Institute of Mining Engineers will hold its 119th meeting in New York during the week of Feb. 17. Members of the Canadian Mining Institute, the National Research Council and the American Institute of Electrical Engineers will join the mining engineers in their discussions.

The Topeka Engineers' Club was organized Jan. 25 at Topeka, Kan. Sixty men, residents of Topeka, were present, representing all branches of the engineering profession. The officers for the present year are: President, John Williams; secretary, Lloyd B. Smith.

Personal Notes

Readers who are returning to civil life from military, naval or other Government service are strongly urged to send in items about themselves and about their friends who are in similar situation. Items should give former position, describe character of military or other service and state the civil work to which the engineer or contractor in question is going. In the case of those with service abroad, information regarding the activities of the units to which they were assigned is especially desired.

COL. CURTISS SHOTWELL has been appointed engineer of the Third Mississippi River District, in succession to A. M. Todd.

A. D. WILLIAMS, chairman of the West Virginia State Roads Commission, has resigned in order to devote more attention to his personal business. His successor is Maj. C. P. Fourtney, as noted elsewhere.

RAYMOND BAFFREY, president of the Hennebique Construction Co., New York, and a captain of artillery in the French army, has been made a Chevalier of the Legion of Honor by the French Government. He had previously been decorated with the Croix de Guerre. Captain Baffrey left New York for France in 1914, served three years on the western front, was cited twice for valor, and was seriously wounded in Flanders in 1917. After recuperating in this country he was assigned to service with the French High Commission in New York.

MAJ. EDWARD J. LANGFORD, Engineers, U. S. A., who has been district engineer in France of the Army transportation service, with headquarters at Marseilles, has been discharged from the service and has returned to his home in Mount Vernon, N. Y. Before entering the Army he was chief engineer of the New York, Westchester & Boston Railway.

HARVEY S. OWEN, formerly engineer of construction and principal assistant engineer to the chief engineer of construction, St. Louis Board of Public Service, has joined the staff of the Lime Association, Washington, D. C., as western district engineer of the Construction Bureau, with headquarters in St. Louis.

THOMAS D. MCINERNEY, recently of the engineering staff of the ordnance department, U. S. A., at the Watertown arsenal, and the Bethlehem Shipbuilding Corporation's Fore River plant, Quincy, Mass., has opened an office for the practice of civil, mechanical and electrical engineering at 99 Chauncy St., Boston, Mass.

MAJ. C. P. FOURTNEY has been appointed chairman of the West Virginia State Roads Commission, succeeding A. D. Williams, who has resigned, as noted elsewhere. He has had extensive experience in highway construction, in this country and in the Canal Zone at Panama.

O. P. M. GOSS and R. H. RAWSON announce the establishment of the firm of Goss & Rawson, consulting engineers, with offices in the Yeon Bldg., Portland, Ore., and in the White Bldg., Seattle, Wash. Mr. Goss was formerly consulting engineer for the Association of Creosoting Companies of the Pacific Coast and for the West Coast Lumber Manufacturers' Association. During 1918 Messrs. Goss and Rawson had charge of the kiln drying of lumber at the Spruce Production cut-up plant at Vancouver, Wash. Previous to that Mr. Rawson was for six years in charge of the St. Helen's creosoting plant. The new firm will undertake investigations and reports on kiln drying plants, or the design or remodeling of such plants.

LEWIS S. SADLER of York County, Pennsylvania, has been appointed State Highway Commissioner of Pennsylvania, succeeding J. Denny O'Neil.

RONALD G. STARR, of Toronto, has been appointed engineer of the Orillia, Ont., electrical and water-works plants, in succession to the late W. K. Greenwood.

H. T. ROUTLY, head of the Routly Construction Co., Toronto, has been appointed by the Ontario Government construction engineer for the Provincial Highway, of which 100 miles will be built this season.

MAJ. JOHN F. OSBORN, 101st Engineers, formerly of the staff of Charles T. Main, Boston, has been detached from the regiment and is now working for the American Commission to Negotiate Peace, directly under Maj. Dugald C. Jackson, in estimating the damages that have been done during the war to French textile mills. His headquarters are in Paris, but he is engaged in inspection tours all along the former war front.

CAPT. C. E. HICKOK, until Jan. 1 attached to the office of the Chief of Engineers, U. S. A., Washington, D. C., has returned to his former position as city engineer of Alameda, Cal. Captain Hickok has been appointed a member of the board of engineers investigating an additional water-supply for the cities of the East Bay District, consisting of Oakland, Alameda, Berkeley and Richmond.

MAJ. E. M. GRAVES, 529th Engineers, who recently returned from France, has received his discharge from the Army and has resumed his duties as president of the Central Dredging Co., Cleveland, Ohio.

WILLIAM S. EVANS, until recently assistant to the resident engineer in charge of construction work, for the E. I. du Pont de Nemours Co. at its dye-works plant at Carney's Point, N. J., is now at Copperhill, Tenn., as engineer with the Tennessee Copper Company.

JOHN W. ALVORD, of the firm of Alvord & Burdick, Chicago, has resigned his position as chief engineer and member of the board of directors of the United States Housing Corporation of the Department of Labor at Washington, effective Feb. 1, and will return to his engineering practice in Chicago. Mr. Alvord has devoted nearly a year of service in organizing the Engineering Division of the Housing Corporation and serving on its board of directors for war emergency work.

T. C. MITCHELL, formerly junior engineer, United States Engineer Office at Great Bridge, Va., who in 1916 went to Liberia to represent the Liberian Government on the Franco-Liberian Boundary Commission, and who returned to the United States to serve in the Army during the war, will soon return again to Liberia to resume his work there. The war prevented the sending by the French Government of an engineer to coöperate with Mr. Mitchell, acting as the representative of Liberia, in delimiting the boundaries between the French possessions and the Liberian Republic.

G. H. KNUTSON, who for the past eight years has been a partner in the Fargo Engineering Co., consulting engineers, Jackson, Mich., is now associated with the Corporation Department of the Harris Trust and Savings Bank of Chicago.

CAPT. THOMAS F. BOWE, Quartermaster Corps, Construction Division, U. S. A., has been appointed Chief of Engineers, Port Utilities Office, at Newport News, Va.

MAJ. O. C. F. RANDOLPH, who received his discharge from the United States Army Engineering Corps Dec. 13, has taken charge of the sale of buildings to railways for the H. K. Ferguson Co., Cleveland. Major Randolph is a graduate of the University of Illinois, and since leaving the university has been in the bridge department of the Michigan Central R.R., and with the Timken Detroit Axle Co. as construction engineer. He was also for a time the construction superintendent for the Austin Co. He left that company to join the Army in July, 1917, as second lieutenant in the Sixteenth Railway Engineers. In France he was in charge of building work at Is-sur-Tille, some of which work was described in *Engineering News-Record* of July 4, 1918, p. 27. When the armistice was signed Major Randolph was in this country organizing a sapper regiment to return to France.

PAUL E. GREEN, district engineer of the Bureau of Industrial Housing and Transportation, has resigned from the Government service to resume his practice as a member of the firm of Marr, Green & Co., Chicago.

OBITUARY

BRIG. GEN. JOHN M. WILSON, Corps of Engineers, U. S. A., died in Washington Feb. 1. General Wilson, one of the oldest retired members of the Corps of Engineers, was chief of engineers during the Spanish War. He was born in the City of Washington in 1837, and was graduated from West Point in 1860. He served through the Civil War with conspicuous gallantry, being brevetted a colonel in 1865. From the end of the war until 1897 he was on various stations in the engineer department, mostly in Washington. President Cleveland, at the beginning of his first term, placed the then Colonel Wilson in charge of public buildings and grounds in the District of Columbia, and in 1889 he was appointed superintendent of the Military Academy, which office he held for four years. When Mr. Cleveland became president again, in 1893, Colonel Wilson was again summoned to Washington to have charge of public buildings and grounds. He was appointed Chief of Engineers Feb. 1, 1897, and held the position for four years and three months. He retired from active service in May, 1901. General Wilson was a member of the American Society of Civil Engineers and past president of the Cleveland Engineering Society.

FRED J. SAUER, assistant engineer in the office of Metcalf & Eddy, consulting engineers, Boston, Mass., died Jan. 30. He had been connected with Metcalf & Eddy for about 1½ years. Mr. Sauer was the author of the article on "Raising Two Lines of 24-inch Water Mains Seven Feet," published in *Engineering News-Record* of Jan. 30, 1919, p. 254. He was both engineer and contractor for the work described, and personally made all the plans and supervised the work, coöperating with the officials of the Metropolitan Water-Works and the Boston Water-Works.

ROBERT S. VAN RENSSELAER, borough engineer of Punxsutawney, Penn., for ten years, died there Jan. 24. Mr. Van Rensselaer was born in Burlington, N. J., Oct. 27, 1847. He was graduated from Yale University, and was one of the two original engineers who surveyed the right-of-way for the present Cresson division of the Pennsylvania R.R., from Bellwood to Punxsutawney.

JOHN ATLEE, division engineer of the Philadelphia Terminal division, Pennsylvania R.R. Co., was killed in the tunnel under Chestnut St., Philadelphia, Jan. 9. Mr. Atlee was born at Wayne, Penn., Sept. 2, 1873. He was educated by private tutors and entered the service of the Pennsylvania R.R. as rodman on construction of the Georgetown Branch, Washington, D. C., in 1893. From 1894 to 1899 he was with the engineering department of the Fairmount Park Commission of Philadelphia. During 1899 and 1900 he was in Nicaragua with the Isthmian Canal Commission; later he was instrument man in charge of construction work on the Erie R.R. Mr. Atlee reentered the service of the Pennsylvania R.R. as rodman in the maintenance-of-way department, and was promoted through the grades of assistant supervisor and supervisor to that of division engineer of the Renova Divisioin at Erie, Penn., in 1917, and then in 1918, to that of division engineer of the Philadelphia Terminal division.

Government Will Dredge Delaware River Below Philadelphia

Dredging a 35-ft. channel in the Delaware River from Philadelphia to the sea is the reported purpose of the United States Engineers. It is estimated to cost about $3,000,000, and the work will be arranged into 10 districts, so as to be divided among several contractors.

The material to be encountered is soft mud, with some sand and gravel, and will be removed on scows. It will be deposited on shore or behind bulkheads by rehandling machines or other means.

The district engineer, 815 Witherspoon Building, Philadelphia, says that he is ready to give information to contractors or others interested in the project.

National Crushed Stone Association Will Hold Convention

The first annual convention of the National Crushed Stone Association will be held at the Iroquois Hotel, Buffalo, N. Y., Feb. 11-12, 1919. The association was formed in Chicago in February, 1918.

War Department Organizes Office for Selling Surplus Materials

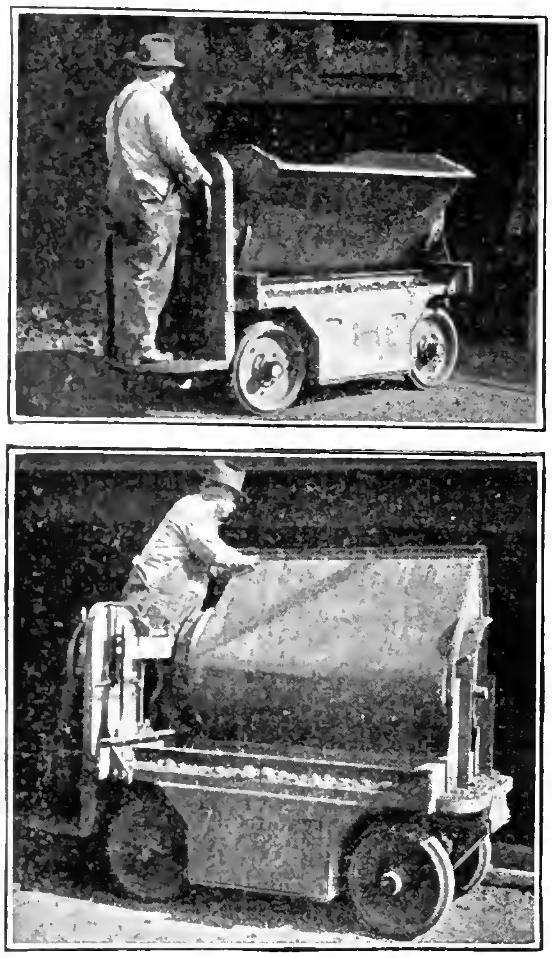
The office of the director of sales for the disposal of war materials no longer needed has been organized by the War Department. The work will be handled under the direction of C. W. Hare by a board of sales review composed of seven members. E. C. Morse is chairman of the board and each member is a division sales manager, except one, who is the legal member.

The class of supplies to be handled by each of the division heads includes machinery, construction equipment and material. Lieut. Col. A. LaMar has charge of machine tools, including all metal- and wood-working tools, railway equipment, steam shovels, locomotive cranes, gantry cranes, hand tools, forging equipment, iron and structural workers' power tools and machinery. Maj. W. W. Crunden has charge of building material, including lumber, millwork, fire protection, water-supply, fabricated steel, roofing, wall board, paints, refrigeration, hardware, brick cement, heating, machine equipment and electrical equipment. Col. Fred Glover has charge of trucks and motor equipment, including trucks, motors, motorcycles, side cars and all surplus supplies and repair parts pertaining thereto, animal- and hand-drawn vehicles.

Electric Truck Reduces Coal-Handling Costs

By the use of a storage-battery truck a Philadelphia manufacturer has reduced his coal-handling costs approximately 50 per cent. The truck is fitted with a V-dump body and hauls the coal from storage bins, where it is loaded by gravity, to the boiler house and store yard. The quick-loading facility, however, was a factor in this saving, since it was found that the truck could be loaded from the bin in 8 sec., the truck holding one ton of coal, whereas in loading the truck from the storage pile it was found that it took 5 min. to do this work by hand.

The coal-handling program commenced in the morning with a haul of 300 ft. from the storage bin to the boiler house. In two hours, however, sufficient coal was hauled to keep the boilers going all day, after which the trucks carried coal from the bins to a storage pile. It was found that in this program about 20 tons of coal were handled per hour. The haul from bins to storage piles was about 115 ft. each way. The loaded truck made the trip from bins to storage pile in 45 sec.,



HANDLING COAL WITH ELECTRIC TRUCK

the return trip having been made in 35 sec. The load was discharged in 10 sec. By this method the company was able to release railroad cars quickly and reduce demurrage charges. The receiving bins were emptied as fast as possible, so that unloading from the railroad cars could be started as soon as the cars were placed.

The truck is manufactured by the Lakewood Engineering Co., of Cleveland, Ohio.

England To Investigate South American Machinery Market

The Department of Overseas Trade of England and the British Engineers' Association will shortly dispatch a joint investigating committee to Brazil. The object of the investigation will be to ascertain the conditions and the prospects for the sale of British engineering products in Brazil. The cost of investigation will be defrayed in equal shares by the association and the Government, and the subjects to be covered include: Local importers, shipping methods, Brazilian law, statistics and England's chief competitors. The investigation will also include the following industries, so far as they are likely to provide openings for engineering plants and machinery: Shipping and shipbuilding; harbor and dock development; hydro-electrical possibilities, and the development of public utilities.

Business Notes

W. H. Kinsey, for the past 20 years selling water-works supplies, has been appointed New England representative, with offices at 201 Devonshire St., Boston, Mass., for the Warren Foundry & Machine Co., of New York, manufacturer of cast-iron pipe.

A. W. Greetham, manager of excavator sales of the Pawling & Harnischfeger Co., has resigned to accept a position with the T. L. Smith Co. as assistant sales manager. Mr. Greetham has been interested in the promotion of excavating and contractors' machinery for 10 years.

Bery G. Danley, formerly manager of the Haughson-Freenaughty Co., Spokane, Wash., has entered the general road-contracting business, with headquarters in Spokane.

The Blaw-Knox Co., Pittsburgh, Penn., announces that it will reopen its San Francisco office, at No. 528 Second St., in charge of Ensign Irving Burrows, recently released from the service of the Government.

Trade Publications

"Ladew Leather Belting" is the title of a 6 x 9-in., 108-p. catalogue issued by the Edw. R. Ladew Co., Inc., Glen Cove, N. Y. It illustrates and describes the manufacture of the company's leather belting, and also gives diagrams and other data regarding the use of belts.

Roadbuilding with Novaculite, a species of gravel, is the subject of a 23-p. pamphlet, $7\frac{1}{2}$ x $8\frac{1}{2}$ in., issued by the Egyptian Gravel Co., Railway Exchange Building, St. Louis, Mo.

The Economy Drawing Table and Manufacturing Co., of Adrian, Mich., has issued catalogue N A, 7 in. x 10 in., a 32-p. pamphlet illustrating and describing its drawing tables, sectional filing cases and other drafting-room equipment.

Price advances are indicated by **heavy type**; declines by *italics*.

PIG IRON—

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	*$35 85*	$37 60
Northern Basic	*31 80*	34 80
Southern Ohio No. 2	*32 80*	35 80
NEW YORK, Tidewater delivery		
Penna. 2X	*36 15*	39.55
Southern No. 2 (Silicon 2.25 to 2.75)	*39 95*	.....
BIRMINGHAM		
No. 2 Foundry	*31 00*	34.00
PHILADELPHIA		
Eastern Pa. 2X	*36.15**	39 15*
Virginia No. 2	*38 10†*	40.50†
Basic	*33 90**	36.90*
Grey Forge	*33 90**	36.90*
Bessemer	.....	39 10*
CHICAGO		
No. 2 Foundry Local	*31 00*	34.50
No. 2 Foundry Southern	*37 20*	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	*31 00*	35.40
Basic	*30.00*	34.40
Bessemer	*32 20*	36.60

* F.o.b. furnace. † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh		Chicago	
	Current	One Year Ago	Current	One Year Ago
Standard bessemer rails	$55 00	$60–65	$65.00	$60–65
Standard openhearth rails	57 00	63–65	67.00	63–65
Light rails, 8 to 10 lb	3 13½	3.125*	3.13½	3.125*
Light rails, 12 to 14 lb	3 09	3.125*	3.09	3.125*
Light rails, 25 to 45 lb	3.00	3.125*	3.00	3.125*

* Per 100 lb.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots together with the warehouse prices at the places named:

	Pittsburgh				
	Current	One Year Ago	Chicago	St. Louis	San Francisco
Standard spikes, 9/16-in. and larger	$3.70	$3.90	$4.50	*$5.04*	$6.15
Track bolts	4.90	4.90	5.50	Premium	7.50
Standard section angle bars	....	3.25	4.45	Premium	5.15

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

		7 In. x 9 In. by 8 Ft. 6 In.	6 In. x 8 In. by 8 Ft.
Chicago	Plain	$1.48	$1.33
San Francisco	Douglas Fir—Green	1.35	.96
San Francisco	Douglas Fir—Creosoted	2.70	1.92

Prices per tie at Missouri mills; St. Louis prices about 25c. higher:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0.70	No. 1	$0.55
No. 2	.80	No. 2	.65
No. 3	.90	No. 3	.75
No. 4	.98		
7x9x8 white oak			1.05
7x9x8 red oak (No. 4)	$0.80	No. 5	.87

Note:—Add 36c. each for treatment

PIPE

STEEL AND IRON PIPE—The following discounts are for carload lots f.o.b. Pittsburgh, basing card of Jan. 1 for steel pipe and iron pipe:

Inches	Steel Black Per Cent.	Galvanized Per Cent.	Inches	Iron Black Per Cent.	Galvanized Per Cent.
BUTT WELD					
¾ to 3	54	40½	¾ to 1½	36	20
LAP WELD					
2	47	34½	1¼	21	6
2½ to 6	50	37½	1½	28	14
7 to 12	47	33½	2	29	15
13 and 14	37½	...	2½ to 6	31	18
15	35	...	7 to 12	28	15
BUTT WELD, EXTRA STRONG PLAIN ENDS					
¾ to 1½	52	39½	¾ to 1½	36	21
2 to 3	53	40½			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45	33½	1¼	22	7
2½ to 4	48	36½	1½	28	14
4½ to 6	47	35½	2	30	17
7 to 8	43	29½	2½ to 4	32	20
9 to 12	38	24½	4½ to 6	31	19
			7 to 8	23	11
			9 to 12	18	6

From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
¾ to 3 in. butt welded	*48%*	*44.9%*	*42%*
2½ to 6 in. lap welded	*38%*	*40.9%*	*38%*
	Galvanized		
	New York	Chicago	St. Louis
¾ to 3 in. butt welded	27%	*29.9%*	*27%*
2½ to 6 in. lap welded	23%	*26.9%*	*24%*

Malleable fittings, Class B and C, from New York stock sell at +15% list prices. Cast iron, standard sizes, 10% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York						
	Current	One Month Ago	One Year Ago	Chicago	St. Louis	San Francisco	Dallas
4 in	*$65.70*	$70.70	$58.35	*$64.80*	*$58.00*	*$80.50*	$74.00
6 in. and over	*62.70*	67.70	55.35	*61.80*	*55.00*	*77.50*	71.00

Gas pipe and 16-ft. lengths are $1 per ton extra.

CLAY DRAIN TILE—The following prices are per 1000 lin. ft.:

	New York				
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco
3	$35.00	$35.00	$22.50	$30.00	......
4	51.00	51.00	27.00	40.00	$45.00
5	65.00	65.00	45.00	50.00	65.00
6	90.00	90.00	55.00	60.00	90.00
8	130.00	130.00	100.00	80.80	150.00

SEWER PIPE—The following prices are in cents per foot for carload lots:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$0.117	$0.096	......	$0.125	$0.09	$0.138
4	.117	.096	......	.125	.15	.138
5	.1755	.144	......	.175	.1875	.207
6	.1755	.144	$0.16	.175	.225	.207
8	.273	.224	.22	.25	.3475	.2875
10	.4095	.336	.30	.375	.45	.4025
12	.5265	.432	.43	.475	.60	.5175
15	.702	.576	.65	.63	.9375	.78
18	.975	.80	.96	1.00	1.275	1.02
20	1.17	.96	1.14	1.20	1.71	1.20
22	1.56	1.28	1.46	1.60	......	1.56
24	1.755	1.44	1.64	1.80	2.125	1.80
27	2.73	2.145	2.00	2.75	......	2.70
30	3.024	2.376	2.70	3.45	......	3.30
33	3.96	3.15	3.25	4.00	......	4.20
36	4.51	3.5875	3.55	4.35	......	4.80

	3	5	8	12	24	36
Boston	$0.12	$0.18	$0.28	$0.54	$1.80	$5.53½
St. Paul	.12	.18	.25	.45	2.00	4.75
Seattle	.15	.....	.33¾	.64	2.00	......
Kansas City	.12	.18	.25	.50	1.80	4.60
Los Angeles	.06¼	.13¾	.24¾	.44	1.50	......
New Orleans	.10¾	.13½	.27	.459	1.75½	......
Cincinnati	.108	.162	.252	.486	1.66½	3.99¾

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8000 gal. minimum f.o.b. place named:

	Current	One Month Ago
New York, 45–65% asphalt	$0.07½	......
New York, liquid asphalt	.08	......
New York, binder	.08	......
New York, flux	.07½	......
St. Louis, 35% asphalt	.09	$0.09
Chicago, 15–20% asphalt	.10	.10
Chicago, 100% dust layer	.11	.11
Dallas, 40-50% asphalt	.09	.09
Dallas, 60-70% asphalt	.10	.10
Dallas, 75-90% asphalt	.11	.11
San Francisco, 75-95% asphalt, per bbl	*2.10*	2.15

ASPHALTUM—Price per ton in packages and bulk in carload lots:

	Brand	Package	Bulk
New York	Texaco	$35.00	$30.00
Chicago	Mexican	35.50	33.50
San Francisco	California	17.00	13.75
Dallas	Texaco and Mexican	32.00	30.00
Seattle	D grade	23.10	......
Denver	Trinidad	59.00	......
Denver	California	39.00	......
Boston		35.50	......
St. Louis	Stanolind	30.90	22.90
New Orleans	Mexican	26.20	20.00

PAVING STONE—

New York	Manhattan	$2.80 sq.yd.
	Other boroughs	2.80 sq.yd.
New York	5-in. granite	2.80 sq.yd.
Chicago	About 4x8x4 dressed.	2.70 sq.yd.
	About 4x8x4 common	2.35 sq.yd.
San Francisco	Basalt block 4x7x8	57.75 per M
Kansas City	Limestone	2.90 sq.yd.
Boston	5-in. granite	98.00 per M
St. Paul	Sandstone	1.75 sq.yd.

FLAGGING—

New York	Bronx	$0.20 sq.ft.
	Manhattan	.21 sq.ft.
	Queens, 5 ft. square	.20 sq.ft.
	5x20-in. cross-walk	.70 lin.ft.
Chicago	18 in. wide	.80 lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3½	16	$3.25
New York	4	16	3.50
Chicago	4	16	3.10
Chicago	3½	16	2.95
Chicago	City specifications		3.10
St. Louis	3½	16	2.45
St. Louis	4	16	2.60
St. Louis, Minneapolis spec.	3½	..	2.40
St. Louis, Minneapolis spec.	4	..	2.55
Kansas City	4	16	3.00
St. Paul	3½	Minneapolis specifications	2.50
Dallas	3½	18	3.17
Dallas	4	18	3.56

CURBING—Prices per linear foot are as follows:

New York	5 x 16	$0.45
	5 x 20	.55
Chicago	6 x 18	.95
St. Louis	5 x 16 square edge	.92
St. Louis	5 x 16 bull nose	.97
San Francisco	5 x 16	.65
	5 x 20	.80
Dallas	6 x 20	.45

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, FEBRUARY 13, 1919 — Number 7

An American Mayor

OLE HANSON of Seattle is a mayor to be proud of. Promptly and unanswerably he served notice last week that the legally elected representatives of the voters of Seattle would continue to run the city and that the first strike leader or other person who tried to usurp authority would be shot on the instant. Mayor Hanson's swift, manly action sets an example which may save other cities also from whimsical and tyrannous overnight attempts at minority government.

Irrigation Water Losses Increase with Temperature

THAT loss of water by seepage from irrigation canals may vary with temperature as much as 30% in a single season is the conclusion stated on p. 323 by an engineer who has been studying for many years the duty of water in irrigation. The studies on which this conclusion is based are part of a series carried on for an irrigation company during the past few years. The company deserves commendation for these investigations, as also do both it and the author of the paper for making them public.

Finish the Government Housing Developments

STOPPING a running machine dead is not good for the machine or its operator. It should be allowed to slow down. This seems to be the case with the Government housing program, as very cogently pointed out by Mr. Knowles on another page. Housing as an engineering problem is so new that the full benefit of the forced Governmental experiment is necessary to develop future possibilities. Half-finished projects will serve no useful purposes either to house workmen or to provide examples of practice. Let the Government complete all of the now necessary developments it has started, and leave the question of Government housing as a social panacea for future settlement.

Public Service Through United Engineering Action

TRUE public service was done by the engineers and engineering organizations that made the battle against the arbitrary action of New York City authorities in dismissing hundreds of engineers engaged in rapid-transit construction, a month ago. Now that the battle is won and the engineers have been reinstated, it is even clearer than before that the issue was of primary importance to the entire community and that those who championed the cause of the unjustly discharged men stood as the defenders of the public's interests. Though sympathy was engaged primarily by the immediate victims of official arbitrariness, the underlying spur to action was the certainty that necessary work would be paralyzed, to the community's great loss. By entering an energetic protest, the engineering profession took a step that is likely to be long remembered as a precedent. The success of this protest is an encouragement to further united action. No case could show more clearly than this one that in defending his own interests the engineer also serves the interest of the public. And if the professional interest can be upheld only through union, such union is not merely a privilege, an opportunity, but also a duty which every engineer owes to his fellow citizens.

Pass Some Kind of Water-Power Bill

NINETEEN days are left in which a Federal water-power bill can be enacted by the present Congress. If Mar. 4 goes by with the conference deadlock intact, years may pass before another Congress can bring a bill to the advanced stage the present Senate and House bills have now reached. Argument pro and con in the public prints can no longer avail much. Everything that is to be said has been said, except that it would be a crying shame to let petty differences now interfere to prevent the passage of some sort of act which will permit the necessary development of the water-powers of the United States.

An Engineer To Direct Construction

NEW lines of development of rapid-transit construction and planning in New York will come into prospect if the proposed appointment of Col. William Barclay Parsons to head the work is made a reality. There is so obvious a gain in handling a large construction enterprise through a competent and responsible directing head that many of the troubles which have attended the Public Service Commission's course would disappear. When five nontechnical men are set to carry out executive functions requiring knowledge of engineering and construction, difficulties are bound to develop. Of these, lack of coördination of thought is perhaps the most serious, and in New York transit matters very tangible evils have resulted herefrom. Governor Smith's offer to Colonel Parsons is reassuring evidence of progress in administrative methods—all the more so because it would separate the direction of construction work from rate regulation and other phases of state utility control.

Engineering Societies Show Greater Activity

THAT the organized activities of engineers are at last responding to the persistent exhortations of the past few years, that greater part should be taken in civic and social activities, is evidenced by the record found on the news pages of our last week's issue. Notice of a meeting of the New York members of the American Society of Civil Engineers, which developed an unusual discussion on the railroad situation and proposed principles of legislation; a suggestion by Michigan engineers for a state board of public works; a proposition by Indiana engineers for a joint license law with the architects, and insistence by Illinois engineers upon many kinds of state legislation—all are tangible demonstration that the profession is fast learning the art of progress through service. The time for talk and theorizing is past, the time for action has arrived. So many signs pointing toward right development are encouraging.

One Structure Where Operation Is Important

AS AN engineering performance, the Brooklyn Army Base is stupendous. Words and such illustrations as can be presented in these pages can suggest only faintly the hugeness of the operations that have been under way there for the past ten months. In its concentration of expenditure in comparatively small area it surpasses all of the many war jobs which have killed all hopes of record-breaking structures for many years to come. Everyone connected with the design and the construction helped mightily toward the winning of the war, though the base itself never got into operation. But in contrast to many war structures—or in fact, to most of the structures that civil engineers build—the most important interest in the base will be its operation. Together with the companion terminal at Boston, the Brooklyn project is expected to have a peace-time use as a freight-handling unit. It is, however, far larger and more elaborate than any similar terminal ever built, and this very elaboration complicates the design. The only excuse for a huge unit port terminal is the expected saving due to an orderly and rapid movement of freight plus the flexibility in operation and storage brought about by the immense warehouse area. On the economy of such projects as this, then, depend in great measure the future development in port designs and—not so far removed—the future of our merchant marine.

Motor-Driven Tractors Prepare Land for Irrigation

MOTOR-DRIVEN machinery was used in preparing a large tract of California land for irrigation, as described on p. 337. This practice will increase, since it is now seen that neither public nor private agencies do their part by merely selling so much rough land and so much water to the settler, but that they should level and perhaps otherwise prepare the land for the first crop and deliver water to the farmers' ditches. The apparent but not the real first cost of the farms will be increased by this practice. In the long run, both capital and operating charges will be reduced, and many a farmer saved from disappointment and disaster if his land is ready for cultivation when he takes possession of it. Besides the economy of large-scale operations under engineering direction, and the possibility of getting crops from all the land the first year, the farmer knows at the start just what the ready-to-use land will cost him, instead of facing the many risks due to uncertainties.

Motor-Truck Routes as Substitutes for Railway Branch Lines

FOR many years some British railways have preferred to run vehicles over highways into regions where comparatively little business originates, rather than to construct and operate branch railways. It has been known for some time that the engineering section of the United States Railroad Administration has been considering this subject. At the Jan. 16 meeting of the New York Railroad Club Charles A. Morse, in charge of engineering and maintenance in the Railroad Administration's organization, indicated his belief that under some conditions motor trucking would answer all the purposes of a branch line and save the railroad company the almost invariable loss which the operation of a branch entails. This is not a new thought from a railroad official. The late W. W. Finley was an ardent advocate of the improvement of roads leading out from railroad stations, and some of the most able arguments ever made for such betterments were presented by him with this principle of economic transportation as the basic reason for such public work.

It is pointed out by Mr. Morse that a branch railroad can often be built at a lower cost than a highway suitable for motor traffic, but this branch can only be used by rolling stock. The highway must be built, anyway. The economic problem is to determine whether it is wise to put enough money into the highway to make it fit for motor trucking, or whether it is better to leave the road fit only for light vehicular travel and put money into a branch railroad for the heavy freighting. Mr. Morse acknowledges that there may be branches which should be abandoned and their roadbeds turned into highways. He points out that long hauls by motor trucks may save transfer charges and other expenses which make branch lines unprofitable to the company and the shipper alike. In short, he takes the position that the subject to study is transportation as a whole, and not the relative merits of trucking and railway haulage as unrelated, conflicting rivals.

It is refreshing to have these comments from an eminent railway engineer. It is gratifying to have another dispassionate appeal for a comprehensive study of the economics of transportation from the viewpoint of the shipper and taxpayer and security holder. The engineering features of both railroad and highway construction are very simple, even elementary, compared with the economic problems which are presented by any real investigation of the choice of mode of transportation to be improved. These economic problems are little appreciated and still less studied. Moreover, in the present state of knowledge, essential data are to a large extent lacking in regard to highways. Nobody has been commercially interested in intensive and intelligent

studies of the transportation facilities which will best serve the welfare of the great mass of the people. But until such studies are made, and we really know as much about transportation as a whole as we now know about that limited part of transportation between the receiving and delivery doors of railroad freight houses, we are doing a good deal of guessing about what is the best thing to do. Some of our guesses will be incorrect and cause a waste of money.

Keeping Up the Shipbuilding Spirit of Shipyard Workers

WHEN we read of shipyard strikes here and there in the country, strikes of which that at Seattle is only a pronounced example, we link the news with other items on labor unrest, and think no more of causes. The phenomena of readjustment are hard facts. One man may call them inevitable, and another may charge them to unwise leadership, but they are with us, whether in textile mill or in copper mine or in shipyard.

But conditions in the shipyards are fundamentally different from those in other productive industries. Shipbuilding is not glutted with stocks like the copper field, or confronted by an uncertain market like the textile field. Its hours and wages are controlled by the Macy board. There are not the same causes for dispute as at Lawrence and Lowell. If conditions, then, are in every respect favorable to stability, to efficient production, the Emergency Fleet Corporation has at its command an engine of production that should function without friction. Yet there are strikes and disputes.

Four months ago we needed ships urgently. We need them just as urgently today. Four months ago every shipbuilding agency was driving forward at full speed; but today, though the drive is still on, it has not the same intensity of spirit.

Serious concern has been aroused in some shipbuilding districts by orders received from the Emergency Fleet Corporation to cancel plans for starting work on ships that would be completed late in the year. Among managers as well as among workmen, apprehension grew that shipbuilding would soon be brought to a stop. If the results are a safe criterion, these apprehensions played a part in stimulating unrest, in reducing efficiency, and in building up a strike sentiment.

The unfortunate part of the matter is that no curtailment of the shipbuilding program is involved either in this order or in prior orders issued by the corporation since October, and that nevertheless rumors of curtailment have been allowed to exert their harmful, disturbing influence.

Revision of the shipbuilding program with respect to types and sizes of vessels is now in progress. This important work will be of maximum value if its results can be applied as soon as possible, and are least hampered by the presence of keels on the ways and material in process. While this very good reason for the Fleet Corporation's order existed, yet an announcement in arbitrary form was allowed to disturb the working spirit of the yards. Together with earlier orders and announcements of the Shipping Board and the Fleet Corporation, it added measurably to the causes of industrial unrest.

An uncomfortable addition to the psychology of the moment has thus been made quite unnecessarily. Most urgent reasons exist, in the need for prompt steadying and resumption, for the exercise of tactful care in announcements and orders relating to labor matters and discontinuances. In the past the Fleet Corporation has often had to act summarily and sometimes in arbitrary manner. Now, however, the war period is over, and whatever causes may have justified arbitrary action and secrecy on the part of the corporation in that period have disappeared. The present times call for changed methods.

A Commission to Study the Colorado and Save Imperial Valley

JUST before the Colorado was turned back into its channel in 1906 a retreating waterfall marked the head of a new low-level channel which was moving up stream at the rate of one-fourth mile a day. With the repair of the break, the destructive waterfall was dried up, but there was left the long, deep channel through which the water had cut a way to Salton Sea. Should flood waters once again pour into that channel until its head cuts back across the present river bed, the fertile lands of the valley would become the bed of a great inland sea. There would be no hope of turning the river out of a channel cut below sea level. Last year's flood saw water lapping at the crest of Volcano Lake levee with nothing but low land beyond, and that sloping toward the dangerous channel cut in 1906. It is well known that the bed of the Colorado silts up rapidly, and no one can say how soon the flood menace may again become a reality in this as well as in other ways.

Too much emphasis, therefore, cannot be placed on the urgent and immediate need of protective measures. The half-million acres of irrigated lands in Imperial Valley alone produce annually crops valued at $25,000,000. It is absurd to jeopardize such valuable lands when permanent safeguards can be certainly and economically provided. Because of the present-day importance of productivity, such as that for which Imperial Valley is noted, it is more than ever necessary that the needed protection be provided speedily. Governor Cantu, of Lower California, has indicated his willingness to consider plans for improving the present situation, and the recent Imperial Irrigation District, election, on Jan. 21, although of no legal binding effect, was almost three to one in favor of the proposed contract with the Secretary of the Interior for an All-American canal, and nearly six to one for control by the United States Reclamation Service and for reservoir regulation of the Colorado.

In these conditions, the present is a most opportune time to take up in earnest the control measures so long deferred. Surely, there is common ground on which the various interests involved can get together and forget the petty quarrels that have made enemies of adjacent districts. Uncontrolled, the river is a constant menace to all, but with proper regulation it could be made a safe source for additional water which would

make possible a greater irrigated area for all the districts involved.

By way of constructive suggestion, the following is proposed as a means of securing the measures necessary: Let there be formed a Colorado River Commission consisting of three members, one representing the Reclamation Service and one representing the United States Army Engineers, and let these two select a third to represent independent irrigation interests. Such a commission, taking into consideration the rights of all irrigable areas involved with respect to the maximum use of all the water that can economically be made available, should be able to agree upon the necessary protective measures, more particularly the number and location of storage reservoirs on the head waters of the Colorado. It should also estimate their approximate cost and apportion the shares of such costs. This last might be done in the expectation that half the money would be apportioned by Congress from Federal funds, contingent upon the raising of the remainder from state and local sources. Precedent for the general features of this plan is found in the somewhat similar plan applied in the Mississippi levee districts and the Sacramento River flood-control districts. The findings of such a commission should receive the united support of water users along the Lower Colorado, if there is a reasonable degree of willingness to get together on common ground. Moreover, the report of such a commission would constitute the logical starting point for an international commission to draw up some form of agreement to which both the United States and Mexico would subscribe.

The foregoing suggestion is based wholly on economic considerations. For the good of the country at large, and particularly for those interests concerned with the control of the Colorado River, some such plan should be adopted at the earliest possible moment.

Federal Aid and Co-operation in Rural Public Health Work

THERE has been introduced in Congress by Mr. Lever a bill to provide means for the prevention, control and mitigation of the diseases of our people living in the country and in towns of not more than 5000 population. The United States Public Health Service is designated as the agency of the Federal Government in this work, and the states are to be represented by their health departments or officers. The bill carries an appropriation of $480,000 annually to be allotted $10,000 to each State, besides an appropriation of $250,000 for the current fiscal year, $500,000 for 1920, $750,000 for 1921, and $1,000,000 annually after 1921. After deducting administration expenses, not exceeding $50,000 annually, from the appropriations, the annual Federal contributions are to be divided among the states in proportion to their areas and to their rural populations, one-half on each basis. In order that any state shall receive any of this money, it must first give official assent to the law and agree to furnish an equal sum from its own funds, after the current fiscal year. The regulations governing the cooperative work are to be drawn by the Secretary of the Treasury, just as the Secretary of Agriculture draws the regulations governing the laws of this type now in force.

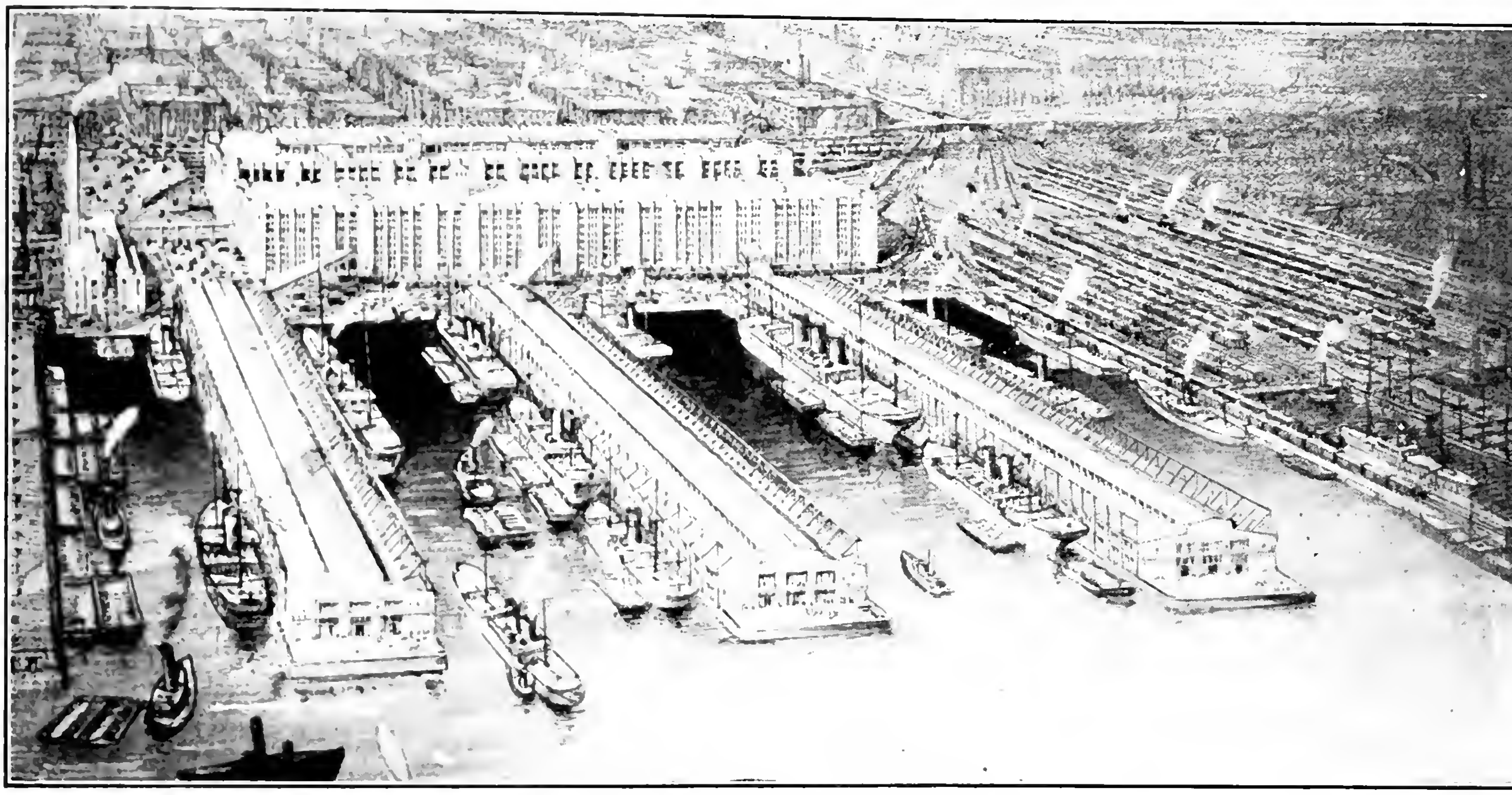
The importance of this act is capable of numerical demonstration, and does not rest on generalities. Its objects will be attained when the people in the country and in the little towns know what they can do to protect themselves against disease and apply this knowledge, thereby eliminating the diseases which are now common but which should be matters of medical history. Our large cities have gone a long way toward that desirable end. The cities in the states maintaining public health registration service had their death rates decreased an average of 21.2% in the period 1900-1912, while the death rate in the rural sections decreased only 8.6 per cent. The last typhoid-fever census figures were taken in 1900 and showed that even that disease, peculiarly likely to occur in cities, was actually more prevalent in the country, outside New England. The Public Health Service estimates that as a result of unsanitary conditions in the country and in the small towns there are 350,000 cases of typhoid annually in such sections, with about 30,000 deaths. There are about 9,000,000 cases of malaria and 3000 deaths. The service estimates that the economic loss from these two causes in the country is about $900,000,000 annually. Then there is the hook-worm disease, also due absolutely to unsanitary conditions. There are about 2,000,000 cases of this, and some of them are fatal. Economists have not yet reached a satisfactory estimate of the financial burden of this disease, because persons afflicted with it have their working value reduced from one-fourth to one-half, so that any estimate of the financial burden due to the disease must be far less accurate than that for typhoid or malaria. The detail figures have recently been made public, in part, in Bulletin 94 of the Public Health Service, so it is unnecessary to go into them here.

The bill is specially interesting to the sanitary engineer in that, if it is passed, it will enable him to have the support and coöperation of a fairly efficient rural health organization, wherever his work may be done. The Public Health Service is coöperating in some places with the county agents working under the Lever act of 1914, because of the inadequate provisions made in such localities for local health work. The typhoid and malaria brought to the cities annually by persons who have been spending their vacations in the country give the urban resident a very strong reason for backing this proposed law. The sanitary engineer who is trying to force the innumerable little towns of the country to clean up and stay clean will find in this proposed legislation the help he has heretofore sought in vain. There is nothing spectacular about these small local skirmishes with filthy and slovenly conditions; they have none of the interest of the engineering problems of the larger cities. But they are of great collective importance, and call in many cases for just as much good judgment and engineering ability as larger operations, so that the Lever rural health bill, as it is called, is really a measure of unusual significance to a very large group of engineers who are rendering the same valuable class of service that is performed by the country doctors.

Brooklyn Army Base Is Largest Port Terminal

Huge Freight-Handling Unit Designed for Overseas Service Has 138 Acres of Pier and Warehouse Floor and Track Space for 1300 Cars—Designed as a Whole for Rapid and Economic Operation

THREE deep-water piers, each larger than any other pier in New York harbor, a small lighterage pier, two reinforced-concrete warehouses with 91 acres of storage floor, and railway yards accommodating 1300 cars, make up the huge Army base which was rapidly approaching completion in Brooklyn, N. Y., when the armistice was signed. Begun in May, 1918, the whole terminal would have been well toward completion by the end of the year had not the return of the eight-hour day, following the armistice, precipitated strikes which cut down the output. As it is, the buildings and one pier are now nearly ready for service. About $17,000,000 had been paid out, in the nine months up to Feb. 10, which puts the operation near the head of the concentrated building constructions incident to the war.



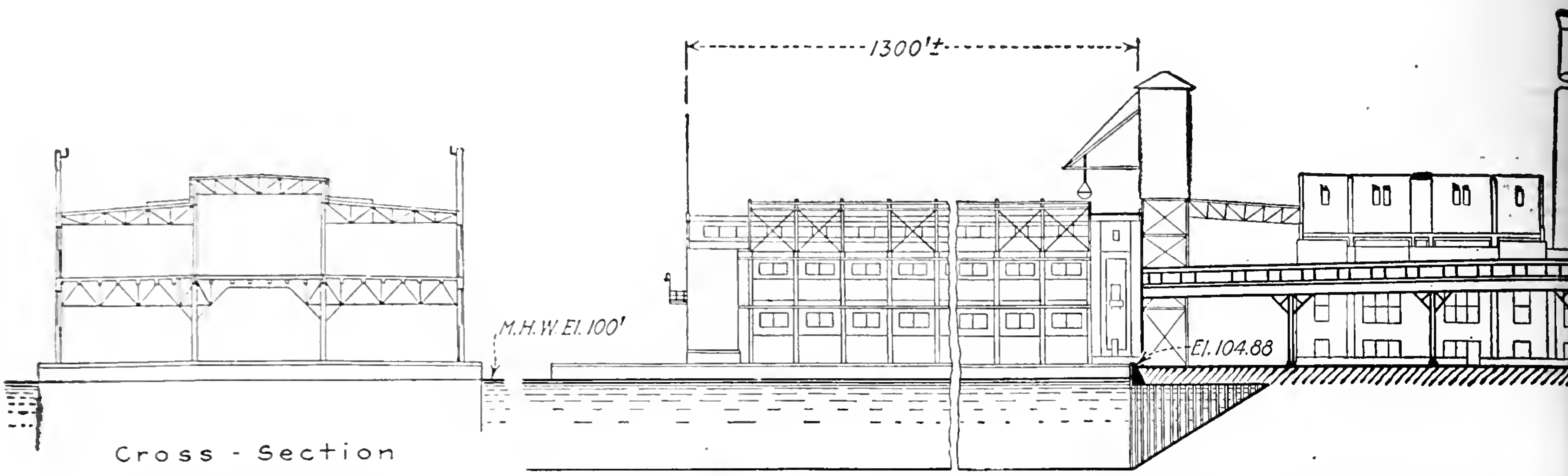
PERSPECTIVE OF FINISHED BROOKLYN ARMY BASE FROM THE WATERSIDE LOOKING SOUTH

Individually, any one of the units which make up the Brooklyn base is a large and important engineering structure worthy of detailed description. Collectively, the whole project is a remarkable example of a modern freight-handling port terminal, a necessary shipping element hitherto rare in this country. The attention of this article, therefore, will be mainly directed to the composite design of the base rather than to those structural details which in so enormous an undertaking would require space far beyond that available here.

The Brooklyn Army base is the largest and in many ways the most nearly complete of the six port terminals built in 1918 to handle the supplies to the American Army in France. Soon after the United States entered the war a committee of the Council of National Defense, in coöperation with the War Department, made a thorough study of the storage and traffic necessities, as a result of which they recommended the establishment of a series of interior and ocean terminals which would insure a steady flow of the needed materials to France. For one reason or another, however, the port terminals themselves did not get under way until nearly a year after the war was started. Few of them were in operation at the time of the signing of the armistice. Their design was predicated on a war use, which meant primarily that the material through them would flow mainly from land to the ship. Where any question of alternative design arose, the war use naturally controlled, but in the permanent terminals of the Boston and Brooklyn type the possible future peace-time use was always kept in mind.

The terminal is located on the east shore of New York Bay, immediately alongside of the harbor terminal of the Long Island Railroad, with its car-storage tracks and car-float bridges permitting transfer to and from any part of New York harbor. Here an area extending 1560 ft. along the waterfront and 1305 ft. back of the main bulkhead line was taken over by the Government. This extends from Second Ave. to the bay; the total land and water area of 100 acres (including the cross streets and First Ave.) is all inclosed in the Government reservation.

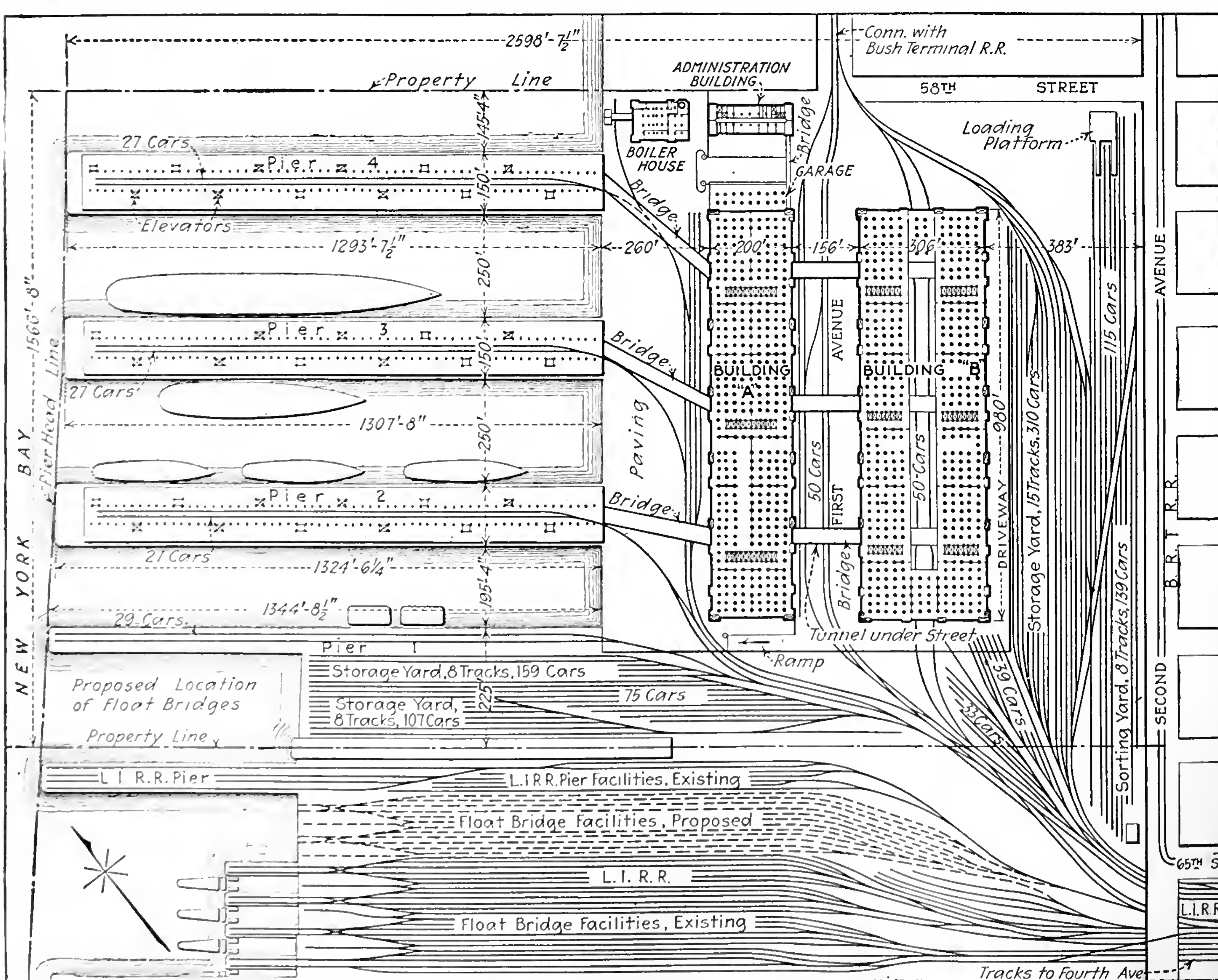
As shown in the accompanying map and plan of the base, the terminal consists essentially of two large reinforced-concrete warehouses connected by tunnels and bridges, approached by railroad tracks and paved streets, and further connected by a paved area and bridges to three double-deck piers, each 150 ft. wide



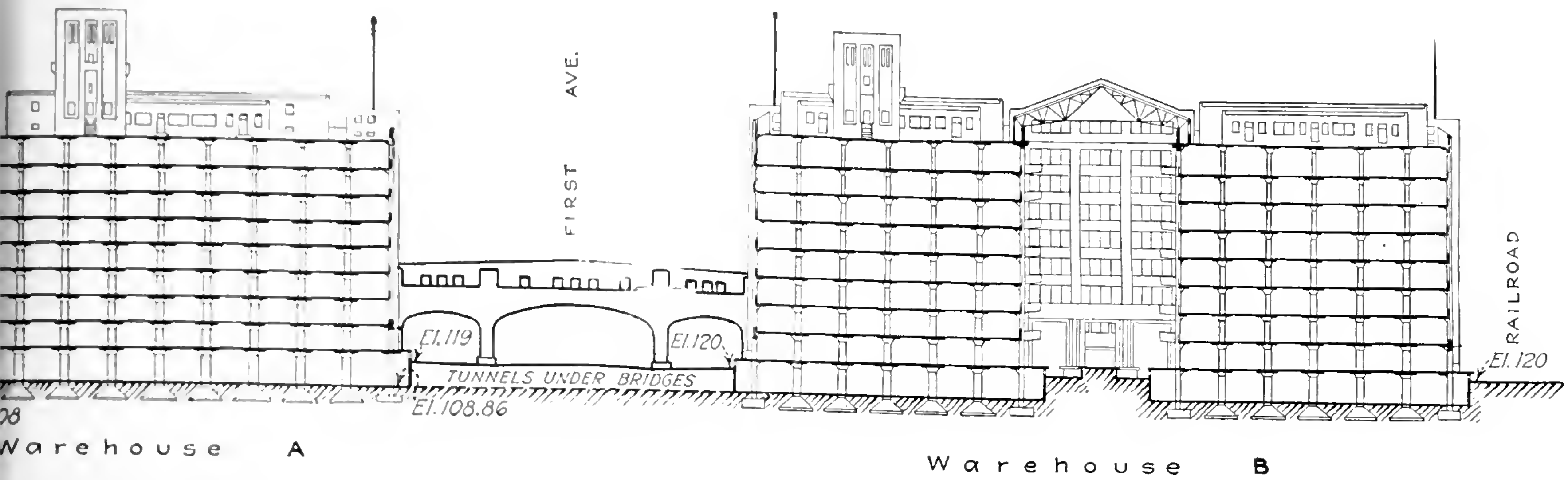
CROSS-SECTION THROUGH THE BROOKLYN ARMY BASE SHOWING, FROM THE LEFT, ONE OF THE 1300-FOOT PIERS WAREHOUSE B, AND WAREHOUSE

and varying in length from 1294 to 1325 ft., the variation being due to the fact that the pierhead line is not parallel to the bulkhead line. There is in addition a 60-ft. lighterage pier 1345 ft. long on one side and about 600 ft. on the other, and the necessary administration building and boiler house. Tracks paralleling the warehouses and the slips at the south end of the site provide storage for cars. South of the site is the large storage yard of the Long Island R.R., connection to which is made at the southeasterly end of the site. Track connections at the north end of the site lead to the Bush Terminal railroad. The slips, with a maximum width of 250 ft., are dredged to a depth of 35 feet.

The warehouses are of reinforced-concrete construction throughout and of similar structural design. Building A, the one nearest the wharves, is 200 ft. wide and 980 ft. long, and eight stories and deck story



PLAN OF THE NEW ARMY BASE ON NEW YORK HARBOR AT BROOKLYN



HE BRIDGE CONNECTING THE PIERS TO WAREHOUSE A, FIRST AVENUE, AND THE BRIDGE CROSSING TO WITH THE RAILROAD YARD

high. It has a floor area of 41 acres. Building B is 306 ft. wide, 980 ft. long, and has eight stories and basement. Its floor area of 50 acres makes it the largest concrete building. It has an interior court 66 ft. wide, covered over with a steel and glass skylight, and provided with concrete track girders on which run girder cranes controlling the freight on the cars which run through the court. Extending out from the windows of the court at each floor are concrete balconies onto which material is loaded for transfer to or from storage on the floor. These balconies are staggered in plan so as not to interfere with each other. The two buildings are connected by three lines of bridges at the third floor and tunnels at the basement of warehouse B to the dock floor of warehouse A, all being in direct line with bridges leading to the piers.

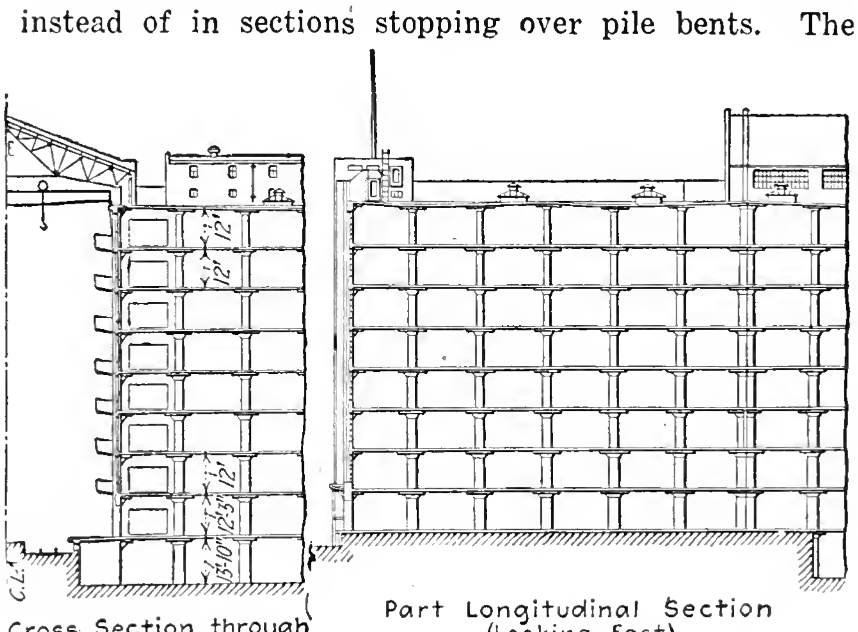
Both buildings are of the two-way flat-slab type, with round, spirally reinforced columns. The curtain walls are of concrete throughout. Intermediate partition walls, located as shown on the typical floor plan, are also of concrete. The design of these buildings is in accordance with the local city regulations and the provisions of the National Board of Fire Underwriters. The first, second and third floors are designed for a live load of 300 lb. per square foot and the upper floors for 250 pounds.

Building A is supported on reinforced-concrete spread footings, using a total safe load of 3 tons per square foot, with the exception of a small part of the building where a continuous mat footing was used on account of poor soil. Building B has the same type of foundations except at the north end, where Raymond concrete piles were used to eliminate the excessive excavation that would have been required for spread footings. Each of the buildings is divided into four separate parts by three expansion joints, their location being determined by storage space requirements and elevator groupings, but in general being about 300 ft. apart.

Outside stairways are provided in pylons, according to fire-protection standards, and the windows are all wire glass, those having exposure being of the Underwriters' type. Architecturally, the buildings are fairly simple, but the general effect is remarkably fine. The tremendous emphasis of so great a pile as either of the warehouses cannot be escaped in any part of the site. This effect can only be partly implied by the photographs of them which are reproduced herewith.

The three main piers are identical in design and size, except for the slight variation in length. They are 150 ft. wide and from 1294 to 1325 ft. in length, and carry over practically all of their area a double-deck shed, with first-floor tracks and roadway connecting with the main level of the yard, and the second floor connecting by simple plate-girder steel bridges to the third floor of building A, where they enter in front of the elevator banks. Slips 250 ft. wide are dredged to 35 ft. now, and in one case to 38 ft., but the substructure will permit the 40-ft. New York harbor standard.

The substructure follows the design of similar piers in the New York district; that is, untreated wood piles carrying, above the water line, timber caps and a reinforced-concrete slab deck, with pile clusters capped at mid-tide for the pedestals under the columns. A departure from local practice was the design and construction of the concrete deck as a continuous slab instead of in sections stopping over pile bents. The



DETAILS OF PARTS OF WAREHOUSE B

early practice had been adopted because of fear of unequal settlement of the bents and consequent severance of continuity, but the present designers were willing to assume this continuity, with a consequent saving in steel.

Structural design of the pier superstructure was made at a time when there was the greatest demand

for saving in steel, particularly in plates, which were needed for ships. The resulting design, therefore, does not follow current practice, nor is it advanced by its authors as the best possible under normal conditions. Its main difference is in the use of longitudinal concrete stringers and wood roof purlins, as a part of a structural steel frame, the unusual arrangement of the middle-bay cross frames, and the use of a side-bay truss instead of a girder. All of these details saved steel, especially plate steel, the claim being that in each pier the saving in plates over normal design was enough to build one ship.

Each shed is in three continuous bays for the full length of the pier. The second floor, a concrete slab, is supported in the outer bays in trusses with longitudinal girders of reinforced concrete supported on brackets on the steelwork and in the middle bay on a cantilevered frame, of which the supporting members are trusses and the suspended members a Bethlehem 26-in. girder 20 ft. 8 in. long. The roof, with a center bay monitor, is a light steel truss carrying wood purlins and sheathing with tar roofing. Outside columns rise above the roof and carry the longitudinal beams from which freight-handling hoists are hung, according to local practice. All openings in both decks have metal doors which slide back under the ceiling.

Loadings of 500 lb. per square foot on the first deck and 300 lb. on the second were provided for.

Between the piers extends a bulkhead which consists of a concrete wall resting on a pile and timber platform, and retaining about 10 ft. of fill some 25 ft. out from a row of sheet piling.

Full provision has been made for the lighting, heating, drainage and water-supply of the entire base, an engineering operation of considerable magnitude but of no particular complication. Warehouses and piers are all provided with sprinklers and high-pressure service lines, as well as connections to the pumps in the boiler house. Light and power are purchased from the local service company, but all heating service comes from the central boiler house. The administration building is a reinforced-concrete structure of the office type connected by a bridge to warehouse A.

The pavements in the base are of three types, depending on traffic conditions and considerations of laying. Granite blocks are laid on First Ave. and on the streets south and east of the warehouses and on the ramps between First Ave. and the bulkhead. Bitulithic pavement is to be laid in the area between building A and the bulkhead, and asphalt block will be used on the first deck of the piers, on the bridges to the warehouse A, and over First Ave., and on the loading platforms and main traffic aisles in the warehouses. Concrete floors in buildings and on the second floor of the piers have a 1-in. granolithic surface. Quantities are 47,000 sq.yd. of granite block, 44,000 sq.yd. of bitulithic, and 104,000 sq.yd. of asphalt block.

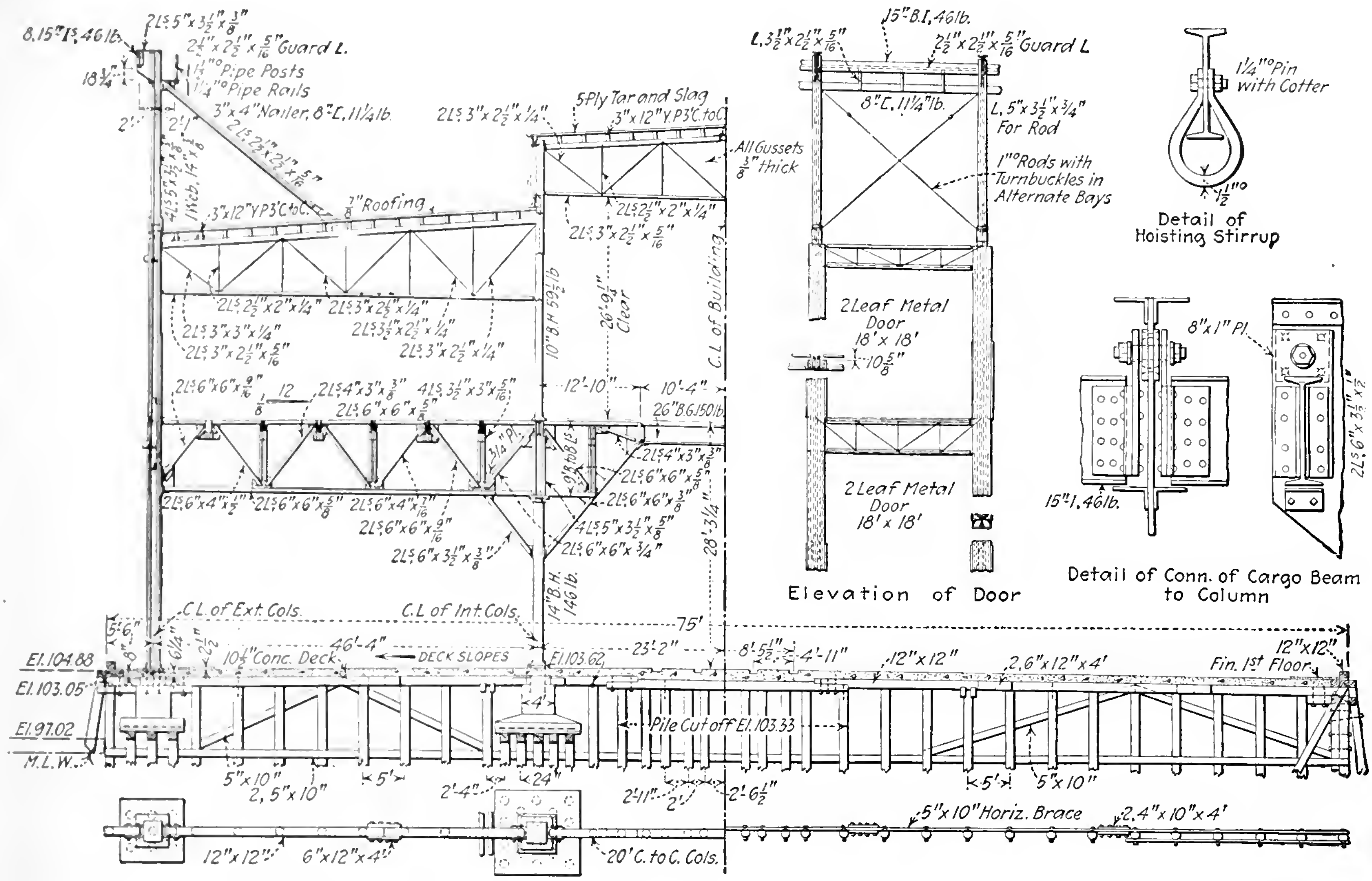
Granite blocks are laid under standard New York specifications, on a 2-in. sand bed over a concrete base. Each block is about $5\frac{1}{4}$ in. deep, except in track areas, where it is 4 in. deep and is laid on a 1-in. sand cushion. As the tracks are laid with a T-rail instead of the usual girder rail, the blocks adjoining the rail have a flanged groove cut $2\frac{1}{2}$ in. deep. Expansion joints are placed transversely over the pavement every 50 ft. and over the edges of the tunnels between buildings. The base in all cases is a 1:3:5 gravel concrete 6 in. thick without expansion joints. The blocks are grouted with a 1:1 grout.

LOOKING EAST FROM LONG ISLAND TERMINAL TOWARD BUILDINGS NEARING COMPLETION

Bitulithic is the standard pavement made by the Warren Bros. Co., and has an 8-in. concrete base. Asphalt-block pavement on the piers is made up of 5 x 12 x 2-in. block made by the Hastings Pavement Co. This pavement is laid on a base prepared of moist 1:3 grout $\frac{3}{8}$ in. thick and struck to a plane surface.

As an indication of the tremendous size of the whole project, a few of the total figures are given in the accompanying table. (See page 322.)

As stated at the beginning of this article, the fundamental design of the terminal was made to insure the even flow of freight to the outgoing ships. To this end the warehouses are in effect reservoirs for the storage of such freight as cannot be transferred immediately to the ship. A direct and readily usable connection between the warehouses and the piers had therefore to be provided, at the same time permitting



Elevation of Door

Detail of Hoisting Stirrup

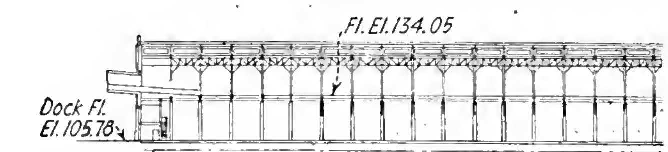
Detail of Conn. of Cargo Beam to Column

Half Section of Shed and Section and Plan of Substructure at Column Footings

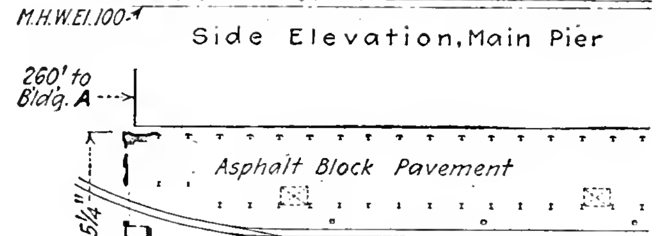
Half Section and Plan of Substructure between Column Footings

an alternative loading or unloading of freight direct to the piers or its temporary storage in the warehouses whence it is to be rehandled. Two definite traffic levels are provided, the lower being the level of the first deck of the main piers, the open area between building A and the water, the lowest or dock story of building A and the tunnel connecting buildings A and B and the basement of building B. At an elevation two stories above it is the second deck of the pier, the bridges from the piers to building A, the third stories of the warehouses, and the bridges between them. At an intermediate level is First Ave. between buildings A and B, which is connected by ramps to the bulkhead areas.

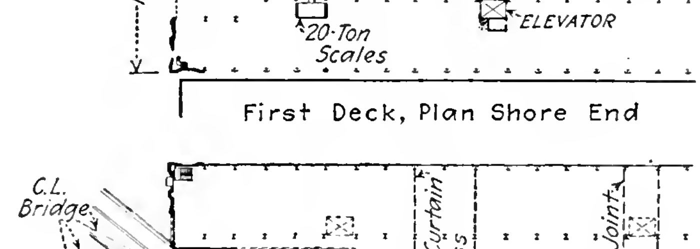
Entering freight, therefore, will come either via railroad or on truck. Railroad cars can be brought either over the car floats to the Long Island yard, from the Bush Terminal at the north, or from the yards of the Long Island R.R. at the east, which yards can



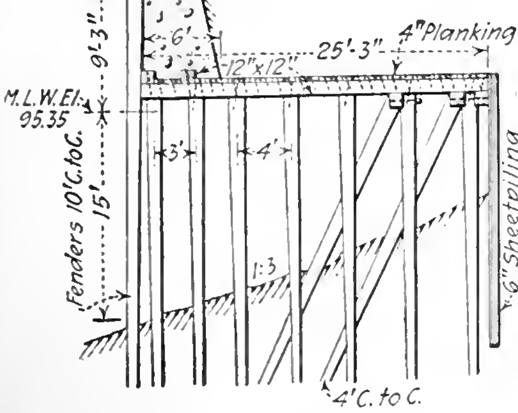
Side Elevation, Main Pier



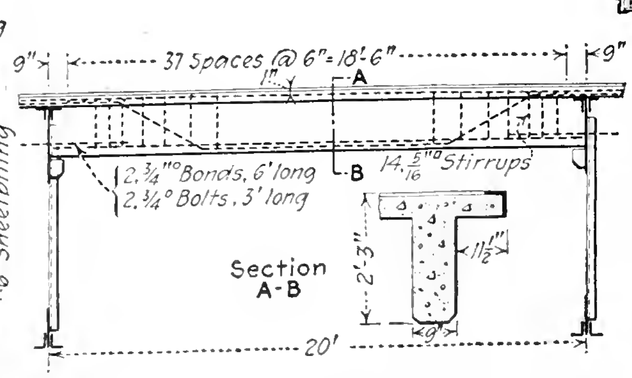
First Deck, Plan Shore End



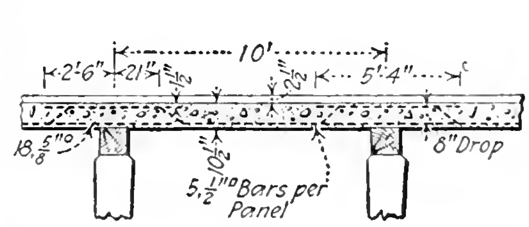
Second Deck, Plan Shore End



Cross-Section through Bulkhead



Elevation of Typical Concrete Beam



Longitudinal Section through First Deck

DETAILS OF ONE OF THE LARGE DOUBLE-DECK PIERS, ARMY SUPPLY BASE, BROOKLYN

be reached via any of the car floats to Long Island or the Hell Gate bridge from the mainland some miles north. Railroad cars stored in the various storage yards can be switched onto the tracks adjoining the east side of building B, in the court of building B, along the center of First Ave., along the east front of building A, or directly onto the first deck of the piers. Trucks will all enter the site from the main entrance at the northwest corner. They can be drawn up along all sides of building B, or on the east side of building A, or they can run down the ramps to the pier level and either approach the west side of building A at its dock floor level there or be run directly onto the first deck level of the piers themselves.

The loading and unloading platforms of the terminal will accommodate a total of 129 cars, and on the bulkhead space west of building A, in addition to the loading and switching tracks, two storage tracks are

LOOKING NORTH TOWARD BUILDING B OVER RAILROAD YARD, BROOKLYN ARMY BASE

provided, accommodating 36 cars in storage, which can be unloaded by derricks onto the bulkhead space if necessary. Each pier is provided with two tracks, 1200 ft. long; allowing 50% empty for traffic requirements, these will accommodate 28 cars each, or a total of 84 cars on the three piers. The completed yards will include about 17 miles of track and 172 switches, and will provide storage for a total of 1300 cars.

The standards followed in the track work are those of the United States Army and the Director General of Military Railways. Eighty-pound steel rail of the A. R. A. section is laid on all curves and through turnouts and on drill tracks and leads subject to much traffic. The balance of the yard will be laid with 67½-lb. Russian rail, which was rolled for the Russian railways and which, after the Russian revolution, was diverted for use in this country. No tie-plates are used, but all curves are double spiked. The maximum curve is 300-ft. radius except one instance at the First Ave. connection, where a curve 274-ft. radius is used. Within paved areas granite block is to be laid between and outside of the rails, and ground levers are to be used at the switches. The ballast is cinders 6 in. deep under the bottom of the tie.

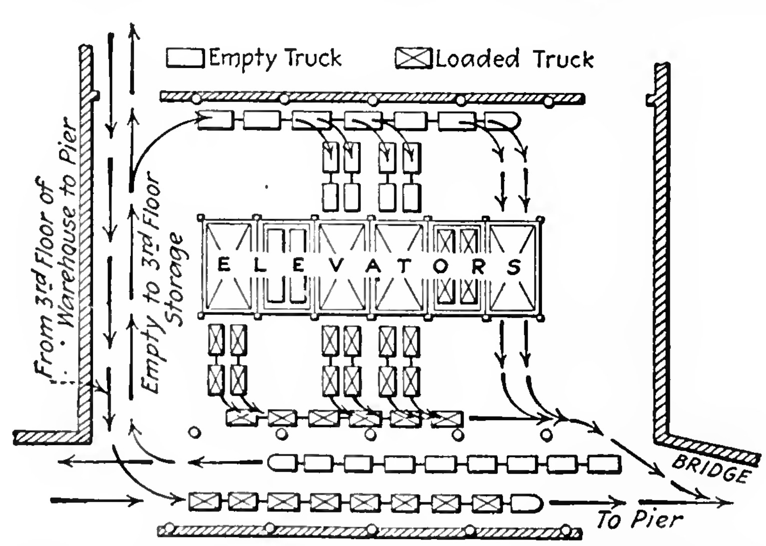
The truck-unloading platforms of the warehouses will accommodate 228 motor trucks, and in addition, freight may be delivered direct to the piers by truck. Furthermore, of course, lighters may be unloaded along the 60-ft. pier.

In the expected operation of the terminal, the two general traffic levels will be the main arteries of traffic

Item	Buildings	Piers	Misc.	Total	Unit
Land area of reservation				57	Acres
Water area, including that occupied by piers				43	Acres
Area occupied by building and piers	12	15		27	Acres
Land excavation				704,000	Cu.yd
Dredging				1,700,000	Cu.yd
Total floor area	4,699,000	1,220,000	40,000	5,959,000	Cu.yd.
Timber and lumber, construction use, forms	6,614,000	1,500,000	600,000	8,714,000	Ft.b.m
Cement	381,200	67,500	51,000	500,000	Bbl.
Sand	138,000	3,000	15,000	156,000	Cu.yd.
Stone	194,100		20,900	215,000	Cu.yd.
Mixed aggregate		71,000		71,000	Cu.yd.
Grits	11,000	3,000		14,000	Cu.yd.
Concrete	214,600	41,700	26,900	283,200	Cu.yd.
Reinforcing steel	13,650	1,900	450	16,000	Tons
Structural steel	425	9,070	1,005	10,000	Tons
R.R. track, storage capacity (including railroad track on piers)				20	Miles
Railroad track, storage capacity				1,300	Cars

and the other floors will be used entirely for storage. All material will be moved from truck or railroad platform to elevators by industrial trucks and trailers, from the elevators to the required storage floor, there to be placed by tractors and trailers. In rehandling, all material will be taken from its storage location by elevators to one of the two traffic levels, and thence carried to the pier for unloading. Special provision in the court of building B is made for the handling of packages from the freight cars or trucks to the staggered balconies shown on the drawing. Onto these balconies may be run the small trailers, and the materials dropped onto them from the traveling cranes. No provision for outside handling of freight to different floors is made on building A, except that the tracks west of the building are so close as to permit unloading of cars on them by whip hoists which can be put on the roof of building A.

A total of 90 freight elevators is to be provided in the various buildings and piers. Building A has three



DETAILS OF OPERATION OF TRACTOR TRAILERS AT ELEVATOR IN WAREHOUSE

groups of ten each and building B six groups of seven each. There are, besides, one passenger elevator in building A and two in B, with provision for four in each.

As shown in the drawing, the elevators are arranged in three groups, at the ends and middle of each of the buildings. These elevators are of 10,000-lb. capacity traveling 150 ft. per minute, and have 9 x 17-ft. clear floor space. They are so designed as to accommodate four trailer trucks at one time. They are to be open at both ends to permit of through circulation and so as to prevent interference and congestion of traffic.

The elevators are of the special central-control type which has been used in several of the Army bases; that is, they are provided with an auxiliary mechanism which automatically levels the car floor at the level of the warehouse floor. A special dispatch central located in each building will have full control of all of the cars in the building.

On each of the three covered piers there are six elevators with a provision for six additional, to be installed at some future time. In addition, provision is made for spiral chutes from the second to the first deck.

In general, all traffic movements in the buildings and piers will be made by trailer trucks drawn by electric tractors. The average load of each trailer will be about 1500 lb., and they will be drawn in trains of from four to eight trailers in a train. At each floor, when receiving and discharging are in progress, there should be a continuous movement of loaded trucks in one direction and empty trucks in the other, between the point of loading or unloading and the elevators. The trucks will then be placed on the elevators and make continuous trips from point of loading to point of unloading and return—as, for example, for a storage space on an upper floor to the pier—but the tractor will move generally from point to point on its own floor. This results in three main circuits of travel for each group of elevators, proceeding simultaneously: (1) Between unloading platforms and elevators on the first floor; (2) between elevators and piers on the third floor; (3) between storage spaces on the upper floors and the elevators.

Normal Operation of Base

Normal operation of the base at a freight-handling unit is intended to be as follows: Incoming freight will be loaded on trailers and drawn by trucks to the elevator on the first floor. The door will then be closed and the car dispatched to the upper floor on which the goods are to be stored. When it reaches that floor the doors will be opened automatically, the trailers will be moved off by a tractor on that floor and replaced with empties. The doors will then be closed by the pressing of a button and the car returned to the first floor by the pressing of the dispatch button. Outgoing freight will be handled in similar fashion, the elevator with empty trucks being dispatched from the third floor to the loading floor, and the loaded elevator returning to the third floor. Special devices, of course, are provided whereby the elevators may be manually controlled, at which time the central dispatch system is thrown out of gear.

It is difficult to give full credit to all who are responsible for the rapid and effective construction of this mammoth project. The credit for initiative for its location and design should probably be given to Irving T. Bush, of the Bush Terminal Co., who early in 1917 began to study the problem of a big terminal in New York harbor. Its design was made by Cass Gilbert, New York architect, under the direction of Maj. Gen. G. W. Goethals, U. S. A., director of storage and traffic of the Army. The construction was carried out under the direction of the Construction Division of the Army, Brig. Gen. R. C. Marshall, Jr., chief of the division. The Turner Construction Co. of New York City is general contractor. In an organization chart prepared by the general contractor there are listed 36 separate subcontractors and fully a hundred responsible engineers and contractors' superintendents. In charge of the work for the Army as constructing quartermaster is Lieut. Col. H. S. Crocker, Quartermaster Corps, who before entering the service was a well known engineer of Denver, Colo. A. C. Tozzer is executive manager at the Army Base for the Turner Construction Company.

Canal Seepage Losses Are Affected by Temperature

Records Kept on Western Irrigation Project Show Increase of Losses with Warmer Water

By Lynn Crandall
Chief Hydrographer Twin Falls North Side Land & Water Co., Jerome, Idaho

THE effect of temperature on canal losses has not always been fully appreciated in studies made in the past, but it is a fact that the variation in temperature during the irrigation season may readily cause a 30% variation in the rate of seepage losses. The results of seepage investigations made early and late in the season must be considered in connection with water temperatures if information is desired regarding the loss at the time of maximum demand. In connection with detailed hydrometric investigations carried on for the past two years on the project of the Twin Falls North Side Land & Water Co. in southern Idaho, a fairly definite relation has been worked out between water temperatures and rate of loss; it is shown in the accompanying diagrams.

Fig. 1 shows the average monthly rate of loss over the entire canal system, comprising some 2600 acres of water surface. The results are based on daily records of use and supply, computed separately for each of the several hundred laterals on the project. The decreased rate of loss during 1917 compared with 1916 was probably due to the unusually silty character of the water during 1917. During August, 1917, when the demand was supplied almost entirely from storage, the water was quite clear and the rate of loss was the same as in 1916.

The losses are expressed in terms of depth lost per day over the water surface area, instead of the wetted perimeter, as commonly used. The water surface area is the easiest to determine, and probably the loss varies more nearly in proportion to it than to the wetted perimeter, as for conditions in ordinary canals the loss is mostly due to the action of gravity. For ordinary conditions on the North Side project the canal widths are about 5% less than the wetted perimeters, so the losses shown on Fig. 1 would be about 5% less if expressed in terms of the wetted perimeter.

Two storage reservoirs, Wilson Lake and Jerome Reservoir, are located on the tract. Wilson Lake, when full, covers an area of 1400 acres, with a storage of 18,000 acre-feet. Jerome Reservoir, if filled, would cover 5800 acres, with a storage of 60,000 acre-feet. On account of the excellent underground drainage, it has been impossible to build up the ground-water table underneath these reservoirs, and the present loss is nearly as

great as in ordinary canals in the same kind of material. This has rendered the reservoirs practically worthless for storage purposes. Wilson Lake is generally filled at the beginning of the irrigation season and used as a regulating basin for several months, but with the approach of the peak of the irrigation demand the large losses make it necessary to draw all water out of the reservoir and use it as a canal channel. No attempt is now made to fill Jerome Reservoir, but it has to be maintained at an elevation covering 400 acres, in order to furnish water to canals below.

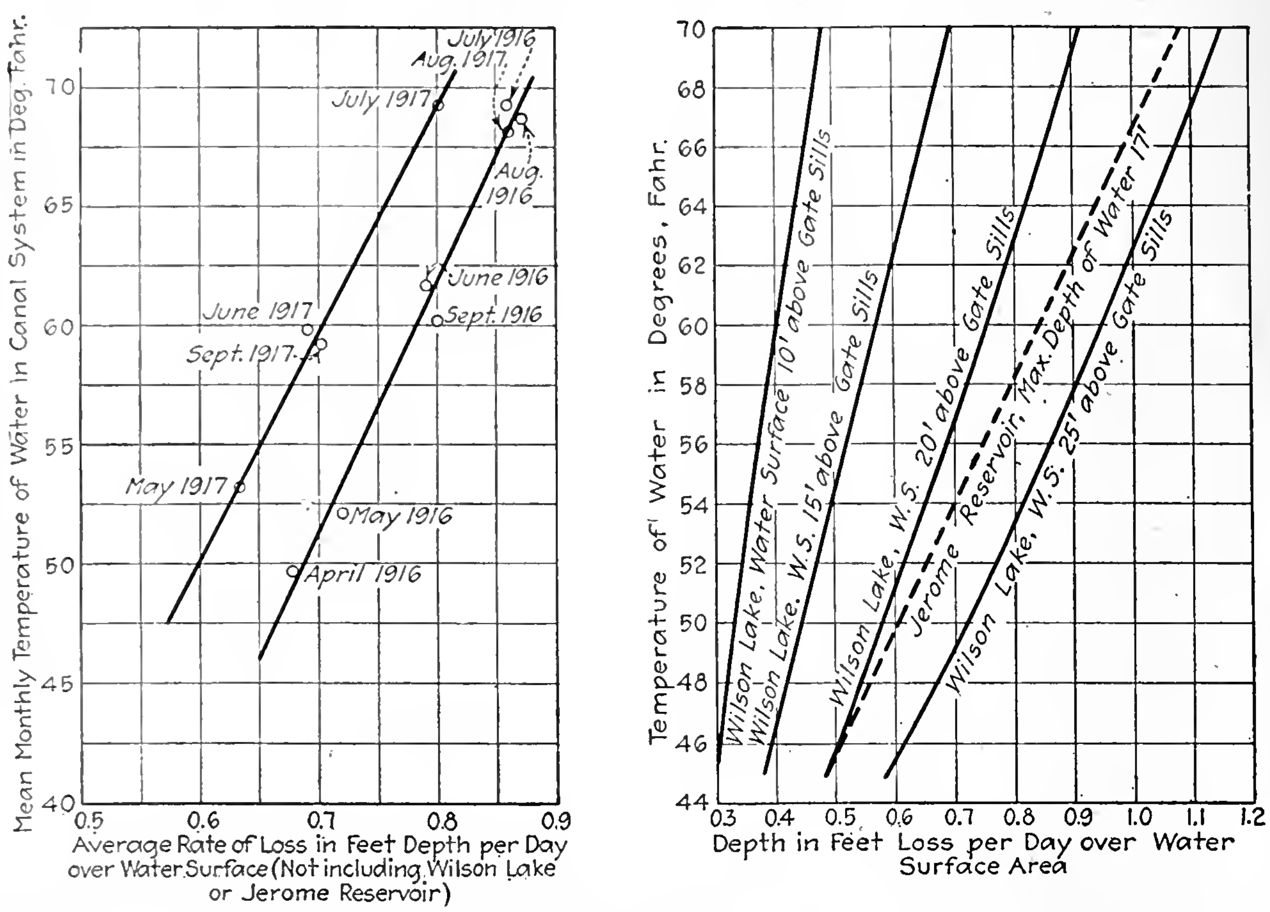


FIG. 1. RELATION BETWEEN SEEPAGE LOSSES AND WATER TEMPERATURE IN CANAL SYSTEM. FIG. 2. RELATION BETWEEN SEEPAGE LOSSES AND WATER TEMPERATURE IN WILSON LAKE AND JEROME RESERVOIR

Fig. 2 shows the losses for different water temperatures at various stages of Wilson Lake and at the height at which Jerome Reservoir is maintained. For the same depth of water the loss is somewhat less in Wilson Lake than in Jerome Reservoir, and the losses in the former increase rapidly with increasing depths. This is probably due to the fact that the bottom of Wilson Lake is largely composed of lava rock, which is more impervious to the passage of water than the deep, fine, sandy loam soil in the bottom of Jerome Reservoir and at the high elevations in Wilson Lake.

An interesting comparison between the seepage losses on the tract and the results obtained from ground-water flow formulas is given in the accompanying table:

TABLE SHOWING RATE OF LOSS AT VARIOUS TEMPERATURES COMPARED WITH RATE OF LOSS AT 45 DEGREES FAHRENHEIT

	Ratio of Loss to Loss at 45°		
Water Temperatures	50°	60°	70°
Hazen formula for ground-water flow	109%	128%	146%
Schlicter formula for ground-water flow	107	125	143
Loss in North Side Canal system, not including reservoirs; average, 1916-17	108	125	141
Loss in Jerome reservoir; maximum depth, 17 ft.	123	173	218
Loss in Wilson Lake; depth, 10 ft.	114	132	165
Loss in Wilson Lake; depth, 15 ft.	118	148	182
Loss in Wilson Lake; depth, 20 ft.	122	158	192
Loss in Wilson Lake; depth, 25 ft.	126	166	200

It will be noted that the actual canal seepage losses agree very closely with the results from the Hazen and Schlicter formulas for ground-water movement, but that the losses in the reservoirs show a greater proportional effect of temperature with increasing depths of water.

British Shipbuilding Below Production of 1913

Ship production in Great Britain during 1918 (in the year which ended Oct. 31) reached 1,600,000 tons, according to a statement of the Parliamentary Secretary of the Ministry of Shipping in the House of Commons Nov. 14. This is below the output reached in 1913, the kingdom's greatest shipbuilding year, when the production was 1,900,000 tons. The tonnages for four years, 1914-1917, are 1,700,000, 650,000, 540,000 and 1,200,000.

Cement Joints for Water Mains Save Money in Portland, Oregon

PORTLAND cement for making joints in cast-iron pipe is used by the Bureau of Water-Works of Portland, Ore., for all sizes from 6-in. to 30-in., except in some particular cases where it has been necessary to put the main in service without leaving sufficient time for the cement to set.

This practice was begun about three years ago, after a series of experiments, and gave such excellent results that it has been continued. During the past two years nine miles of cast-iron main have been laid, using 19,256 lb. of lead and 27,790 lb. of cement. A pound of cement will go as far as three pounds of lead, according to information furnished by F. M. Randlett, engineer for the bureau. With cement at ½c. per pound, the material for these joints cost $139. The same work would have required 68,390 lb. of lead at 8c. per pound, or $5470, therefore a saving of $5331 in material is shown.

It was thought at first that the labor of making the joints would be materially less for cement than for lead, but as the cement joints have to be kept wet for 36 to 48 hours the labor cost is about the same. In making the joints a small amount of yarn or oakum is first driven, to keep the cement from passing into the pipe. The cement is used neat, and only sufficient water is added to make it hold together while it is being forced into place.

Workmen at first showed considerable antagonism to this method of making joints, possibly because they believed their services might be reduced, but this has been overcome and the men have become skilled in making the cement joints.

Laboratory tests made at the University of Minnesota on cement, lead and metalium joints were noted in *Engineering News-Record* of May 23, 1918, p. 991.

Comparison of Formulas for Computing Parabolic Arcs

Limit of Applicability of Common Formula Defined—Exact Formula Simplified

BY ROBERT C. STRACHAN
Civil Engineer, New York

IN COMPUTING the lengths of parabolic arcs covering any considerable range in the ratio of rise to span, the engineer is called upon to reconcile discrepancies between different formulas, and to determine what is meant by a "small" ratio. While these questions may be academic when the actual dimensions do not exceed a few feet, they are of real weight in connection with long-span suspension bridges and transmission lines.

The commonly-used formula for the arc L in terms of the chord c and ratio k (rise divided by chord) is

$$L = c\left(1 + \frac{8}{3}k^2\right) \tag{1}$$

and usually a cautionary note is added, stating that this is true only for "small" values of k.

Investigation of the derivation of Formula 1 shows that beyond a certain limit, both this formula and the one of which it is an abbreviation are incorrect; the determination of this limit is then of prime importance.

Formula 1 is derived by integrating

$$\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{1}{2}} dx$$

after expanding by the binomial theorem, as follows:

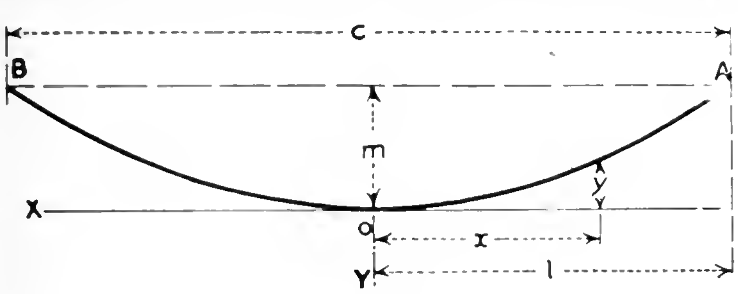


FIG. 1

$$y = \frac{mx^2}{l^2} \therefore \frac{dy}{dx} = \frac{2mx}{l^2}$$

and if L = arc BOA

$$L = 2\int_0^l \left(1 + \frac{4m^2x^2}{l^4}\right)^{\frac{1}{2}} dx \tag{2}$$

Expanding and integrating, representing the element of arc by ds, we obtain

$$\int_0^l ds = l + \frac{2m^2}{3l} - \frac{2m^4}{5l^3} + \frac{4m^6}{7l^5} - \frac{10m^8}{9l^7} + \frac{28m^{10}}{11l^9} - \ldots$$

Substituting for l its value $c/2$ and for m/c the symbol k, we have, finally, in notation coinciding with that used in (1)

$$L = 2\int_0^l ds = c(1 + \frac{8}{3}k^2 - \frac{32}{5}k^4 + \frac{256}{7}k^6 - \frac{2560}{9}k^8 + \ldots) \tag{3}$$

The expansion from which results Formula 3 is a legitimate method by which to transform an expression of the form

$$\left(1 + \frac{r}{q}\right)^{\frac{1}{2}}$$

into a series; but the series thus obtained fails to converge if r/q is greater than unity. Applying this criterion to the second term of the binomial in (2), recollecting that x becomes l at the upper limit, we find

$$\frac{m}{l} < \tfrac{1}{2} \therefore k < \tfrac{1}{4}$$

Formula 3 therefore fails to give the true value of L however great the number of terms computed unless k is equal to or less than $\frac{1}{4}$: that is unless the chord c is between the focus and the vertex. The degree of approximation attained in different regions as k varies between 0 and $\frac{1}{4}$ will be considered after deriving a second formula for the length of the arc, the results of which will serve as a basis for comparison.

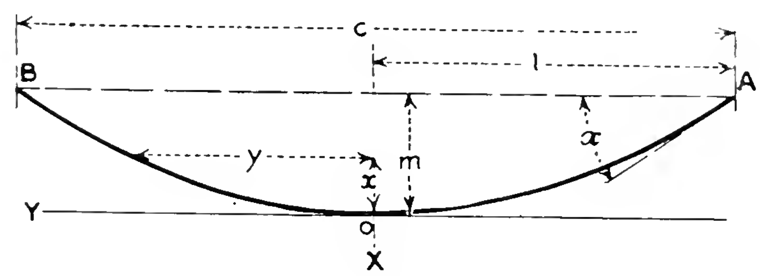


FIG. 2

Referring to Fig. 2, and writing the symbol a for the distance from vertex to focus,

$$y^2 = 4ax \therefore \left(\frac{dy}{dx}\right)^2 = \frac{a}{x} \text{ and } ds = \left(\frac{x+a}{x}\right)^{\frac{1}{2}} dx$$

Hence

$$\int ds = \sqrt{x(x+a)} + a \log_e(\sqrt{x} + \sqrt{x+a}) + C$$

and

$$Arc\ OA = \int_0^m ds = \sqrt{m(m+a)} + a \log_e\left(\frac{\sqrt{m} + \sqrt{m+a}}{\sqrt{a}}\right)$$

which is equivalent to

$$Arc\ OA = a\left[\sqrt{\frac{m}{a}\left(1 + \frac{m}{a}\right)} + \log_e\left(\sqrt{\frac{m}{a}} + \sqrt{1 + \frac{m}{a}}\right)\right]$$

From the equation of the curve, $l^2 = 4am$; therefore

$$a = \frac{c^2}{16m} = \frac{c}{16k} \text{ and } \frac{m}{a} = 16k^2$$

After these substitutions have been made the expression for the length of the arc BOA will appear in the well-known form

$$L = \frac{c}{2}\sqrt{1 + 16k^2} + \frac{c}{8k}[\log_e(4k + \sqrt{1 + 16k^2})] \tag{4}$$

which is true for any value of k.

Formula 4 may be made more concise by introducing the hyperbolic functions.

If we denote the tangential angle at A or B by α and its antigudermannian by u, then

$$\tan \alpha = 4k = \sinh u \qquad \sqrt{1 + 16k^2} = \cosh u$$

$$\log_e(4k + \sqrt{1 + 16k^2}) = u$$

and the expression for the arc will therefore be

$$L = \frac{c}{16k}(2u + \sinh 2u) \tag{5}$$

A comparison between the values of L/c obtained from the three formulas will indicate the percentage of error involved in the use of (1) or (3), and the process of obtaining the results will show the greater conciseness of (5).

Example 1. Let $k = 0.2$; then,

By Formula (5)

$$\begin{array}{rl} & 4k = 0.8 = \sinh u, \text{ and,} \\ \text{from table,} & 0.73267 = u \\ & 1.46534 = 2u \\ \text{from table,} & \underline{2.04901} = \sinh 2u \\ & 3.51435 \div 16k = 1.09823 = \dfrac{L}{c} \end{array}$$

By Formula (1) *or* (3)

$$\begin{array}{rlll} 1 + \tfrac{8}{3}k^2 = & 1.10667 & & \\ 6.4k^4 = & -\ .01024 & 1.09643 & \text{3 terms} \\ 36.57k^6 = & +\ .00234 & 1.09877 & \text{4 terms} \\ 284.44k^8 = & -\ .00073 & 1.09804 & \text{5 terms} \\ 2606.55k^{10} = & +\ .00026 & 1.09830 & \text{6 terms} \end{array}$$

Example 2. Let $k = 0.1$; then,

By Formula (5)

$$\begin{array}{rl} & 4k = 0.4 = \sinh u, \text{ and,} \\ \text{from table,} & 0.39004 = u \\ & 0.78008 = 2u \\ \text{from table,} & \underline{0.86163} = \sinh 2u \\ & 1.64171 \div 16k = 1.02607 = \dfrac{L}{c} \end{array}$$

By Formula (1) *or* (3)

$$\begin{array}{rlll} 1 + \tfrac{8}{3}k^2 = & 1.02667 & & \\ 6.4k^4 = & -\ .00064 & 1.02603 & \text{3 terms} \\ 36.57k^6 = & +\ .00004 & 1.02607 & \text{4 terms} \end{array}$$

Example 3. Let $k = 0.01$; then,

By Formula (5)

$$\begin{array}{rl} & 4k = 0.04 = \sinh u, \text{ and,} \\ \text{from table,} & 0.039988 = u \\ & 0.079976 = 2u \\ \text{from table,} & \underline{0.080065} = \sinh 2u \\ & 0.160041 \div 16k = 1.00026 = \dfrac{L}{c} \end{array}$$

By Formula (1) *or* (3)

$$\begin{array}{rll} 1 + \tfrac{8}{3}k^2 = & 1.00027 & \text{2 terms} \\ 6.4k^4 = & -\ .00000 \ldots & \end{array}$$

It appears from these examples that for values of k near 0.01 Formula 1 may be depended upon to the fourth decimal place, and farther as k grows smaller. For values of k near 0.1 Formula 1 is accurate only to the third decimal place; and not less than four terms of the series of Formula 3 must be computed to insure accuracy in the fourth place. For values of k considerably above 0.1 Formula 1 is a comparatively rough approximation, and Formula 3 is cumbersome because of the large number of terms which must be computed to insure accuracy even in the third decimal place. Formula 3 is of course useless for all values of k above or slightly below 0.25.

Formula 1 may then be said to be sufficiently accurate for practical purposes for most cases in which k is 0.01 or less. Formula 5 is preferable whenever k is greater than 0.01, if hyperbolic tables of suitable range are available. If not, Formula 4, which is merely another form of (5) though more time-consuming in its application, may be substituted.

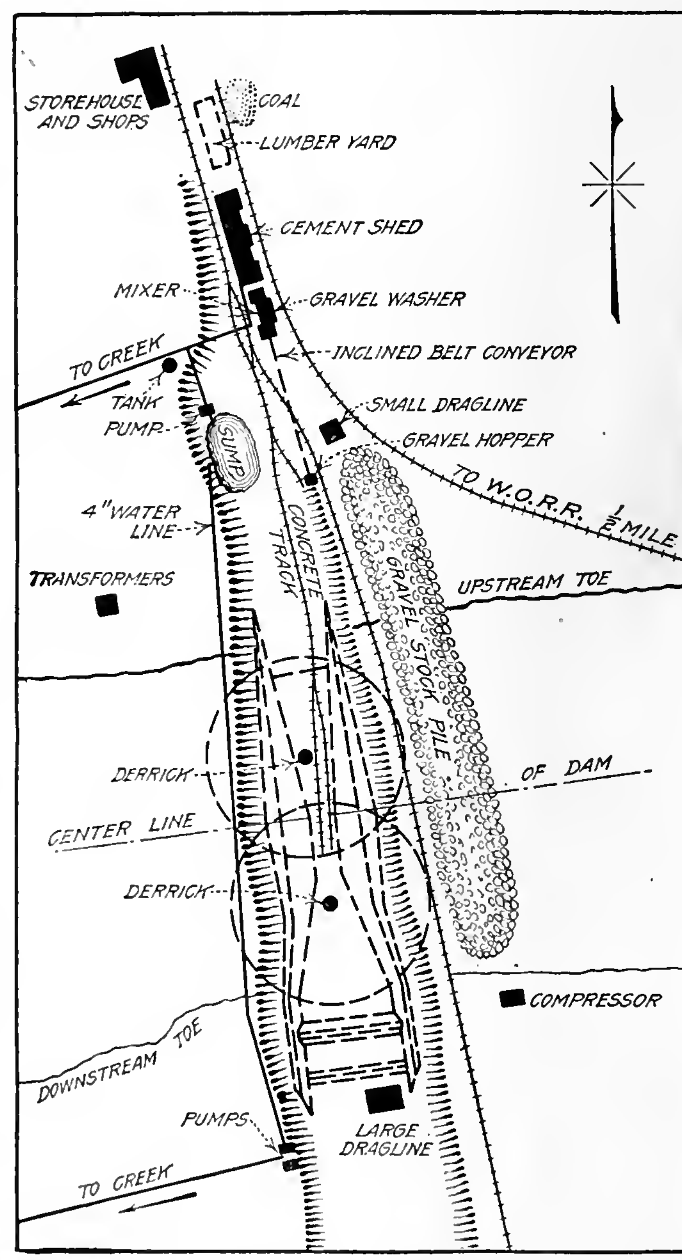
Large Increase in Motor-Truck Traffic

Motor trucks in New York State during the past year increased from 55,402 to 75,268 or 36 per cent., according to Secretary of State Hugo. A similar increase in 1919 would add over 27,000 trucks. Reports state that this will be considerably exceeded. Of the total number of trucks mentioned above about 32,000 are registered from New York City, an increase for the year of 7000.

Mammoth Derricks Build Concrete Outlet for Lockington Dam

Gravel from Excavation Washed and Screened for Concrete — All Operations Mechanical from Pit to Forms

TWO electrically-operated guy derricks of unusual size are concreting the 38,000-cu.yd. outlet and spillway structure for the Lockington Dam of the Miami flood-control works. With 120-ft. masts and 105-ft. booms these derricks cover the full 140-ft. width of the structure and reach its full height of 82 ft, handling both concrete and forms. Concrete is brought by rail to the derricks from a gravel-washing and concrete-



COMPACT LAYOUT KEEPS HAUL DISTANCE MODERATE

mixing plant of the standard type adopted by the flood-control engineers and described in *Engineering News-Record* of Oct. 10, 1918, p. 680.

Lockington Dam is an earth structure about 7000 ft. long, 440 ft. thick at the base and 74 ft. high. The concrete spillway and outlet structures, extending through the embankment, consists of two side walls about 500 ft. long parallel at the center and flaring out at the ends, as indicated by the dash lines on the plant layout map. The walls are 82 ft. high and are 140 ft. apart, out to out. Between the walls is a floor of concrete, and at the center is a cross wall having two 9 x 9-ft. 2-in. openings through which the river waters will normally find outlet The space above the cross wall and between the side walls, which are 82 ft. high, forms the

DERRICKS TOWERING ABOVE WALLS REACH ALL PARTS OF LOCKINGTON DAM OUTLET STRUCTURE

spillway for extraordinary floods. In the plan of construction the cross wall will be built last, so as to afford a clear channel for the stream during the construction of the dam embankment.

Where the concrete spillway and outlet are being built, a remarkably level bedrock occurs only a few feet below the stream bed. Excavation of only a foot or two of the surface is necessary to reach solid rock on which the concrete can be laid. Above the rock is gravel covered with earth. Very little water is carried by this overburden. The gravel, moreover, is entirely suitable, after screening and washing, for use in concrete, and as the channel for the concrete structure is excavated, the earth is piled to one side and the gravel is stored at the other side for future use. A dragline excavator is excavating the channel.

The plant layout for the spillway construction is shown by the map and by the view looking south. Beginning at the north end, the large dragline worked south, excavating the channel, depositing the earth in the west bank and piling the gravel on the east bank. The routine of handling materials and concrete is then as follows: A standard-gage service railway, as shown by the map, runs along the east edge of the cut, and between it and the gravel pile and alongside the gravel hopper of the washing plant. Gravel is transported in 4-cu.yd. dump cars hauled by dinkeys. While the large dragline is still excavating the cut it dumps the gravel directly into the cars, but when the excavation is finished the cars will be loaded from the gravel pile by means of the small dragline.

Gravel cars dump into a ground-level hopper, where a grizzly separates out the large stones, and whence the fine material feeds onto an inclined belt conveyor leading to the screens and washer. The screens separate the washed gravel into coarse and fine gravel and into sand, and discharge each size into a compartment of an elevated bin over the mixer. Close to and in line with the bin is the cement house, to which a service track connecting with the Western Ohio Electric Ry. delivers the cement cars. Structurally the cement house and bins are duplicates of those described in *Engineering News-Record* of Oct. 10, 1918, p. 680, and the mechanical equipment is the same.

The water for washing the gravel is supplied by seepage into the cut. The water which seeps from the north end is collected into a sump and thence is pumped to the screens. If this supply pulls short, water from seepage from the south end is pumped to the sump. All surplus ground water and waste water from the washers are discharged to Loraine Creek, running roughly parallel to the cut and west of it. Water for mixing is taken directly from the line to the gravel washers, and a reserve supply is stored in the tank.

Service tracks of 30-in. gage passing under the mixer discharge extend along the bottom of the cut to the derricks. Three two-car trains hauled by gasoline locomotives deliver the concrete. The cars are small platform cars, each carrying a 1¼-cu.yd. bottom-dump bucket. The buckets are lifted to the forms by the derricks. The derricks also handle the sectional forms and the plum stones which are embedded in the concrete.

Most of the plums are stones separated from the gravel by the hopper grizzly. These stones are hosed clean, loaded into concrete buckets and, like the concrete, are taken by cars to the derricks.

The subsidiary plant, such as the lumber yard, the shops and the compressor house and its rail connections, is explained by the map. Except the dinkeys, all machinery is operated by electricity.

Lockington Dam is a part of the flood-control works of the Miami Conservancy District. Arthur E. Morgan is chief engineer, Charles H. Paul is assistant chief engineer, and C. H. Locher, construction manager. Barton M. Jones is division engineer in charge of the dam.

Opportunities for Chicago Engineers to Work Together

Combined Activities in Actual Practice Needed—Low Wages, Unemployment and Reconstruction Challenge Attention

By C. E. Drayer

Secretary of the American Association of Engineers, Chicago

At the onset of the world conflict, business and industry were immediately marshalled by the United States Chamber of Commerce into the most powerful voluntary instrumentality in the United States for winning the war. It kept these forces mobilized for the problems of peace, by the great conference at Atlantic City. Are our engineers big enough to cease weighing progress in the balance of prejudice, and can they get together and do collectively the works of peace with something of the brilliant success of the individual engineer in the war?

Organized to mobilize engineers of Chicago to help win the war, the War Committee of 19 Chicago technical societies must now either disband or direct its activities into channels where they will be useful to the constituent societies in times of peace. In discussing the possibilities of future work, the suggestion was made that the War Committee offer its services to the engineering societies' employment bureau, for the establishing of a branch in Chicago.

The War Committee placed directly, in the six months of its existence, from 50 to 75 men. During the same period the Division of Engineering of the United States Employment Service placed some 5000 engineers, and the Service Clearing House of the American Association of Engineers from three to five men a day. Setting up another engineering employment agency in Chicago would lead, therefore, not to integration but disintegration of existing agencies. This is a step backward. The principle should be *combined engineering organization for effective service to the entire profession.*

All engineering societies are preaching coöperation. Why not put it in plain English and get busy and work together? Only when organized engineering gives employment service in a more effective way than the leeching private agencies can we hope to compete so successfully with them as to put them out of business. Unless we give better service, they will continue to thrive, sucking from the unfortunate engineer who is out of employment from 50 to 60% of the first month's salary. Unless those in charge of the direction of engineering societies do get together and perform employment service, especially in the uncertain times at hand, we shall merit the censure of inefficiency. The need is for even a more vigorous and comprehensive performance than the Division of Engineering was able to deliver.

The argument is that either the Service Clearing House of the American Association of Engineers should be unselfishly supported by all, or all engineers should get unreservedly behind the Division of Engineering of the United States Employment Service, another going organization. Employment must be cared for *now,* and the work must be well done.

Let the War Committee take up some of the many things challenging attention of engineers collectively. The wages of engineers in Chicago have not been raised for 20 years. Here is a job for the 8000 engineers in Chicago. How about the administration of the $60,000,000 bond issue for good roads in Illinois? Why not have an engineer experienced in politics at the constitutional convention soon to be held in Illinois? Where are we engineers to take our place in the great reconstruction problems? Another society employment service in Chicago means "carrying coal to Newcastle," in view of the many things challenging our best efforts.

Another phase of the employment situation involves developing work where none exists. In other words, why should not the engineer be the chief promoter, particularly in the field of public works? If, by spending one dollar for good roads, two dollars are returned to the investing public, why shouldn't the engineer be the first to demonstrate this to his employer, the public? There are other fields for equally profitable exploitation. It is almost a maxim in the business world that, where demand does not exist, it may be created by advertising.

Still another phase of the employment situation concerns the study of salaries that are paid and that should be paid. The profession is being invaded right now by unionism, by the formation of a draftsmen's union as a branch of the American Federation of Labor (see *Engineering News-Record* of Jan. 23, 1919, p. 201). Such things do not happen without good cause. It is probable that hardly any engineers now in union ranks receive as much as $2500 per year, with an average of much less. In other words, the reason seems to be that our engineering societies have failed to face fearlessly the wage-problem phase of the profession, with the result that the men in the lower-paid positions are willing to try another agency.

Here is an indictment of our failure in getting together. How long will the rank and file of the profession permit these conditions to exist?

Pennsylvania Labor Turnover 100 Per Cent. Yearly

In a 10-day period recently 4477 employees left the divisional forces of the eastern lines of the Pennsylvania R.R. and 5122 new ones were hired, stated a bulletin issued by Elisha Lee, Federal manager. The net gain of 645 occurred entirely in the last two days of the period and was apparently sporadic. During the period the number of women employees increased 1545—from 5682 to 7227—while the number of men employees decreased 900. As the total divisional forces had been averaging between 148,000 and 150,000, the bulletin pointed out that the 10-day test indicated a turnover of about 100% per year.

What About the Government Housing Program?

Engineers Should Be Active in Study of Housing in General and of Solution of the Problem of Disposing of Those Government Projects Already Under Way

By Morris Knowles
Chief Engineer, Division of Passenger Transportation and Housing, United States Shipping Board, Emergency Fleet Corporation, Philadelphia

As a necessary war measure, the United States Government about a year ago entered into extensive housing operations which were only partly completed when the armistice was signed. Now that the immediacy of the demand has passed, there is much clamor of one sort or another for the shutting down forthwith of all such operations and the closing out of the whole Government experiment in housing. Engineers have not, as a rule, paid to this problem the attention it deserves. The present article is intended to stimulate thought in the profession which should be most vitally concerned with housing.

Two Government bodies conducted housing operations; one, the Emergency Fleet Corporation, with an appropriation of $75,000,000, for the purpose of housing shipyard workers and their families; the other, the United States Housing Corporation, a bureau of the Department of Labor, with an appropriation of $110,000,000, which has planned towns for the accommodation of munition workers and those engaged in similar war activities other than shipbuilding. The work of these agencies was brought about by a war necessity. Generally, the question was not alone one of improving a sociological condition; men simply could not be induced to work in the munition plants or shipyards where there was a more or less complete lack of houses to live in; and the labor overturns resulting amounted to as much as 700 per cent. per month in some plants. But, as in certain other war-time activities, the results that either have been or may be accomplished by these agencies give promise of solid and enduring benefits in the arts of peace.

What Has Already Been Done

About 90 separate industrial housing projects, to house approximately 150,000 persons, were contemplated by the United States Housing Corporation, and about one-half of these had been placed under contract at the time of the signing of the armistice. Thirty community housing projects are being built by the Division of Passenger Transportation and Housing of the Emergency Fleet Corporation; most of these are complete towns, of from 240 to 7000 contemplated population, while the total population to be served amounts to about 55,000. The aim of these departments has been to create convenient, healthful and attractive living quarters for the workingmen and their families, at an expense consistent with good business judgment. The results, where they have been permitted to come to realization, have been generally in strong contrast to dreary, unappealing laborers' tenements, built in the habitual cramped, stereotyped rows, dingy, squalid, and too often lacking in the first requisites of cleanliness and good sanitation.

The end of the war found these activities with some building work completed, many things accomplished, and much of importance yet to be done. Shortly after the signing of the armistice a resolution was introduced at the convention of the United States Chamber of Commerce, assembled at Atlantic City, which sought to declare in favor of Government abandonment of its housing projects. The United States Senate, anxious to curtail expenditures instantly, provided shortly thereafter in a sweeping resolution. (S. J. Res. 194)

> That the United States Housing Corporation . . . be, and hereby is, directed to suspend work upon all buildings on which it is now engaged in all cases where the construction is not more than 75 per centum completed.

This action was followed by numerous protests, among which is that of the American Civic Association, which by its executive board stated, Dec. 9, 1918:

> The association holds that where these projects are situated in communities urgently in need of additional housing to meet post-war conditions . . . . the proper course for the Government is to complete the projects without interruption . . . . and then to dispose of them in an orderly, deliberate manner; except only in those cases where the Government can clearly obtain a greater net salvage by immediate abandonment and liquidation.

The association further holds that the arbitrary cancellation of existing contracts both with builders' organizations and with public service corporations and municipalities involves a serious economic loss; both actual, in the throwing away of that which has been done; and potential, through loss of expected benefits. Such protests have been effective in bringing about a substitute resolution of the House Committee, under the same name (S. J. Res. 194), which orders the completion of 24 of the projects and further proposes that the Secretary of Labor make to Congress recommendations and suggestions to meet the demands for homes for the citizens of the United States.

The question now is, Shall Government activities be continued and the initiation of successful management be the goal?

Projects Call for Different Answers

It is evident that different stages of progress in the various housing projects call for separate answers in different places, dependent upon the needs. Many situations exist where the investment is so large and the need of houses still so great, the opportunity for wise management in starting operations so opportune, and the waste so great which would come from stopping now, that good business judgment means the keeping of control until some favorable method and opportunity can be found for sale or disposal otherwise. No general rule can be laid down; the decision must rest upon the facts presented in each case. Surely, the engineer, in his new realization of citizenship, will be not less than alert to his opportunity to promote sound thinking and wise planning for the future, by insisting that the present occasion be used to the utmost to demonstrate

what wise and honest endeavor can do to prevent labor shortage and turnover. It is necessarily a matter of good judgment to determine the nice balance of economics between the salvage to come from abandonment, and the estimated results to come from the sale of completed projects, which in turn demands an intelligent estimate of the need, and the continuance of such need as a post-war condition.

Community Gain the Critical Element

It is unnecessary, even were space available, to present here the case for better housing conditions. Much has been said and written elsewhere on that subject, and it surely will be realized that the question of housing and living conditions is an important one in our future industrial life. The question, then, is not so much whether our Government organization, or one or more of its various agencies, shall save money out of its appropriation; nor is it a question of individual loss or gain. The real question is whether the community as a whole shall realize the full advantage from the already large expenditure made for the Governmental housing developments. In other words, the question is one of loss or gain in economy to the entire country, and not to one of its creatures.

Of secondary importance, perhaps, but none the less of real concern to the engineer, will be the stultifying effect upon the subject of correct housing which surely will ensue from arbitrarily stopping in many places the first comprehensive housing projects to be undertaken in the country on so large a scale. The practical results of many aims are at stake. It is plain, and probably needs no argument, that the projects now started, if abandoned, will now and for a long time in the future present a stumbling block in the particular community, as an example, to be quoted by some, of alleged insecurity and bad policy of the paternal care of labor. Notwithstanding this, there will be many who will think that the work should now be stopped rather than to continue to "sink good money after bad."

Advocates and opponents should not confuse the housing situation with that relating to Government ownership or landlordism, for the question of permanent Government control and management with the necessary acceptance of such paternalism is not before us now; even the most radical are not proposing this. Nor does the advocacy of continuing the present projects until they are going concerns savor of or favor Government ownership of public utilities *per se*. Nor should it be considered as equivalent to the much mooted proposition to continue the control and operation of the railroads, telephone or telegraph lines for the next five years. The former is an undertaking stated to be a war measure for the transportation of soldiers and materials for fighting purposes only; and, in the case of the latter, such facilities were also taken over as an emergency measure, with the understanding that return should take place as soon as the emergency is past. The utilities can be turned back to those agencies, long created and familiar with their duties and with the correct handling of their problems without the necessity for building new organizations. It is not so with housing. New agencies must be established in many cases, and can be successful only after careful and thoughtful consideration, and as a result of some experience. It must be remembered, however, that the danger of Government ownership, operation and control of workmen's homes, without a well considered program being developed, may open the way to a wasteful, political, paternalistic policy respecting certain institutions, industries, workmen and the occupants of the dwellings, and involve practices with regard to rentals and welfare activities which will saddle the Government with a policy not yet determined and approved.

There are, too, differences in the fundamental arrangements among the several projects already started which need careful consideration. For instance, in most of the housing developments of the Emergency Fleet Corporation the shipbuilding company, through a realty corporation, has provided the land without cost to the Government. Thus it has an equity in the proceeding, an interest and a privilege to take over the project and repay to the Government the investment made less the write-off due to excess war cost, as determined by appraisal; such amounts to be paid in 10 annual installments with interest of five per cent.

It is evident from the foregoing that decision should not be reached post-haste or as the results of any preconceived opinions. For instance, a loading-plant in the wilderness, never possible for any other use and perhaps only partially completed, will be considered differently than the shipyard likely to be permanently used in commercial maritime work, and whose need has always been felt and will continue.

What Is the Engineer's Interest?

It appears, therefore, that there is not only at stake a large part of the value of $185,000,000, but also the welfare of an important branch of engineering and its beneficial effects on labor. The interest of the engineer in this proceeding is self-evident. He is interested, first, as a public-spirited citizen in seeing that the community as a whole derives the utmost benefits from the work already done and the expenditures already made. He is also interested in seeing to it that no prejudice results to an important branch of his profession from arbitrary or ill considered legislation.

The determination of whether a given community development should be completed or not, necessarily involves more than consideration of the question of house building, for suitable and adequate facilities for water-supply, sewer, gas and electricity, highways, walks and transportation—all engineering features—are needed to make a town livable. It is no wild flight of the imagination to see beautiful and attractive houses, pleasantly grouped under shady trees, that remain unoccupied because there is a lack of street paving and walks, with failure to grade lots and gutters, resulting in muddy tracking of nice hardwood floors, and also in mosquito-breeding pools in the back yards.

Nor should the engineer be less interested in the complete communal development, such as provision for zoning, stores, schools, churches, and recreation areas, grading of yards, reasonable planting, and the initiation of those neighborhood facilities which promote agreeable social and community life. And it is not answering to say that private initiative, group arrangements by

those who live in a common block, or municipal endeavor, under taxation methods, will be a solution; for the new community finds many ways to use the public moneys and the subscription method is resorted to for many fields, and is usually overdone. In specific cases, however, certain of the group and communal activities may well be left to private initiative, on the basis that something must be left for people to do for themselves.

Too often has the engineer been subordinated in such community planning and development, partly because building houses is the primary purpose and the creation of the architect, which has resulted in a forgetfulness that the engineering questions of street layout, drainage, adequate and safe water-supply and disposal of wastes, are important and vital matters of such an enterprise; and, partly, it must be confessed, because the engineer, with his modesty and desire not to appear too prominent in the discussion of such enterprises, does not let it be known that he, too, is interested in other than plain houses, and that he, too, has a soul and likes to live in attractive, comfortable and convenient community developments.

Constructive criticism should be most apropos. A clear statement, based upon sound business judgment—a matter upon which the engineer should insist—is offered in the following program:

1. A project situated in such a place that during post-war conditions it will fill a demand for more housing facilities, should be completed as promptly as possible.

2. A project where salvage coming from abandonment and liquidation will not exceed the return which would come from sufficiently completing it in an orderly and deliberate manner, should also be completed.

3. The degree of completion must depend in each case upon the facts, and may or may not include all communal facilities. Certain facilities, however, are needed in order that a correct start as a going concern may be obtained.

4. Arbitrary cancellations of projects based only upon percentage of completion, without consideration of other factors, will generally be unwise and uneconomical.

5. Plans for continued operation should, in the absence of a definite Governmental policy, be approached with careful consideration of the influence upon the welfare, both of the worker and of industrial concerns, and possible discrimination, due to the advantageous situation of those favored by Governmental participations, should be guarded against.

6. On the other hand, a belief in complete failure of such endeavors should be avoided, by the institution of a wise program calling for management until a going concern is obtained; with an endeavor to turn over to existing agencies as soon as this result has been gained. Obviously, paternalism must be avoided.

United States Water Laboratories in France

NONE of the 48 officers and 69 enlisted men operating the water-analysis laboratories in France is on an early list to return home, according to Lieut.-Col. Edward Bartow, senior officer, formerly director of the Illinois State Water Survey. It is expected that the work in the Service of Supplies will continue for some time in the camps of concentration and embarkation.

Lieutenant Colonel Bartow's first service in France on his arrival, in October, 1917, was under the French Interministerial Commission, by which he was assigned to work in the laboratory of Prof. Louis Lapicque, *Laboratoire Muséum Histoire Naturelle*, on water sterilization by liquid chlorine. Tests made on the raw Seine river water formed the basis of a 30-p. article in the *Revue d'Hygiène* for January-February, 1918. This was reprinted and used by the engineers and sanitary corps officers of the United States Army to explain the process to the officials of French cities in which liquid-chlorine machines had been installed, including Brest, St. Nazaire, Savenay, Tours and Dijon.

Since March most of Lieutenant Colonel Bartow's work has been the organization and supervision of the laboratories of the Service of Supplies and the sanitary control of the water-supplies furnished by the engineers to the armies. Five mobile laboratories have been operating with the armies, and laboratories were established in Paris, St. Nazaire and Tours, France, and in Winchester, England.

Because of the necessity for speed and uniformity in obtaining results, the methods of the American Public Health Association, the American Chemical Society and the United States Treasury Department (Health Service) were adapted to the conditions existing in the American Expeditionary Forces, and were published in bulletin form.

The duties performed by the laboratory staffs included sanitary surveys of occupied areas; bacterial and chemical control of filter plants operated by the United States Army; industrial analyses of waters used in locomotives, laundries and airplane motors, and a comprehensive study of water supplied to troops in transit, leading to a recommendation for the addition of the requisite number of faucets, and facilities for sterilization.

Coal Saved by Electrifying Railroads in Italy

Saving in the use of coal has been effected in Italy in the past few years through the electrification of railroads and the harnessing of the water power of the country to generate electricity. The percentage of railroads electrified in Italy from 1900-1915 is greater than in any other European country. Electric traction of railroads began in Italy in 1900 with installations on the Varesina line, which runs through Milan, Gallarate, Varese and Ponteceresio, and on the Valtellinese line, which runs from Lecco to Chiavenna. Railways which run on mountainous routes and carry heavy trains are the Moncenisio line, the Ceva-Port Savona line, the old line of Giovi and the new supplementary Giovi line. The Moncenisio line is the longest—8.5 miles long, at an altitude of more than 1000 yd. above sea level, continuously on the ascent. The systems installed on these mountain routes increased the carrying capacity and the speed of the railways. There is at present under consideration the electrification of 1250 miles more.

Inland Ship-Steel Fabricating Plants of the Emergency Fleet Corporation

Shops at Pottstown and Leetsdale for Fabricating Hog Island Material, Designed To Produce 10,000 Tons Per Month Each, Are Laid Out for Straight-Line Movement of Material Through Five Aisles

By Leyburn G. Fishach
Authorized Representative, Emergency Fleet Corporation, Leetsdale, Penn.

STRUCTURAL-STEEL shops have fabricated a large tonnage for the shipbuilding program of the Emergency Fleet Corporation. Yet there are certain radical differences, between ship work and bridge or structural work, due principally to the large percentage of bent frames and wide plates characteristic of hull steel. These features affect not only the type and capacity of the equipment, but also the arrangement and spacing of the machines in the shop. Two great ship-steel fabricating plants which have been built for the Emergency Fleet Corporation by the McClintic-Marshall Construction Co. of Pittsburgh, Penn., are therefore strikingly different from bridge shops. They were laid out to suit the classifications of work represented in hull steel and give proper balance of the several departments.

One of these plants is at Pottstown, the other at Leetsdale, Penn.; each will have a capacity of 10,000 tons per month when in full operation and will fabricate for the Hog Island Shipyard. They are of the same general design, but in plan are of opposite hand. The following description applies specifically to the Leetsdale shop.

The plant consists of a single shop-building, with receiving yard at one end and shipping yard at the other, all planned for direct straight-line travel of material. The building is 594 ft. long, 390 ft. wide for half the length and 310 ft. for the remainder. It is one story in height, and has steel framing, brick walls, wood sheathing covered with asbestos, and steel sash in both outer walls and roof lights.

The roof construction is of the familiar high-and-low-bay type (see the view, Fig. 1), the bays running across the building. The high bays are 47 ft. wide, the low bays 23 ft.; this alternation of spaces was adopted to reduce the cantilever of the cross-travel cranes. Except for a small area of cement floor at riveter runs and clay floor in the forge shop, the floor is made of 1⅝ x 6-in. maple laid on 4 x 6-in. chestnut sleepers over a 4-in. concrete foundation. All the exposed steelwork and brickwork on the interior of the building, down to within 8 ft. of the floor, is painted white, to improve the interior lighting, as is also the under side of the roof sheathing.

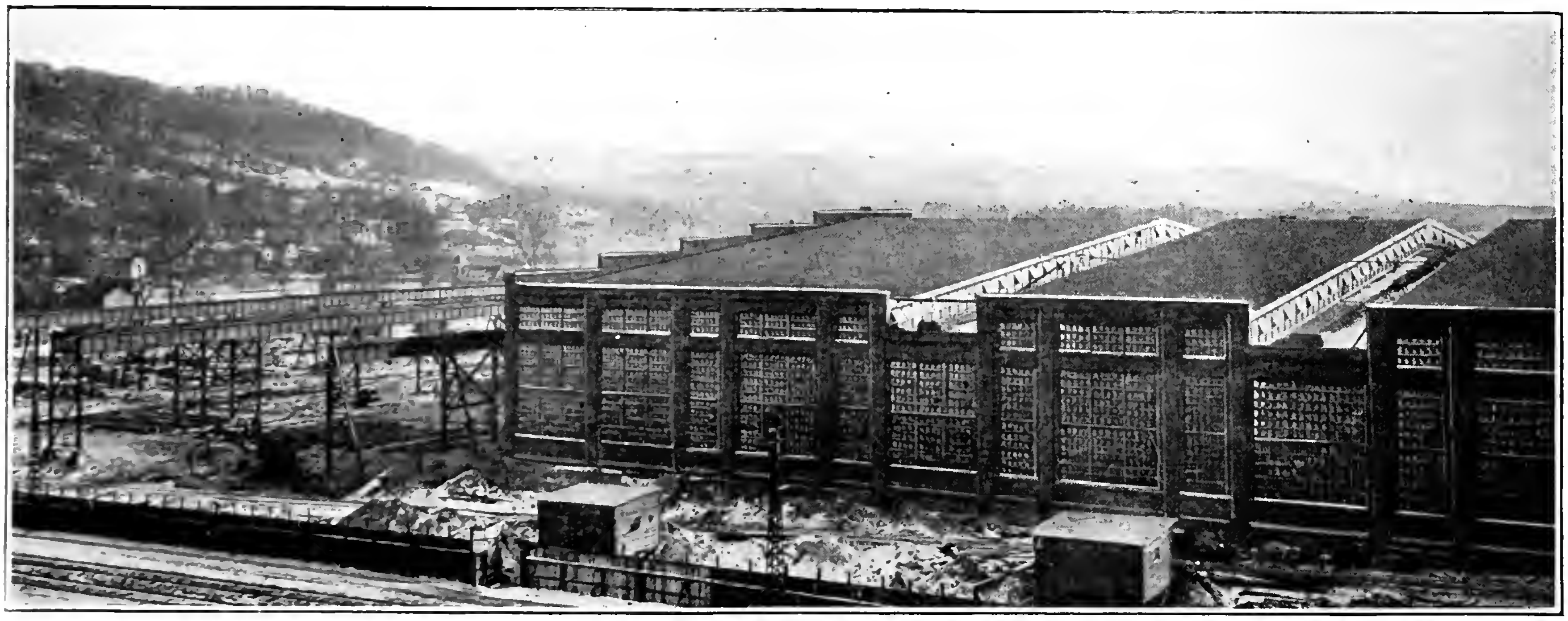


FIG. 1. RECEIVING-YARD END OF LEETSDALE SHOP—AMPLE GLAZING FOR GOOD INTERIOR LIGHTING

Continuous forward movement of ship steel will begin in the receiving yard and terminate in the shipping yard, at opposite ends of the building. These yards are 510 x 210 ft. each, placed at right angles to the building. They consist of two 80-ft. aisles, formed by runways for five-motor electric traveling cranes of 20 tons capacity, with 28-ft. height of lift; each aisle has one crane. Adjoining the receiving yard is additional storage area of 70,000 sq.ft., served by locomotive cranes.

Raw material in the receiving yard is stored opposite the shop aisle in which it is to be fabricated. It is thus most easily reached from the narrow-gage tracks which run down the center of each aisle and, as the stock is close to the machines, delays in getting the steel to the operator are minimized.

This latter effect is aided by the arrangement of the outside trackage, which prevents the interruptions to the shop program that would result from unnecessary handling of the raw and finished steel. A double line of tracks extends the full length of the site on each side of the building, and passes under the end spans of the receiving and shipping yard runways. A fifth line crosses the receiving yard and enters the shop. The entire system of trackage within the lot lines has a

total length of 5700 ft. It is connected with a siding 1200 ft. long adjacent to the main line of the Pittsburgh, Fort Wayne & Chicago Railroad.

Shop Division to Suit Fabricating Equipment—The desired arrangement of the fabricating equipment determined the length of spans of the trusses across the building, and divided the floor area into five aisles between the longitudinal column rows. The center aisle is 70 ft. wide, the other four 80 ft. each. These five aisles constitute separate shop units, equipped to act independently in the fabrication of their respective classes of ship steel: Furnaced and forge work, plate and angle work, and beam work. But as the plate and angle work requires more floor area than the other two classes, it occupies the three interior aisles, though there are subdivisions within that area for convenience in handling the steel. This unit system prevents backward motion of material and reduces cross travel into other aisles, so that it is a determining element of economical operation.

Transverse Crane System—The crane system within the building is contrary to the usual practice in that all cranes operate across the shop or aisle, while forward motion through the entire length of the building is by means of steel-framed trucks on an industrial track in the center of each aisle. One cross-line with turntables at each main line makes all parts of the shop accessible by the track system.

Traveling-crane rails are framed below the roof trusses at a spacing to give crane spans of 23 ft., and intermediate spaces 12 ft. wide. The run of cranes in the first and fifth aisles is confined to those aisles, while the three aisles forming the plate-and-angle shop have runs continuous across all three, corresponding to the unity of work in these aisles. Sixty of the 23-ft. cranes are installed, 52 being of six tons capacity and eight of 10 tons. All are operated electrically and are controlled from the floor. They furnish a complete handling equipment for each machine or small group, as the case requires, thus preventing the delays that are likely to occur when cranes traveling longitudinally serve a number of operators.

At the receiving-yard end of the building are two 5-ton electric traveling cranes with a span of 43 ft., operating on a runway extending entirely across the shop, by means of which it is possible to transfer material crosswise without using floor trucks on the cross-track near the center of the building. As shearing and most of the detail work are performed before other fabrication, these two cranes distribute the steel to the different aisles after this preliminary work is completed.

Furnace and Forge Aisle—Designed for the fabrication of all furnaced and smith work, the first aisle has three channel and angle furnaces for material 40 ft. long and one for shapes 50 ft. long, all built out into the receiving yard. These furnaces are inclosed within brick walls and are protected by reinforced-concrete roof slabs.

Some of their auxiliary mechanical features, of very unusual type, accomplish marked saving in labor. The shapes to be bent enter the furnaces from the receiving-yard end over a roller table and are moved forward by a motor-driven frame. When the steel is heated, it is

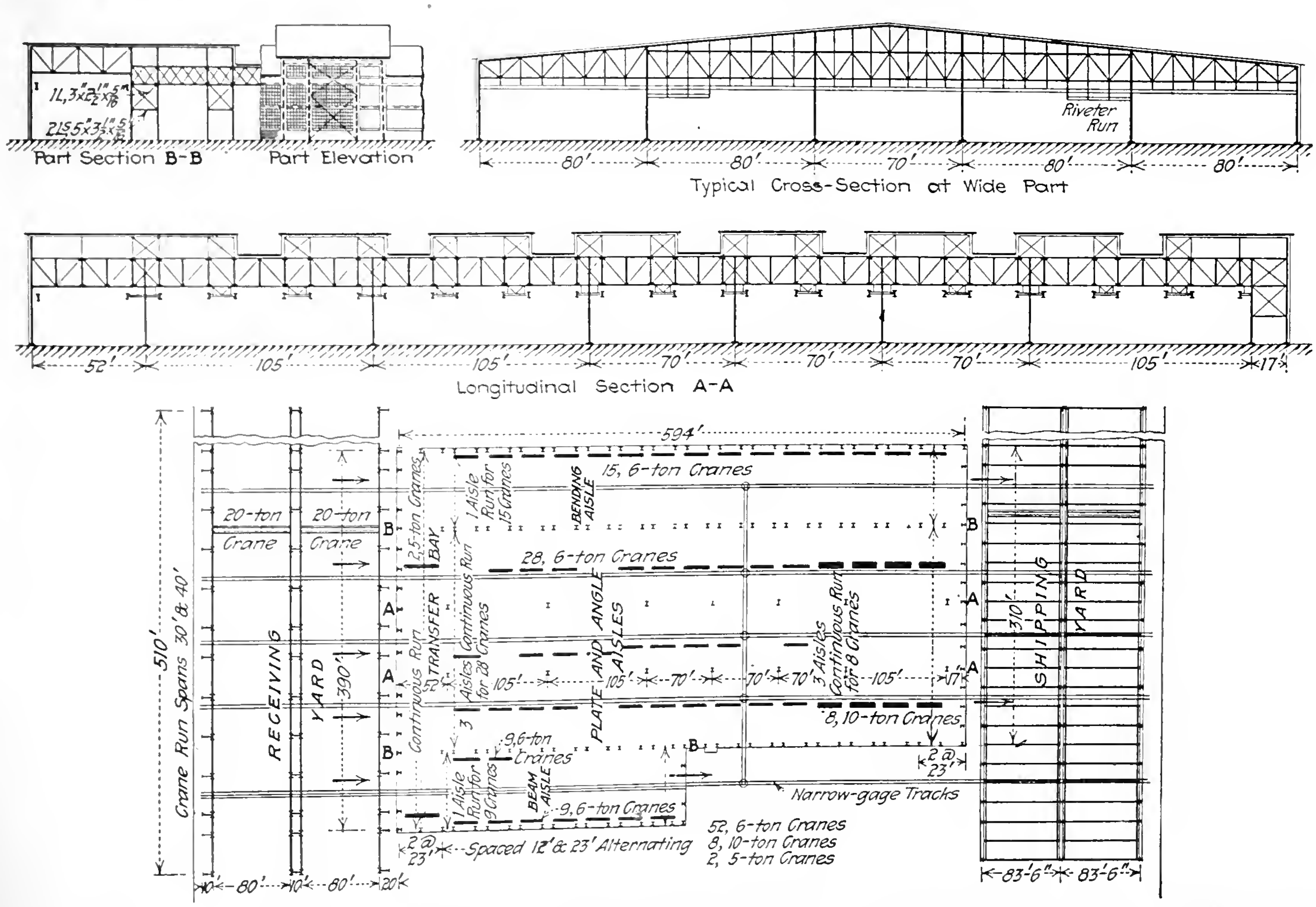


FIG. 2. SHIP-FABRICATING SHOP ARRANGED IN FIVE AISLES SERVED BY TRANSVERSE OVERHEAD CRANES AND LONGITUDINAL TRACKS; RECEIVING YARD AT LEFT, SHIPPING YARD AT RIGHT

pushed out of the other end of the furnace by the same power and then through a flaring or beveling machine, which, in the case of channels, flares both flanges at the same time. The shape is then on the bending floor and is pulled by electric winches around pins in the floor set to templet. This is all done in one heat.

The bending-slab area of the two sets of furnaces is 4200 sq.ft. One motor-driven beveling machine is provided for each pair of furnaces, each being mounted on a truck running on a narrow-gage track parallel to the front line of the furnaces, so that the machines can readily be placed in position where needed. Of the two machines, one is designed for angles and the other for channels.

The forge shop, following next after the bending floor, contains 12 forges and five blocks, for bending small angles and similar parts. There are also knuckling forges, hammers and a flanging press with furnaces adjacent, and a bulldozer and a gag press. Beyond these machines all material is worked cold. Layout skids are followed by four punches, two horizontal and two vertical.

At this point the cross-track enters the aisle. A 700-ton keel bender is located here for convenience; its base is set in a reinforced-concrete pit. An electric hoist on an overhead runway is provided for handling the steel fabricated by this machine.

Assembling Division—The remaining portion of the furnace and forge aisle forms the fitting and assembling shop. Two riveter runs with rivet-heating furnaces adjacent are required for the built-up sections; they are installed opposite each other along the sides of the aisle, in order to centralize the work. A second hydraulic gag-press, which is a duplicate of that near the forges, and two radial countersinking arms, complete the equipment. This division of the aisle, then, forms an independent shop for certain classifications of ship steel.

Fabricated material leaving the aisle is finally advanced by truck over a track scale at the entrance to the shipping yard and is ready for shipment.

All the hydraulic machines in the plant, except one, are located in the bending aisle. Tables are provided for the countersinking arms only. All other equipment is served by two-ton jib cranes with electric hoists. Similar hoists are provided for the riveter runs.

Plate-and-Angle Section—The second, third and fourth aisles may be considered the plate-and-angle shop, though it is subdivided into several separate units. In the second aisle narrow rectangular plates, sketch plates and angles (except the largest sizes) are fabricated. Further, this aisle, in conjunction with the first, builds the floors of the ship, as they consist of narrow vertical plates, angle frames and intercostals. This is all punched and riveted work which can be carried along uniformly and assembled without transfer to other parts of the shop.

For plate punching, one 12-in., three 48-in., and four 72-in. punches are provided in the second aisle, those with 48-in. throat being equipped with roller tables, and the large punches with tables manually operated in two directions. Two 48-in. plate shears, with roller tables, and a rotary shear were installed near the 72-in. punches for convenience in fabricating sketch plates and similar work. Opposite one of the 48-in. punches is a joggling press of 350 tons capacity, provided with electric hoist and runway, and designed also to cut manholes up to 18 x 30 in. at one stroke. These openings were formerly cut by flame in most shops, and this part of the floor fabrication was therefore performed with unnecessary delay and difficulty, on account of lack of better facilities.

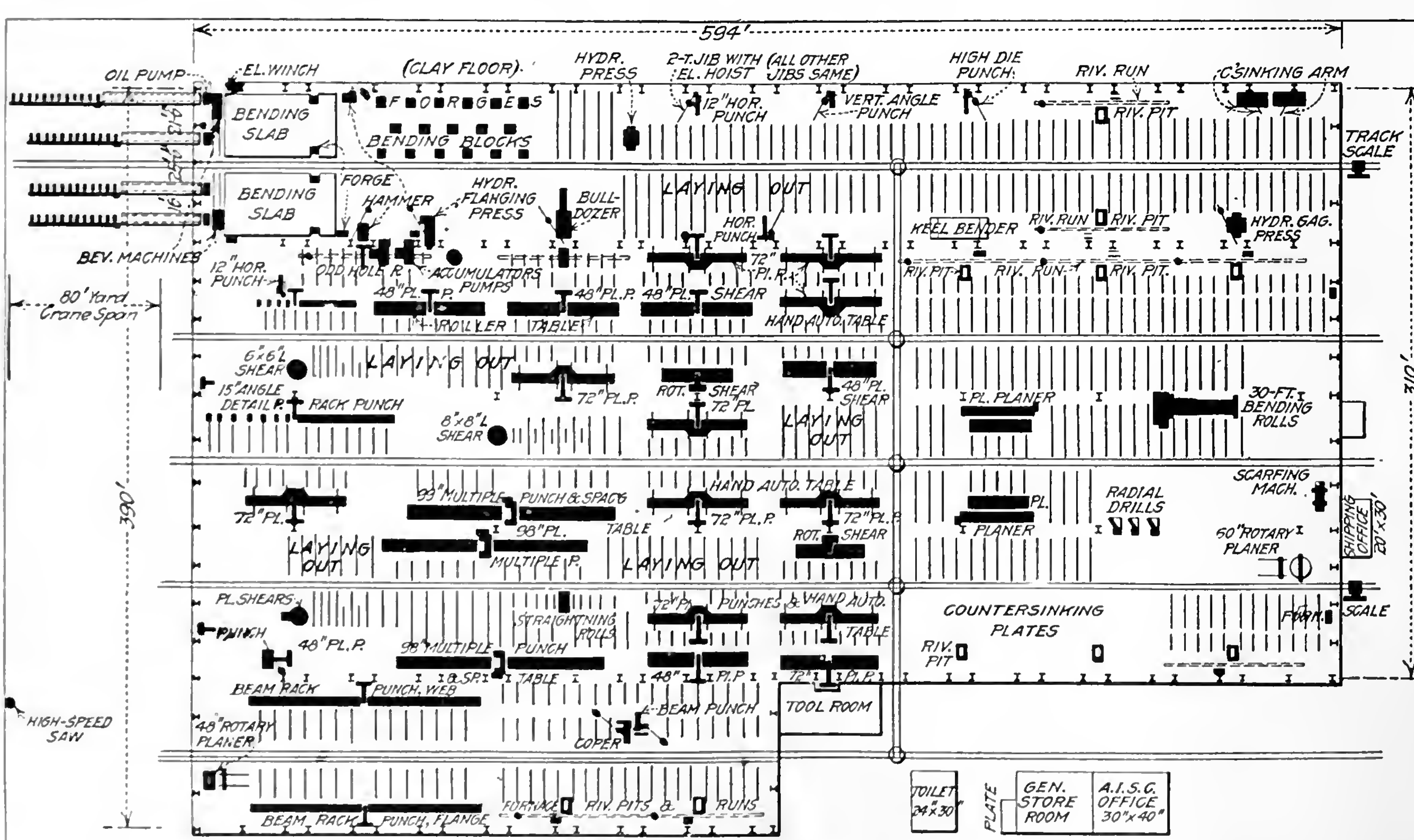


FIG. 3. ARRANGEMENT OF MACHINES; MATERIAL MOVES FROM LEFT TO RIGHT IN FABRICATING SHOP

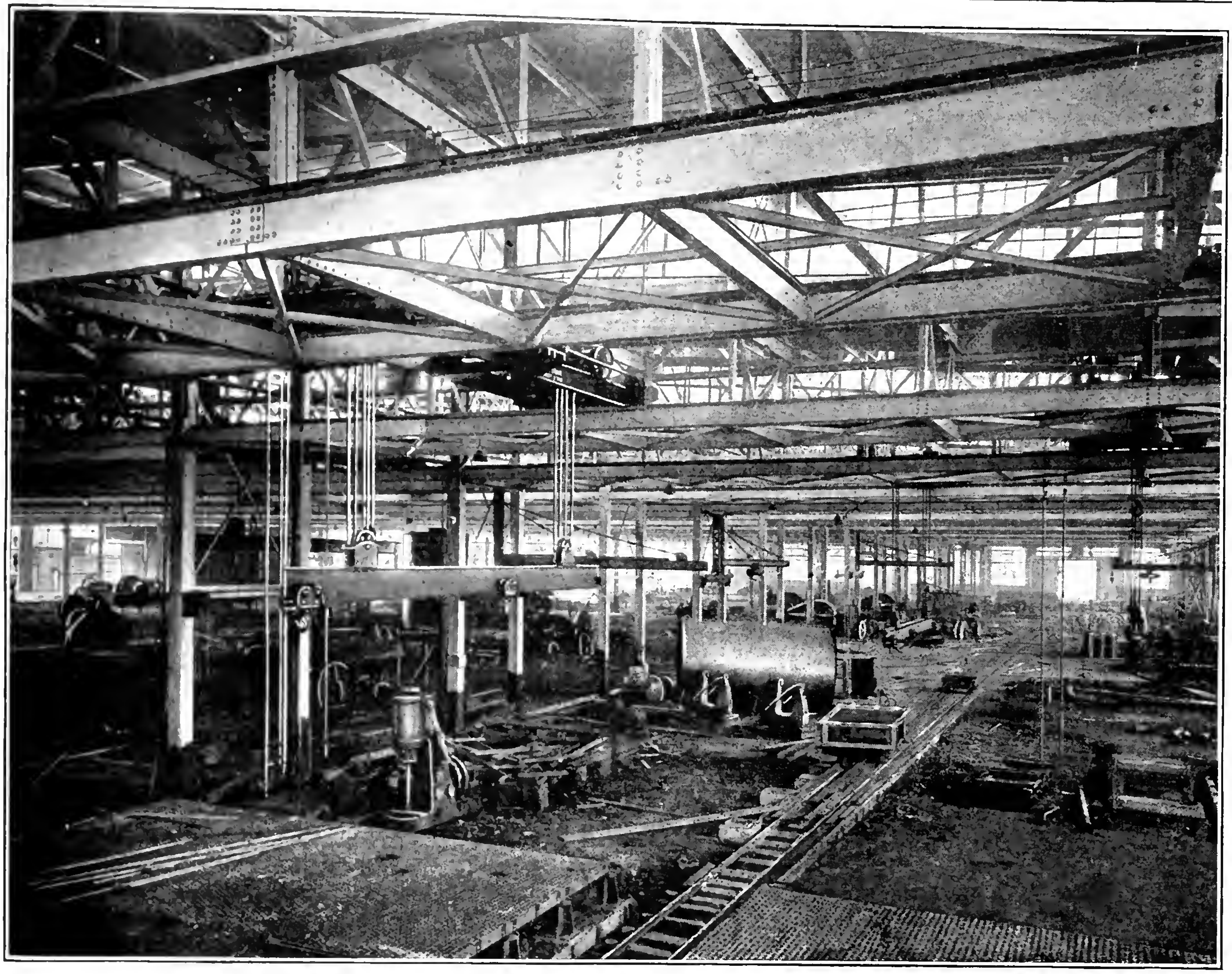


FIG. 4. BENDING AISLE OF POTTSTOWN SHOP IN DECEMBER, 1918, WHILE MACHINERY WAS BEING INSTALLED

The angle shop is not a separate division within the aisle, but the equipment is located at the beginning of the aisle for convenience. It consists of an angle shear on a rotary base, a two-angle rack punch with a spacing table, an odd-hole punch, and a 15-in. detail punch. The remainder of the aisle, which represents two-fifths of its area, is arranged for assembling the parts, and three riveter runs are provided for the purpose.

Multiple Punches for Large Plates—All large plate work, such as shell and deck plating, bulkheads and tank tops, and also large angles, will be fabricated in the third and fourth aisles. Since this plate work involves only planing, punching and countersinking, a large tonnage will be obtained from the three 98-in. multiple punches located near the receiving-yard end of the shop. These machines will punch 40 holes $\frac{15}{16}$ in. in diameter through $\frac{3}{4}$-in. metal and shear a plate 84 x $\frac{3}{4}$ in., all at one stroke. Two of the punches are equipped with end shears and side-trimming knives. Roller tables of original design are provided.

For plates which cannot be entirely punched in the multiples, and for other single punching, six 72-in. punches with manually operated tables, and one 48-in. punch with a roller table, follow the large machines. Irregular and curved cuts are made by a rotary shear after the plates are laid out. The detail work is done at the beginning of the aisle by a 25-in. and a heavy 48-in. punch. Special shearing is also done at this point, the plates being deposited over an inclined table. For straightening plates, a set of six rolls has been installed near the punches, with capacity to correct 1-in. plates at a speed of 35 ft. per minute.

After punching is completed, the plates are laid out and are advanced to the planers, located in the third aisle. Two of these machines are required to balance the plate capacity of the punches. They will plane the edges of plates 1 to $1\frac{1}{2}$ in. in thickness to a length of 30 ft. at one setting; the plates are clamped by a series of pneumatic jacks.

Molded plates will be passed through a set of 30-ft. bending rolls adjacent to the planers. A row of three radial drills for holes that cannot be punched, and also floor space for operating portable buggies carrying motor-driven countersinking drills, are provided near the end of the third aisle. Ten of these buggies, each operated by one man, are required for the plate shop.

Before passing over the scales, the plates from the third and fourth aisles are planed by a 60-in. rotary planer, and are also scarfed, where necessary, on a double-head machine. Three riveter runs at the end of the fourth aisle handle the work requiring shop riveting, which is fabricated on this side of the plate-and-angle shop.

The angle shop in these two aisles was placed at the receiving-yard end, adjacent to the second aisle, where it forms the part of the group handling the heavier

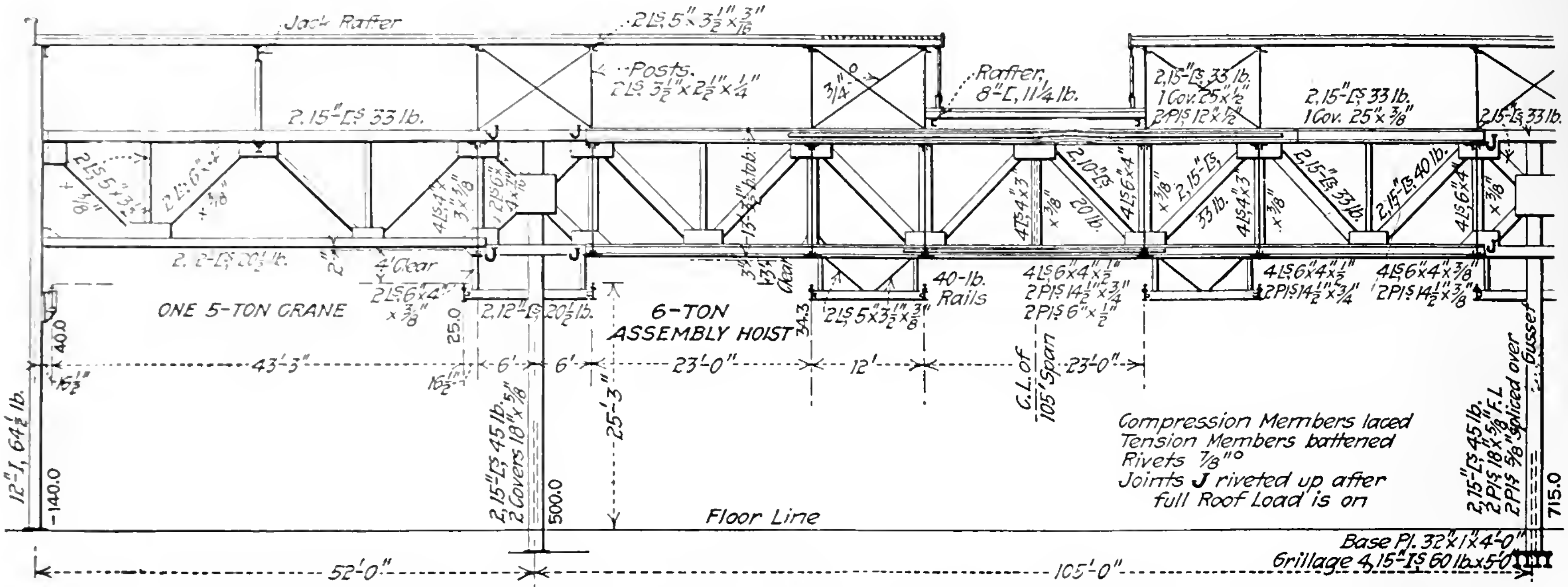


FIG. 5. PLATE-AND-ANGLE AISLES KEPT CLEAR BY WIDE SPACING OF COLUMNS AND SUPPORT OF ROOF BY LONGITUDINAL TRUSSES

material. A 15-in. detail punch, a 4-angle rack punch with a spacing table, and double shears on a turntable for angles up to 8 x 8 x 1¼-in., constitute the equipment.

Beam Shop—The fifth aisle, forming the beam shop, is only 303 ft. long, about half the length of the building. A high-speed friction saw, operated by a 45-hp. motor, is included in this equipment, although located not in the shop itself but just opposite its entrance, in the receiving yard. This saw is designed to cut continuously up to 24-in., 80-lb. beams, and equivalent channels, Z-bars and angles. One 48-in. rotary planer, with tracks and carriage, at the beginning of the aisle, is sufficient to meet the requirements.

On opposite sides of the track, near the entrance, are two beam punches, one for webs and the other for flanges, with die blocks of sufficient height to punch also 8 x 8-in. angles. Spacing tables are provided for these machines. A special beam punch and coping machine follow the punches, with capacity for all standard sections up to 24 in. and for Bethlehem sections up to 30 in. A 24-in. odd-hole beam punch adjacent to the coper completes the equipment in the aisle, except for the riveter runs, of which there are two. No tables are provided for the coper and adjoining punch, as the steel will be handled by jib cranes. This aisle contains the only standard-gage track entering the building; it is laid in conjunction with the industrial track.

Full Equipment of Skids—Throughout the entire building, skids built up of angles and channels form part of the equipment at each machine, wherever their use will facilitate the handling of the steel. Laying-out and assembly skids are 2 ft. high; those for partly fabricated material are 9 in. high; those for certain other machines are of heights required by the special conditions. At the plate-and-angle shears, skids with roller tops are used, and at the riveter runs the skids are movable. In the yards 10 x 10-in. oak skids with steel bar or rail wearing surface are provided.

The offices for the shipping-yard and receiving-yard clerks, and for the superintendent and the inspector, are built as lean-tos, as are also the tool room and electric repair shop. All other auxiliary buildings are detached. The electrical shop contains transformers which step the voltage (2300) down to 220, used for power throughout the shop, except for the cranes, which are operated by direct current of the same voltage. From the second floor of this lean-to a walkway extending through the roof trusses gives access to the cranes for repairs. The main shop is well lighted throughout, with 500-watt lamps in reflectors.

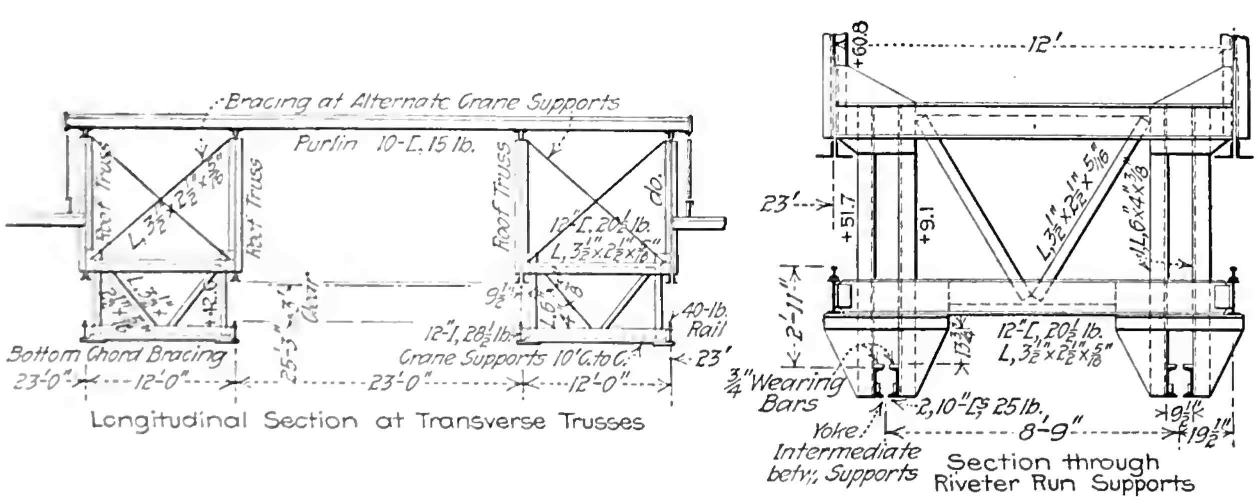


FIG. 6. TYPICAL CRANE-RUN SUPPORT DETAILS

A. McKinley of the McClintic-Marshall Construction Co. designed the Leetsdale and Pottstown plants. The buildings were erected by the Hughes-Foulkrod Co., under the supervision of C. H. Harlan and H. C. Walton, managers of construction at Leetsdale and Pottstown, respectively. J. W. Fenton, assistant authorized representative, was in charge of the work at Pottstown for the Emergency Fleet Corporation.

Head-Office Expense of Highway Department

The division of head-office expense in the New York State Highway Department for the year 1917 is shown in the annual report of H. Eltinge Breed, first deputy commissioner of highways, to be as follows: Checking of final estimates, 23.12 per cent; maps, 13.53 per cent; plans, 13.40 per cent; miscellaneous, 25.22 per cent; lettings, 9.76 per cent; repair work, 7.46 per cent; bulletin, 3.98 per cent; Federal aid, 3.53 per cent.

Preparing Six Hundred Acres of Land for Irrigation

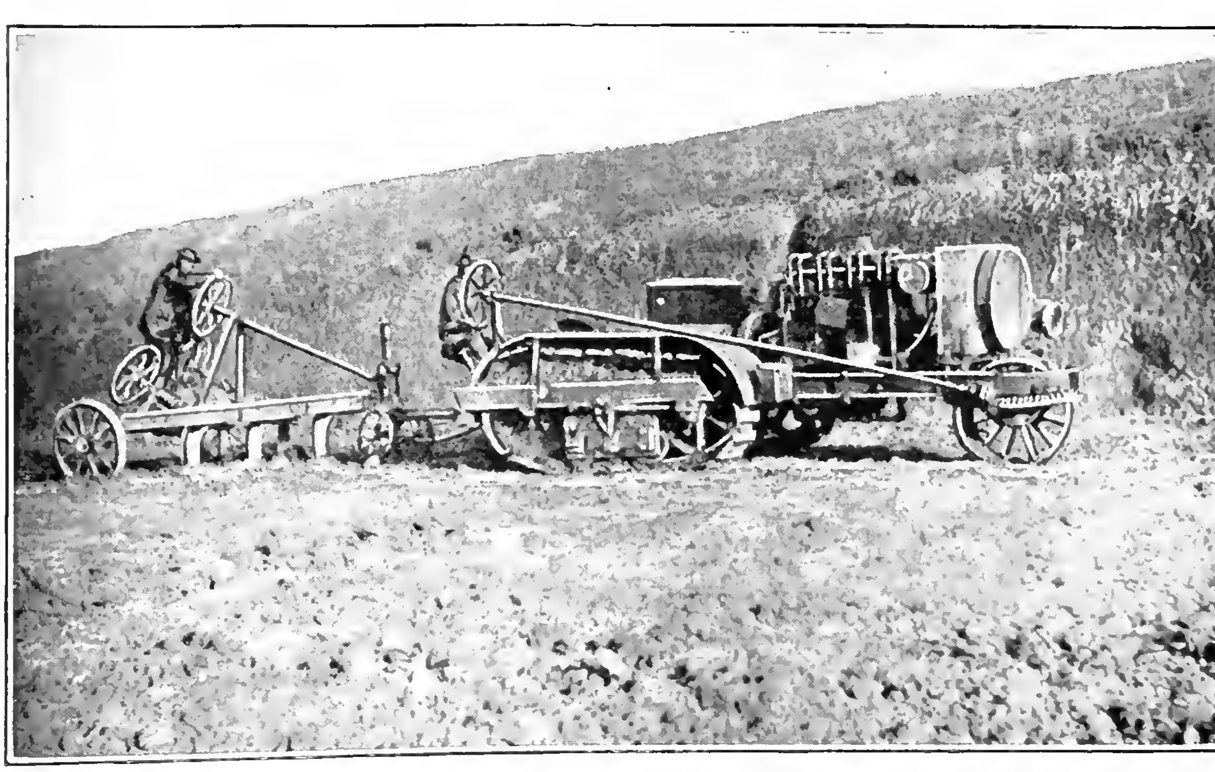
Soil Studies, Surveys, Supply and Drainage Ditches—Land Leveling and Ditch Construction Operations Described—Tractor Plows Run Day and Night—Ground Planes and Scarifiers Used

By F. W. Herron
Daly City, Cal

In preparing large tracts of land for irrigation, engineering methods are employed to an increasing extent. Especially is this true when modern farm tractors are used, as the large amount of capital invested in equipment of this kind and the high cost of operation render it essential that the work shall be carefully planned and economically executed. The following account of the preparation of a 600-acre tract with a construction outfit that included 35 scraper teams and five Holt caterpillar tractors describes briefly the engineering features of this kind of work, and gives a summary of costs.

The tract in question is the property of the Crocker-Huffman Land & Water Co., of Merced, in the San Joaquin Valley, California. For some time it has been the policy of this corporation to prepare and seed to alfalfa each year a part of its extensive land holdings included in the Merced irrigation system. The writer was in charge of field work for the company from August, 1915, to July, 1917, and during this two-year period supervised the preparation of about 2500 acres of land, including the tract described in this article. These notes on the work were prepared directly after its completion, but for reasons beyond the control of the writer could not be published then.

The soil on this tract is classed by the Bureau of Soils, United States Department of Agriculture, as Madera clay, and is described as follows: "The Madera clay is a dark brown or reddish brown clay or silty clay varying considerably in texture within short distances. It is compact and very difficult to handle, especially when not worked under proper moisture conditions. When drainage is established, the soil is well adapted to irrigation." In reading this article, and especially considering the cost data, it should be borne in mind that this work was done under very unfavorable moisture conditions, when the ground was too dry and hard to be handled with ordinary horse-drawn farming implements. Before designing the irrigation and drainage system, the writer made a contour map of the tract, to a scale of 400 ft. per inch, and a contour interval of 0.5 ft. Field work was done with transit and stadia. On the finished map a rough paper location was made of all laterals and field ditches and also of all main drainage ditches. Distances and bearings were scaled from the map, and the ditches located in the field with transit and stadia, using compass bearings.



SCARIFIERS DRAWN BY 30-HORSEPOWER TRACTORS LOOSEN DIRT FOR DITCHES AND CUT DOWN KNOLLS

All laterals and field ditches were 8 ft. wide on the bottom, with side slopes of 2: 1, a total depth of 4 ft., and with banks 3 ft. wide on top. The usual grade was 1 ft. per 1000 ft. These ditches were so located and constructed that water could be held in them 1 ft. above the highest ground to be irrigated, but in no case was the high-water mark allowed to approach closer than 1 ft. to the top of the ditch bank. Ease of construction and maintenance and an ample water-supply were assured by the adoption of the 8-ft. bottom width for all ditches, while the substantial banks and generous freeboard allowance insured against expensive breakages and seepage losses. Drain ditches were also 8 ft. wide on the bottom, and about 2 ft. deep, and were located as far as possible on natural drainage lines. They were intended, of course, to provide surface drainage only.

As the ground surface was rough and broken, with numerous large knolls and depressions, it was necessary in laying out the tract to adopt the method known as contour checking. In this method low levees are built on contour lines, and the areas between levees are irrigated by flooding. The contour interval used in this case varied from 5 to 0.3 ft., the latter being employed wherever possible. The check levees were 6 ft. wide on the bottom, and from 12 to 16 in. high. Levee lines were located on the ground by a level party, which set stakes from 50 to 100 ft. apart, marking them with the contour elevation. In order to render these stakes plainly visible, the writer adopted the cheap and very

TABLE I. COST OF PREPARING 600-ACRE TRACT FOR IRRIGATION

	Per Acre	
Engineering and Superintendence:		
Surveying	$1 37	
Superintendence and overhead	1.90	$3.27
Team work:		
Irrigation ditches	10.73	
Drainage ditches	5 68	
Checking and leveling	5 19	21.60
Tractors:		
Plowing	3.15	
Leveling	7.96	
Scarifying for ditches	2 62	
Scarifying finished checks	2.71	
Scarifying for leveling	.25	
Building levees and small drains	1 45	
Harrowing finished checks	21	18.35
Structures:		
Canal structures	4 20	
Service structures	11.61	15.81
Total cost per acre		$59 03

Total length of irrigation ditches, 33,200 ft. Total yardage moved, 44,513 cu.yd., or 1.34 cu.yd. per linear foot of ditch. Cost per cubic yard, $0.172.

effective expedient of dipping the tops in whitewash. Great care was taken in locating the levees to avoid all sharp bends and loops and to make the total amount of earthwork a minimum, at the same time securing a check that could be irrigated quickly and evenly. After the lines were located they were marked by a single plow furrow, and the levees were constructed by a small gang of scraper men with special experience in that kind of work.

In starting construction work, a block containing about 100 acres was laid off at one end of the tract and plowed by the tractors. One 75- and two 60-hp. tractors were employed on the plowing, each drawing two six-gang disk plows. The ground was so hard that the plows were frequently broken, and in the case of the 60-hp. tractors it proved necessary to remove two disks from each rear gang. As soon as this block was plowed, work was started on another, about the same size, and immediately adjacent to the first, plowing with night shifts only. Day crews were started on the first block rough leveling with ground planes. Ditches were also staked out on this block, and construction work was started on them with teams and fresnos. As soon as the ground was approximately level and the ditches were completed, the levees were staked out and built, and the ground inside the checks was finally leveled by the ground planes. Work proceeded in this way from one end of the tract to the other, the different gangs being so proportioned that all main ditches were built well in advance of the levee building and finish leveling.

As soon as the checks were completed, stakes were set to mark the location of all water gates and boxes and a gang of men was put to work making the excavations for them. Double-wing wooden gates, with a 6-ft. opening, were placed in the canal banks at all points at which water was to be diverted to the checks, and also in the levees wherever water was to be turned from one check to the other. Smaller single-wing boxes were placed in the levees at points where the water from a check was discharged into a drainage ditch. All these service structures were built at the ranch headquarters, three miles away, and hauled to the work by a three-ton motor truck, which distributed them in convenient piles along the road bordering the tract. From these piles the gates were loaded on wagons and hauled to their places in the field. Over 200,000 ft. bm. of cedar lumber, costing about $30 per 1000 in place, was used in making these gates and boxes.

Some special implements used on this work were the ground planes and the scarifier shown by the two views. These ground planes were invented by Henry A. Lage, general superintendent of the Crocker-Huffman Co., and were built on the ranch under his direction. They are easily handled, move dirt at a low cost, and very thoroughly pulverize the most refractory soil during the process of leveling. A 12-ft. plane, drawn by a 60-hp. tractor, will average about 2 yd. of dirt at a load, and in ordinary leveling will handle from 200 to 300 yd. per day. The depth of the cut or fill is easily regulated, and excellent leveling can be done by the ordinary unskilled laborer, after a few days' practice.

TABLE III. PERFORMANCE RECORD OF 45-HORSEPOWER TRACTOR NO. 20080

Item	Hours	Minutes	Per Cent. of Total Time
Starting delay	20	50	4.84
Engine trouble	8	20	1.94
Repairing track	5	30	1.28
Repairing cooling system	12	45	2.96
Repairing implements	5	35	1.29
Filling and greasing	23	00	5.35
Traveling to and from service station	18	45	4.36
Rain	8	00	1.86
Lost time	102	45	23.88
Working time	327	15	76.12
Total time, 43—10-hr. days	430	00	100.00

The scarifier was used in loosening dirt in the ditches and in cutting down some of the large knolls, as the very hard soil could not be plowed successfully by the teams. This scarifier was drawn by a 30-hp. tractor and loosened about 1000 cu.yd. of dirt per day, breaking it up so that it was easily handled by the fresnos. In the illustration the scarifier is shown breaking up hardpan in a large canal constructed in another part of the county.

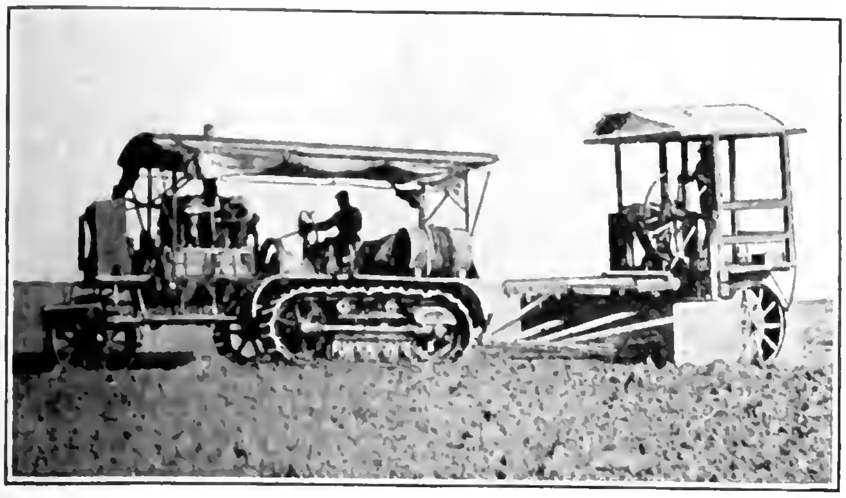
Itemized costs of the work are given in Table I. Table II shows the daily cost of operation of a 60-hp. tractor and Table III is a performance record of a 45-hp. tractor which was used in plowing, harrowing, and scarifying in the finished checks, to prepare them for seeding. These performance records were kept for each machine and served a double purpose. Not only did they reveal errors in operation and deficiencies in equipment but they also fostered a healthy spirit of rivalry, between individual tractor drivers, that resulted in decidedly increasing the amount of work performed per tractor per day. All data shown in these tables were abstracted from the complete records kept by the company, and are accurate and reliable.

In the past the irrigation engineer has considered his

TABLE II. DETAILED COSTS OF OPERATING 60-HORSEPOWER TRACTOR NO. 2008

Item	Cost per Day
Interest and depreciation	$4 56
Wages of tractor crew	4 80
Board of tractor crew	1.68
Teams	.50
Distillate, 36 gal	2.17
Engine lubrication, 2.5 gal	.78
Track lubrication (crude oil), 13.5 gal	.42
Cup grease, 2.5 lb	13
Repairs	4 08
Miscellaneous labor	2.43
Miscellaneous supplies	.78
Implements (repairs, interest and depreciation)	2.71
Superintendence and general overhead	2 67
Total daily cost	$27.71
Total daily cost:	
Tractor No. 2116, 75 hp	30 20
Tractor No. 2003, 60 hp	25.70
Tractor No. 20080, 45 hp	17.25

work completed when he has brought the water to the outskirts of the irrigable land. The equally important and rather more difficult task of preparation for the efficient and economical application of the water to the soil has been left largely to the farmer. The partial or complete failure of most of our irrigation projects will testify to the fact that this method of procedure



GROUND PLANES DRAWN BY 60-HORSEPOWER TRACTORS LEVEL LAND AND PULVERIZE SOIL FOR IRRIGATION

has not been an unqualified success. Since increased crop production has become and will doubtless remain a matter of great national importance, the writer believes that the engineering profession can well afford to devote some of its attention to the problem of the economical preparation of land for irrigation.

American Engineer at Burma Camp Fights Epidemics

Detention Camp on Railroad Effective, but Coolies Bring in Cholera Through Jungle—No Uncooked Food Permitted

By Harry N. Jenks

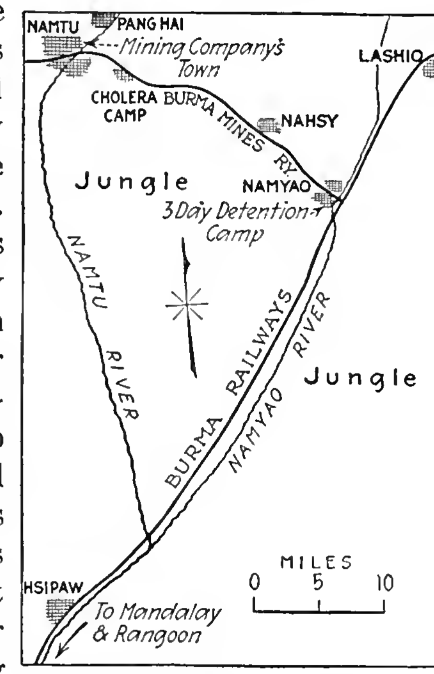
Sanitary Engineer, Burma Mines, Limited, Namtu, Burma

Combatting three highly contagious deadly diseases within six months, two of them simultaneously, in the experience of the author of this article, a young sanitary engineer of Berkeley, Cal., who has been with a British mining company at Namtu, Burma, India, for the past two years. As an instance of where and into what the coming international trade will carry pioneering American engineers, these notes and also Mr. Jenks' longer article on sanitation at the Namtu mining camp, printed in "Engineering News-Record" of Jan. 23, p. 172, are timely and informing.—Editor.

Things may happen slowly in Burma, but when they do happen they take a long time to stop. For the first time in the camp's history, we had bubonic plague last spring; and it is only now (Oct. 18, 1918) that we are nearing the end of a four months' fight against cholera, a fight that was made all the more difficult by the simultaneous occurrence of a severe epidemic of influenza. From the standpoint of training in public health work, this year has furnished me with exceptionally good experience, but the number of coolies that have been claimed by the epidemics, and those that have disappeared into the jungle to escape infection, have left us with barely enough labor to "carry on."

This has been a particularly untoward year all over India, as regards the prevalence of sickness. Unseasonable weather created conditions that seemed to favor the spread of both influenza and cholera. Earlier in the year the unusual conditions of temperature and moisture were, presumably, largely responsible for the appearance of plague, which in the first instance came probably from some previously infected place, such as Mandalay. Neither the plague nor the cholera was in true epidemic form, occurring as each disease did in sporadic cases, mainly with no apparent causal connection. If, however, there ever was an epidemic anywhere, the influenza that struck us takes highest honors. It started about last June in Bombay, traveled all over India, came up through Burma from Rangoon, and carried away with terminal pneumonia some 200 known cases among the natives in Namtu.

Our cholera troubles started last June, when the disease broke out in Hsipaw and spread through the jungle, paralleling the Burma Rys., as far as Lashio. The sketch shows the position of these towns in relation to Namtu and the company's railway that connects with the Burma Rys. at Namyao. Precautionary measures were taken immediately to prevent the infection from traveling up our line to Namtu. We established a detention camp at Namyao, where all third-class passengers from the Hsipaw side as far as Maymyo were kept under observation for three days before being allowed to proceed on our railway. All foodstuffs from infected areas were destroyed. No food that could be eaten uncooked was permitted to be kept for sale in the local bazaars. Guards were placed on roads and trails through the jungle to intercept all persons going from infected areas toward Namtu.



THREE-DAY DETENTION CAMP AT NAMYAO KEPT CHOLERA FROM NAMTU FIVE WEEKS

In this and other ways we kept the infection at a distance for about five weeks, when a case suddenly developed in Namtu, and within a few days sporadic cases were reported all along the line to Namyao. Pretty nearly everybody was then taken off his regular job and detailed to help the medical and sanitary staff to cope with the situation. In this work we received the assistance of Government medical officers, who spotted cases and administered treatment. We built a big cholera camp at Hsaikhao to receive contacts and to care for the cases that developed among them, and for such cases as could be sent to the camp.

In Namtu we placed a European guard, working in eight-hour shifts, over our water-supplies. We discontinued the fresh milk supply, and for a while subsisted mainly on potatoes and onions for vegetables. A cordon of men was flung around the European side of the camp, and a guard was stationed at the bridge across the Namtu, in order to prevent any coolies from

the jungle coming into camp. This step was necessary because of the fact that the coolies had the dangerous habit of straggling along the open road or through the jungle from village to village when in the initial vomiting and purging stage of the attack.

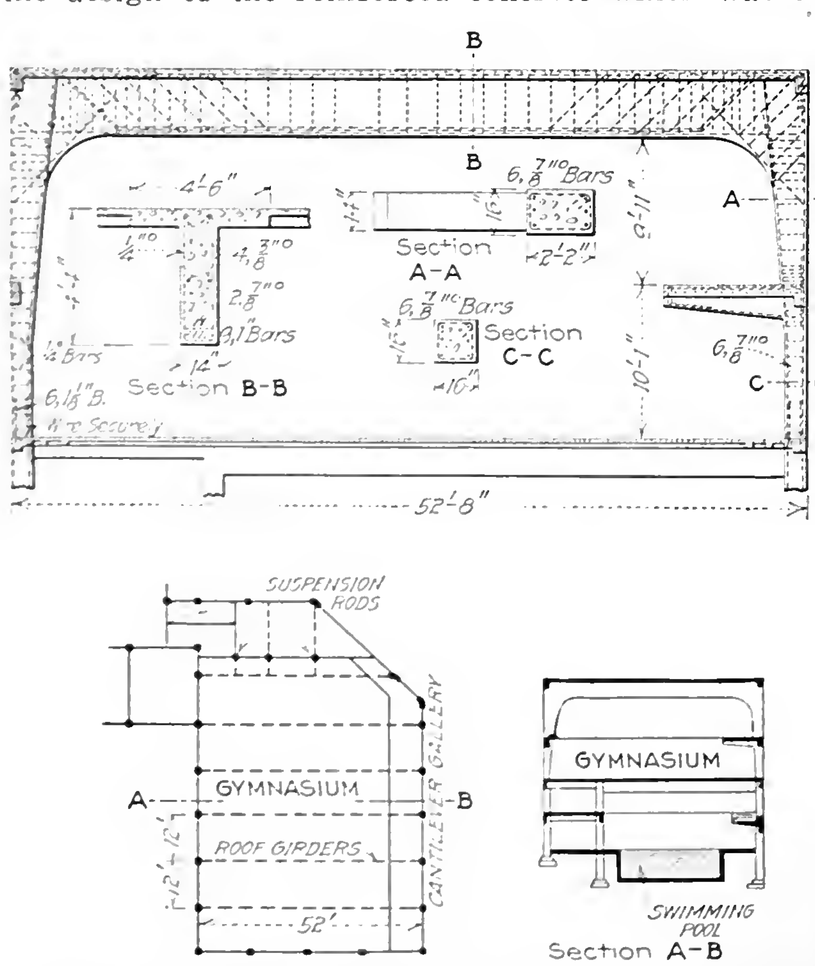
Within a short time Namtu itself was freed from infection, but up to Oct. 18 residual cholera has persisted in the jungle stations and villages. About four weeks ago I was detailed to take charge of the anti-cholera work along the railway, with headquarters at Nahsy, in order to attack the last footholds of the infection. After three weeks' work, the chief features of which were the continual inspection of all dwellings, the spotting of cases of sickness and provision for their treatment, and the disposal by incineration of those cases that terminated fatally, we have apparently attained our object; although even after the required 21 days' time has elapsed since the last case one cannot be certain that a sporadic case may not appear suddenly.

Long Girders and High Columns Designed as Rigid Frame

Gymnasium Requiring 52-Foot Span and 20-Foot Clearance in Height Carried as Third Story of Building

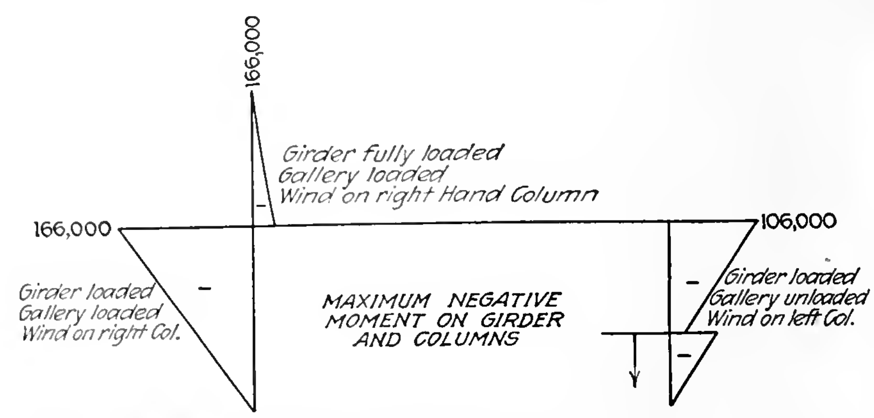
By A. E. Wynn
Truscon Steel Co., Syracuse, N. Y.

Architectural requirements in the layout of the Y. W. C. A. building, at Syracuse, N. Y., necessitated the use of some rather unusual details in the design of the reinforced concrete which was used throughout the building. In the gymnasium, a wing of the main building, a rigid frame analysis was followed for the 52-ft. roof beams and attached columns.



ROOF OVER GYMNASIUM OF REINFORCED CONCRETE, DESIGNED AS RIGID FRAME

The lower portion of this section of the building is excavated for a swimming pool 60 ft. by 25 ft. in plan and sloping in depth from 4 to 8 ft. The sides are 10-in. concrete walls reinforced for both earth and water pressure. Above the tank, and on all sides, is a gallery. Along two sides this consists of a slab, varying from 4 to 7½ in., thick cantilevered out 7 ft. from the wall lintels, and on the other two sides it is carried on beams and columns. Above the swimming pool is the gymnasium floor. This is carried over the pool by beams of 38 ft. span, 14 in. wide and 30 in. deep,



MAXIMUM NEGATIVE MOMENTS FOR EACH COLUMN AND GIRDER

Showing the column not carrying the gallery is under larger bending moment

with a floor slab of 4-in. terra cotta tile and 2-in. concrete.

The gymnasium itself had to be free of columns, so in order to frame the roof it was necessary to span 52 ft. from wall to wall at a height of 24 ft. above the floor. Long girders of this type are usually designed as simple beams freely supported at the ends, and the columns simply to take the total loads and then increase to a section conforming to some empirical rule, such as making the depth a certain fraction of the span and adding so much steel to the outside face. This method generally gives sections which are too large, and there is usually doubt as to what stresses exist in the columns. In this particular case the structure was designed as a rigid frame, the girder being considered monolithic with the columns. As it was to be used for sport, the roof slab was designed for a live-load of 100 lb. per square foot, and the columns and girders for 60 lb. per square foot. Maximum fiber stress in the girder was 650 lb. and in the column 700 lb. per square inch.

The design of the frames is shown in the accompanying detailed drawings. The columns are 12 ft. apart and in section are 16 in. wide and 26 in. deep at the top, and 16 in. wide by 16 in. deep at the bottom. They are reinforced symmetrically, the columns carrying the gallery with six ⅞-in. square bars, and the opposite ones with six 1⅛-in. square bars. The girders are 14 in. wide by 52 in. deep, the roof slab forming a T 54 in. wide, and they are reinforced with nine 1-in. and two ⅞-in. square bars. Some of the outside bars in the columns are bent over into the top of the girder, and some of the bars in the girder are bent well down into the columns, thoroughly bonding the girder and columns. At the junction of the columns and girder are curved brackets, which add greatly to the appearance of the structure and provide greater depth to the columns and girder at points of maximum negative moment.

The method used in designing these frames was as follows:

Any load acting upon the frame will cause the girder to take a certain slope at its junction with the columns. This slope can be calculated for any condition of loading and is dependent not only upon the loading but upon the relative stiffness of the girder and columns and the amount of fixation at the base of the columns. Knowing the angle of slope, the moment at the junction of column and girder required to produce this slope can be found. By equating the moments of the external forces on one side to this moment, the thrust at the base of the column is obtained. The moment at any point in the frame can then be easily found, and then the stresses.

Taking the simplest case of the girder uniformly loaded and using the following symbols:

l = span of girder columns c. to c.;
h = height of columns;
w = uniform load per foot;
L = slope of girder at junction to column;
E = modulus of elasticity;
I_B = moment of inertia of girder;
I_C = moment of inertia of column;

then

I_B/l is a measure of stiffness of girder

and

I_c/h is a measure of stiffness of column.
K = constant depending on amount of fixation at base of column = 3 if base is considered free.

Then for a beam uniformly loaded and considered as monolithic with the columns the slope L is given by

$$L = -\frac{wl^2}{12}\left(\frac{1}{\frac{3I_c}{h}+\frac{2I_B}{l}}\right)\frac{1}{E}$$

and the moment required to produce this slope is given by

$$M = K\frac{I_c}{h}EL$$

$$M = \frac{3I_c}{h}\left(-\frac{wl^2}{12}\times\frac{1}{\frac{3I_c}{h}+\frac{2I_B}{l}}\right)$$

$$= -\frac{wl^2}{12}\left(\frac{\frac{3I_c}{h}}{\frac{3I_c}{h}+\frac{2I_B}{l}}\right)$$

and if H = horizontal thrust, $H = M/h$. In a similar manner the thrust for other conditions of loading are found.

The different steps in design are as follows:

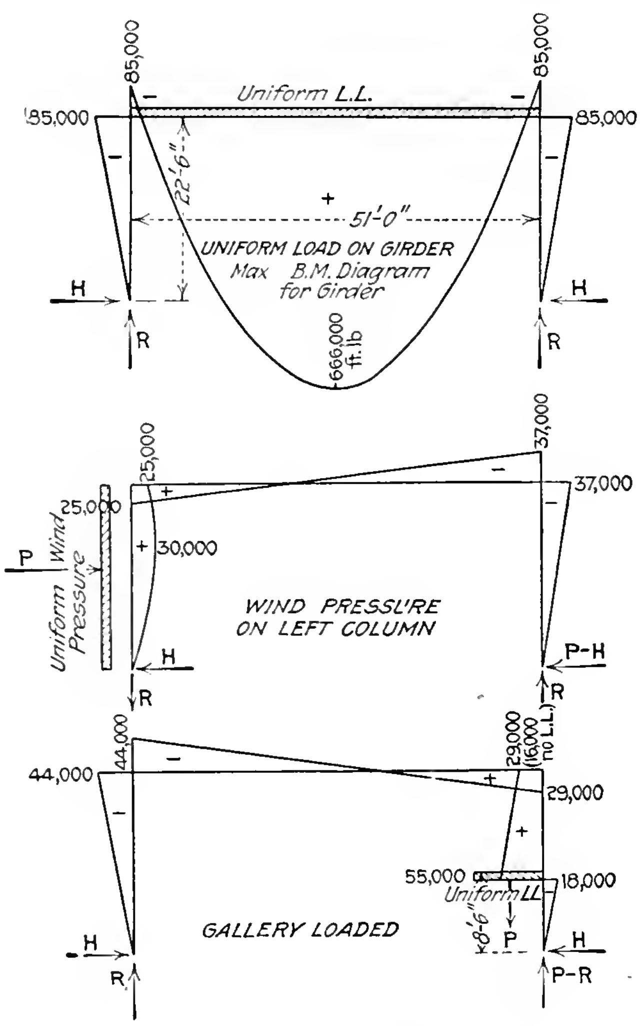
1. Design the girder with full live load for a bending moment of $wl^2/12$ at the center and $wl^2/24$ at the supports to obtain the approximate size, area of steel and width of T. Assume a column section, placing the steel symmetrically.

2. Calculate the moments of inertia of the girder and column.

3. Take the different conditions of loading, such as girder loaded and unloaded, gallery loaded and unloaded, and wind pressure on either side, and for each condition calculate the horizontal thrust H and vertical reaction R at the base of the columns, assuming that they are free at these points, as this condition gives the maximum moments in the columns.

4. Knowing these thrusts and reactions, the bending moment at any point in the frame can be found by taking moments about that point. Draw the moment diagram for each force acting upon the frame.

5. It will be seen from these, as shown in the accompanying diagrams drawn, for this particular case, which combination of loadings will give the maximum positive



BENDING MOMENT DIAGRAMS SHOWING BENDING ACTION OF LOADS ON GIRDERS FOR THREE DIFFERENT CONDITIONS OF LOADING

and negative moment in the girder and columns. Draw a final moment diagram giving these worst conditions combined.

6. Check the maximum moments found for the girder with those originally assumed.

7. Combine the maximum moment in the columns with the corresponding vertical reactions, and hence find the fiber stress for a column under bending and axial thrust.

8. If the moments in the girder differ materially from those assumed, and if the stress in the columns is higher or much lower than the allowable stress, it will be necessary to change the sections or steel areas or both, and as this will change the respective moments of inertia, the calculations will have to be repeated. Experience tells the sections to assume, and it is not often necessary to make more than two sets of calculations.

9. The outward thrust at the base of the columns must be taken care of by tie rods or if, as in this case, they are connected by beams, by the tension steel in the beams. It is not really necessary to draw the bending-moment diagrams, as an examination of the direction and magnitude of the thrusts will show which

are the worst conditions. Even if, as in this case, the columns are continuations of columns carrying the floors below, they cannot be considered as fixed at their base, but if any doubt exists as to the amount of fixation the calculations can be repeated for a frame with fixed ends and the stresses found at the foot of the columns. A much higher fiber stress can be assumed as safe, as absolute fixation hardly ever occurs.

Referring to the accompanying moment diagrams, it will be seen that the maximum positive moment occurs in the girder when the roof is fully loaded, the gallery is unloaded and there is no wind pressure. The column not carrying the gallery has maximum moment when the girder and gallery are fully loaded and with wind pressure on the opposite column. These conditions also give the maximum negative moment in the girder. The worst condition for the column carrying the gallery is when the girder is loaded, the gallery is unloaded and there is wind pressure on the opposite column. The roof load brings tension on the outside face of the columns and is a maximum at the top. Wind pressure brings tension upon the inside face of the column it is acting upon and upon the outside face of the opposite column, thus decreasing and increasing, respectively, the tension at the top of the columns.

When the gallery is loaded it brings tension on the inside face of the column above the gallery and on the outside face of the opposite column, having an effect similar to that of wind pressure.

The maximum fiber stress in the girder was 650 lb. per square inch and in the columns for worst conditions 700 lb. per square inch. The architects for the building were Taylor and Bonta, of Syracuse and the general contractors were Dawson Bros., of Syracuse.

Mechanical Devices Help Overcome Engineer Shortage

Combined with Tables and Standard Formulas, They Work Out Well in South Carolina Highway Department

By R. A. Brown

Assistant Engineer, South Carolina State Highway Department, Columbia, S. C.

WITH so many draftsmen and computers called into military service, it was a problem to utilize the less experienced men and get out presentable plans in a reasonable length of time. The State Highway Department of South Carolina lost 27 men to military service during the past 15 months. To utilize new recruits and some of the field men on plans and computations mechanical devices have been adopted, as it is easier for the average boy under 18 years of age to learn the use of a mechanical device than to perform intricate or even fairly easy computations.

A calculating machine is used by the department for most of the larger computations. Much of this work is done by a young woman who had no previous experience in engineering computations. To aid her in computing grades on vertical curves, the formula and a typical example worked out in detail were written out and pasted alongside the keyboard. The formula used is that for the approximate parabola: Middle ordinate, $M = \frac{1}{8}(G_2 - G_1)L$, where G_1 is the grade of the back tangent with proper sign, G_2 is the grade of the forward tangent with proper sign and L is the length of curve in stations. A plus result indicates that the ordinate is to be added to the elevation on tangent.

To enable the computers to find from the middle ordinate the ordinates at other points on the curve, the table herewith was computed for the curves usually used by this department. Having the middle ordinate, multiply it by the factor opposite the given distance and under the length of curve being used, to get the ordinate at any given distance from either end of the curve.

Since the grades can be added, the result multiplied

VERTICAL CURVE TABLES

Factors by which the middle ordinate must be multiplied to obtain ordinate at a given distance from point of curve. Example: On a 200-ft. curve, the ordinate at a distance of 27 ft. is 0.073 × middle ordinate.

Dist. Along Curve	200-Ft. Curve Factor	250-Ft. Curve Factor	300-Ft. Curve Factor	Dist. Along Curve	200-Ft. Curve Factor	250-Ft. Curve Factor	300-Ft. Curve Factor
1	0.0001	0.00006	0.00004	51	0.260	0.166	0.116
2	0.0004	0.00027	0.00018	52	0.270	0.173	0.120
3	0.0009	0.00058	0.00040	53	0.281	0.180	0.125
4	0.0016	0.0010	0.0007	54	0.292	0.187	0.130
5	0.0025	0.0016	0.0011	55	0.303	0.194	0.135
6	0.0036	0.0023	0.0016	56	0.314	0.201	0.140
7	0.0049	0.0031	0.0022	57	0.325	0.208	0.144
8	0.0064	0.0041	0.0028	58	0.336	0.215	0.149
9	0.0081	0.0052	0.0036	59	0.348	0.223	0.155
10	0.010	0.006	0.004	60	0.360	0.230	0.160
11	0.012	0.008	0.005	61	0.372	0.238	0.165
12	0.014	0.009	0.006	62	0.384	0.246	0.171
13	0.017	0.011	0.008	63	0.397	0.254	0.176
14	0.020	0.013	0.009	64	0.410	0.262	0.182
15	0.023	0.015	0.010	65	0.423	0.271	0.188
16	0.026	0.017	0.012	66	0.436	0.279	0.194
17	0.029	0.019	0.013	67	0.449	0.287	0.200
18	0.032	0.021	0.014	68	0.462	0.296	0.205
19	0.036	0.023	0.016	69	0.476	0.305	0.212
20	0.040	0.026	0.018	70	0.490	0.314	0.218
21	0.044	0.028	0.020	71	0.504	0.323	0.224
22	0.048	0.031	0.021	72	0.518	0.332	0.230
23	0.053	0.034	0.024	73	0.533	0.341	0.237
24	0.058	0.037	0.026	74	0.548	0.351	0.244
25	0.063	0.040	0.028	75	0.563	0.360	0.250
26	0.068	0.044	0.030	76	0.578	0.370	0.257
27	0.073	0.047	0.032	77	0.593	0.380	0.264
28	0.078	0.050	0.035	78	0.608	0.389	0.270
29	0.084	0.054	0.037	79	0.624	0.399	0.277
30	0.090	0.058	0.040	80	0.640	0.410	0.284
31	0.096	0.061	0.043	81	0.656	0.420	0.292
32	0.102	0.065	0.045	82	0.672	0.430	0.299
33	0.109	0.070	0.048	83	0.689	0.441	0.306
34	0.116	0.074	0.052	84	0.706	0.452	0.314
35	0.123	0.079	0.055	85	0.723	0.463	0.321
36	0.130	0.083	0.058	86	0.740	0.474	0.329
37	0.137	0.088	0.061	87	0.757	0.484	0.336
38	0.144	0.092	0.064	88	0.774	0.495	0.344
39	0.152	0.097	0.068	89	0.792	0.507	0.352
40	0.160	0.102	0.071	90	0.810	0.518	0.360
41	0.168	0.108	0.075	91	0.828	0.530	0.368
42	0.176	0.113	0.078	92	0.846	0.541	0.376
43	0.185	0.118	0.082	93	0.865	0.554	0.384
44	0.194	0.124	0.086	94	0.884	0.566	0.393
45	0.203	0.130	0.090	95	0.903	0.578	0.401
46	0.212	0.136	0.094	96	0.922	0.590	0.410
47	0.221	0.141	0.098	97	0.941	0.602	0.418
48	0.230	0.147	0.102	98	0.960	0.614	0.427
49	0.240	0.154	0.107	99	0.980	0.627	0.436
50	0.250	0.160	0.111	100	1.000	0.640	0.444

by the length of curve, divided by 8, and the quotient multiplied by the factor taken from the table without clearing the calculating machine, the operation of figuring ordinates is accomplished very quickly. To find ordinates for 400-, 500- and 600-ft. curves, take one-fourth the ordinates given under 200-, 250- and 300-ft. curves, respectively, for the same distance.

It might be added that the calculating machine is used also for finding elevations of grade on tangents, as well as on vertical curves. Starting from a given elevation on the grade tangent, the rate of grade is added or subtracted successively for each 100-ft. station. For fractional stations the rate is quickly multiplied on the machine by the fractional station, and applied.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Properly Allocating the Cost of Highway Transportation

Sir—The letter by W. Earl Weller, city engineer of Binghamton, N. Y., in *Engineering News-Record* of Jan. 9, 1919, p. 107, brings up a question that must be settled sooner or later, and to which I believe consideration should be given now—that is, the question of properly allocating to the cost of goods transported over the highways by motor trucks their fair share of the cost of building and maintaining those highways.

Though I do not agree with Mr. Weller that the ton-mile cost is the proper basis for comparing the cost of motor-truck transportation with rail transportation, because the elements of flexibility of delivery and time of delivery demand careful consideration in determining the choice of method of transportation, I feel that he has brought up a very important subject for discussion when he reminds us that under present conditions the consumer of rail-transported goods pays his full proportion of the cost of roadway construction and maintenance, while the consumer of truck-transported goods shifts that portion of the cost to society as a whole. The exception to this would be in a state where motor vehicles were taxed as nearly as possible in proportion to their destructive effect upon the highway.

As an abstract proposition, that would seem to be the ideal solution of the whole problem; but I fear that the practical difficulties of equitably determining the rate to apply to each vehicle would be insurmountable, since neither weight or speed alone, nor the two together, are always the only or even the most important factors in determining the destructive effect of a vehicle.

There can be no doubt that within a moderate radius of the larger cities and between large cities situated comparatively close together, there is a marked tendency to transport all perishable and other high-class freight by motor truck, and it is probably but a question of comparatively few years until all of this work will be handled by motors, leaving the railroads to handle the through freight and the low-grade bulky freights.

This is going to mean an even more insistent demand than at present for good interurban roads and for wider roads to take care of the denser and—because of the rapid increase in the use of pneumatic tires on trucks—more rapidly moving traffic. Unless some satisfactory method of assessing the cost of building and maintaining these roads is worked out, the cost of these items is likely to be unjustly distributed.

As an instance, consider the State of New Jersey. The roads of that state, though the condition of many of them at present offers nothing to be proud of, represent the investment of large sums of money, yet I believe that more than half of the heavy traffic using the roads across the central portion of the state neither originates nor terminates in New Jersey and, naturally, the state receives no other revenue from this traffic than the small amount of the license fee from those trucks which are registered in New Jersey.

I do not, at this time, feel prepared to offer any solution of this important problem, but merely write because I feel, as Mr. Weller and many other engineers seem to feel, that we cannot have too much discussion on the subject. CHARLES F. DINGMAN.

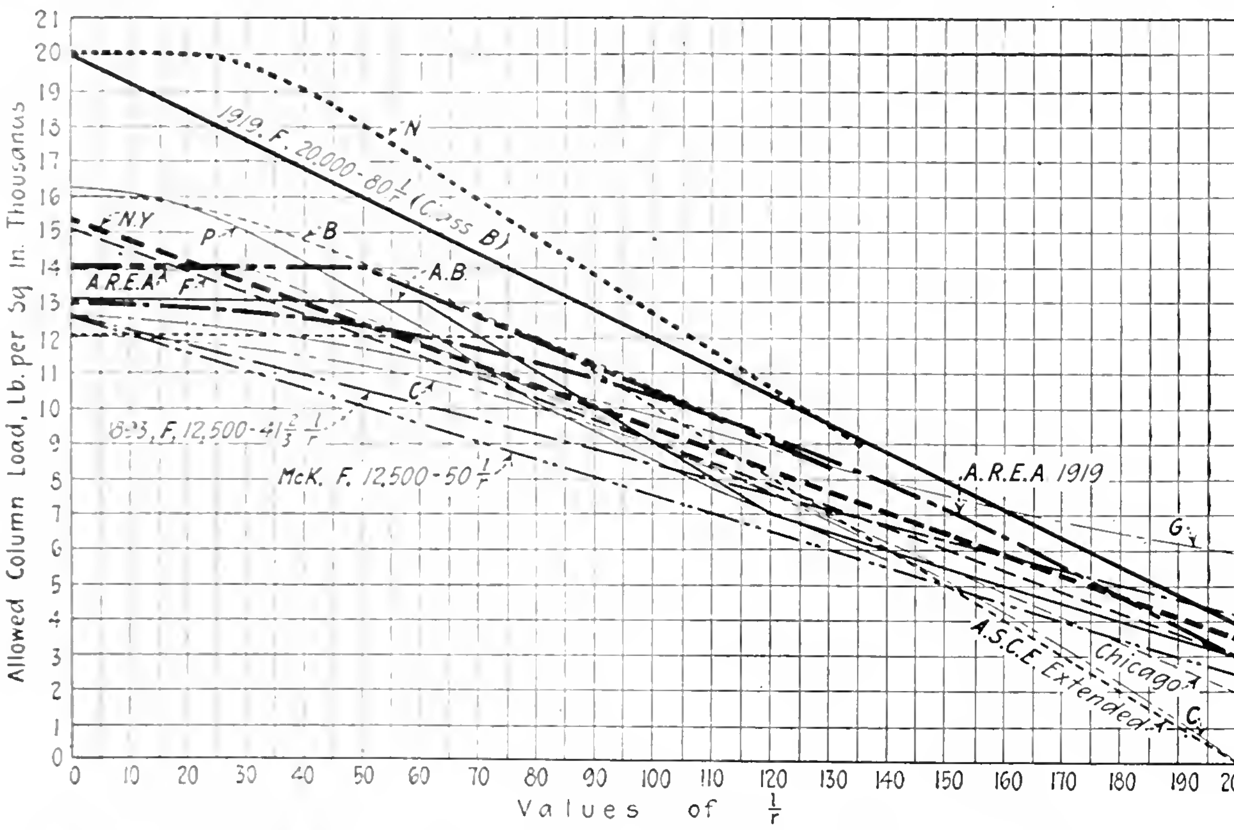
Palmer, Mass.

Restudy of Column Loadings to Unify Column Formulas

Sir—Dr. Waddell's letter in your issue of Jan. 16, 1919, p. 155, is along the lines of the discussion offered by me on the report of the Committee on Steel Columns and Struts of the American Society of Civil Engineers. Many engineers can testify that this report has caused a doubt to be raised among designers, and not only among those who have no ready means of verifying the basis for the formulas that they must use, but seemingly among many that should have confidence in what has been done in the past and in their long experience in designing steel columns.

That there was not unanimity of opinion among the members of the committee in propounding the formula $20,000 - 100l/r$, between the limits of 80 and 100 l/r, with a maximum of 12,000 lb. is certain, and it is to be regretted that there was not a minority report to call attention to the fact that the formula was not one having the approval of the entire committee, thus saving the whole society from having to stand sponsor for it before structural engineers and engineers generally.

However, there is yet time for the various societies to get together and make every endeavor to arrive at an agreement on one straight-line formula for each grade of material, and discard the dozen or more that are now in common use to a greater or less extent. There should be no doubt that the Engineering Institute of Canada, of which the writer is a member, would join in such a movement. Extended use has not yet been made of the new parabolic formula which they have recently adopted. That formula would cause a great deal of difficulty in designing long spans, especially such a structure as the Quebec cantilever, for which was used the formula $17,500 - 70l/r$ with a maximum of 14,000 lb. or, when all the stresses had been included and



A. B.....Am. Bridge Co.....19,000—$100l/r$
A. R. E. A...Am. Ry. Eng. Assn...16,000—$70\ l/r$
A. R. E. A., 1919.....Am. Ry. Eng. Assn. proposed....13,000—$0.25(l/r)^2$
C....Eng. Inst. Canada..12,000—$0.3(l/r)^2$
Chicago. Bldg. Code.........16,000—$70l/r$
F., 1893...Fowler's Spec., 1893...12,500—$41\frac{2}{3}l/r$
F.......Fowler's Spec. (Cl. A.), 1919.....15,000—$60l/r$
F., 1919..Fowler's Spec. (Cl. B.), 1919..20,000—$80l/r$
McK.-F....Fowler, mod. by McKibben....12,500—$50l/r$
N....Niagara, approx. Hell Gate..23,000—$100l/r$
N. Y......N. Y. Bldg. Code.....15,200—$58l/r$
Q.....Queb. Cantilever.....17,500—$70l/r$
B...........Boston Bldg. Code...........$16,000/[1 + l^2/20,000r^2]$
G ....Gordon Formula...........$12,500/[1 + l^2/36,000r^2]$
P...........Phila. Bldg. Code...........$16,250/[1 + l^2/11,000r^2]$
Maximum, Proposed for discussion....24,000—$120l/r$
Lower limit diag. zone....12,000—$60l/r$
Upper limit diag. zone....18,000—$60l/r$

PRESENT FORMULAS FOR STEEL COLUMNS COMPARED WITH NEWLY PROPOSED FORMULAS

secondaries as well, a maximum of 18,000. This is for a medium steel with a yield-point of 35,000 pounds.

An investigation of the Niagara railway arch just carried out by the writer necessitated the careful study of the proper unit stresses to use, including column formulas; and as it was proposed to include all kinds of stresses in the totals, including secondaries and impact, the resulting total stress was in effect an equivalent dead-load stress, as is the case for any complete stress sheet at the present period. Therefore, the most logical column formula or curve of unit stresses for columns seemed to be one derived from the table of unit stresses, for the same class of steel and type of columns, established for the Hell Gate arch by Gustav Lindenthal. This is shown at the top of the annexed diagram, and is nearly 23,000 — $100l/r$ for the ordinary form of chord section and for steel with a yield-point of 33,000 lb., the maximum to be 20,000 lb. and the superior limit of l/r to be 135.

The diagram shows an essentially correct plotting of the principal column formulas that have received the sanction of engineers for various purposes, although some of them are of local adoption. All of the more commonly used ones lie in a zone between 12,000 — $60l/r$ and 18,000 — $60l/r$, and the new Canadian and the proposed A. R. E. A. formulas lie in the same zone. The mean of these two, or 15,000 — $60l/r$ is of course at the center of the zone, and is practically the same as the formula of the New York City building code. This is what the writer had adopted for a 1919 edition of "General Specifications for Steel Roofs and Buildings," but now that a still more unsettled condition of this subject has come about, it would seem advisable to await an adjustment and an agreement by all concerned. The lower limit of the zone represents the ultra-conservative opinion, and the upper limit the approach to what must eventually be adopted if the seemingly ultimate conclusion is to be reached. The practice of adopting a maximum stress limit below a certain value of l/r is to the writer by no means rational if the columns are properly detailed, except in the case of the formulas like the topmost one, giving values in excess of 20,000 lb., or corresponding values for other formulas for other grades of steel. The same formula for a given grade of steel might, however, be used for various classes of work, by adopting one set of limits of l/r for building work, one set of limits for highway bridges, and another set of limits for railway bridges. The maximum for such a formula might be considered 24,000 —$120l/r$, with a maximum of 20,000 lb., and of course making the rest of the specification conform to the formula. This would entail a study of whether to adopt the use of the net section in designing the columns of a structure, after the method developed by Mr. Lindenthal on the Hell Gate arch, and of many other seeming refinements. The loading to be incorporated in railway specifications is also inseparably tied up to the unit stresses, and seems quite far from a final settlement. The limits would, as stated, be much greater in the value of l/r for highway bridges, and greater still in the columns and struts for mill buildings and similar structures.

When we study the very unsatisfactory condition as shown by the diagram, it would seem to be only a logical course for the American Railway Engineering Association to ask for conference committees from the American Society of Civil Engineers; the Engineering Institute of Canada; the state highway departments; the building departments of the larger cities; the bridge division of the National Highways Association, and similar other interested organizations.

The necessity would then present itself, in arriving at the proper formulas, of a careful selection and plotting of all of the column tests of the past, and the more recent ones, such as those made by the American Society committee, and those given in the more recent report of the Bureau of Standards, using of course only those tests made on fairly well designed columns and those which are reliable from every point of view. The lower lines in the zone too often represent formulas that took account of tests of columns that were improperly designed and detailed. The matter of end conditions,

especially for high buildings, should be settled and plainly defined.

The parabolic curve C on the diagram, beginning at 12,000, is the Canadian formula $12{,}000 - 0.3\ (l/r)^2$, and that starting from 13,000 is the proposed formula of the A. R. E. A.—$13{,}000 - 0.25\ (l/r)^2$. While they are comparatively simple, it is by no means certain that it is wise to go back to curved formulas after having abandoned them to a very great extent in favor of the more-simple and, in the opinion of many, equally exact straight-line formulas. The restudy of all of the available data will, however, determine this to the satisfaction of all concerned.

CHARLES E. FOWLER,
Consulting Engineer.

25 Church St., New York City.

Corrects Statement of Levelman's Pay

Sir—Replying to the letter of R. Reimann in your issue of Jan. 30, 1919, p. 253, relative to the pay of a levelman *on a line now owned by the Baltimore and Ohio R.R.*, the line referred to was the Pittsburgh Southern R.R., acquired and now operated as the Wheeling division of the Baltimore and Ohio.

It is a matter of congratulation that the pay of levelmen is at least $145, which shows that there has been an advance.

E. N. GINEER.

Buffalo, N. Y.

Engineers' Salary Schedule Proposed

Sir—On account of the responsibility resting upon the railroad technical engineer for the success of transportation, it is important that he receive proper recognition in the way of pay. This is of interest and of importance to the public.

Had the engineer been adequately represented in the hearings before the Wage Board of the United States Railroad Administration prior to the issuing of Order No. 27, that order might not have been totally oblivious of his work. A conference of railroad technical engineers will be held in Chicago Mar. 17 to discuss economic questions of interest to the profession. Among these is the application of overtime rules of the Railroad Administration. Many engineers are opposed to overtime on the ground that it does not permit the best work. They hold that the monthly salary should be adequate and that overtime should not be considered.

The inclosed schedule, which was prepared by the American Association of Engineers and approved by its railroad committee, consisting of W. H. Finley, E. H. Lee and W. W. K. Sparrow, is the first attempt made by an organization of engineers to say what salaries should be paid. This is not a final schedule but a preliminary one, and comment is invited. It is being sent to managers and to others interested in this subject. You will note that there is no attempt made to take up specialties in the railroad field, but it does lay the groundwork for uniformity in classifying the various positions in railroad engineering departments.

Chicago, Ill.

C. E. DRAYER,
Secretary, American Association of Engineers.

Over $5,000,000,000 Worth of Minerals Mined

Mineral products worth more than $5,000,000,000 were produced by the mines of the United States in 1918, according to estimates by the United States Geological Survey. This, it is estimated, is more than $150,000,000 increase over 1917, and nearly $2,000,000,000 more than 1916. The estimates show that the output of pig iron, copper, ferro alloys, lead, zinc, gold, silver and aluminum was valued at slightly under $2,000,000,000 in 1918, as against a little more than $2,000,000,000 in 1917, whereas the nonmetallic products, the principal of which are coal, petroleum, clay products, cement and natural gas, were valued at more than $3,250,000,000 in 1918, as against less than $3,000,000,000 in 1917. These figures, as announced, are preliminary estimates of the production of 1918.

SCHEDULE OF MONTHLY SALARIES FOR TECHNICAL ENGINEERS RECOMMENDED BY AMERICAN ASSOCIATION OF ENGINEERS

	Monthly Salary: Railroads Having Over 5,000 Miles of Track	Monthly Salary: Railroads Having Less Than 5,000 Miles of Track
Chief engineer: In charge of entire railroad system, responsible for all engineering work and organization, including valuation	Salaries commensurate with duties performed	
Assistant Chief Engineer: In charge of portion of line or entire territory; reporting to chief engineer; responsible for such work as may be assigned to him by the chief engineer	Salaries commensurate with duties performed	
District Engineer: In charge of two or more divisions; reporting to assistant chief engineer in charge of that territory; responsible for all maintenance of way and minor construction	$425	$375
Assistant District Engineer: Same territory as district engineer—like responsibilities. Reporting to district engineer	350	300
Division Engineer: In charge of one division; responsible for all maintenance of way and permanent way work	375	350
Resident Engineer: In charge of one residency; reporting to division engineer. In charge of construction work only. This position not required for maintenance of way or permanent way work	275	275
Assistant Engineer: Acts as assistant to division engineer, assistant district engineer, and assistant chief engineer. Responsible for such duties as may be assigned him	275	275
Chief Draftsman: Reports to chief engineer or assistant chief engineer; in charge of general drafting room at principal headquarters	Salaries commensurate with duties performed	
Engineer of Bridges: Reports to assistant chief engineer or chief engineer. Responsible for maintenance and construction of all bridges—wooden, steel and concrete	400	350
Valuation Engineer: Responsible for all valuation work on entire system. Reports to assistant chief engineer or chief engineer	400	350
Assistant Valuation Engineer: Reports to valuation engineer; has like responsibilities	350	275
	Permanent Work, One Year or More	Temporary Work, Less Than One Year
Instrumentman: Reporting to engineer or chief of his assigned department	$200	$225
Rodman: Reporting as assigned	125	150
Tapeman: Reporting as assigned	100	120
Designer: Reporting to chief draftsman or as assigned, and qualified to prepare original design on engineering or architectural work	250	275
Draftsman: Reporting to chief draftsman or as assigned, or general drafting work involving general detailing	160	200
Junior draftsman: Reporting as assigned and qualified for general drafting room work	115	160
Tracer: Reporting as assigned, and qualified to prepare neat tracings on special designs	110	120

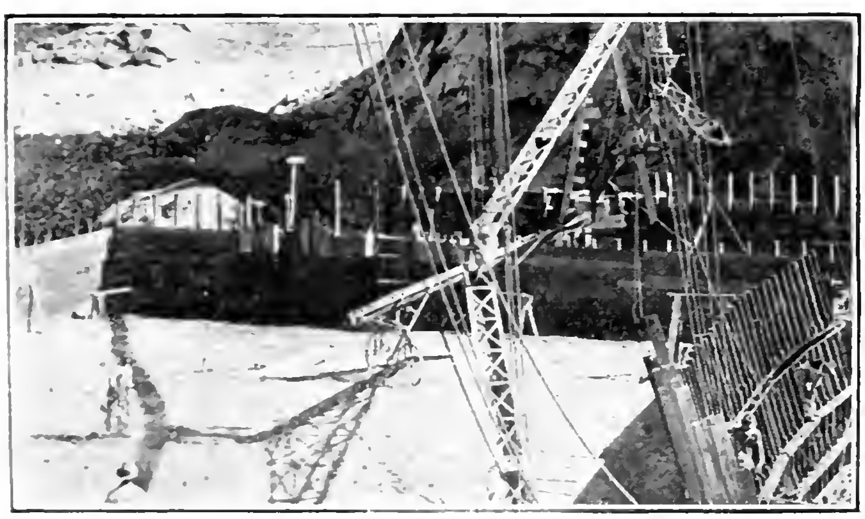
Hints for the Contractor

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Home-Made Bicycle Support for End of Concrete Chute

IN THE construction of the Gibraltar dam, near Santa Barbara, Cal., there was built on the job a two-wheeled support for the end of the concrete chute. This device made it easy to shift the delivery end of the chute, thereby saving the expense involved in a separate block-and-tackle support or the delay occasioned in moving when the delivery section is supported on a trestle.

As shown in the accompanying illustration, the "bicycle" was made up of two wheels taken from an ordinary concrete buggy and mounted on a frame built



THIS CHUTE HAD BICYCLE TO RIDE AROUND ON

up of scrap-iron and short pieces of old pipe. By putting a through bolt and nut in the head of the fork supporting each wheel, and keeping the bolt fairly tight, the wheels could be kept steady in any direction after being aligned by hand. Thus, for moving ahead the wheels would be directed at right angles to the frame, or for swinging around the swivel joint they would be placed parallel to the frame, and wherever placed would retain their relative positions as the end of the chute was moved to a new location.

A slope of 3 to 1 was standard for concrete chutes on the job, so the irons used to attach the bicycle frame to the chute were made accordingly. To change the device to another section of chute it was only necessary to remove the bolts, two on either side where the frame was attached to the lip of the chute, and make the same connections on the new chute section.

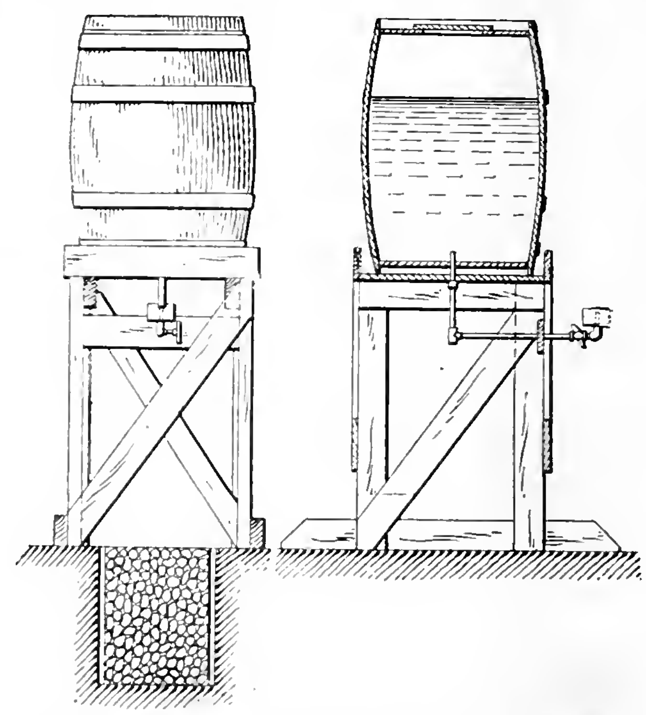
The device was developed by Mr. Slocum, one of the superintendents for Bent Bros. and W. A. Kraner, contractors on the Gibraltar dam.

Camp Drinking Fountains Improvised From Barrels

DRINKING water was distributed by means of bubbling fountains improvised from barrels to workmen constructing the extension to Camp Custer. As shown by the drawing, 50-gal. casks were mounted

Other Articles in This Issue of Interest to Contractors:

upright on stout wood frames 2 x 2 x 3 ft. A half-inch connection in the cask bottom connected with ¼-in. pipe to the bubble jets. These were set in ordinary pint tin cups so that the lips of the drinkers would not touch the jets. The jets were also slightly inclined to prevent the water from falling back on itself. Perforations in the tin cup permit it to drain out. To prevent formation of a puddle to breed mosquitoes a sump, as shown, is built under the bubblers. This sump



BUBBLING FOUNTAINS SUPPLY DRINKING WATER TO WORKMEN AT CAMP CUSTER

is 1 x 1 x 1½ ft., and is filled with broken stone. The barrel is filled through a hinged door in the top.

At the height of operations, when the working force was about 2500, one driver and two helpers with a wagon kept all the fountains supplied with fresh water.

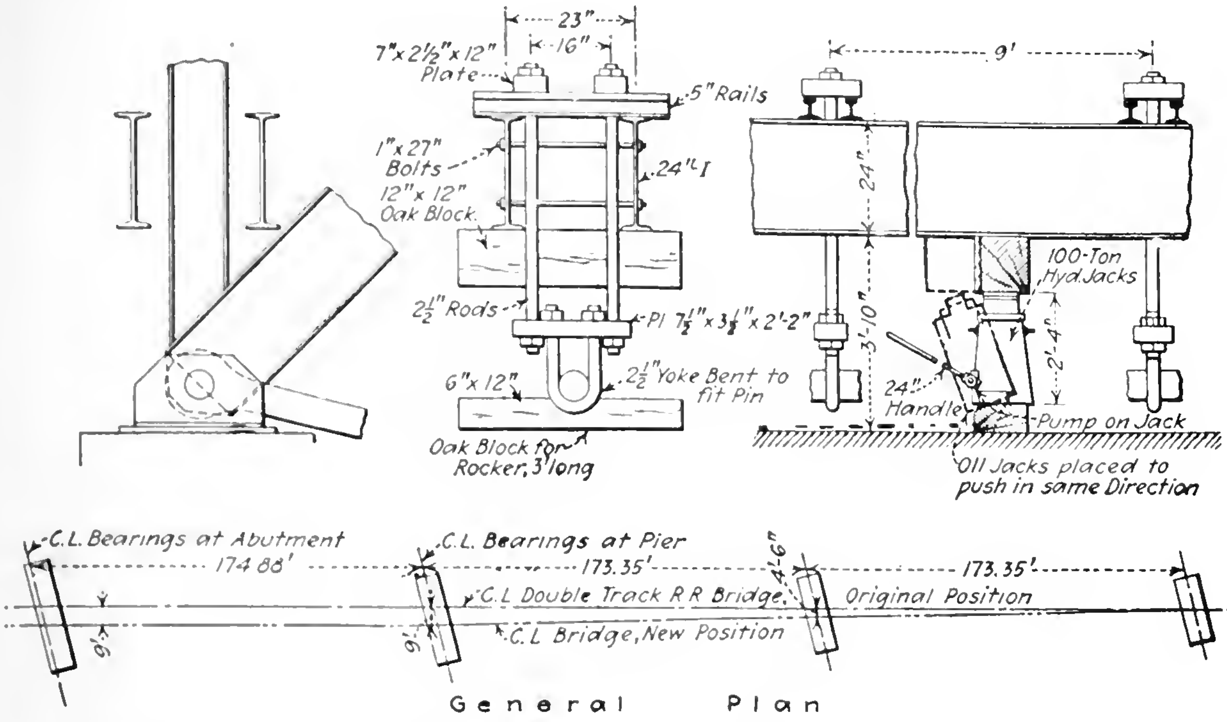
Camp Custer was built by the W. E. Wood Co., Detroit, Mich., contractors, under the direction of Maj. T. A. Leisen, constructing quartermaster, and Samuel A. Greeley, supervising engineer.

Skew Bridge Spans Shifted Laterally by Jacks on Rocker Blocks

By S. A. Snyder

Field Superintendent, The Foundation Co., New York City

A UNIQUE method of shifting bridge spans was recently applied successfully at the Delaware River bridge of the Central R.R. of New Jersey at Easton, Penn. Three 174-ft. double-track railroad spans were



DETAILS OF JACKING SCHEME FOR SHIFTING BRIDGE SPANS LATERALLY

shifted 9 ft. south when it became necessary to build a new bridge of heavier design alongside of the old bridge. The sketch herewith indicates in outline the details of the method used. An acetylene torch was first applied to cut through the plates of the main shoes, which were made in one piece and had to be divided in order to allow independent movement of the spans.

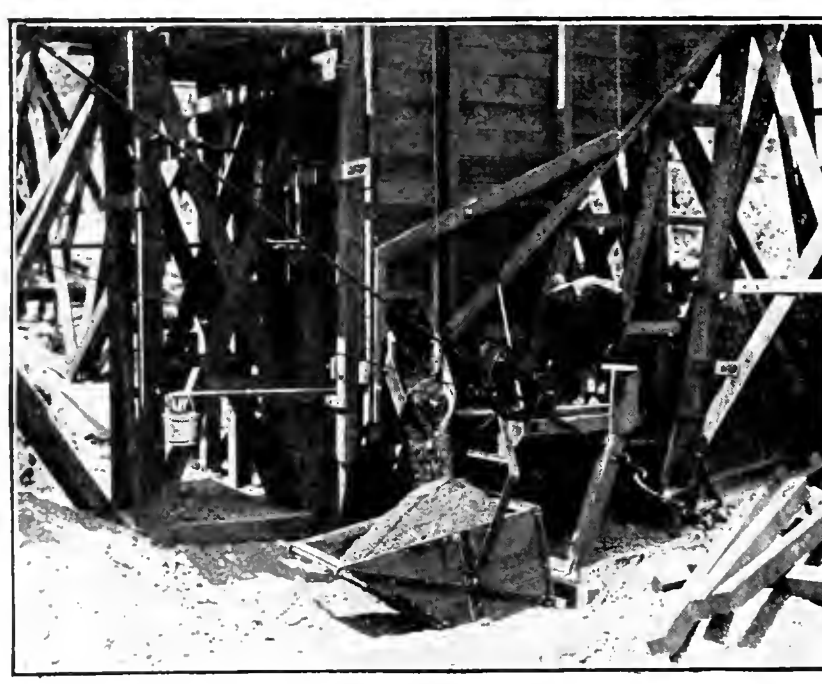
A special yoke, of 2½-in. diameter, bent into the shape of U-bolts with 3½ x 7-in. steel yoke plates, was made fast under the end pins. Hanger bolts carried the load to the 24-in. 80-lb. I-beams, as shown in the sketch, by the 5-in. rails laid across these beams and the 7 x 2½-in. plate on top. Oak blocks, 12 x 12 in. in size, were fastened to the under side of the beams with nails, and below them 100-ton hydraulic jacks were erected upon the rocker blocks 6 x 12 in. in size.

Twenty-two jacks in all were used, and two men were stationed at each. At the given signal all started pumping at once; when the spans lifted the jacks rolled on the rocker blocks, moving sidewise and endwise at the same time to allow for the skew. The movement was made in six working hours by The Foundation Co., 233 Broadway, New York, with the writer as field superintendent, under the general direction of A. E. Owen as chief engineer of the Central R.R. of New Jersey.

Single Line Automatic Dump Skip Makes Speedy Record

TO ELEVATE mixed sand and gravel to screens, on the dam near Santa Barbara, Cal., a wooden skip was designed to be operated on a cableway by a single line, and to dump automatically. The skip was supported from a two-wheeled carrier, as shown in the illustration, in such a way that when full it balanced in a stable position. The forward end of the skip carried a round bar projecting on either side. As the skip passed over the bunkers these projections were caught by slots in a pair of rails, thus stopping and holding the forward end. Then, as the carrier was advanced a few feet farther, the skip would revolve around the pins on which it was supported, and turn over into dumping position. The slope of the forward end of the skip, as shown, insured a clean delivery of materials. The weight of the skip and the steep angle of the cableway (something over 30 degrees) were found sufficient to secure a prompt return to the loading point when the hauling line was slacked away. The skip was built up on the job partly for economy and partly because all equipment for this work had to come through a tunnel with a maximum clearance of 42 x 46 inches.

The skip was devised by W. A. Kraner, of Bent Brothers and W. A. Kraner, contractors on the dam, and worked so successfully that two of them will be used when the work is resumed after the season's high water. During the season just closed the skip regularly made a round trip per minute, handling 50 cu.ft. of material on a 185-ft. lift.



THIS SKIP SAVED MONEY FOR THE CONTRACTOR

Cost of Resurfacing Street Excavations in Los Angeles

Resurfacing of street excavations to the amount of 579,062 sq.ft. has been done at Los Angeles for the following unit costs, according to the annual report of the Engineering Department. The names of the various pavements included and the unit cost per square foot for replacement are as follows: Asphalt, 27.31c.; macadam, 16.16c.; brick, 33.34c.; granite block, 18.67c.; concrete, 17.58c.; oiled gravel, 10.51c.; streets not oiled, graveled nor paved, 0.42c.; sidewalks, 18.69c., and curb per linear foot, 43.39c. All excavations are taken care of by city forces under the supervision of a city foreman, which method is reported to be both satisfactory and economical.

NEWS OF THE WEEK

New York, February 13, 1919

Conference Promotes "Build Your Own Home" Movement

Discusses Legislative Measures Whereby Loan Association Securities May Be Made Available

At a recent conference held in Washington ways and means were discussed by which legislation may be enacted to make negotiable the securities of the building and loan associations, for the purpose of financing the "Build Your Own Home" movement. The conference was called by F. T. Miller, director of the Division of Public Works and Construction Development, Department of Labor, and was held in the offices of the division in Washington, D. C. A number of delegates representing the legislative committee of the United States League of Local Building and Loan Associations were present.

It was announced by Mr. Keesler, president of the league, that a caucus had been held previously to the meetings. The Solicitor of the Treasury was present at the caucus, which decided informally upon the following:

"A law should be advocated modeled somewhat upon the Federal farm loan act and somewhat upon the provisions of the act establishing the Land Bank of the State of New York—in other words to establish home loan banks in each Federal Reserve district, providing for small fixed capital and safeguarded by proper restrictions, of which banks the local building and loan associations would become stockholders. These would be authorized to accept building and loan collateral from member associations and issue debenture bonds therefor. Such bonds and the assets of the home loan banks would be declared instruments of the United States Government and exempt from taxation."

The league has a membership of 7269 associations with a collective individual membership of 3,838,612. It was stated that it had loaned all its available money and that it was now six months in arrears in making loans. In the present condition of affairs, the members are unable to assist the construction movement because of the non-negotiability of their assets, but, it was pointed out, if this could be remedied, the associations could make loans for home-building purposes to a very large extent.

Their assets, it was stated, which are estimated at $2,000,000,000, are for the most part first real estate mortgages. These are not acceptable at the Federal Reserve or national banks, and in many states are not transferrable by state.

(Concluded on page 350)

American Delegates to Paris Engineering Congress Report Conditions in France

Describe Waterways, Road Situation, Lens Mines, Hydro-Electric Conditions and Ports—Franco-American Commission Proposed

That French engineers do not desire help from American engineers, except certain specialists, was again emphasized at a large meeting of the New York members of the four national societies in the auditorium of the Engineering Societies Building on Feb. 10. Most of the delegates to the French engineering congress in Paris were present and informally reported on the trip to France and their impressions of the French attitude and engineering conditions there. Col. H. S. Crocker, vice-president of the American Society of Civil Engineers, presided.

This delegation was invited by the *Société des Ingénieurs Civils* to visit a Paris Congress of Engineers, as described in our issue of Nov. 28, 1918, p. 1003, and attended various sessions and committee meetings from Dec. 16 to Jan 18. A significant action of the Congress was reported—it proposed a permanent Franco-American International Commission.

Dr. George F. Swain, past president of the civil engineering society, who was made chairman of the delegation after Maj. J. S. Case left for Italy, described the work of the Congress and stated that it included public men and business men. M. Millerand, former Minister of War of France, was chairman of the Congress. It was desired to consult American engineers with reference to three problems: (1) Changing war industries to a peace basis; (2) rebuilding the devastated districts, and (3) the great engineering problems. The last were discussed by the Congress through committees on ports, navigable waterways, roads, waterpower, and technical education. Reports are to be prepared by the American delegates and sent back to the Congress.

Dr. Swain described their visits to various ports in southern France, Grenoble, Marseilles, and Lyons, where they were entertained by the Chambers of Commerce, and said that French engineers are anxious to coöperate and learn American methods, having been surprised by the speed of the Army construction in France. He reported the action of the Congress in voting to ask for the permanent Franco-American International Commission. The delegates left a preliminary report, answering questions and commenting on the action of the Congress on various subjects.

Employment

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western zone, 63 E. Adams St., Chicago.

American Association of Engineers, F. H. Meyers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Navigable Waterways and Technical Education

Dr. Swain stated that France had spent more than any other European country in improving her inland waterways and expected a great increase of commerce through her ports to replace Hamburg and Bremen, and that they are making plans for developing canals and navigable rivers. He commented on the lack of economic studies, and comparison with railroad costs. The state assumes all the burden; but he claimed that the present emergency required more economic study to insure sound economy.

Technical education in France is more theoretical than in this country, but many changes in their educational methods are being considered. The desirability of exchanging students with France was discussed at the Congress, and hopes were expressed that more American students would go to France for technical study, rather than to Germany as in the past. The French are hoping to change their previous restrictions, which have discouraged the attendance of American students.

George W. Tillson, one of the civil engineering delegates, discussing the roads situation in France, stated that the French wish to build for permanence, but are very conservative. They believe in the use of asphaltic macadam, using the penetration method rather than the mixing method, apparently because the latter is more costly in requiring larger plant. The American engineers urged concrete and brick for such permanent roads.

Mr. Tillson discussed the methods of financing for road building, stating that many French roads are paid for by fifteen annual instalments, the cost thereby being at least 65 per cent. more.

E. G. Spilsburg, who represented the Institute of Mining Engineers, described a trip to Lens and the devastation in the coal region. He stated that not a building was standing in Lens, where there were sixty mines, eighteen of which were operating before the war. All the head frames had been leveled, being pulled over by motor trucks after the legs were cut by oxy-acetylene flame, if they had not been blown down by shells. The mines were flooded by laying pipes from the Somme Canal. He stated that it would require 30,000 horsepower per year to unwater the mines, and that probably coal mining would begin about nine months from next spring. He insisted that the French were not seeking the help of foreign engineers, except specialists; they expect to use their own machinery and man power.

AGRICULTURE, FINANCE AND HYDRO-ELECTRIC POWER

George W. Fuller, one of the civil engineering delegates, discussed the subject of agriculture and finance, saying that France had increased her government expenses by at least $2,000,000,000 per year as a result of the war and had lost 2,000,000 men from active life. The transition to peace is relatively slow, the rehabilitation program being quiescent, due to the fact that the railroads are tied up in rationing Belgium, Alsace-Lorraine, and French devastated regions. The French are inclined to wait for the results of the Peace Conference, and the reparation and indemnity funds to be asked from Germany. They also await Parliamentary elections soon to occur.

Lewis B. Stillwell described the three regions for waterpower development in France—the Alps, drained by the River Rhone, the Pyrenees, not yet much developed, and the highlands in the south of France, where low heads are available, with good locations. The total estimated horsepower developable is from 4,500,000 to 6,000,000. After mentioning some of the historic developments of high-head plants, he stated that we could teach the French nothing in the technique of hydroelectric application to industry, except perhaps in the magnitude of operation. An electrolytic process for making iron pipe by depositing iron on drums was described, the plant being near Grenoble. The French believe in taking industry to the waterpower. The delegation's preliminary report recommended that the coal regions should be connected up with the waterpower centers. They are making a serious effort to standardize frequency and potentials, so as to allow inter-connection in the future—a frequency of 50 has been recommended by the Paris Congress.

PORT DEVELOPMENT—MARSEILLES TRIP

A. M. Hunt—one of the civil engineer delegates—described the port developments in France and the French plans for an east and west railroad to Basle, Switzerland. They expect to act promptly and one plant is already being developed at Saint Lazaire. They ask a report on the methods of handling freight at ports in America, especially for ports where there is a great range of tide, 16 to 20 ft., as in France. Floating docks are also greatly needed.

One of the most stirring addresses of the evening was the last, by Nelson C. Lewis, a civil engineer delegate, describing the "Smiling Valley of the Marne" which they passed through on the first sunny day of their trip. He pictured the great changes in France, the separation of families, and the question was raised whether many of those who are now in southern France would desire to return to the devastated districts. The problem of women in industry is causing serious complications, and the French are attacking the industrial essentials before they can return to their artistic development. He cited the figures on the devastated areas, which include 6000 sq.mi. in the north of France, quoting the total as $13,700,000,000 as the estimated amount of this destruction and pleading for the necessity to force Germany to pay every cent of this as reparation.

Position Offered Parsons as Transit Construction Commissioner

Governor Smith of New York has offered to Col. William Barclay Parsons the position of director of rapid-transit construction in New York City. Colonel Parsons is still in France, and a reply to the offer has not yet been received. According to the Governor's recommendation to the legislature, regulation of public utilities is to be separated from the direction of construction work, and a single commissioner is to administer the latter. Up to the present the legislature has not acted on the recommendation, but some form of revision of public-utility work in New York State is considered certain.

Departments Report on Canals

Two reports relating to canals have just been made public by Congress. One is a report from the Secretary of Commerce to the Senate on the Atlantic intracoastal canal system; the other, a report from the Chief of Engineers through the Secretary of War to the House of Representatives on the Houston ship channel in Texas. The Atlantic canal report goes thoroughly into the proposed canal system paralleling the Atlantic coast and some distance back from it. It includes descriptions of the Cape Cod Canal, the New Jersey Canal and the Chesapeake & Delaware Canal, all of which make up the proposed connected system. The Houston report is in effect a recommendation by the Chief of Engineers to extend this channel, which now connects the hitherto inland city of Houston with the Gulf of Mexico.

An Innovation in Motor-Truck and Good-Roads Boosting

In Macon, Ga., an innovation is being undertaken by the Chamber of Commerce to promote the use of motor trucks for hauling produce and freight to and from the suburban districts. The test will take place Apr. 3, and more than 250 trucks will be used.

The plan is to have six motor-truck fleets leave the city in six directions, proceeding to terminals approximately the same distance from the city. On the outgoing trip they will be loaded with merchandise, and on the return trip with livestock and farm products. A parade in Macon before the start and a rally at each terminal point, with stops along the way, will be used to advertise the experiment.

Motor-truck dealers and manufacturers, together with merchants and farmers, have promised their coöperation, and it is planned to have with each train specialists whose duty it will be to record every phase of the test, including mechanical operation and cost, bridge and road conditions, tonnage, time, etc. The plan is to demonstrate what can be done with motor trucks over good roads.

Engineering Council Appoints License Committee

The question of the licensing of engineers has been taken up by the Engineering Council, and a license committee has been appointed, with the following members: Chairman, T. L. Condron, Chicago, Ill.; F. C. Shenehon, Minneapolis, Minn.; Farley Gannett, Harrisburg, Penn.; John H. Dunlap, Iowa City, Iowa; Arthur M. Greene, Jr., Troy, N. Y.; Caleb M. Saville, Hartford, Conn.; James H. Herron, Cleveland, Ohio; A. M. Schoen, Atlanta, Ga.; John Klorer, New Orleans, La.; Philip N. Moore, St. Louis, Mo.; A. Lincoln Fellows, Denver, Colo.; C. H. Snyder, San Francisco, Cal.; and Amos Slater, Seattle, Wash.

The country is being divided into districts by the chairman, to be assigned to the various members of the committee for the gathering of information from state officers and others, relative to existing and proposed legislation on the subject of licensing engineers and architects. The committee is already receiving inquiries for information, and assistance on this subject from many quarters.

Build a Home Movement

(*Concluded from page 348*)

law. Because of the excellent character of the securities, members of the associations were of the opinion that they would be able to rediscount at a comparatively low rate. The associations, it was said, did a business in 1917 of $1,250,000,000, at an expense of 0.00875 per cent.

Motion Pictures Show Essentials In Making Concrete

At the meeting of the American Society of Civil Engineers in New York City Feb. 19 Nathan C. Johnson, consulting concrete engineer, will present a moving-picture film which illustrates the essentials, in materials and mixing, in the making of good concrete. The film embodies the results of Mr. Johnson's five years' study of concrete with the microscope and the motion-picture camera. The early results were presented in *Engineering Record* of Dec. 4, 1915, p. 684.

The film takes up the materials and processes through which they are put, examining each material and each step in the mixing and placing in its effect on the final product. The effects of erroneous methods are shown as well as those of correct procedure. Throughout the film, which consists of two and a half reels, are full explanations of the various parts of the picture, so that it is entirely self-explanatory. However, in presenting it Mr. Johnson will use a type of projector that allows the film to be stopped for any length of time, so as to permit full explanation and discussion.

Among the most interesting features are sections of the film which show setting and other operations; this picture was taken over long periods. One particular portion was made with exposures extending continuously over 50 days, a motor-driven camera being used for the purpose.

Kansas Engineering Society Wants State Aid for Roads

At the annual meeting of the Kansas Engineering Society held at Topeka, Jan. 30-31, the retiring president, C. M. Buck, pointed out the necessity for hard-surfaced roads, and urged the society to use its influence with the state legislature to have measures passed allowing state aid on roads and bridges and increasing the salaries of county engineers. A special legislative committee was appointed to prepare resolutions.

Dean Shaad, of the school of engineering of Kansas University, spoke on engineering education, emphasizing four main points: (1) Vocation schools; (2) designing, covering the courses generally included in a technical curriculum; (3) executive and administrative, covering special courses in these fields; (4) good citizenship, taught in the entire course.

Lieut. K. P. Cecil discussed the subject of artillery at the front, explaining three methods of range-finding—the three-point-sound method, the flash range, and the high-burst range, where trial shots are made above the target that they may be observed by the range-finders. The Lambert system of coordinates as used in mapping the battlefield was explained. Capt. L. R. Tillotson presented a paper on "With the Engineers in France." He praised the roads of France, and said that they were a key to the success of the army. Railway and harbor improvements were described in detail. Maj. Clark Mandigo gave a short description of some of the engineering construction that was undertaken at the front.

Resolutions were adopted to be submitted to the four national engineering societies, requesting their aid in the matter of increasing salaries. The following officers were elected: President, A. A. Potter, dean of engineering, State Agricultural College, Manhattan; vice-president, H. A. Rowland, McPherson; secretary-treasurer, Lloyd B. Smith, Topeka.

Research Assistantships Available at University of Illinois

There will be eight vacancies in the research graduate assistantships, Engineering Experiment Station, University of Illinois, Urbana, Ill., at the end of the current academic year. Two other such assistantships in gas engineering have been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $500 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry.

Nominations, made from applications received by the director of the station not later than Mar. 1, are subject to the approval of the president of the university and are based upon the character, scholastic attainments and promise of success in the principal line of study or research to which the candidate intends to devote himself. Preference is given to those applicants who have had some practical engineering experience following the completion of their undergraduate work.

Bill Introduced To Promote Industrial Education

Representative Caldwell of New York on Feb. 4 introduced a bill into Congress to provide for further educational facilities by requiring the War Department to loan certain machine tools not in use for Government purposes to trade and technical schools and universities. Each institution so equipped shall be responsible to the United States, under regulations to be prescribed by the Secretary of War, for the proper care and safe return of such equipment when demanded, ordinary wear and tear excepted.

Technical Editors Make Trip to War Areas of Europe

Notes on Journey of Observation to England, Belgium and France at Invitation of British Government

Last October Great Britain, through its Ministry of Information, invited a party of 15 editors and publishers of technical and business papers in the United States to visit England and France, in order that civilian intercourse might continue in spite of the obstacles interposed by military regulations. While in Europe the travelers attended many social functions, but back of the luncheons and dinners there was a serious purpose, the former being merely the medium chosen for its accomplishment. It was a tribute to the technical and business press of America of which, says one of the returning editors, we may well be proud.

Notes of the Trip

The following notes have been abstracted from an article by one of the party, H. C. Parmelee, editor of *Chemical and Metallurgical Engineering.* Among others on the trip were Samuel O. Dunn, editor of *Railway Age*, Chicago; William W. Macon, managing editor of *The Iron Age*, New York; Floyd W. Parsons, editor of *Coal Age*, New York; H. C. Estep, editorial director, Penton Publishing Co., Cleveland; and Arthur J. Baldwin, vice-president of the McGraw-Hill Co., Inc., New York, Mr. Parmelee writes:

"Before leaving England we were entertained at luncheon by Lord Northcliffe, owner of the London *Times*, at Printing House Square. For this occasion our host had invited leaders of industry and political thought to meet and talk with us, and we counted the affair one of the most instructive we had attended. Sir Robert Hadfield spoke of the possibility of giving workmen a summer holiday with pay instead of making them take their holidays on their own time.

"A brief visit to Sheffield University allowed an hour with Prof. J. O. Arnold, who is at the head of the department of metallurgy and engineering.

It is greatly to be regretted that work such as that Professor Arnold has done and is doing is not adequately supported. It seemed to me as though England had not yet risen to an appreciation of her technical men, despite the fact that they were the ones on whom she had to call when she was confronted by a foe skilled in technology and the application of science in the art of warfare. I was told that the Government had actually contemplated providing chemists for some of its works with the munificent salary of £125, about $625, per annum, a sum which would not attract a bottle washer in our American laboratories. This was but one instance of what seemed to me to be a lack of appreciation of

technical education, but I was told that a change is coming and that England is alive to the needs of research, coordination of industry and universities, and the value of technology in the national life. Incidentally, some excellent work has been done by such men as Professor Arnold and Sir Robert Hadfield, and we may expect some good papers from their pens.

"France gives one the impression of being somewhat dazed over her recent experience, and at a loss to know just where to begin to retrieve her lost fortunes. We had a number of dinners and luncheons with their leaders of industry, who said frankly that France was in the position of having to ask preferential treatment at the hands of the other nations. One gentleman even suggested that they would like to see French goods enter the United States duty-free, and American goods pay a duty on entering France. They are alarmed at the prospect of the Germans capturing world markets before France can even rehabilitate her factories and get new machinery in running order. The Germans return to factories that are intact, ready to turn out their products into world trade, while France must begin at the bottom and build again her principal industries. These are the things that worry France and are probably having something to do with the new terms in the extension of the armistice.

Gained a New Point of View

"We landed in New York on New Year's Day, glad that our home is in the U. S. A., but not forgetting the ties that must inevitably bind us closer to our English-speaking friends on the other side. One cannot experience two months of travel in foreign lands and contact with peoples with whom we have been united in a vital struggle without getting a new point of view, broader, larger, more comprehensive and sympathetic. We have been deeply impressed with the endurance and fortitude of the British and French, and we can but admire the high ideals that animate them in their approach to the solution of problems that concern the world's future welfare. Our own participation has been deeply appreciated, so much so that we are likely to be led into exaggeration of the importance of our part in the great struggle. At the same time our help is just as urgently sought in meeting the problems of peace, and to that end we must all lend sympathetic and broadminded aid."

No Federal Aid for Hudson Tunnel as Postal Route

Vote of the United States Senate, Feb. 7, defeated the Calder amendment to the Post Office appropriation bill authorizing Federal participation in building a vehicle tunnel under the Hudson River at New York. The amendment was held to be in order, but a vote on its adoption defeated it, with 12 votes in favor to 48 against.

Castle Formation by Engineers On Last Day Under Arms

The accompanying photograph of the 209th Engineers, Camp Sheridan, Alabama, was taken on their last day under arms, Jan. 21. The men were photographed from a tower 40 ft. high. The camera was 5 ft. higher, and the nearest edge of the castle formation was 57 ft. away.

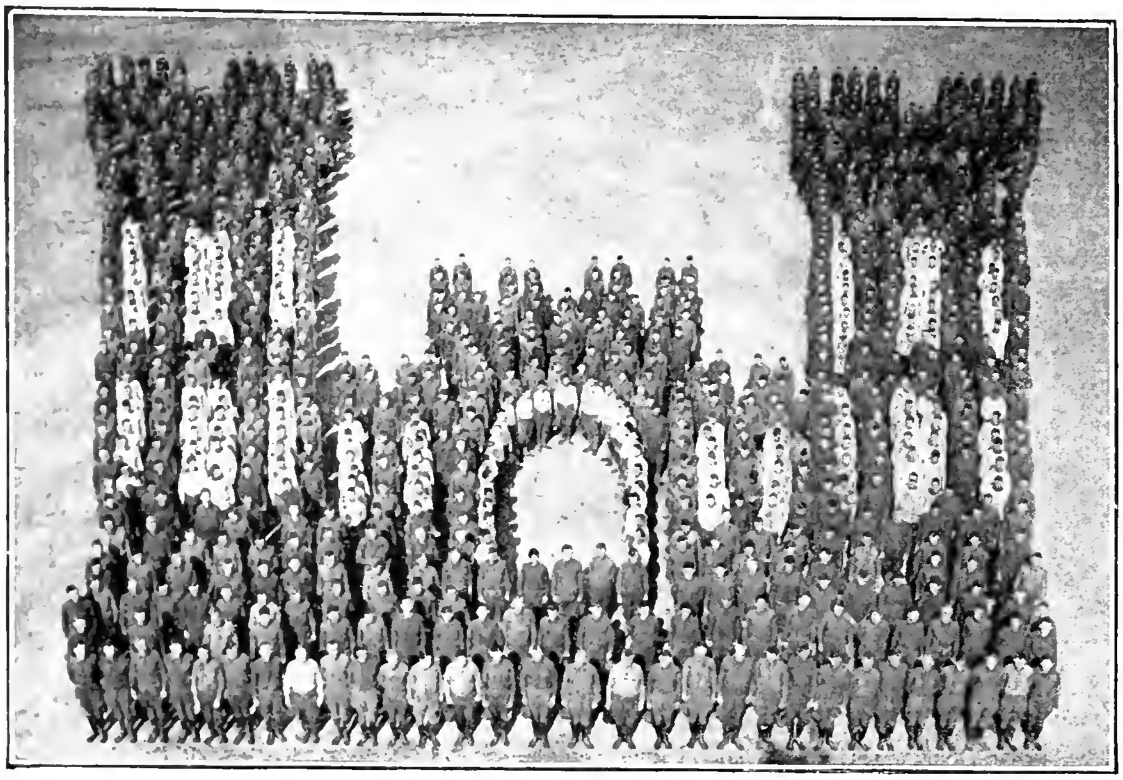


Photo copyright by G. F. Jennings, Montgomery, Ala.

209TH ENGINEERS IN CASTLE FORMATION PHOTOGRAPHED FROM 40-FOOT TOWER AT CAMP SHERIDAN, ALABAMA

The design called for 1000 men to fill in the castle, but only 925 were used. The design was made by Capt. D. C. McConnell, regimental topographical officer. A camera with a focal length of 14 in. was used. Col. Beverly Dunn, Engineers, was the commanding officer, and Lieut. Col. H. F. Cameron was second in command.

Propose To Take Office of County Engineer Out of Politics

Abolition of the elective office of county engineer in the State of Washington and the substitution of a superintendent of highways, appointed by the county commissioners to serve as long as he proves efficient, are the purposes of a bill that has been introduced in the state legislature now in session at Olympia. The bill is recommended on the ground that it would take the county engineer's office out of politics.

Qualifications of the superintendent of highways are set forth and include as a requisite that he shall be a civil engineer of recognized standing, shall have had a degree conferred by some college or university having recognized courses in civil engineering, and shall have practiced his profession in connection with highway engineering or railway engineering for two years, or, in case he does not hold such degree, he shall have practiced his profession for five years. The bill requires a bond in the sum of $5000.

The state shall pay the superintendent $100 a month, with traveling expenses, to be paid out of the county current expense fund. The bill contemplates that each county shall pay the superintendent an additional salary, the total not to exceed $5000 per year. It would make the county commissioners agents of the state highway department, and require that they appoint a competent engineer to work under direction of the department.

To Build Devil's Gate Dam

Bids for the construction of the Devil's Gate dam, a portion of the project to control floods in the Arroyo Seco, will be received by the Board of Supervisors of Los Angeles County, California, on Feb. 19. The estimated cost of the dam and appurtenances is $290,000. The structure will be an arch dam, with a maximum height above the stream bed of 100 ft. and a crest length of 310 ft. Cyclopean masonry will be used. On top of the dam there will be a roadway 20½ ft. wide and two 4½ ft. sidewalks. Besides a spillway with 10 openings, each 10 x 11 ft. in size, there will be an outlet tunnel. The latter will be controlled by three 7 x 9 ft. sluice gates. The site of the dam is near the northwest corner of the City of Pasadena. The drainage area above the site is 30 square miles, and the estimated maximum discharge is 11,400 sec.-ft. The proposed contract calls for beginning work within 30 days after the award and for completion by Dec. 19, 1919. The purpose of the dam is to control the flashy winter floods on the Arroyo Seco, a stream which joins the Los Angeles River near Elysian Park. J. W. Regan is chief engineer for the project.

Active Construction Delays As Labor Unrest Increases

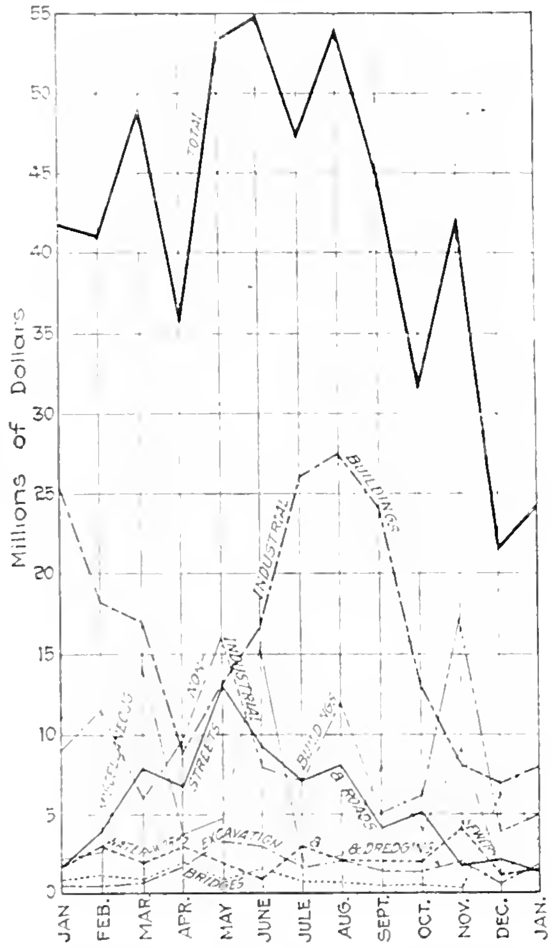
With Work Under Contract Millions Less Than Year Ago Proposed Work Shows No Advance Over Last Month

A survey of contracts let and projected work reported to *Engineering News-Record* shows that the hoped-for construction boom has not yet started. Contracts let, as indicated in the accompanying diagram, total some $20,000,000 less than those reported a year ago, and do not include the cantonment and other heavy war construction of the Federal Government at that time.

In an effort to learn the amount of public work that will be undertaken in 1919 *Engineering News-Record* sent letters and telegrams to all state highway departments, to state architects, and to city engineers of municipalities down to 50,000 in population. Of the replies received those on highway work were the only ones that were even approximately complete, and they totaled but a little over $350,000,000 for the year, which is only a small fraction of the annual amount of road work usually carried on throughout the country in normal times. The replies on municipal work were so fragmentary that they give no indications as to the probable trend of work, less than $60,000,000 worth being reported. A majority of the replies, however, show that, although the engineers were prevented from giving definite data on account of incomplete budgets, etc., they were alive to the gravity of the situation and were bending their efforts toward getting as much work started as possible.

The campaign for emergency construction started by the War Labor Policies Board in Washington deserves credit for some of this activity, the members of the board having made strenuous efforts to stimulate work to the utmost. Questionnaires have been sent to every city in the country to get information to enable the War Labor Policies Board to make a survey of the anticipated demand by municipalities for capital and labor. The data from the replies to date are still incomplete, but so far approximately $50,000,000 is reported, for which funds are already provided, $80,000,000 for work already authorized, the money to be raised by bonds, and $40,000,000 for work already, or likely to be, authorized and to be paid for by tax levies. Although small, these figures, it is believed, are more definite than those given in the table, since much of the latter amounts were derived from estimates. The figures in the table represent thousands of dollars.

It is evident, however, that the real start of construction work has not yet been made. It will be noted in the table that the proposed building construction amounts to but a bare $200,000,000, in spite of the dearth of building throughout the country and that contracts let in January amounted to less than $5,000,000. The amount of building construction in any one year cannot be definitely determined, but the pre-war work is variously estimated as amounting to between $2,000,000,000 and $3,000,000,000 annually. The war-



MONTHLY VOLUMES OF CONTRACTS LET REPORTED BY "ENGINEERING NEWS-RECORD"

time restrictions and the increase in population have been such that builders believe that for the next five years building construction will average in excess of $3,000,000,000 annually. It is evident that if the labor situation is to be relieved much heavier amounts must be reported than these to consider the work as even having started. The Bureau of Public Roads estimates that for every $1,000,000 worth of road work only 1000 men are employed, so that even should the total amount of estimated road work as shown in the table be converted into active projects, it would absorb less than 400,000 men. The Bureau of Public Roads recently requested the various state highway departments to send in an estimate of the requirements of labor that would be needed on the road work in the various states. Thirty-eight states replied, but only 29 gave definite figures. They report that they can use approximately 12,000 soldiers and sailors as skilled laborers, and slightly over 19,000 as unskilled. Those classed under skilled labor include masons, carpenters, quarry bosses, concrete finishers, road foremen, roller men and superintendents. Unskilled laborers were not classified.

Holding out for better prices of labor and material is, of course, the key reason for the delay. Better prices are hoped for, and a saving on construction work generally is believed possible by waiting.

The material men say, however, that there will be no decline in prices. Labor has stated that wages will not be reduced, and the owners, architects and builders are holding off for a more favorable season. Commenting on the situation, a prominent engineer in the cement industry pointed out the fallacy of the waiting, in that the threatened upheaval that will surely come if relief is not promptly forthcoming will be far more costly than the prosecution of work at the prevailing high prices.

CONSTRUCTION WORK PROJECTED FOR 1919

[*All Figures in Thousands of Dollars*]

	Reported by Construction News Section December	Reported by Construction News Section January	Amounts for Public Work, from Replies to ENR Letters	Amounts for Road Work Included in Public Works Reported
Ala..	88	62	5,494	5,474
Ariz....	480	2,681	......	......
Ark....	19,089	240	......	......
Calif...	18,481	18,842	30,442	29,600
Col....	1,175	797	3,941	....
Conn..	2,641	9,690	7,555	4,300
Del....	275	......	4,700	4,700
D. C...	122	1,709	1,950	650
Fla.....	900	4,538	......	.....
Ga.....	3,294	2,555	8,085	8,025
Ida....	1,046	105	5,000	5,000
Ill. ..	34,699	23,452	18,800	18,500
Ind....	35,880	1,105	16,000	16,000
Ia......	1,538	3,686	15,383	15,228
Kan...	3,625	4,641	14,185	13,880
Ky.....	110	4,000	......	.....
La.....	520	1,661	5,000	5,000
Me.....	120	138	2,969	2,469
Md....	10,942	2,502	6,374	6,374
Mass...	2,985	9,176	19,660	19,310
Mich...	5,995	20,698	16,025	15,125
Minn...	2,222	7,275	11,706	8,919
Miss...	......	1,038	3,500	3,500
Mo....	76,094	12,702	10,100	10,100
Mont...	125	1,823	1,150	1,150
Neb....	643	1,174	7,705	7,115
Nev....	......	......	1,638	1,638
N. H...	......	55	1,680	1,680
N. J...	9,830	12,470	6,760	5,078
N. M..	......	......	1,665	1,665
N. Y...	23,963	19,649	18,268	14,267
N. C...	3,410	300	100	100
N.D...	812	500	3,720	3,720
Ohio...	28,767	19,447	20,720	10,502
Okla...	4,137	1,312	7,700	6,700
Ore....	4,486	4,618	11,001	6.998
Penn...	19,709	13,213	25,722	16,920
R. I....	327	516	1,735	1,098
S. C....	92	1,767	1,000	1,000
S. D....	171	600	3,650	3,650
Tenn..	625	1,909	1,449	1,449
Tex....	2,994	14,801	29,184	29,184
Utah...	1,468	3,707	4,176	2,544
Vt...	85	......	850	850
Va.. ..	1,157	1,491	4,250	4,250
Wash...	715	4,084	21,950	13,420
W. Va.	45	633	18,030	18,030
Wis....	7,646	7,914	14,740	14,625
Wyo...	123	4,730	1,260	1,260
Total	333,651	250,006	416,933	364,950

PROJECTED WORK BY CLASSIFICATIONS

	Dec.	Jan.	Total
Water Works.....	22,982	13,184	36,166
Sewers...........	4,128	12,048	16,176
Bridges.........	25,602	13,658	39,260
Streets and Roads	61,087	51,358	112,445
Excavation and Dredging....	15,962	13,255	29,217
Industrial Bldgs. .	58,860	22,795	81,655
Non-Industrial Buildings	102,749	97,310	200,059
Miscellaneous.....	42,281	26,398	68,679
Totals	333,651	250,006	583,657

Bursting of Molasses Tank in Boston Charged to Bad Design

A steel tank for storing molasses belonging to the United States Industrial Alcohol Co., and standing on the company's ground in Commercial St., Boston, burst Jan. 15, and 19 persons were killed. The tank was full, having been filled, for the first time in its history, two days before. It was 90 ft. in diameter by about 50 ft. high, and contained 48 ft. 10 in. of molasses when it burst. In an inquest on the deaths, Municipal Court Justice Bolster found Feb. 8 that the building law was violated in the obtaining of a permit and the passing of plans for the tank, and that the city building department passed the plans without technical examination. The plans were found to be defective. They were drawn to an order for a tank to hold molasses weighing 11¾ lb. per gallon, with a factor of safety of 3. Plans were prepared by the iron works that built the tank.

No evidence was found to show that explosion or external violence brought about the failure, though the molasses in the tank was in a process of fermentation at the time. The court finds:

"My conclusion from all this evidence is that this tank was wholly insufficient in point of structural strength to handle its load, insufficient to meet either legal or engineering requirements.

"I am satisfied that the adequate and predominating cause of this accident was a bursting from internal pressure exceeding its structural strength."

Columbus, Ohio, Engineers Effect Close Relation With Council

As in the case of Atlanta, Ga., an unpaid advisory engineering board is to be appointed to assist the city of Columbus, Ohio, and its officials in the consideration of questions of a technical nature. The action is the result of an effort of the Columbus Engineers' Club, which presented the matter to the mayor and council Jan. 23. It is not proposed that the board should render services of a nature conflicting with the legitimate duties of engineers employed by the city or to interfere with the employment of consulting experts as needed, but it should act simply as an advisory board for the purpose of aiding in a determination of policies in regard to improvements, and in the settlement of difficulties or differences of opinion which may arise from time to time, either during the preliminary stages or during construction.

A bill to establish a state board of engineering registration and to regulate the practice of civil and mining engineering and surveying is being pushed by the club. The mechanical, electrical and chemical engineers and other classes felt that the bill should include them. The club went on record as favoring the licensing of professional engineers and the appointment of representatives of the different branches of engineering to take part in the meeting of the Association of Ohio Technical Societies, when the bill will be considered finally.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN INSTITUTE OF MINING ENGINEERS: 29 West 39th St., New York City; Feb. 17-20, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION: 150 Nassau St., New York City; Feb. 25-28, New York City.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The Providence, R. I., Engineering Society held its third annual banquet Feb. 12. Captain Delport, of the French Army, and Lieut. J. A. H. Muirhead, Royal Engineers, British Army, spoke on some of the engineering problems in connection with the armistice and reconstruction. Alfred D. Flinn, secretary of the Engineering Council, addressed the meeting on war activities of engineers. P. H. W. Ross, president of the National Marine League, spoke on "Public Participation in Maritime Affairs," and Leonard W. Cronkite of Boston, special agent of the United States Department of Labor, on "Co-operating for Reorganization." Newly released motion pictures were shown of the assembling and operation of 14-in. naval guns at the front, by Ensign C. S. McCrae, U. S. N. R. F., of the Naval Bureau of Ordnance.

The Colorado Society of Engineers was addressed by E. A. Moritz, of the United States Reclamation Service, on "The Engineer's Part in Reconstruction," at the third annual banquet of the society Jan. 25. A. L. Fellows, irrigation engineer, United States Department of Agriculture, read a paper on "The Future of Irrigation Engineering." Other papers read were: "Reconstruction and Good Roads," by T. J. Ehrhart, chairman of the Colorado State Highway Commission, and "Problems of Railroad Readjustment," by Arthur Ridgway, assistant chief engineer of the Denver & Rio Grande R.R. It was recently voted to change the name of the society from the "Colorado Society of Civil Engineers" to the "Colorado Society of Engineers."

The Detroit Engineering Society was addressed Feb. 7 by Dr. W. F. Rittman, of the United States Bureau of Mines, who spoke on "Motor Fuel," the principal theme of the address being the potential supply of fuel. The society will hold a joint meeting with the Michigan Chapter of the American Society of Heating and Ventilating Engineers, Feb. 21, at which L. D. Royer, of the Power and Construction Department, Ford Motor Co., will speak on "The Measurement of Flow of Liquids and Gases by Means of the Pitot Tube."

The American Association of Engineers will hold a conference in Chicago Mar. 17, under the auspices of its railroad committee, to discuss a tentative report of the committee, including the alleged need of an association of all railroad engineers to look after their economic welfare, and to consider the application of Order 27, and supplements, of the United States Railroad Administration, especially with reference to overtime and classification of engineers and rates of pay. W. H. Finley, chairman of the committee, will preside.

The Engineering Council will hold its annual meeting Feb. 20 at the Engineering Societies' Building, 29 West 39th St., New York City. The first session of the meeting will be held at 2 p. m. and will be continued in the evening, if necessary.

The International Federation of Draftsmen's Unions, Chicago, Local 14, accepted 122 new members at the semi-monthly meeting Feb. 1. John Fitzpatrick, president of the Chicago Federation of Labor, installed the following new officers for the year: President, M. J. Brown; vice-president, C. H. Monger; recording secretary, E. Hemmer; financial secretary, F. Wizeszez; treasurer, H. Matthei; business manager, F. C. Brodman, 4954 West End Ave., Chicago.

The Illinois Section of the American Water-Works Association will hold its 11th annual meeting at Urbana, Mar. 25-26.

The Engineers' Club of Seattle elected the following officers at the recent annual meeting: President, H. E. Horricks; vice-president, L. Murray Grant; secretary, E. J. Bartells, and treasurer, Amos Slater.

The Technology Club, Syracuse, N. Y., was addressed Feb. 3 by George T. Hammond of Brooklyn, who spoke on sewage disposal, in light of the plan of the City of Syracuse for a complete system of disposal. City officials attended as guests of the club.

The Louisiana Engineering Society was addressed by Maj. A. M. Shaw on "The Construction Division of the Army," at the regular meeting held Feb. 10.

The Colorado Association of Members of the American Society of Civil Engineers held a regular meeting Feb. 8, which was addressed by Walter L. Drager on "Federal Ownership of Railroads." The subject was discussed by Charles W. Comstock and Arthur O. Ridgway.

The Brooklyn Engineers' Club will be addressed Feb. 13 by William H. Grove, electrical engineer, Republic Engineers, Inc., New York City, who will speak on "A New 66,000-Volt Steel Tower Transmission Line in the Steel

Mill District of Ohio." A meeting of the club will be held Feb. 20, at which Walter E. Truesdell, of Joseph H. Wallace & Co., will speak on "Wood Pulp Machinery."

The Engineers' Club of Philadelphia will be addressed by Joseph A. Steinmetz on "News from the Peace Zone," at the weekly luncheon Feb. 18.

The Rochester Engineering Society, Rochester, N. Y., will hold its regular monthly meeting Feb. 14.

Personal Notes

Readers who are returning to civil life from military, naval or other Government service are strongly urged to send in items about themselves and about their friends who are in similar situation. Items should give former position, describe character of military or other service and state the civil work to which the engineer or contractor in question is going. In the case of those with service abroad, information regarding the activities of the units to which they were assigned is especially desired.

J. H. Knowles, bridge engineer, Western Pacific R.R., Tidewater Southern R.R., and Deep Creek R.R., has been appointed chief engineer in charge of construction and maintenance of way and structures, under Federal Manager W. R. Scott, sucsucceeding T. J. Wyche, resigned.

Capt. D. A. Tomlinson, until recently assistant senior instructor in orientation, Coast Artillery, Fort Monroe, Va., has become special agent, Professional and Special Section, United States Employment Service, with headquarters at 63 E. Adams St., Chicago, under Ward R. Robinson, manager, Central and Western Zone. Captain Tomlinson, who served six months on the Mexican border, was valuation engineer for the Chicago & Western Indiana R.R. He reënlisted at the outbreak of the war, acting first as camp adjutant to the constructing quartermaster, Camp Grant, Illinois, before entering the Coast Artillery service.

O. C. Smith has been appointed manager of the recently reorganized Division of Steel and Machinery of the American International Shipbuilding Corporation at Hog Island, Penn. The division was previously known as the Division of Ship Design and Production. Other appointments in connection with the reorganization of the division are as follows: C. C. Thomas will continue as manager of the department of machinery; C. L. Harkrader has been appointed manager of the department of hull fabrication; H. W. Osgood will continue his duties as electrical engineer; D. E. Bigelow as estimator. All of the departments and sections are in charge of Mr. Smith.

Maj. James C. F. Shafer, 52nd Artillery, who previously was general manager of the Structural Concrete Co., Dayton, Ohio, has returned from France and received his discharge from the service. He has become vice-president of the Boldt Construction Co. of Cleveland, specializing in the construction of industrial and power plants.

W. A. Leland, formerly president of the Tennessee Eastern Electric Co., Johnson City, Tenn., has been appointed chief engineer and general manager, Charleston Engineering and Contracting Co., Charleston, S. C.

Maj. Edward D. Rich, Sanitary Corps, U. S. A., who was director of the School of Sanitary Engineering at Camp Greenleaf, Georgia, succeeding Maj. William C. Hoad, promoted to lieutenant colonel and ordered to the Surgeon General's office, has received his discharge from the service and has returned to his duties as state sanitary engineer of Michigan.

George W. Brown, who for 21 years has been engaged in the construction and operation of coaling plants for the Navy Department, has been relieved from duty at the Naval fuel depot, Tiburon, Colo., and placed in local charge of coal storage for the department at Hampton Roads, with headquarters at Norfolk, Va.

I. W. McConnell has resigned from the Division of Ship Design and Production, American International Shipbuilding Corporation, Hog Island, Penn.

Capt. W. J. Carrel, Engineers, U. S. A., who was attached to the training school in highway engineering at Camp A. A. Humphreys for the instruction of replacement troops for the expeditionary forces, has received his discharge from the service and resumed his duties on the faculty of the College of Engineering, University of Kentucky, in charge of courses in structural engineering.

Charles L. Spaulding, resident engineer, electric zone, New York Central R.R., with headquarters at New York City, has been appointed secretary and engineer to the Yonkers, N. Y., Water-Front Commission. In 1914 he became resident engineer in charge of construction work on four-tracking and grade-crossing elimination and new station buildings in the electric zone of the New York Central from the Grand Central Terminal to Harmon. He has also been engaged in the preparation of plans for the West Side improvement project of New York City.

H. G. Balcom has resigned from the Division of Ship Design and Production, American International Shipbuilding Corporation, Hog Island, Penn.

Capt. H. E. Babbitt, Engineers, U. S. A., who was engaged in work in the advance section in France, has returned to the United States and received his discharge from the service. He has resumed his work as associate in sanitary engineering, College of Engineering, University of Illinois.

James G. Esch, for the past year general manager of H. Schmitt & Son, Inc., general contractors, Milwaukee, has become vice-president of the Boldt Construction Co., Cleveland.

Col. C. H. Crawford, U. S. A., formerly of the Purchase, Storage and Traffic Division, General Staff, has been elected director of the American Association of Engineers, succeeding T. M. Chapman, deceased. Colonel Crawford is now associated with the Baldwin Locomotive Works, Philadelphia.

J. A. L. Waddell, consulting engineer of New York and Kansas City, has been made a corresponding member of the Sociedad de Ingenieros de Peru.

Lester E. Armstrong, previously of Babcock & Wilcox, has become advisory engineer for the Powdered Coal Engineering & Equipment Co., Chicago.

Capt. Herbert T. Nowell, Engineers, U. S. A., who previously practiced as a consulting engineer in Montana and Wyoming, specializing in city planning and public works, has received his discharge from the service and is now at New Rochelle, N. Y.

G. L. Gillette has resigned from the Division of Ship Design and Production, American International Shipbuilding Corporation, Hog Island, Penn.

E. Earl Glass, road department, Los Angeles County, California, has resigned to become sales manager, Hydrometric Co., Los Angeles, in charge of the sale of Reliance irrigation meters.

John F. Nealis, Aëro Observation, U. S. A., formerly engaged in research work for the United States Steel Corporation, has received his discharge from the service and become associated

with the Powdered Coal Engineering & Equipment Co., Chicago, as advisory engineer.

OBITUARY

WILLIAM N. BANNARD, formerly special agent, Pennsylvania R.R., in the office of the general manager, at Philadelphia, died in Wilmington, Del., Jan. 31. He was born in 1848 and was graduated from the Massachusetts Institute of Technology in 1869, when he entered the service of the West Jersey R.R. as a rodman. In 1872 he was appointed resident engineer of the West Jersey line, and two years later was made assistant engineer, New York Division, Pennsylvania R.R. In 1883 he was appointed superintendent of the Camden & Atlantic R.R., and a year later of the Schuylkill division. After serving for a short time as superintendent of the Schuylkill division he was appointed superintendent of the Amboy division, and afterward became superintendent of the Altoona division. In 1895 he was appointed superintendent of the Maryland division, with headquarters at Wilmington, and served in this capacity for 15 years, until his appointment as special agent in the office of the general manager.

DR. BROWN AYRES, president of the University of Tennessee since 1904, died in Knoxville Jan. 28, at the age of 62. He received his early education and course in civil engineering at Washington and Lee University and was afterward graduated from Stevens Institute. He was professor of physics, College of Technology, from 1880 to 1904.

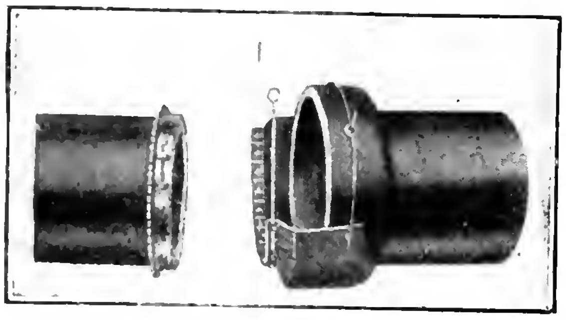
A. C. SCHILLING, attached to the Office of the United States Engineer, Mobile, Ala., died in that city Feb. 5. He was formerly connected with the engineering department of the Borough of the Bronx, New York City, and more recently had been assistant engineer and chief of sewers, United States War Department, in connection with installations at Camp Meade, Maryland.

FREDERICK DONALD HART died in Brooklyn, N. Y., Feb. 2, at the age of 84. He installed the first pumping engine for the Ridgewood pumping station of the old Brooklyn water-supply service. He also supervised the erection of the pumping engines, then said to be the largest of their kind, for Woodruff & Beach Iron Works, Hartford, Conn., installed in the Atlantic Ave., Brooklyn, pumping station in 1858. He remained in the service of the old City of Brooklyn as supervising engineer of the water-works until 1878, when he became associated with John W. Masury & Sons. He retired from active life in 1898.

Gasket and Form for Cementing Joints in Tile Pipe

A gasket and form has been designed by a New England contractor to simplify the making of waterproof cement joints in tile pipe sewers. It makes possible the maintenance of proper alignment of the invert while the pipe is being laid, and also the laying of the pipe in water.

The gasket consists of a sheet-iron flange, the inner edge of which is turned over to fit on the spigot end of the pipe, while the outer ring is notched to fit into the hub of the pipe into which it is to be placed. The outside diameter



GASKET AND FORM IN PLACE

of the gasket is the same as that of the inner diameter of the hub, and is held tight on the pipe by means of a small stove bolt through two lugs. The sheet-iron form is made to fit closely the outside of the hub as well as the pipe. It is placed on the lower half of the hub and is wired in place.

When pipe is laid the spigot with the gasket on it is placed in the hub in the usual manner and forced into place. No attempt is made to center the pipes, as the gasket does this automatically. The pipes are then tested for line and grade, and the trench is back-filled to a depth of one-half the diameter of the pipe. When this is done there can be no disturbance of the joints after they are made. After a convenient number of pipes have been laid in this manner the joints are poured with a thick grout from one side of the form. The upper half of the joint is then plastered with cement mortar in the usual manner.

With this device sewers have been laid in trenches containing water and with water running through the pipe to a depth of one-half the diameter of the pipe, thus saving the expense of pumping or the use of subdrains.

The device is made by L. A. Weston, Adams, Mass.

Foreign Trade Council Will Hold Convention in April

A formal call for the sixth National Foreign Trade Convention to be held in the Congress Hotel, Chicago, Apr. 24-26, 1919, was made by the president of the council. The urgency of the foreign-trade situation will be the theme of the convention.

"The abrupt termination of the war in Europe," says the chairman, "has brought the United States suddenly face to face with questions of grave concern to American foreign trade and industry."

BUSINESS NOTES

The Alexander Millburn Co., 1420 West Baltimore St., Baltimore, Md., announces that it has opened a branch office at 998 Monadnock Building, San Francisco, Cal., under the management of E. F. Walter.

Capt. Edward E. Ashley, Jr., formerly mechanical and electrical engineer for Starrett & Van Vleck, architects, New York City, has resigned his commission in the air service of the Army to accept an appointment as sales engineer of the Mercury Manufacturing Co., Chicago, Ill. The Mercury company manufactures electrically driven tractors for use in connection with industrial haulage systems.

Wharton Clay, director of the Military Training Camps' Association, has become associated with the Expanded Metal Manufacturers' Association as commissioner, and is located in the Cleveland office. Mr. Clay left the United States Gypsum Co. to take up association work when the association named above was founded.

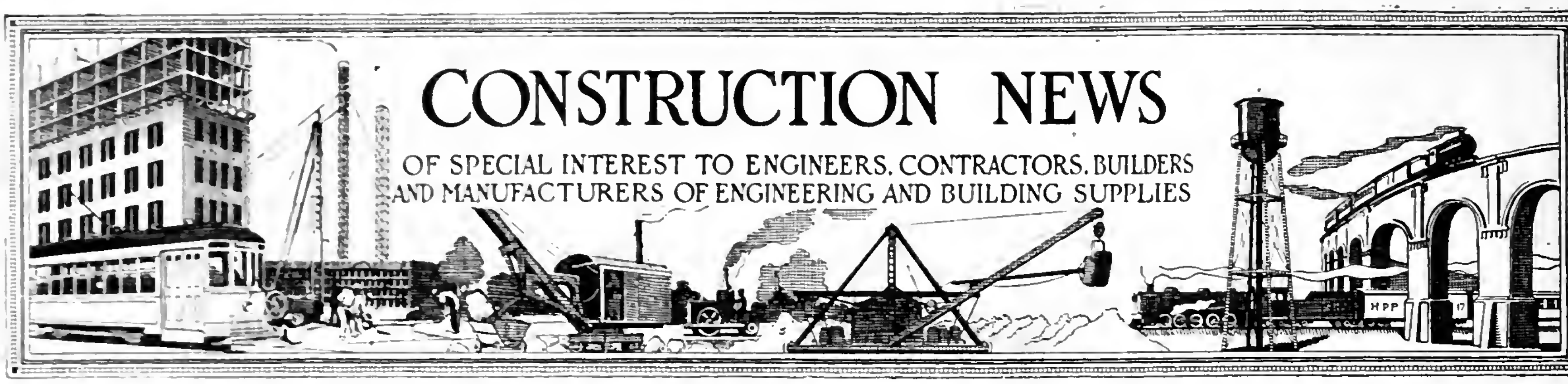
The Portland Cement Association announces the appointment of H. G. Meigs as district manager of its Milwaukee office, First National Bank Building, Milwaukee, Wis.

TRADE PUBLICATIONS

The A. S. Aloe Co., of St. Louis, Mo., has isued a supplementary catalogue describing and illustrating engineering, drawing and drafting supplies which the company carries in stock.

The Wallace & Tiernan Co., 349 Broadway, New York City, has issued a 65-p., 8½ x 11-in., paper-bound book entitled "Chlorine Control Apparatus for Water and Sewage Purification." Besides being a treatise on the chlorination of water, its history and development, it contains a large amount of data and charts for use in the installation and operation of the apparatus manufactured by the company. It is illustrated with a large number of half tones showing the various equipment at work, as well as installations throughout the country. A summary of types and characteristics of the company's chlorinators is given.

The Blaw-Knox Co., Pittsburgh, Penn., has issued a pamphlet describing its automatic single-line clamshell bucket. The pamphlet illustrates the bucket in several operating positions, and gives other information regarding the machine.



PROPOSALS

For Proposals Advertised See Pages 63a-b-c-64 inclusive

WATER-WORKS

Bids Close — See Eng. News-Record

Feb. 18 Bayard, Neb. .... Feb. 13
Feb. 18 Jersey City, N. J. .... Jan. 30
Adv. Jan. 23, 30, Feb. 5 and 13.
Feb. 19 Brunswick, Md. .... Feb. 13
Adv. Feb. 6 and 13.
Feb. 20 New York, N. Y. .... Feb. 13
Feb. 20 Ottawa, Ont. .... Feb. 13
Feb. 21 Akron, O. .... Feb. 6
Adv. Feb. 6.
Feb. 21 Bayonne, N. J. .... Feb. 13
Feb. 25 East Chicago, Ind .... Jan. 30
Adv. Jan. 30.
Feb. 28 Clarksburg, W. Va. .... Jan. 30
Adv. Jan. 30.
Mar. 7 Pembroke, Ont. .... Feb. 6

SEWERS

Feb. 17 St. Paul, Minn. .... Feb. 13
Feb. 18 Bayard, Minn. .... Feb. 13
Feb. 18 Wyandotte, Mich. .... Feb. 6
Feb. 19 Creedmore, N. Y. .... Feb. 6
Feb. 20 Cleveland, O. .... Feb. 13
Feb. 25 Columbus, O. .... Feb. 13
Feb. 25 St. Louis, Mo. .... Jan. 30

BRIDGES

Feb. 17 Los Angeles, Cal. .... Feb. 6
Feb. 25 Sneedville, Tenn. .... Feb. 13
Mar. 3 Bisbee, Ariz. .... Feb. 6
Mar. 23 Buckhannon, W. Va. .... Feb. 13

STREETS AND ROADS

Feb. 10 Fayetteville, W. Va. .... Jan. 16
Adv. Jan. 23, 30 and Feb. 6.
Feb. 10 Idaho .... Jan. 30
Feb. 11 Indiana .... Jan. 23
Feb. 11 Moulton, Ala. .... Jan. 16
Feb. 11 Jasper, Tex. .... Feb. 6
Feb. 12 Ft. Meyers, Fla. .... Feb. 6
Feb. 14 Oswego, Kan. .... Jan. 30
Feb. 14 Oswego, Kan. .... Feb. 6
Feb. 17 Philippi, W. Va. .... Jan. 23
Adv. Jan. 30 and Feb. 6
Feb. 17 California .... Jan. 30
Feb. 17 Tulsa, Okla. .... Jan. 30
Adv. Jan. 23, 30 and Feb. 6.
Feb. 17 St. Paul, Minn. .... Feb. 6
Feb. 17 San Diego, Cal. .... Feb. 6
Feb. 17 Virginia .... Feb. 13
Feb. 17 St. Paul, Minn. .... Feb. 13
Feb. 18 Albany, N. Y. .... Jan. 23
Adv. Jan. 23.
Feb. 18 Clifton, Ariz. .... Feb. 6
Feb. 18 Indiana .... Jan. 23
Feb. 18 Philadelphia, Pa. .... Feb. 13
Feb. 18 Santa Ana, Cal. .... Feb. 6
Feb. 20 Hamlin, W. Va. .... Jan. 23
Feb. 20 Rumson, N. J. .... Jan. 23
Adv. Jan. 23, 30, Feb. 6 and 13.
Feb. 20 Santa Barbara, Cal. .... Feb. 13
Feb. 24 Los Angeles, Cal. .... Feb. 13
Feb. 21 Middlebourne, W. Va. .... Jan. 30
Adv. Jan. 23, 30, Feb. 6 and 13.
Feb. 25 Columbus, O. .... Feb. 13
Mar. 1 Shreveport, La. .... Feb. 13
Mar. 3 Indianapolis, Ind. .... Feb. 6
Mar. 3 Marshall, Minn. .... Feb. 13
Mar. 4 Ripley, W. Va. .... Jan. 23
Mar. 4 Indianapolis, Ind. .... Feb. 6

Bids Close — See Eng. News-Record

Mar. 5 Alexandria, Minn. .... Feb. 6
Mar. 6 Fairmont, W. Va. .... Feb. 6
Adv. Jan. 30, Feb. 6 and 13.
Mar. 31 Lockport, N. Y. .... Feb. 6

EXCAVATION AND DREDGING

Feb. 17 Tunica, Miss. .... Feb. 6
Feb. 18 Jonesboro, Ark. .... Feb. 6
Feb. 18 Albany, N. Y. .... Jan. 23
Adv. Jan. 23, 30 and Feb. 6.
Feb. 19 Albany, N. Y. .... Jan. 23
Adv. Jan. 23, 30, Feb. 6 and 13.
Mar. 13 Tyler, Minn. .... Feb. 6
Apr. 8 Hollandale, Miss. .... Feb. 13

INDUSTRIAL WORKS

Feb. 18 Albany, N. Y. .... Jan. 23
Adv. Jan. 23.
Feb. 21 Brooklyn, N. Y. .... Feb. 6
Feb. 25 New York, N. Y. .... Jan. 30
Mar. 4 Thiells, N. Y. .... Jan. 16
Apr. 1 Sioux City, Ia. .... Jan. 16

BUILDINGS

Feb. 14 Brooklyn, N. Y. .... Jan. 23
Feb. 14 Malone, N. Y. .... Feb. 6
Feb. 15 Far Rockaway, N. Y. .... Feb. 13
Feb. 17 New York, N. Y. .... Feb. 6
Adv. Feb. 6.
Feb. 19 Brooklyn, N. Y. .... Jan. 30
Feb. 19 Chicago, Ill. .... Feb. 13
Feb. 19 Waterloo, Ia. .... Feb. 6
Feb. 20 London, Ont. .... Feb. 13
Feb. 20 Magnolia, Minn. .... Feb. 13
Feb. 21 Cincinnati, O. .... Feb. 13
Feb. 21 Phillipsburg, O. .... Jan. 30
Feb. 24 Norwood, O. .... Jan. 23
Feb. 24 Cincinnati, O. .... Jan. 30
Feb. 24 Cleveland, O. .... Feb. 13
Feb. 25 St. Louis, Mo. .... Feb. 13
Mar. 1 Cloquet, Minn. .... Jan. 30
Mar. 1 Cloquet, Minn. .... Feb. 13
Mar. 1 Mountain Iron, Minn. .... Jan. 30
Mar. 1 Duluth, Minn. .... Jan. 23
Mar. 1 Duluth, Minn. .... Feb. 6
Mar. 3 Rockport, Ill. .... Jan. 23
Mar. 3 Utica, N. Y. .... Feb. 13
Mar. 4 Wards Island, N. Y. .... Feb. 13
Mar. 15 Culver, Ind. .... Dec. 26
Mar. 15 Duluth, Minn. .... Feb. 13
Apr. 2 New York, N. Y. .... Jan. 23
Apr. 10 Newaygo, Mich. .... Feb. 6
Apr. 15 Newark, N. J. .... Feb. 6

FEDERAL GOVERNMENT WORK

Feb. 15 Laboratory — Washington, D. C. .... Jan. 23
Adv. Jan. 23
Feb. 15 Laboratory — Washington, D. C. .... Feb. 6
Feb. 17 Piping and Circulating System — Spec. 3416 — Portsmouth, N. H. .... Jan. 30
Feb. 17 Crane Runway—Spec. 3769 —Philadelphia, Pa. .... Feb. 6
Feb. 17 Electric Elevator—Spec. 3731 —New York, N. Y. .... Feb. 6
Feb. 17 Railroad Extension—Spec. 3727—Ft. Mifflin, Pa. .... Jan. 30
Feb. 17 Equipment, etc.—Spec. 3328 Hampton Roads, Va. .... Jan. 30
Feb. 20 Surgical Dressing Room— St. Louis, Mo. .... Jan. 30
Feb. 21 Dredging, etc. — Norfolk, Va. .... Jan. 23
Adv. Jan. 23, Feb. 6 and 13.
Feb. 21 Dredging—Norfolk, Va. .... Feb. 6
Adv. Feb. 6.

Bids Close — See Eng. News-Record

Feb. 24 Addition to Dispensary—Spec. 3780—Rockaway, N. Y. .... Feb. 6
Feb. 24 Piping and Equipment—Spec. 3759—New York, N. Y. .... Feb. 6
Feb. 24 Dredging—Spec. 3774—Chatham, Mass. .... Feb. 6
Feb. 24 Wells and Pumps—Spec. 3577 —North Ft. Worth, Tex. .... Feb. 6
Feb. 24 Fuel Oil Storage Plant— Spec. 3631—Mare Island (Vallejo P. O.) Cal. .... Jan. 30
Feb. 25 Jetty Work—Sabine Pass, Tex. .... Jan. 23
Adv. Jan. 30, Feb. 6 and 13.
Feb. 27 Post Office—Martinsburg, W. Va. .... Feb. 13
Mar. 1 Foundation and Rip Rap— Baltimore, Md. .... Jan. 16
Adv. Jan. 16
Mar. 1 Dredging—Superior, Wis. .... Jan. 16
Mar. 3 Barracks — Spec. 3728 — Fire Island, N. Y. .... Jan. 30
Mar. 3 Barracks—Spec. 3733—San Diego, Cal. .... Feb. 13
Mar. 3 Hospital—Baltimore, Md. .... Feb. 13
Mar. 3 Post Office—Walden, N. Y. .... Feb. 6
Mar. 7 Lavatory Annexes — Shiprock, N. M. .... Feb. 13
Mar. 7 School and Assembly—Hall —Wahpeton, N. D. .... Feb. 13
Mar. 10 Railroad Extension—Spec. 3727—Ft. Mifflin, Pa. .... Feb. 13
Mar. 11 Dredging — Philadelphia, Pa. .... Feb. 13
Adv. Feb. 6 and 13

MISCELLANEOUS

Feb. 13 Road Oil, Asphalt, etc., Montclair, N. J. .... Jan. 30
Feb. 14 Additional Window Guards —Bedford Hills, N. Y. .... Jan. 23
Adv. Jan. 23.
Feb. 14 Pier—Philadelphia, Pa. .... Jan. 23
Adv. Jan. 23.
Feb. 18 Truck, Tractor, etc.—New York, N. Y. .... Feb. 13
Feb. 19 Gantry Crane — Seattle, Wash. .... Jan. 2
Adv. Jan. 2 and 9.
Feb. 19 Dam—Los Angeles, Cal. .... Feb. 6
Feb. 19 Gasoline — New York, N. Y. .... Feb. 13
Feb. 20 Oiling—Baltimore, Md. .... Feb. 13
Adv. Feb. 6 and 13.
Feb. 21 Crushed Rock—Visalia, Cal. Feb. 6

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Mass., Boston—Metropolitan Water & Sewerage Bd. filed bill in State Treasury for authority to issue $11,000 bonds to complete watermains in East Boston.

Md., Cumberland—City plans to lay 3 mi. water pipe and build sewers in various streets. About $165,000 available for projects. R. L. Rizer, city engr.

Ga., Atlanta—City plans election Mar. 5 to vote on $500,000 bonds for improvements to water works system, including pumps, etc. H. L. Collier, city engr.

Ky., Ashland—City plans to purchase and improve water works system and build filtration plant and pumping station. T. Boggess, city engr.

A Consolidation of Engineering News and Engineering Record | McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 | NEW YORK, THURSDAY, FEBRUARY 20, 1919 | Number 8

Psychological Test for College Entrance

ONE definite effect of war experience on education is seen in the recent announcement that Columbia College will abandon the old system of entrance requirements and in September substitute psychological tests. These tests are patterned after those used in connection with the admission to the Students' Army Training Corps, but will be designed definitely to test the applicant's fitness for continuing academic work. As Dean Hawkes aptly expresses it, "We expect these tests to show us whether it will be worth our while to try to educate the student, and whether it will be worth his while to have us try." One of the best results of the new experiment, it may confidently be predicted, will be the more intelligent selection of students—for the system must by its very nature introduce more of the element of judicious choice, which is to be based not alone on the new psychological test, but also upon the high-school and general previous record of the student. In this way, the highly reprehensible practice of accepting men who cram up a few weeks before college entrance examinations, and then disgorge upon examination day, will be effectually abolished. It is to be expected that engineering colleges all over the country will follow in the adoption of tests of the new type, in order to determine those qualities of general intelligence and maturity of mind which in the last analysis make a given student's career in college valuable, both to himself and for the future of his profession.

Monolithic Brick Pavements Justified

CONCLUSIONS drawn from the investigation of the construction of the ramps of the Pennsylvania Station in New York City favor the use of rigid brick construction. Considerable interest centers around these ramps, the replacement of small sections of which is described on p. 378. This is due to the fact that they were among the earliest instances of rigid construction and also because they were a bone of contention between those who held to the old theory that vitrified brick must be laid upon a sand cushion, and those who favored the rigid system of construction known as the monolithic. The excellent service which these ramp surfaces have given is all the more striking because the brick were only slightly more than half the standard depth for paving block, which is 4 in. Furthermore, they had worn more than halfway through and were still in an unshattered condition, which certainly discredits the theory that impact has a pulverizing effect upon rigid brick surfaces, and supports the contention of those who advocate the use of much thinner brick in monolithic and semi-monolithic construction. In the reconstruction it has been necessary to use a deeper cement-sand bed than is usually recommended, to bring the pavement up to the new street grade. This would have been dangerous on the old sand-cushion type of construction, and the action of these surfaces with mortar bed will be watched with interest.

Work of National Society Secretaries

PROTEST has been made against a letter signed "M. Am. Soc. C. E.," printed in *Engineering News-Record* of Jan. 23, 1919, p. 201, wherein the author criticises the secretaries of our national engineering societies and foundations, declaring, among other things, that their sole occupation is to write useless reports and letters, and that they get two to three months' vacation a year. The sweeping scope of the criticisms is their own condemnation. Manifestly, it is absurd to characterize the work of the societies as useless, even though one does not agree with policies, while the statement that the secretaries get from two to three months' vacation each year does not accord with the facts. The thoughtful reader, conversant with the work of the societies, will realize that the concluding paragraph of the letter was perhaps written in a Pickwickian sense. We regret that, through an error in the editorial office, the offending paragraph was left in the letter.

Public Works or Public Charity

SINCE the signing of the armistice this journal has persistently urged the quick resumption of public works on a large scale, holding that it was the duty of the community to "take up the slack." In fact, even while the war was in progress, we persistently urged the planning of public works, holding construction in abeyance until hostilities should cease. Since the armistice came, the public-works propaganda has received considerable impetus. Much literature has been produced, but nowhere have we seen the case of public works versus public charity presented so clearly as in a pamphlet by Prof. Harold G. Moulton, of the University of Chicago, published by the Union League Club of Chicago. He puts the case in his conclusion in these expressive words:

"We know as a matter of course that we cannot permit either our returning soldiers or war workers to starve; we know that the least we can do, if jobs

are not available for all, is to open our charitable purses and extend them such indirect alms as we may. We have the choice, therefore, of two methods of meeting the situation: (1) By providing employment on public works of enduring value; (2) by supporting by public charity an army of unemployed in nonproductive idleness. The former is the way that will make for satisfied, self-reliant American citizenship; the latter is but a palliative—it prevents starvation, but it does not avoid ingratitude and bitterness of spirit, nor make for orderly social and economic life. The former is the socially efficient way, the way that conserves human resources and increases the productive capacity of the nation; the latter is the socially wasteful and inefficient way—that makes for the degradation of the individual and the depletion of national productive power.

"The latter is the way of the old era of ill adjusted and unregulated industrial life; the former is the way of a new era of economic and social efficiency. Which way shall we make the AMERICAN way?"

Universities Should Act to Help the Engineering Profession

THE protest of Dean Richards, of the University of Illinois, against the low pay of engineers in railway service, printed on p. 368 of this issue, is a protest from the right source. Such protests ought to be forwarded from dozens of the universities. There has been in the past a regrettable tendency on the part of engineering school authorities to close their eyes to the evidence that all was not well with the engineering profession. There has been ample publicity of statements from the engineering schools as to the great need for engineers and the great future of the engineering profession as a factor in the world's activities; but how seldom has there been outspoken public utterance to impress upon the public its great loss from failure to appreciate properly and reward properly the engineer's service!

The heads of our engineering schools are but human, and it has been quite natural for them to force into the limelight those of their graduates who have achieved phenomenal business success and quietly ignore the men, in many cases of equal ability, who, through force of circumstances, and—to put it frankly—the oversupply of engineers in particular fields, have been forced to continue in routine work at meager compensation. The heads of our great engineering schools and universities, however, have a large influence on public opinion. Such protests as that which Dr. Richards has so well voiced might well be heard from every school in the United States which teaches railway engineering. Such protests are called for not merely in justice to their own graduates and to the men they are preparing for service, but on the ground of public welfare. No one doubts the truth of Mr. McAdoo's recent declaration that national prosperity depends upon the efficiency of the country's transportation system. That efficiency is largely determined by the quality of the men placed in charge of the railways and their expert knowledge of the business. Unless railway engineers can receive adequate compensation, the engineering schools may as well abandon their courses in railway engineering.

Improving the Efficiency of Ship Fabrication

SHIPBUILDERS have been very slow to accept the idea of ship fabrication. Many of them are indifferent to the subject, some even to the degree of denying it a hearing in their own thoughts. With the completion of the two great inland fabricating shops built at the initiative of the Emergency Fleet Corporation, the fabricated-ship system takes on a new aspect. The layout of these shops, described in our issue of Feb. 13, 1919, p. 332, was not hampered by any external conditions, and had the benefit of thorough experience in all classes of steel fabrication. Shipyard shops lack similar advantages, and their comparative working results are likely to reflect this fact. They will find these new shops redoubtable competitors.

A recent English word on the prospective future of fabricated ship construction compels attention. Describing the "N" or national fabricated steel ships being built in England, *Engineering* of Jan. 17, 1919, said:

"The fabricated ship is a vessel of almost mathematical precision, which may in subsequent years set a distinct shipbuilding precedent, even among private owners. . . . No estimate of the cost of a fabricated vessel is available, but whether it be higher or lower than the cost of a vessel built in the ordinary way is no comparative criterion of value. Organization and facility of resource are the only weapons with which to combat the abnormal costs due to the war, and in consequence with the lapse of time the fabricated vessel is bound to prove a cheaper vessel than what might be termed a 'single-effort' ship."

For a year past, experiences in America have pointed substantially to this conclusion, available to all concerned with the shipbuilding industry; yet many yard men may regard the above expressed views as a weighty confirmation of what we ourselves had learned.

With shops now available for shipwork that are larger and more skilfully laid out than any shipyard shops, and, furthermore, are free from all the local limitations of the yard, the question of economy in the steel-fabrication part of shipbuilding will depend solely on the organizational skill with which the relations between shop and yard are handled. Given a satisfactory solution of this problem of organization, it may be said at once that on the score of economy the outside-fabrication system of shipbuilding will succeed in holding its own, since design and templet processes and the task of erection are easily adjusted to the system.

However, any new system, in order to become a working success, must be handled with sympathy and even a certain degree of enthusiasm. It is hardly open to doubt that the concerted hostility of all shipyard men would kill off the fabrication system temporarily, in spite of the most convincing demonstration of superiority. On the other hand, since the support and cultivation of any system tending to promote economy and efficiency is greatly in the national interest, it is to be hoped that the operation of the new shops will be directed with unusually careful attention to efficiency and schedule sequence, and that the facts as to results obtained may be made public as soon as possible. By this course the real possibilities of outside fabrication should be fully developed, and their application for the benefit of our shipbuilding industry made certain.

Garbage During the War and After

THE war wrought sweeping and, it may be, lasting changes in garbage disposal. It lessened the volume and grease content of garbage and led many cities to utilize vast quantities of fats and fertilizer base which had been going to the dumps or the furnaces. It is hardly to be expected that the household economies which resulted in decreased volume and richness of garbage will be fully maintained now that the war-saving spur is over, but in the interests of family, community and national thrift it is to be hoped that not all this gain will be lost. Certainly, for some years to come engineers, contractors and municipal officials having to do with garbage disposal cannot safely ignore these reductions in the quantity and richness of municipal garbage

How extensive have been the changes from nonutilization to utilization methods, the great further possibilities in this respect, and the main trends in garbage collection yields during the past two years, are shown by data and analysis in a contribution by F. C. Bamman, based on United States Food Administration investigations, which appears elsewhere in this issue.

The outstanding fact in the article is that during the year 1918 alone, 40 cities changed from dumping or burning their garbage to feeding it to hogs. That only three cities changed to reduction was chiefly due to war inhibitions on using capital, labor and materials for building reduction works. But now that the possibilities of hog feeding, with its relatively small plant and capital equipment, and the speed with which it can be got into use, have been shown, further rapid extension of this method of disposal may be expected.

Experience shows that garbage feeding is practicable for large cities. Some of the cities that changed from waste to feeding in 1918 have populations of more than 100,000. Moreover, already in 1919 Baltimore has let a five-year contract under which the garbage of that large city will be fed to hogs, as set forth at length in *Engineering News-Record* of Feb. 6, 1919, p. 287, and St. Louis has made terms for disposal by feeding while drafting specifications on which to invite bids for a longer contract. It should be noted that this change at St. Louis means the closing of a garbage-reduction plant.

Demands for glycerine and fats during the war stimulated garbage reduction wherever plants for that purpose were available. A world shortage of fats still exists, but recently the price of grease has fallen heavily, apparently due to after-war conditions which it is hoped will be but temporary. There is still need for fertilizer tankage which, like grease, is a product of garbage reduction. It is to be expected that ultimately both grease and tankage will sell at considerably less than war prices. This must be taken into account in projecting new garbage-reduction plants, as must also the present high prices of material and labor entering into their construction.

Until the various uncertainties now attending garbage reduction are removed by time and experience, conservatism in entering on new projects will be the part of wisdom. This does not mean that a pound of garbage need be wasted. Hog feeding is a ready means of utilization which should receive consideration wherever reduction—in existing or new plants—is for the time being impossible or of doubtful expediency.

The municipal field for garbage utilization by either reduction or feeding is still large. Mr. Bamman's conclusion is that the garbage now wasted would yield 30,000,000 lb. of grease and 60,000 tons of fertilizer tankage, with a remainder sufficient to produce 40,000,000 lb. of pork yearly. The world needs this grease, fertilizer and pork. Our cities, engineers and contractors should join hands for their production.

At such a juncture those unfamiliar with political and other local conditions in New York may well be surprised to hear that the garbage of some 5,000,000 people is to be dumped at sea temporarily while plans are being made and effected to burn it in refuse destructors scattered over the city. No evidence has been brought forward to show that the reported decision to destroy vast potential quantities of grease and fertilizer is based on careful engineering studies. The subject is one to which the engineers and engineering societies of Greater New York might well direct immediate attention.

A Federal Department of Public Works

IN TWO committee hearings recently members of Congress have discussed with witnesses proposals to establish a Federal Department of Public Works. One of the proposals was, it is true, for an emergency board, but the principle of a single engineering construction organization for the National Government was involved.

To the surprise of the civilians who appeared before the committees, the attitude of the senators was a sympathetic one. The war lesson as to the value of coöperation has had a telling effect, and the absurdity of scattering the Government's engineering and construction work through five administrative departments stands out stronger now than in the days of antagonistic individualism. A government which demanded of each industry that it mobilize in a single trade association or war-service committee does not find it so difficult now to see prospective benefits from combining under one head all its own functions of a similar character.

We do not believe that there is a member of Congress who would undertake to defend the placing at one time of public-building work under the Treasury, river and harbor work under the War Department, the Geological Survey under the Interior, and the Coast and Geodetic Survey under the Department of Commerce. No logic can defend the existing situation. Administrative exigencies or influences, which long since have disappeared, made for a now indefensible distribution.

But that which exists, no matter how absurd and illogical it may be, will always have defenders. Consequently, it will be necessary for those—the engineers of the country—who realize the absurdity of the present scattered scheme, to press home repeatedly and with emphasis the advantages of coördinating all of the Government's construction and engineering work. What are the advantages?

Under centralization, there would be elimination of duplication, especially in supervising the widely scattered work of the Government. There would be standardization of specifications and of materials. The large scope and volume of work would permit of the employ-

ment of a goodly number of broad-gaged engineers at the top, whose experience and counsel would make for the broader planning and execution of work. In private engineering enterprises it has been demonstrated that a high-salaried engineering organization is a *sine qua non* of economy. Then, too, come all the advantages of close alliance between men engaged in the same class of enterprise—the interchange of thought between experts—while the size of the organization would permit of a degree of functionalization not possible when the same amount of work is split up among ten or more bureaus.

These are obvious advantages; advantages such as are reaped in any consolidation, whether in industry or in government bodies; advantages that have been aimed at in several states in consolidating their engineering and construction bureaus into a state department of public works.

But there is another advantage which in the National Government weighs heavily for a Department of Public Works. It so happens that the great Congressional pork barrels are the rivers and harbors and the public buildings bills. These have become public scandals because no great administrative department in the President's cabinet was in a position to lay out a defensible scheme of public improvements that the President could back as a policy and on which he could solicit the support of the country. The execution of rivers and harbors work has been a side issue with the War Department, and its immediate execution placed in the hands of men whose habit is to obey without question, whose initiative is discouraged by the Army system, and who lack the business experience and point of view to assume responsibility for an economic program. Consequently, though executed under a body of notably highminded men, our river and harbor work has been—counting returns for our expenditure—one of the shames of the nation. A Secretary of Public Works and Engineering in the President's cabinet could secure for a sound policy that Presidential support which on occasion, by threatened veto, has forced river and harbor bills into some semblance of decency. Moreover, a sane policy would be a refuge for many a Congressman now forced into the pork scramble by real or assumed pressure from constituents and by the contagious example of his fellow legislators.

Were the ten or more engineering and construction activities of the Government thrown into one department, the aggregate expenditure, on the pre-war (1916-17) basis, would be nearly $100,000,000. This would be no mean department, for, on the basis of amount of appropriation, it would be exceeded only by the War and the Navy departments.

Reforms of this sort do not come easily. They do not come through the silent wishes of thinking citizens, nor even through the resolutions of engineering or other bodies. They come through the education of the people's Congressional representatives by the people themselves.

If you believe that there should be a national Department of Public Works, if your engineering society believes it, there is but one useful course of action—to tell it to your Senators and Representatives. And, in the telling, it might be wise to soften your strong views on the iniquity of pork-barrel methods.

How Not to Start a Canal Going

OFFICIAL explanations of last year's low traffic on the completed New York canal system, as abstracted on another page, do not increase public confidence in the Federal control of the system. Operating a modern canal is a new business in this country. Neither navigators nor shippers are used to it; the one is not at all persuaded either of its economy or its effectiveness, the other does not sufficiently realize that old mule-boat methods mean the added time and expense which defeat the purpose of the waterway. They both, in the advertising man's parlance, have to be "sold" on the canal "proposition." The State of New York has $155,000,000—much more if the old canal is capitalized—tied up in the Barge Canal, and it cannot get a fair return on this investment unless the canal is used. To get it used is the main duty of those who control it. Here is where the Railroad Administration failed.

The Federal authorities took the canal over as a going part of a successful transportation business—that is, the railroads adjacent to the canal—and expected it to show like returns on the investment. It did little to encourage canal traffic except to provide boats, which, contrary to prediction, were available far in excess of the freight offered. It permitted an erroneous impression of Federal monopoly of operation to remain abroad many months. Finally, it insisted on freight rates which paid a profit according to its own system of bookkeeping, the bookkeeping of a going concern. "Here is the canal; use it or leave it," was, in effect, its attitude.

No waterway today can be started on any such basis. The economy of canal transportation is at best debatable, and it will not be settled in this country until a fair experiment is carried through. An experiment will not be fair unless all the methods of starting any new business are tried. Such methods include liberal advertising and publicity, and small profits until trade is developed. To expect a waterway business automatically to spring full grown into successful financial competition with long-established railways is to kill it before it is well started.

There is a growing sentiment in favor of waterways in the United States, in spite of what appears to be good economic evidence against them. Strangulation of the one full-sized experiment will not kill off the growth of others. In justice to the whole transportation problem, on which the critical cost of living so depends, the New York canal system should have a fair chance to show what the modern inland waterway can do. It cannot have that so long as it is run entirely by railway men or is under divided control—or, worse yet, under an unprejudiced administration which considers it as a passive route ready for those who may want to use it. It must be administered by those who want to show that it is eventually to be successful. It first must be made known to the people who should use it, and then its use must be made attractive. If there is anything at all in the inland waterway idea, it is that the increased public first cost will be returned to the people in reduced final cost of the commodities which go over the waterway. Increasing that first cost a little, then, to make the proposition known, and to get it used, is only good business judgment.

Economic Balancing of Highway Excavation by a Semi-Graphic Method

Device Called "Trace Curve," Used in Designing Storm King Highway of New York State Highway Department, Is Particularly Useful to Supervising Engineers in Checking Earth Distribution

By Dudley P. Babcock
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DETERMINATION of the economic distribution of excavated material in the location of the Storm King and other highways of the New York State Highway Department has been effected by a new method, utilizing what is called a "trace curve." The solution is partly graphic and partly analytical, and has for its underlying principle the assumption that for slight raising and lowering of cuts and fills the added and subtracted quantities are proportional to the surface areas multiplied by the change in elevation. The device is particularly applicable in new locations which are unhampered by existing improvements, and where the excavation quantities are large. By requiring his assistants to plot a trace curve of their grade design, the supervising engineer will find it easy to detect quickly any uneconomical balances and compute roughly, without recourse to the cross-sections, the probable saving which would result from any proposed change.

Selection of the grade and alignment of highways has ever been, and always will be, largely a matter of judgment developed by experience, rather than an exact mathematical science. This is evident because no formula can adequately represent the ground surface; also, the governing factors in determining grade and alignment are not only the economic haul and quantity of earth to be moved, but also involve the adjacent structures, trees, fences and roads, together with the maximum grades permissible in each direction, the drainage—and last, but not least, the æsthetic features, For example, wide shoulders, shallow ditches, fairly long grades with decided breaks, large vertical curves and a winding alignment will make a road attractive but not necessarily economical.

There are cases, however, where a road is to be built over rough country where no previous roads existed and where many of the factors mentioned above are either nonexistent or at least unimportant. After the maximum grade has been established on such roads, the principal factors affecting the design of the grade and alignment are reduced to two classes—the æsthetic and the economic. If the earthwork is comparatively heavy, which is often the case on roads of this type, a thorough study is warranted, to determine minimum hauls and excavation. The former may easily be determined by means of the mass diagram, but the latter, while seldom neglected entirely, does not receive the attention it deserves.

The trace curve may be defined as follows:

If upon the plan of a road in side-hill cut the traces formed by the intersection of the side slopes with the original surface were drawn, also the line of zero cut and fill; then if the zero cut-and-fill line were rectified and the above-mentioned traces were modified so as to bear the same relation to the rectified line that they bore to it before rectification, the result would be a trace curve. If the zero cut-and-fill line happened to be straight, originally, then the traces of the side slopes would be trace curves and no modification would be necessary.

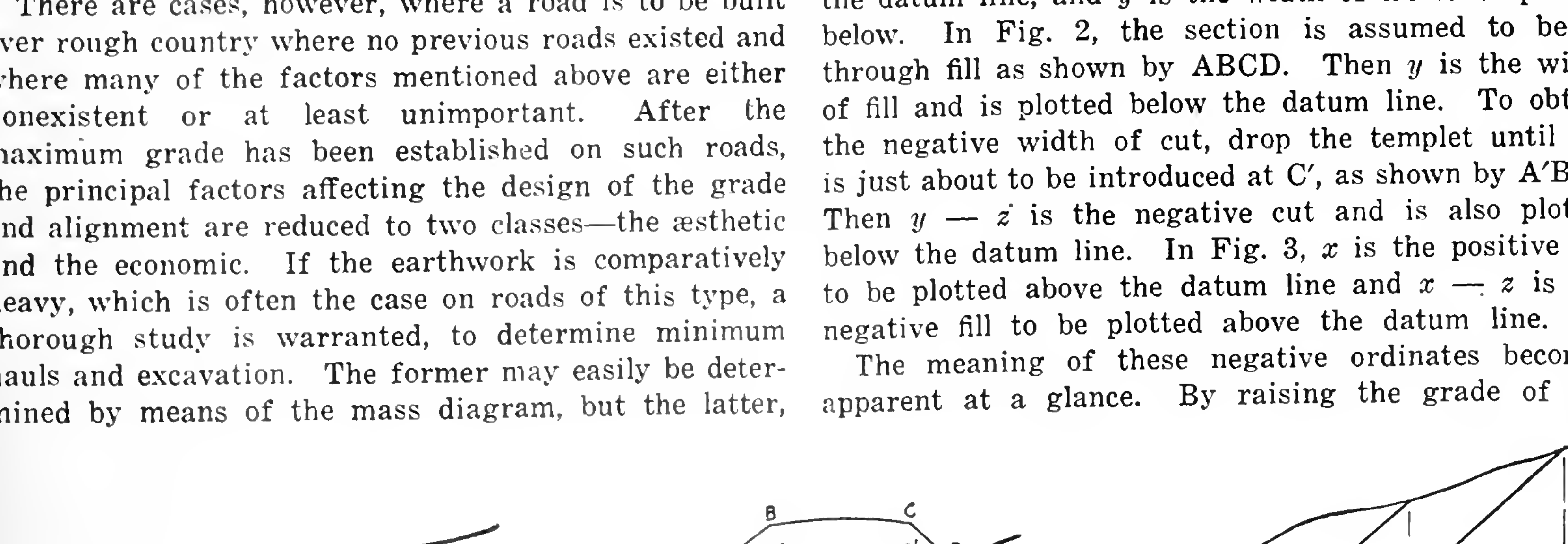
The trace curve is made by plotting center-line stations as abscissas and widths of cuts and fills of corresponding sections as ordinates. The cut widths are plotted above the datum line and the fills below, resulting in two curves—one normally above and the other normally below the datum line.

In the case of through cuts, the fill is assumed to be negative (i.e., plotted above the datum line) and equal in amount to the width of the cut minus the width which the cut would have if the grade were raised until the first iota of fill were introduced. In the case of through fills, the cut is assumed to be negative (i.e., plotted below the datum line) and equal in amount to the width of the fill minus the width which the fill would have if the grade were dropped until the first iota of cut were introduced. This may seem somewhat complicated, but, as a matter of fact, it is quite simple and takes but a moment to apply.

The following figures illustrate the matter:

In Fig. 1, x is the width of cut to be plotted above the datum line, and y is the width of fill to be plotted below. In Fig. 2, the section is assumed to be in through fill as shown by ABCD. Then y is the width of fill and is plotted below the datum line. To obtain the negative width of cut, drop the templet until cut is just about to be introduced at C′, as shown by A′B′C′. Then $y - z$ is the negative cut and is also plotted below the datum line. In Fig. 3, x is the positive cut to be plotted above the datum line and $x - z$ is the negative fill to be plotted above the datum line.

The meaning of these negative ordinates becomes apparent at a glance. By raising the grade of the



FIGS. 1, 2, 3. WIDTHS OF POSITIVE AND NEGATIVE CUTS AND FILLS

road shown in Fig. 1, the decrease in the value of x roughly equals the increase in the value of y, until the condition is reached as shown at A′B′C′, where the value of x is reduced to zero. Assuming, however, that the same relation continues to exist between x and y as the grade is raised further, the value of x for the position ABCD is negative and equal to $y - z$. In like manner, when the grade is dropped it may be shown that the negative value of the fill width designated by y will be $x - z$.

Meaning of the Trace Curve

Primarily, the object of the trace curve is to determine the highway profile requiring the minimum quantity of excavation. It does not take the place of the profile nor the usual method of balancing cuts and fills, but simply furnishes the criterion as to whether the particular arrangement of cuts and fills in question (assumed to be balanced) gives the minimum quantity of excavation possible under the circumstances. For example, assume two adjacent stretches of highway, A and B, each a few hundred feet long, which have been grouped together to form a balance. Let

b = balance ratio;
C = total cut;
F = total fill.

Then

$$\frac{C}{F} = b.$$

Now assume that the grade is raised a small amount over the section A and lowered a small amount over the section B, the latter change being so related to the former that the balance ratio b is preserved. Let

c_1 = cut eliminated by raising the grade in A;
c_2 = cut introduced by lowering grade in B;
n_1 = ratio of fill introduced to cut eliminated in A;
n_2 = ratio of fill eliminated to cut introduced in B.

So that

$$c_1n_1 = \text{fill introduced in A;}$$
$$c_2n_2 = \text{fill eliminated in B.}$$

Then

$$c_1 - c_2 = \text{net saving in cut;}$$
$$c_2n_2 - c_1n_1 = \text{net saving in fill.}$$

But if the balance ratio is preserved after as before the change

$$c_1 - c_2 = b(c_2n_2 - c_1n_1) \qquad (1)$$

Now let

$$k = n_2 - n_1$$

or

$$n_2 = k + n_1.$$

Substituting in (1)

$$\begin{aligned} c_1 - c_2 &= b(c_2k + c_2n_1 - c_1n_1) \\ &= bkc_2 - bn_1(c_1 - c_2) \\ (c_1 - c_2)(1 + bn_1) &= bkc_2. \end{aligned} \qquad (2)$$

From (2) we see that the saving in excavation is positive if k is positive, and it is negative (i.e., the change represents an increase in excavation) if k is negative. If k is positive then $(n_2 - n_1)$ is positive or n_2 is greater than n_1. Now, it may be easily shown that the values of n for small changes in grade are equal to the ratio of widths of fill to widths of cut. Thus, referring to Fig. 1, if the section is raised a small amount v, the increase in fill will be vy and the decrease in cut will be vx. Therefore,

$$n = \frac{vy}{vx} = \frac{y}{x}$$

i.e., n equals the ratio of width of fill to width of cut.

The method of using the trace curve should now be apparent.

Method of Applying Trace Curve

The road is first balanced roughly, using the profile and cross-sections in the usual way. The trace curve is then drawn, showing the widths of cut and fill plotted to any convenient scale vertically and the stations horizontally. The positive cuts are plotted above the x axis, the negative ones below and the fills vice versa, as described above.

Wherever the area included between the cut-and-fill lines drops below the x axis, the grade, if possible, should be lowered and then raised somewhere else where the reverse condition holds; for n for the grade being lowered is higher than n for the grade being raised, and $n_2 - n_1 = k$ is positive. Also, in general, wherever two adjacent stretches can be found where the values of n differ, the grade corresponding to the higher n should be lowered and the other raised to preserve the balance.

A few illustrations will serve to make the above more clear. First, assume perfectly level ground, transversely, and a profile as shown in Fig. 4. The road has been balanced between A and C. It will at once

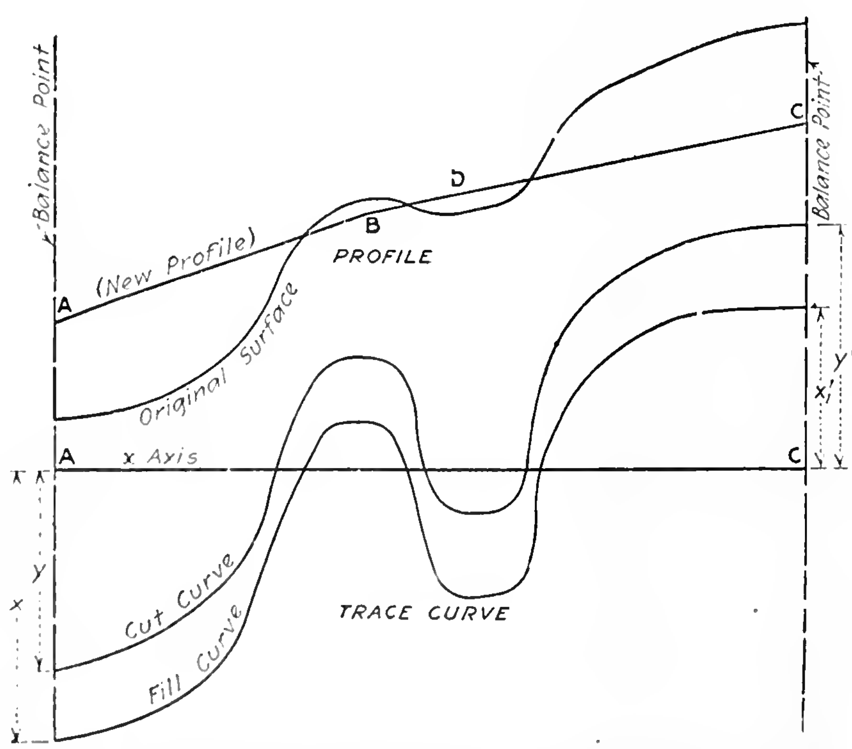


FIG. 4. FORM OF TRACE CURVE WHERE GROUND IS LEVEL TRANSVERSELY OF ROAD

be apparent from the profile that the grade as designed is uneconomical and should, if other conditions permit, be revised. If AB is already a maximum grade, it should be dropped bodily, thus eliminating a large amount of fill at A and introducing a smaller amount of cut at B. To restore the balance BC may now be raised, which will reduce the cut greatly at C, although introducing a small amount of fill at D.

Better yet, it may be possible to hold the B end of grade BC and raise the C end, thereby eliminating cut to even greater advantage. This is shown also

by the trace curve (Fig. 4). The uneconomical fill is shown at A by the fact that the area between the cut-and-fill line is below the x axis, and the uneconomical cut is likewise apparent at C because this area is here well above the x axis. In case the ground is level transversely (as assumed above), it is very evident that the trace curve is superfluous. Here the profile is all that is necessary for economical balance. If, however, the ground sloped transversely and with varying pitches in amount and direction between A and C, then the profile would be of little or no use for this purpose, and the trace curve alone would serve as the criterion for economical balance.

This last condition is shown in Fig. 5. Here the road is assumed to be in side-hill cut with the grade

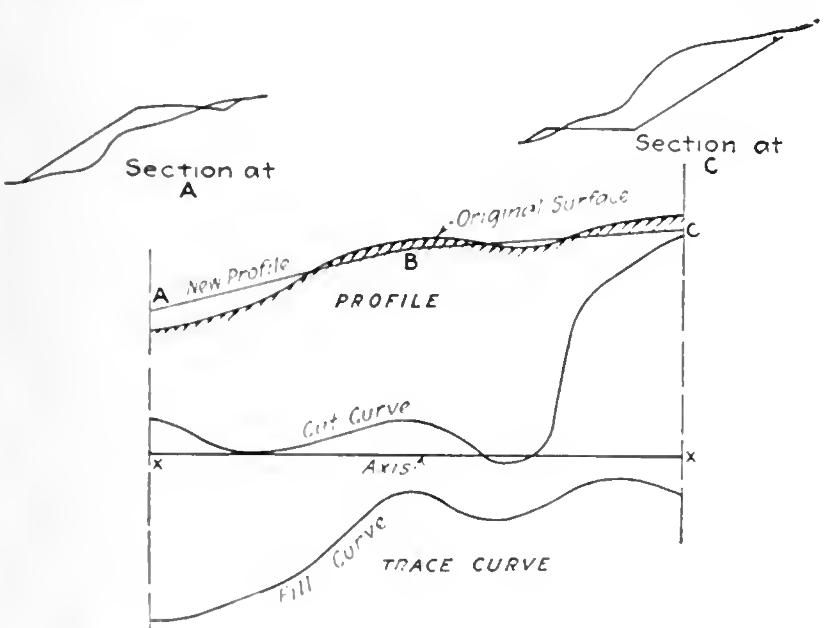


FIG. 5 FORM OF TRACE CURVE WHEN ROAD IS IN SIDE-HILL CUT OR FILL

profile following the center line very closely, but at A the fill side is very steep and the cut side almost level, whereas at C the reverse holds. An economical balance of the section AC requires the same changes of grade as in the first case—viz., the dropping of grade AB and the raising of grade BC. But, unlike the first case, the profile in no wise indicates the fact.

Fig. 6 shows a short section of the trace curve of an actual highway. It covers one balance, i.e., the cuts are in excess of the fills by the balance ratio assumed; in this case about 1½. A study of this trace curve will reveal the following characteristics:

1. Both the cut-and-fill curves follow the surface profile in a general way.

2. Through cuts occur when both the cut-and-fill trace curves lie *above* the x axis, as at A. Through fills occur when both curves lie *below* the x axis, as at B. When the x axis lies *between* the curves the section is partly in cut and partly in fill, as at C.

3. The distance between the curves at any point is a measure of the average transverse slope of the ground at the corresponding section. Thus, the transverse slope at D is much steeper than at A, B, or C.

4. When in through cut the distance between the cut curve and the x axis at any point is a measure of the total width of the corresponding cross-section, for example, rA. When in through fill the distance between the fill curve and the x axis is the measure of the total width of the corresponding cross-section, for example, uB. When the section is partly in cut and partly in fill, the measure of the width of section is the distance between the cut-and-fill curves, for example, xy.

5. The area included between the x axis and that portion of the cut curve lying *above* the x axis is the measure of the amount of cut obtained by lowering the grade uniformly a small unit amount. Thus, if this area $= M$ and the grade is lowered a small amount n (less than 1 ft.), then the amount of cut obtained by such lowering $= Mn$. Similarly, the amount of fill introduced by raising the grade uniformly a small amount q is measured by Pq where $P =$ the area between the x axis and the fill curve lying *below* the x axis.

The value of M or P may be obtained by the planimeter, or a transparent straight-edge may be laid parallel to the x axis and at such a distance from it that the areas included between the straight-edge and the curve will be about equally distributed above and below the straight-edge. This can be done by eye, involving an error of less than 1 ft. It gives the average ordinate of the curve, which, when multiplied by the station interval under consideration, gives the required area. The latter method is preferred. It is accurate enough and much quicker. In either case, all negative cuts and fills are taken as zero. Thus ee′, gg′, kk′ show graphically the average width of cut sections over the grades —4.6%, —0.36% and +4.8%, respectively, while ff′, hh′ and ll′ give the corresponding width of fill sections.

If a change of elevation of more than 1 ft. is made at any point, then the above method of determining the resulting change in yardage becomes very approximate, because the change in the trace curve itself becomes appreciable.

6. The ideal trace curve would be two lines parallel to the x axis.

FIG. 6. METHOD OF APPLYING THE TRACE CURVE TO AN ACTUAL ROAD BALANCE

From the above statements it is evident that the trace curve not only indicates the efficiency of balance, but also affords a rough means of rebalancing a road wherever the curve indicates the need of so doing; and it gives the approximate yardage to be saved thereby, without reference to the cross-sections.

Application of Method to an Actual Case

The trace curve shown in Fig. 6 indicates a fairly satisfactory arrangement of grade, and the road is now being built on this design. It may be used, however, to illustrate the method of procedure in case the curve indicated the need of rebalancing.

By using the transparent straight-edge, as described above, the lines ee′, ff′, gg′, hh′, kk′ and ll′ were obtained, showing the following approximate average widths of cut and fill over the lengths of the various proposed grades:

From Station	To Station	Proposed Grade	Average Width of Cut	Average Width of Fill
66+83	68+68	—4.6%	19	22
68+68	76+13	—0.36%	23	12
76+13	82+34	+4 8%	21	19

Here the value of n for the —0.36% grade is lower than that for the +4.8% grade—for the former $n = \frac{12}{23}$ and for the latter $n = \frac{19}{12}$. Hence, for an economical balance, the —0.36% grade should be raised and the +4.8% grade lowered an amount sufficient to restore the balance. With side slopes of 1 on $1\frac{1}{2}$ and level ground a change of elevation of 0.5 ft. will change cut and fill trace curves 1.5 ft. each.

Try, therefore, raising the —0.36% grade 0.5 ft. The calculation of the net saving in cut would then be:

Cut eliminated on the —0.36% grade would equal the product of the amount of the raise, the average width of cut and the length of the section raised, or

$$0.5 \times 23 \times 745 = 8568 \text{ cu.ft.} \quad (1)$$

Likewise, the fill introduced would equal

$$0.5 \times 12 \times 745 = 4470 \text{ cu.ft.} \quad (2)$$

In order to restore the balance ratio of **1.25**, the +4.8% grade must now be lowered to introduce cut equivalent to

$$8568 + (1.25 \times 4470) = 14{,}155 \text{ cu.ft.}$$

Lowering this grade 0.5 ft. will introduce cut equal to

$$0.5 \times 21 \times 621 = 6520 \text{ cu.ft.} \quad (3)$$

and eliminate fill equal to

$$0.5 \times 19 \times 621 = 5900 \text{ cu.ft.} \quad (4)$$

or introduce equivalent cut of

$$6520 + (1.25 \times 5900) = 13{,}895 \text{ cu.ft.}$$

To introduce 14,155 cu.ft. of equivalent cut, therefore, lower the —4.8% grade by

$$\left(\frac{14{,}155}{13{,}895} \times 0.5\right) = 0.51 \text{ ft.}$$

Substituting 0.51 in (3) and (4) above, the cut introduced is 6651 cu.ft. and the fill eliminated is 6018 cu.ft., and, comparing with (1) and (2), a net saving in cut of 1917 cu.ft. and in fill of 1548 cu.ft. is obtained.

If preferred, the following formula may be used instead of the above method. It may be easily derived by substituting the proper symbols in the analysis and applying numerical values for the above case.

$$S = xl_1\left(c_1 - c_2\frac{c_1 + bf_1}{c_2 + bf_2}\right)$$

where

S = net saving in cut (cu.ft.);
x = amount first grade is raised (ft.) = 0.5;
l_1 = length of first grade (ft.) = 745;
c_1 = average width of cut over first grade (ft.) = 23;
f_1 = average width of fill over first grade (ft.) = 12;
c_2 = average width of cut over second grade (ft.) = 21;
f_2 = average width of fill over second grade (ft.) = 19;
b = balance ratio = 1.25;

giving S = 1926 cu.ft., which checks substantially with the other method. The total excavation for this balance happens to be 115,284 cu.ft. and the embankment 90,696. So the maximum possible saving is only about $1\frac{1}{2}$%, and it would hardly pay to make the revision.

Thoughts on the Engineer's Relation To the Community

W. H. Finley, president and former chief engineer of the Chicago & North Western R. R., and president of the American Association of Engineers, spoke informally to an open meeting of engineers at New York Feb. 10. Ranging over the whole field of professional questions, he spoke of public service, of the engineer's backwardness in taking up his responsibilities to the community, of progressing through association, of the need for working upward from the bottom rather than down from the top in welding together the engineering profession, and of establishing the engineer on a recognized plane. Random extracts from the address are printed here as separate paragraphs. They add to the stock of thought on the development of the engineering profession.—Editor.

There is probably no profession of trained and educated men that has had such a rapid development and expansion as the engineer's. Our technical schools are now turning out engineers in shoals, almost, and I am afraid that as a profession they have hardly found themselves yet. They have lacked something in organization.

I have been quite surprised in looking up statistics to find, of the great number of engineers in the United States, how few of them belong to any engineering organization. It is really deplorable, because they need association. Take the vast body of young men coming out every year; they need encouragement, they need help. They must not think that the engineers after they attain some prominence in their profession forget the coming man, and the young man, and the man who has not yet made himself felt.

Strangers Among Their Fellow Men

Although we have so many engineers—and the number is growing constantly—yet they are very little known among their fellow men. They have always been the silent workers. They have not been very good ad-

vertisers. But a certain amount of advertising never hurt anybody. In the earlier years we suffered from the belief of the older professions that advertising is unethical, but I think the engineer has outgrown that. A certain amount of advertising is good for the engineer, good for the community, and won't hurt him one bit.

The only thing is, we need some better way of defining an engineer. He has apparently no legal standing at all. Any one can hang out a shingle and practice engineering. That belief is wrong, and something should be done to correct it. There should be some way to define an engineer and some way to establish the fact that he is competent to practice his profession. The community needs it, and it is the duty of every engineer to give consideration to that fact.

Licensing on Broad Lines

It is a question in my own mind just what sort of license law engineers should have. I believe that they should be licensed not as specialists but on a broad ground, as in the medical profession or the legal profession. When a man passes a bar examination he doesn't pass it as an expert in corporation law or in criminal law; he passes it as a lawyer, having received the necessary fundamental training so that he can specialize afterward. It is the same way in medicine. When a man receives his diploma it does not say that he is an expert on the eye, ear and nose, or any other part of the human anatomy; it simply says that he has received the training and pursued the necessary studies to fit him to practice medicine, and he can afterward specialize in any branch that he chooses. It is a question with me whether engineers should not also be licensed on broad lines rather than on the narrow lines of any specialty.

Local Problems Before Engineers

We have a deplorable condition all over the United States, as far as engineers are concerned. We have it in the West and we have it in the City of Chicago. No doubt you have it here in New York. My attention not long ago was called to a condition in Chicago in the classified service of the city, containing a large number of engineers. For twenty years they haven't had an increase in salary, nothing more than the passage from one grade to another, with the result that the mechanic, the artisan and the tradesman that they direct are getting more than the engineer in charge of the work. That condition should not exist.

They have in that city a position of smoke inspector. The act creating it says it should be filled by a mechanical engineer; they appointed a dentist to the job. Not long ago they were to appoint a mechanical engineer in charge of a municipal plant; I think it is a plant costing about $2,000,000, and the act creating the position in the classified service said it should be a mechanical engineer's. They held a civil-service examination for it, but changed the classification so that any one could take the examination, with the result that a politician got the job, insead of a mechanical engineer.

That is all our concern. It is the concern of every engineer, and he should wake up to it. He should take an interest in his home affairs and in his civic affairs. He should see that these things are run the way they should be, and that positions which call for technical training and call for engineering skill are filled by engineers and not by politicians.

Responsibilities in the Labor Problem

It has always been my hope that the engineer would be the man to solve the questions of capital and labor, and successfully bridge the chasm between the two. There isn't a man who should understand labor better than the engineer, because labor is merely one of the tools he uses to carry out his ideas. It is just as necessary to him as the slide rule; his plans and his hopes and his promises could not be accomplished unless he employed labor.

No trained, educated, professional man comes closer to labor than the engineer. He certainly should understand labor better than any other man. I regret to say that apparently he does not.

In all the work that you handle, all the men that you direct, you should get closer to them. You should know their hopes and their aspirations and their desires, because they are making up this country just the same as you. I have never in my experience failed to find that the human touch meant more than anything else.

The human touch and the human feeling—it's the thing that's going to be necessary in the new condition that is coming over society. It is coming. We have got to have a better understanding with each other, and of each other and our fellow man, whoever he may be. As long as he is associated with us, and is a part of the force that is helping us to build up the country, we should understand him. We should analyze him and we should know him better than we do.

The engineer should really understand labor, should have been the leader of labor, the man whom they would look for advice and for help. But, I must say again, unfortunately the engineer has not been that man. Whether he has been afraid of himself or whatever the reason, he has not established that close relation with the men he was working with or that were working for him that he should have established.

Our Technical Societies

My connection with the activities of technical societies has led me to the conclusion that, as they are organized, technical societies cannot do the things that we hope and wish to do, without losing something. And I believe that the country needs technical societies, high-class, far removed from all the sordid things that we may have to take up as a business organization of engineers.

I have no quarrel with any engineering organization, particularly any of the technical organizations of engineers. I believe they fill a want in the community. I believe they should continue; I believe they should be encouraged to fulfill their destiny. But my experience is that if they are organized as technical societies for the advancement of certain purposes they are not able to accomplish the things that should be accomplished for the engineer. And that has been growing upon the engineers of the country.

Concrete Material for Army Base Hauled by Motor Trucks

Special Equipment Utilized at South Brooklyn Supply Unit for Stevedoring and Haulage—Truck Performance and Cost of Delivery Analyzed

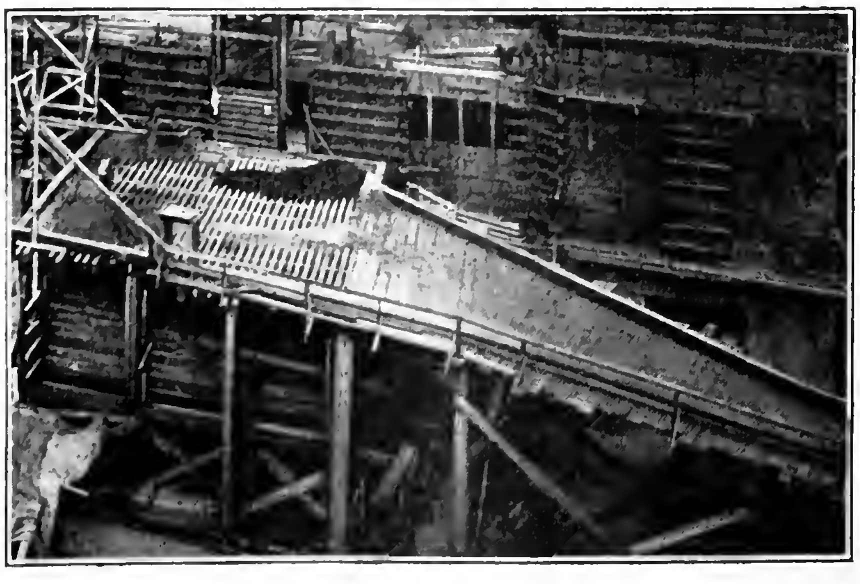
STEVEDORING and hauling of concrete material for the South Brooklyn Army supply base was accomplished by the use of specially designed equipment, working in conjunction with motor trucks. To deliver the aggregate for 250,000 cu.yd. of concrete, concentrated in a relatively small area and in a limited time, required a flexible organization and a systematic layout, so that one part of the work would not obstruct another. The layout selected consisted of long timber trestles to give elevation at the various dumps, connected with return driveways so that the trucks might work continuously around the circuit without interference. By this system the contractors were enabled to deliver aggregate at the work over an average haul of ½ mile for a haulage cost of 21c. per cubic yard, and at a total unloading and haulage cost of 50c. When indirect charges, such as repairs to docks, etc., are included, the total was about 59c. per cubic yard.

UNLOADING STATIONS ON WAREHOUSE B RUNWAY. CEMENT CHUTES IN FOREGROUND

The general dimensions of the warehouses, together with the excavation for them, were described in *Engineering News-Record* of Nov. 28, 1918, p. 993, and the design in the issue of Feb. 13, 1919, p. 317. The area covered by warehouse A was 196,000 sq.ft., that by warehouse B, 299,880, and that by the general office and power house 25,112 sq.ft. Each of the warehouses is nine stories high, including the basement and dock-floor levels, and the office building has four stories. The problem was to deliver the necessary material in this area with the required speed without causing congestion or piling it so as to obstruct traffic.

Two trestle runways about 25 ft. high and similar in design to those used for the construction of the offices of the War and Navy Departments in Washington, described in *Engineering News-Record* of July 4, 1918, p. 21, were constructed. They were built with heavy timber and strongly braced, the uprights and stringers being 12 x 12 in. A track on each side for the motor trucks, separated by wooden curbing, was formed by cross-planking over two closely placed 12 x 12-in. stringers. One trestle stretched along the east side of warehouse A, while the other passes through a central court of warehouse B, as shown in one of the views. A smaller one was used for office building work.

Four mixing stations were located under each trestle. Those on the warehouse A trestle had one 1¼-yd. mixer to each station. Those on the warehouse B trestle had two mixers, one for each half of the building. The trestles widened out from 10 to 30 ft. at the stations, as shown, and were floored with 4 x 10-in. planks on edge and spaced 4½ in. This formed a grate under which were the material bins for stone, sand, grits and cinders, as the case might be. A view of one of these grates is reproduced. Sufficient elevation, so that the bins containing aggregate could discharge by gravity into the charging cars below and in turn into the mixers, was obtained by means of the trestle. A cement chute was provided at the end of each station, down which the cement in bags was dumped by the trucks to the loading and storage floors. Two of these chutes may be seen in the foreground of one of the illustrations. The single stations had bin capacity for 320 cu.yd. of crushed stone, 160 cu.yd. of sand and 160 cu.yd. of grits. Storage space for 4000 bbl. of cement was provided on the charging floor. Materials were delivered by barges at docks which were about ½ mile from the northern end of the buildings. It was planned to have the loaded trucks proceed to the southern end of either trestle, up an incline which was built on a 6% grade, pass along the trestle, dump at the proper bin, and go down the other incline, returning by way of First Ave., which lies between the two warehouses. This was the general plan followed out, although at the start, on warehouse B, it was necessary for the trucks both to go and come by way of



UNLOADING GRATE AND BIN AT MIXING STATION

First Ave., on account of the unfinished condition of the excavation at the southern end of the building. This caused some inconvenience, making it necessary to flag trucks in and out. The average round-trip distance was about one mile.

In all motor-truck operations, the secret of efficiency is to "keep the wheels turning," and this principle was recognized in the layout of the plant. Mechanical unloading and loading of material, combined with the almost immediate disappearance of the material at the grates—thus leaving a clear road—made it possible for the trucks to make the round trip almost without stop.

CLAM DIGGER TRANSFERRING STONE FROM SCOW TO TRUCK-LOADING BIN

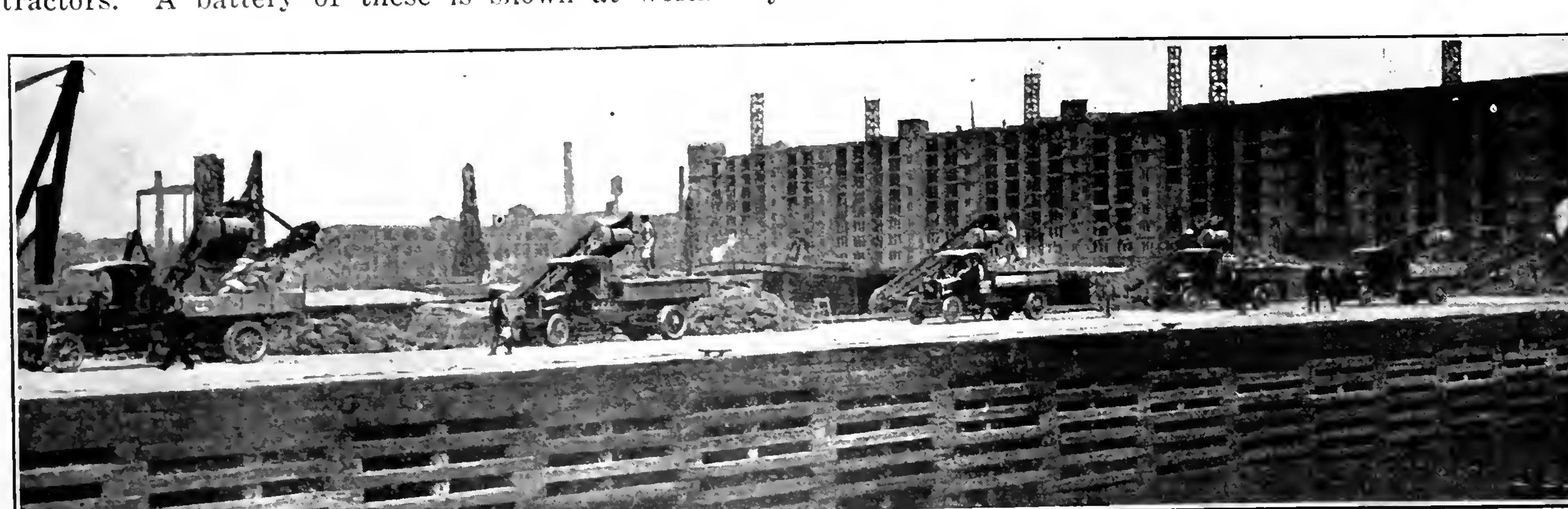
At the docks, the barges containing concrete aggregate were unloaded by two large skid diggers with clamshell buckets of about 5-cu.yd. capacity and two boom derricks with 1½-cu.yd. clams. The buckets dropped their loads into storage bins, as shown in an illustration. The bins were kept constantly filled, and the trucks were quickly loaded by gravity as they passed under the discharge. There were four of these bins, each having a capacity of 20 cu.yd., and the average length of time required to load a truck was about one minute.

Cement in bags was rapidly unloaded from the boats by conveyors designed and built by the general contractors. A battery of these is shown at work. By these conveyors the 110 bags required to make a load could be handled in 10 min. A full description of this apparatus, together with a special truck body which was used to some extent, appears on p. 396.

Although concreting began June 1 when the footings were started, the real rush commenced when the superstructure was begun July 3. From that date to Sept. 26, when the roof was completed, 183,173 cu.yd. of concrete were poured, or an average of 2130 cu.yd. per day. The maximum for any day's work was 4500 cu.yd. These large yardages of concrete required a proportionally greater yardage of loose material to be transported by the trucks. During the 64 days while the frames and floors of the buildings were going up, an average of 600 truck loads of material per 10-hour shift unloaded on the warehouse B trestle. Besides the hauling to buildings, large quantities of material were put in storage piles as insurance against shortage. While this required rehandling, it was considered worth while, to obviate any chance of delaying the completion of the contract. Piles were formed by starting a dump of the required width and gradually building up on a grade of 7 or 8 per cent., smoothing it out and planking the surface as the pile grew. The trucks would back up the grade and dump over the end of the plank. By this means, a pile containing from 9000 to 10,000 cu.yd. of crushed stone was kept stored,

TABLE 1—TRUCK PERFORMANCE IN HAULING TO BUILDING SOUTH BROOKLYN ARMY SUPPLY BASE FROM JULY 10 TO NOVEMBER 14, 1918

	Sand and Stone	Gravel	Grits	Cement
Average haul, round trip, miles	1	1	1	1
Auto truck hours	17,384	71	646	7,651
Auto truck loads—trips	59,899	152	2,014	12,615
Average trips per truck per hour	3.40	2.1	3.1	1.64
Average miles per hour	3.40	2.1	3.1	1.64
Cubic yards moved (boat measure)	246,131	621	8,519	1,308,225
Average load per truck, cubic yards or bags	4.1	4.2	4.1	194



BATTERY OF CONTINUOUS-BELT CONVEYORS TRANSFERRING CEMENT FROM BOATS TO MOTOR TRUCKS

TABLE II. COST OF STEVEDORING, HAULING AND RE-HANDLING MATERIALS FOR CONCRETE SOUTH BROOKLYN ARMY SUPPLY BASE, FROM START MAY 20 TO NOVEMBER 13, 1918.

Stevedoring and Hauling

			Direct Cost														Indirect Cost on 380,000 Cu.Yd.— Building, Repairing, Removing Plant and Towage Charges			
			Labor Loading, etc.		Hauling by Trucks		Loading Plant Rental		Supplies		Supervision Field and Office		Commission		Summary				Grand Total	
Items	Unit	Amount	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit
Aggregates	Cu.yd.	*337,481	$34,217 14	$0 10	$72,015 95	$0 214	$26,571 86	$0 079	$20,635 59	$0 061	$6,766.48	$0.020	$9,740 14	$0.029	$169,947 16	$0 504	$32,193 74	$0 085	$202,140.90	$0 589
Cement	Bbl.	393,692	3,861 86	0 01	28,772 50	0 074					900 52	0 002	1,943 35	0 005	35,478 23	0 090	4,329 95	0 011	39,808 18	0 101
									Rehandling											
Aggregates	Cu.yd.	* 26,749	10,228 13	0 382	10,437 50	0 39	4,056 50	0 15	1,051 00	0 039			1,325 89	0 049	27,099 02	1 01				
Cement.....	Bbl.	22,330	1,936 76	0 086	1,441 00	0 065							104 01	0 005	3,481 78	0 156				

*Quantities comprise stevedoring and hauling to building of following: Sand 122,949 cu.yd.; stone, 193,832 cu. yd., remainder being grits, cinders, paving blocks, coal and gravel. Rehandling covered 6,790 cu.yd. of sand, 19,355 cu.yd. of stone and 604 cu.yd. of grits

so that when it was needed the material could be reloaded by steam shovels working upon the last material stored, which in turn could be replaced.

The hauling was carried on by subcontract under the cantonment form for emergency work. The subcontractor was required to furnish all hauling equipment, labor and supervision. He was paid a rental for his plant and a commission not to exceed a fixed sum on the payroll and supplies.

Accurate costs were kept for the Government by the general contractor, who also kept close account of the performance of the trucks, in trips per hour, average load per truck, and mileage covered. A record of this performance is shown in Table I. Although the mileage covered per hour by the trucks appears low when contrasted with mileages covered on the highway, this may be easily explained by the impracticability of high speeds, the time for loading and unloading, and the delays due to various causes, such as train interference where the trucks passed over the switching tracks. The average load carried per truck was 4.1 cubic yards.

Table II gives the cost of hauling and rehandling materials. These costs do not include the construction of the timber trestles or the loading and unloading bins, which were charged to concrete. All other charges such as supplies, field and office supervision, and a commission of 6½ per cent., together with repairs on the plants, are included.

In Table II, which shows the unloading and hauling costs, the actual hauling cost per cubic yard is shown to be about 21c. Taking the average haul at ½ mile, the cost per ton-mile would be about 16c. The total cost of hauling and handling, including all charges, would be about 44½c. per ton. Hauling cement cost 7.4c. per barrel, while the total cost for handling and hauling, including all charges, was 10c. per barrel. Rehandling covered picking up material from the emergency supply dumps and carrying it to the work. The cost of this rehandling was considerably higher than was the cost of the original handling of the material.

The work is being done by the Construction Division of the Army. Brig. Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut. Col. H. S. Crocker is constructing quartermaster, and Maj. George Perrine, Quartermaster Corps, National Army, assisted by Capt. J. W. McCathon, was directly in charge of the part of the work described. The general contractor is the Turner Construction Co., New York City, of which A. C. Tozzer is executive manager, and the subcontractor for the hauling is Rodgers & Haggerty, of New York City.

University Dean Urges Better Conditions for Railway Engineers

DR. C. R. RICHARDS, dean of the College of Engineering of the University of Illinois, has written the following letter to the Board on Railway Wages and Working Conditions of the United States Railroad Administration:

I have read with much interest the astonishing article entitled "Pay and Position of Engineers in Railway Service," by Charles Whiting Baker, which appeared in *Engineering News-Record* of Jan. 30, 1919, p. 228. While I have long realized that the railroads of this country offer few inducements which render the transportation service a particularly attractive field for engineers, I had not supposed that present conditions are as bad as Mr. Baker's article indicates.

Believing that the transportation interests of the country are fundamental to its growth and industrial prosperity, the University of Illinois has done much to promote the scientific study of problems relating to both the engineering and the administrative work of the railroads. Thus, the College of Engineering offers specialized curriculums in railway civil engineering, railway electrical engineering and railway mechanical engineering, and the College of Commerce and Business Administration offers curriculums in railway administration and railway transportation. To coördinate the administrative and engineering work, we have a School of Railway Engineering and Administration.

In spite of facilities for instruction which are not surpassed anywhere, very few students are attracted into these railway engineering and transportation courses. However fascinating this work may be to the average young man, it is generally recognized that the railroads of the country apparently have so little appreciation of technical and scientific training that they are unwilling to pay to trained experts salaries which are comparable with those offered by industrial corporations.

When a young man asks my advice regarding the opportunities for a successful career in this field, I feel obliged to tell him what the real conditions are. You cannot expect a young man to spend four years in college, with a more or less indefinite apprenticeship thereafter, to prepare himself for a position in the engineering department of a railroad at a salary below that of clerks and mechanics and very much below the salary paid to trainmen. It has been my hope that one of the effects of Government control would be to improve the status of trained experts. In my opinion it is vastly important that the railroads of the country apply the soundest engineering and economic principles in the conduct of their business, for I am convinced that it is only by such means that they will be able to maintain an efficiency which will be satisfactory to their stockholders and to the public.

Material Prices Halt Chicago Building Operations

Costs $1,873,239 Today to Erect a Building Costing $1,000,000 in 1915—Wage Increase Only Partial Cause

By O. M. Fox

BUILDING construction is slow in recovering from the depression caused by the war. When the fighting stopped last November an immediate increase in building was prophesied. Work costing millions of dollars was announced ready for contract as soon as war restrictions were removed. Today, more than three months after release from the stress of hostilities, there is no building under way, nor is any construction announced for the immediate future, except some few improvements which are absolutely indispensable.

Analysis of the construction cost of a hypothetical building at present prices, compared with a similar enterprise carried out in 1915, may perhaps set us on the track of the correct answer.

The accompanying tabulation shows actual costs on a building which was erected in Chicago in 1915, compared with the costs of the component parts thereof as of today's market prices and wages:

	Actual 1915 Costs	Ratio	Estimated 1919 Costs
Masonry..........	$175,400	1.52	$266,608
Steel, material....	100,700	3.15	317,205
Steel, erection...	20,100	1.29	25,929
Foundations.....	81,100	1.54	124,894
Elevators..............	74,000	2.00	148,000
Carpentry..............	73,800	1.86	137,268
Ornamental iron work	62,600	2 20	137,720
Heating and ventilating.	62,100	1.92	119,232
Fireproofing	47,000	1.70	79,900
Engines and generators	41,000	2.00	82,000
Plumbing, drainage	30,800	1.54	47,432
Electric wiring.	29,500	2.00	59,000
Terra cotta....	26,500	1.70	45,050
Various minor items, e.g., glazing, hardware, roofing, painting, lighting, etc....	129,200	1.50	193,800
Architects' and engineers' fees..........	46,200	...	89,201
	$1,000,000	1.87	$1,873,239

These figures of ratio of 1919 costs and the resulting estimates were arrived at in the following manner:

Masonry—Each thousand dollars of expenditure in this division of the job is split as follows:

Item	Cost per Unit, 1915	Amount	Cost per Unit, 1919	Amount	Per Cent. Advance
Brick........	$7.50	$535.70	$12.00 M.	$918.73	71 5
Lime.............	1.50 bbl.	107.20	1.80 bbl.	128.64	20.0
Sand.............	1.35 yd.	35.70	2.10 yd.	45.41	27.2
Skilled labor......	.75 hr.	160.70	.87½ hr.	193.49	16.7
Common labor....	.40 hr.	160.70	.57½ hr.	230.93	43.7
		$1000.00		$1517 20	51 7

Foundations—Concrete caissons were placed under the structure. The division of expense on this class of work per $1000 is as follows:

Item	Cost per Unit, 1915	Amount	Cost per Unit, 1919	Amount	Per Cent. Advance
Cement.........	$1.02 bbl.	$353.00	$2.05 bbl.	$709 53	101 0
Sand and gravel...	1.35 yd.	401.00	2.10 yd.	510 07	27 2
Skilled labor......	.65 hr.	115.00	.75 hr.	132 71	15 4
Common labor....	.40 hr.	131.00	.57½ hr.	188 25	43 7
		$1000.00		$1540.56	54 1

Steel—Steel was furnished on the job in question at $36.50 a ton, f.o.b. Chicago, while current bids on a proposed job range from $110 to $120, or an average advance of 317 per cent. Structural-steel setters' wages in 1915 were 68c. and are now 87½c., an advance of 28.7 per cent. As exact figures are available for a separation of this item into material and erection, it is so shown.

Elevators—In line with all other machinery, elevators are costing approximately twice what they did four years ago, as are also engines and generators.

Carpentry—The price of yellow pine in 1915 was $18, against a quotation of $45 today. The local carpenters' scale was 65c., contrasted with 80c. at present. Allowing half the cost under this head to apply to material and half to labor, we find the cost to have advanced 86.5 per cent.

Ornamental Iron Work—This consisted mainly of iron and labor, in proportion of three to one. With a 150% advance in iron, from $14 to $34.75 per ton, and a 30% advance in iron setters' wages, from 67½c. to 87½c. an hour, the increased cost of this class of work aggregates 120 per cent.

Heating and Ventilating—Iron has advanced from $14 to $34.50 a ton, or 147%, and labor from 75c. to 81¼c. or 9%. Allowing this cost to be split 60% material and 40% labor, we find the advance under this head to be 92 per cent.

Fireproofing—Tile shows a cost increase of 100% from 3½c. to 7c. per foot on a given size, and labor an increase of 9%, from 75c. to 81¼c. About two-thirds of the total cost of fireproofing being material, we find the advance to date to be 69.6 per cent.

Plumbing and Drainage—Metal markets have advanced thus: Lead from $3.80 to $6, brass from $15 to $31, copper from $13 to $23 and iron from $14 to $34.50. The plumbers' scale was 75c. and is now 81¼c. Figuring the average metal advance to have been 100% and the labor 8⅓%, and figuring material at half and labor half of the whole, the resulting increase in cost figures 54.2 per cent.

Electric Wiring—Without troubling to go into detailed figures, it is safe to say that the various lines of conduit and flexible duct have advanced to 2½ times their cost of four years ago. Copper wire has doubled, as have also practically all other elements of this work except labor, on which the scale has advanced 16%. It is, therefore, reasonable to assume that the cost under this head will average double that of the other job.

Terra Cotta—Although the market in this commodity is somewhat deranged at present, no actual quotations being available, it is probably safe to assume that the increase in its cost is very similar to that of fireproofing and it has been so figured.

Minor Items—Too much space would be consumed in analyzing all of the lesser items of construction cost in this short exposition. It is sufficient to say that they have been carefully studied, and that the average increase of 50% as figured in the table is conservative in the extreme.

Architects' and engineers' fees, of course, increase in exact proportion to the average increase in the various other items.

The hypothetic cost figured above has been compared with the actual costs on several jobs of varying grades which have been recently put under way, and are found to be remarkably close to the actual, the slight difference being, in each case, in the direction of greater advance.

We, therefore, arrive at the conclusion that a building

erected today to compete with the $1,000,000 "before-the-war" structure would cost $1,873,239, or an advance of 87.3%. As the older structure has to bring an average rental of $2 per square foot in order to return from 4½ to 6% on the investment, it is apparent that a rental of $3.75 will be necessary in its new competitor, and as the obtaining of such a rental in Chicago is obviously impossible, therein seems to be the reason why building construction is not being undertaken.

The particular subject of this study happens to be an office building, but what is true of a modern office building is equally true in the case of a factory, a hotel, an apartment or a home. The present cost of buildings in all lines is such as to be practically prohibitive.

New York Barge Canal's First Operating Season

One Federal and Two State Officials Report Independently on Canal Operations Under Federal Control, and Give Reasons Why It Carried Less Freight Last Season Than Ever Before

On April 22, 1918, the United States Railroad Administration created the New York Barge Canal Section and authorized the construction and acquisition of equipment for use on the state system of canals which, it was expected, would be opened complete for the first time some time in May. The Federal Government did not take over the canals as a whole, as was commonly believed at the time, but it did assume control of rates, and purchased and leased floating equipment which it proposed to operate. The season opened May 10 and closed Dec. 12, the longest since 1907. In spite of this long season, the recognized necessity for freight carriage and the fact that the canal enlargement was complete, the business done was less than in 1917, which in turn was the smallest in the canal history.

The history of the year is now available in three separate reports, one by W. G. McAdoo, director general of the Railroad Administration, one by Frank M. Williams, state engineer of New York, and the third by W. W. Wotherspoon, superintendent of public works of New York. Enough of the three reports is given here to explain the conditions of the canal operation and to expose certain divergencies of opinion between the state and Federal authorities.

Comparative statistics of freight carriage on the completed Barge Canal system in 1918 and the combined Barge Canal and Erie Canal in 1917 are given in one of the accompanying tables, and total tonnage figures for the past 10 years in the other.

Report of the State Engineer

The State Engineer of New York is responsible for the construction of the canal. When sections are complete he turns them over for operation to the Superintendent of Public Works. As an introduction to the story of the operation, therefore, there is given here a part of State Engineer Williams' report for 1918:

In my report of a year ago I promised that the new canal would be opened to navigation throughout its entire length on May 15, 1918, and that it at that time would have been constructed to its full depth of 12 ft. That promise was fulfilled, even in spite of the fact that more numerous and greater difficulties arose to defeat the accomplishment than were anticipated when the promise was made.

Under the authority conferred upon the President of the United States to take over and operate canals and their floating equipment, and in accordance with the Federal plan to assume control of the transportation media of the country, the United States Railroad Administration assumed control of the canals in a somewhat limited manner. According to our state constitution the canals must remain forever the property of the state. The state has always maintained and operated them and during Government control it has continued to do this, the same as heretofore. Unlike its administration of the railroads, the Federal Government was not called upon to assume certain financial obligations in connection with the canal. What it did was to take over control, either directly or indirectly, of the floating equipment on the canal. It obtained control of a large proportion of the boats which had been in use on the canal during recent years, although the whole number of such available craft is not large, and it built a few new boats, which were just beginning to be delivered when the navigation season ended.

However, the Government became more than a mere transportation company; it stood ready to control all shipping on the canal, assuming the right under authority of Congress to commandeer any and all boats doing business on the waterway and even to direct the activities of those it did not commandeer. In fact, for some time the impression was general among the independent boatmen that the Government would not permit them to operate on the canal. Of course, the Government had no authority to grant or withhold permission to float a boat on the canal. Such authority rested solely in the Superintendent of Public Works of the state and could only be exercised by him. However, the Government could fix canal rates and it proceeded to do so. Much criticism has been aroused by this fixing of an arbitrary rate for interstate traffic approximately 20% less than the railroad rate. It is claimed that this is not based on operating expense and that the differential in favor of the canal would be much greater if the rates could adjust themselves as they had heretofore. The fleet of boats operated by the Government was entirely inadequate, both in number and dimensions, to test the canal's capacity. The new boats which were ordered built were not delivered in time.

The canal was handicapped during the season by much misinformation regarding its condition and possibilities for use, which was spread broadcast, perhaps without malicious intent, but generally without any basis in fact. That the Barge Canal should be completed to a point which permitted its full utilization seemed beyond the belief of many who had noted the long years during which it had been under construction. Entirely new navigation conditions aroused the timidity of the man accustomed to navigation on a shallow, restricted channel. His fears or ignorance often gave rise to false stories of conditions. The mere fact, however, that there have been brought through the entire line of the canal boats having a width of not less than 30 ft. and drawing 9½ ft. of water, as shown by the records of the office of the Superintendent of Public Works, should indicate that the canal is, as claimed, in a condition to accommodate the size of floating equipment for which it was designed and constructed.

Superintendent of Public Works Wotherspoon's comments on operation are partly as follows:

One who studies the record made during the first season of operation of the improved waterways and analyzes the freight movement can take no discouragement from the results attained, in spite of the fact that the total tonnage

fell below the 1917 business by 137,955 tons. He cannot fail to be impressed with the many indications of the rehabilitation of the canals as a commercial factor.

The figures covering the past 10 years of canal navigation show a steady annual decrease, amounting yearly to more than 15 per cent. The opening of the new waterways, while not reversing such process, has arrested the decrease so that the total for 1918 is only about 9% under that of the previous year. Were it not that extraordinary conditions existed, due to the war, it is believed the 1917 tonnage would have been exceeded. This statement is made in view of the great falling off in items of freight whose production was mainly dependent on labor which could not be secured owing to the military draft.

Another feature that stands out prominently is the comparatively small west-bound canal shipments. The decrease must primarily be attributed to the disturbed commercial conditions. A large portion of the industrial activity in the canal territory was in connection with what has been termed "war work." The industries working on war contracts for the most part drew their raw materials from Western producing centers, principally the iron and steel districts. Practically all of the raw materials, therefore, which were consumed in canal territory moved in an easterly direction to the mills, and when manufactured, continued east to seaboard. In normal times the markets of industries in the canal zone extend to the middle and northwest and the flow of west-bound traffic is heavy. During the past year the market or consuming territory was overseas or the military camps adjacent to the Atlantic seaboard. The normal west-bound traffic was naturally affected. Then, too, the discontinuance of imports due to wartime conditions had its effect on the canal business.

In a study of the record of the total business done in the past five seasons the through freight has averaged 27.6% of the total, and the way freight 72.4% annually. For the four years previous to 1918 the total was divided on averages of 25% of through freight and 75% of way freight. In 1918, however, the through freight represented nearly 40% of the total, and the way freight about 60%, thus showing that the long-haul traffic, which is the most desirable from the standpoint of revenue to the carrier, has greatly increased. This again evidences the restoration to the canal of a class of commerce which is much to be desired.

The falling off in shipments over the Oswego, Cayuga and Seneca, and Black River Canals was due to the fact that no service was offered to shippers in those territories, the Federal authorities confining their operations entirely to the main or Erie Canal. In previous years the Oswego, Cayuga and Seneca, and Black River Canals contributed approximately 10% of the total tonnage. During the past season the percentage of contribution of all three lateral canals amounted to only 3.9% of the grand total. [4.9%, according to figures.—EDITOR.]

On Apr. 18 formal announcement was made by the Director General of Railroads of his intentions to secure boating equipment and establish an operating organization to utilize the state canals. A complete organization was effected, with headquarters in New York City, and representatives at various points along the line of the waterway. Approximately 200 of the old-type canal boats were acquired by the Federal authorities by charter. A few tugboats were purchased and a number of others leased for the season. It was announced that operations would be extended to Erie Canal freight only, for the reason, I assume, that the transportation business on the Champlain Canal was well organized, and because the traffic movement in which the Federal Government had the greatest interest moved to the seaboard by way of the Erie Canal.

At the opening of the season, it became apparent that the plans adopted included only the transportation of bulk freight, particularly grain and grain products from the West. While recognizing the supreme importance of this class of traffic and its relation to the nation's military program, I believed that such utilization of the New York canals by the national Government to the exclusion of traffic produced and consumed by shippers located along the waterway from Buffalo to the Hudson River was unfair to New York State's interests. I have always taken the position that since the canals have been built solely by this state, its citizens were entitled to the full benefit of them and to that end, in addition to the movement of Government materials and supplies, some of the boats under Federal charter should be placed at the service of industrial establishments having freight for shipment. The soundness of these views was recognized by the Federal manager, and early in July a fast freight carload and less-than-carload merchandise service was inaugurated, serving some of the larger cities along the route.

TABLE SHOWING TONNAGE CARRIED ON NEW YORK CANALS IN 1917 AND 1918

Year 1917	Branch	East-bound	West-bound	Total	Total Is Made up of Through	Way
185 days open	Erie	518,608	156,475	675,083	76,981	598,102
	Champlain	332,561	183,193	515.754	158,931	356,823
	Others	62,453	43,935	106,388	41,554	64,834
	Total	913,622	383,603	1,297,225	377,466	919,759
1918						
216 days open	Erie	577,155	90,219	667,374	148,353	519,021
	Champlain	296,833	137,951	434,784	293,726	141,058
	Others	15,791	41,321	57,112	4,676	52,436
	Total	889,779	269,591	1,159,270	446,755	712,515

During the first few weeks of the season some opposition developed to what seemed to be a monopoly by the Railroad Administration of all Erie Canal traffic. A conference with shipping interests was called in the latter part of June in the City of Albany, at which this question and the rate level were discussed. At that time, the Federal manager formally announced that there was nothing in the Director General's policy, as it would be carried out, which would prevent entrance of freight-carrying companies into the canal transportation field. The season being well advanced, however, no new companies made their appearance, and the Federal Government continued to be the only carrier operating on the Erie Canal.

The freight carried amounted in all to approximately 210,000 tons, or about 18% of the total of all the canals, and approximately 30% of the Erie Canal tonnage. It was made up of the following items: Wheat, salt, general merchandise, flaxseed, flour, pig iron, copper, coffee, barley, oil meal, oats and other commodities.

Due credit should be given to the canal operations of the Federal officials for some excellent results obtained, in spite of the fact that their work progressed under many handicaps, due to the inadequacy of the available boating equipment and the lack of suitable motive power. To this latter cause may be attributed the excessive time consumed in making passage through the waterway from Buffalo to the Hudson River. With proper equipment five or six days should be ample for the trip. Of 209 grain cargoes loaded at Buffalo, the fastest time recorded for passage to the Hudson River by the Federal boats was 10 days, and the average time consumed was something over 18 days. There is a record of barges having been in transit much in excess of that number of days. It is true, perhaps, that no urgent need existed for a speedier delivery, but in the interest of the rehabilitation of canal commerce it is to be regretted that effort was not made to establish records for trips which would furnish a guide for the carriers of the future.

The excessive time required for the passage of some of the boats can be attributed also to the disinclination, and in many cases the positive refusal, of boatmen to navigate the canal by night. No good reason existed for this other than the difficulty of obtaining additional crews. An elaborate system of lights was maintained on each side of the channel where necessary, and the navigable conditions were equal to those existing on any natural waterway.

REPORT OF THE RAILROAD ADMINISTRATION

The difficulties surrounding operation make up the larger part of Mr. McAdoo's report, the greater part of which is given below:

Contracts were early let for the construction of 51 steel barges, 150 ft. long, 21-ft. beam and 12-ft. molded depth, for service on the Barge Canal, at a cost of $1,697,708, and

TABLE SHOWING TONNAGE CARRIED ON NEW YORK CANALS IN PAST 10 YEARS

Year	Days Open	Total Tonnage
1909	185	3,116,536
1910	185	3,073,412
1911	185	3,097,068
1912	185	2,606,116
1913	172	2,602,035
1914	201	2,080,850
1915	200	1,858,114
1916	200	1,625,050
1917	185	1,297,225
1918	216	1,159,270

for 21 concrete barges of similar dimensions for $458,996. [None of these barges was delivered for the 1918 season.—EDITOR.]

In addition to these contracts, five tugs were purchased, for a total of $56,500, and three wooden barges were purchased on the stocks for $52,650.

During May the general manager had under lease 13 steamers and 118 barges; during June, 14 steamers and 140 barges; during July, 14 steamers and 168 barges; during August, 14 steamers and 175 barges; during September, 14 steamers and 180 barges; during October, 12 steamers and 188 barges; during November, 12 steamers and 180 barges. The average time these vessels were under lease was 27 days per month. All this equipment was of the type that had been in use on the New York Barge Canal for many years, the vessels being designed to draw not more than 8 ft. of water. The 250-ton barges were chartered at $11 per day, including crews; the larger barges at $15 per day, including crews; the steamer and push boat at $50 per day, including crew but not including fuel and oil.

It will be noted that the fleet was gradually increased from the opening of navigation, with the expectation that in July and August a heavy east-bound canal business in grain would develop, as was anticipated by the United States Food Administration Grain Corporation. As a matter of fact this grain was shipped by the owners by rail.

The additional charters were not always completed the first day of each month and the record shows that from May 10 to Dec. 1 an average of 169 barges were in service. The period covers 203 days, so the operation covered 34,307 boat days.

Vessels of the fleet were idle on account of no cargoes as follows:

	Days
May	1,130
June	905
July	448
August	531
September	118
October	192
November	43
Total	3,367

The total number of serviceable boats on the New York Barge Canal is estimated at 760. The fleet not under Federal operation was engaged very largely in short-haul work, while the administration fleet was engaged exclusively in through service. The independently operated boat made its own transportation rate.

At the beginning of operation by the Railroad Administration it was found by actual experience that the minimum depth of the canal did not permit loading vessels to a draft in excess of 7 ft., and up to the close of navigation not more than 8½ ft. was available. The terminals at Buffalo and New York were not completed by the state and are not yet completed, so that the Railroad Administration was required to create temporary terminals. Rochester is as yet accessible only through the old canal, and Syracuse was not accessible by the new canal until September.

The inadequate equipment, which on account of war conditions was all that was obtainable for the past season, and the incomplete state of the canals and terminals, of course made the operating conditions very different from what they will be with new equipment adapted to the new canal and with the canal facilities completed, so that the operating results for the present year are not a measure of what may reasonably be expected in the future.

The movement of freight on the New York Barge Canal by all transportation agencies this season will approximate 1,200,000 tons, about the same volume as last year. Commodities such as building materials, pulp wood, road metals, coal to Canada, etc., always constitute a considerable percentage of the total traffic. The movement in these items decreased 250,000 tons. This decrease may be attributed directly to the war. Owing to the shortage in Northwestern grain crop of 1917, it was impossible during 1918 to obtain any cereal for shipment from Buffalo via the canal until late in September. Grain must always be a very large tonnage factor on the barge canal, and the crop shortage of 1917 was a serious handicap to the usual activities of 1918. Imports were almost entirely cut off at the port of New York and the west-bound movement of freight on the New York Barge Canal has been negligible.

An effort was made to stimulate a movement of coals. Manufacturing enterprises along the waterways were solicited to arrange for the receipt of water-borne coal at their plants. Many receivers said they preferred delivery by rail. There is practically no coal unloading equipment at canal bank, and receivers would not purchase the necessary machinery. It was, therefore, impracticable to construct loading tipples without some assurance they would be of value.

Because of the lack of suitable canal terminals in the port of New York, the barges were compelled to await the convenience of ocean vessels, and as the supply of ocean ships was intermittent, great delays were encountered in discharging cargoes. The lay time at terminals amounted to 1445 days.

The average running time between Buffalo and New York was 18 days towed by tugs, and 13 days for vessels towed by steamers. The average loading or unloading time was five days. The number of loaded boats dispatched during the season follows:

	Westbound	Eastbound	Total
May	14	17	31
June	15	93	108
July	62	78	140
August	50	101	151
September	40	113	153
October	33	139	172
November	12	89	101
Season total	226	630	856

A packet-freight service between Buffalo and Albany was established. Agencies were established in 11 cities. In view of the fact that only small unserviceable packet-freight ships were obtainable, satisfactory financial results were not expected or realized. The service was maintained until Nov. 1. Most of the freight offered was extremely bulky.

When navigation opened freight rates were established all-rail basis, both for local New York State traffic and for interstate traffic. The public was adverse to using the canal at all-rail rates. At the time all-rail rates were in effect on interstate traffic on the canal, the Canada Atlantic Line was maintaining a differential under standard all-rail rates of 10.8.6.4.4.3 on the various classes and commodities. All-rail rates continued until June 25, 1918, when on local New York State traffic a differential of 20% under all-rail rates was authorized. On interstate traffic for points beyond Buffalo to which we had through rates a differential under the all-rail rates of 10.8.6.4.4.3 was promulgated.

There has been a demand for a greater differential between the canal and the rail rates. In view of the actual cost of conducting the transportation on the canal during the past season, a greater differential appeared to be unjustified. The question whether there should be any readjustment of the differential is receiving consideration.

During the season we have handled a total of 194,201 tons at total gross freight revenue of $522,883.50. These tonnage and revenue figures will be slightly changed when our season is finally completed. This tonnage represents a much larger proportion of the total traffic carried on the canal than would be indicated by a comparison with the total tons carried by all transportation agencies, because a large proportion of the Railroad Administration business is through business, whereas other agencies are more largely engaged in local traffic, so that the average distance is much greater on the Railroad Administration traffic.

War's Influence on the Garbage Pail

F. C. Bamman
Consulting Engineer, Washington, D. C.; Formerly Chief of the Garbage Utilization Division, United States Food Administration

The amount of garbage collected during 1918 averaged about 10% less than that collected in 1917. Collections during the summer months of 1918 also averaged about 10% less than for 1917; compared with 1916, the reduction was 22½ per cent.

The 1918 grease content of garbage, its richness, averaged 18% less than in 1917; compared with 1916, the richness of 1918 garbage showed a reduction of about 25 per cent.

The total volume of garbage grease recovered showed a reduction of 28% from 1917 recoveries. As 1917 recoveries exceeded those of 1916 by 13%, the 1918 reduction was only 19% less than in 1916.

Changes to feeding during the year totalled 40, some of them being cities of over 10,000 population; changes to reduction totalled 3.

The amount of garbage still wasted is sufficient to produce more than 30,000,000 lb. of garbage grease, 60,000 tons of fertilizer tankage and 40,000,000 lb. of pork.

FROM a popular point of view, garbage might well be considered as a war-time discovery; something which had no existence in pre-war times. While considerable technical literature on the subject is available, and engineering journals have devoted considerable space to the garbage problem, the general public seemingly remained in ignorance that such a thing as garbage existed; probably, more correctly speaking, the general public was exceedingly indifferent to the subject; the word was in ill repute and the "garbage business" considered as all but illicit.

High prices, the shortage of food and the patriotic response to the need of war-time conservation all combined to focus attention on the garbage pail, and brought about a remarkable change in the attitude with which garbage was regarded. Archaic "sanitary regulations" prohibiting anything but the burning of this waste were set aside almost over night; others were changed to eliminate certain portions which had prevented the utilization of the waste to best advantage; the housewife recognized garbage as a necessary evil, and cut down in every way possible the material finding its way into the garbage pail, while cities having low per capita productions congratulated themselves. On the other hand, many fantastical schemes for recovering the values in garbage were set forward, and a number of failures are to be noted because of the lack of observance of even the fundamental principles underlying its utilization.

The housewife seemingly decided to solve the garbage problem once for all by eliminating garbage. She unquestionably cut down materially not only the volume of her kitchen and table refuse, but even further reduced its meat and fat content.

While elimination of garbage is undoubtedly the ideal solution of the problem this waste represents, even the best efforts of the housewife failed, and they will continue to fail until such time as the nature of our ordinary foodstuffs undergoes considerable change. Great reductions have been claimed by some cities; in fact, claims of entire elimination for considerable communities are not unknown, and any number of cities where mixed or combined collection prevails have reported their respective communities producing so little garbage as to make segregation useless. In cities having separate collection of garbage, the authorities, and even the contractors for disposal, claim as high as 50% decrease in volume. Investigation in such cases almost invariably discloses a large portion of the garbage finding some other outlet.

The plea for conservation of paper, rags, etc., has had a decided effect in cities maintaining a separate collection of such wastes. It is reasonable to suppose that this same decrease has occurred probably in all cities, and that any great reduction with single collection of all wastes is made up partly by lessened quantities of household wastes other than garbage. The high prices of byproducts have also encouraged private collectors to extend their operations, and there are very few cities which do not report that at least a part of their garbage is utilized.

The campaign for food conservation did not gain full force until late in the summer of 1917, and the first year of garbage collections under war conditions may be said to have ended with April, 1918. The year 1916, while possibly not normal because of high prices, did not have the patriotic stimulus condemning wastefulness, nor was an organized effort made to increase exports to the allies. Table I, based on data compiled by the Statistical Division of the Food Administration, shows in part that for a number of cities, and a combined population of over 26,000,000, the reduction for the year which ended April, 1918, over that for the previous year, averages 10 per cent.; the per capita figure is 17 lb. less than for the previous year. For June to October, inclusive, the summer season when garbage production is at a maximum, 1917 collections show a reduction of about 9% under 1916, 1918 shows about 10% less collected than during 1917, while a comparison of the summer season of 1918 with that of 1916 shows a decline of 22½% in collections.

The data given in Table I include reports from a number of cities known to be using a mixed collection system. It is not known how the garbage content of

TABLE I. WAR-TIME REDUCTIONS IN THE AMOUNT OF GARBAGE COLLECTED FOR A NUMBER OF THE LARGER CITIES OF THE UNITED STATES

	Number and Population of Cities Reporting				Tons of Garbage Collected				Relative Amount Collected during the first year named, collection during that last named being taken as equal to 100			Per Capita Production (Given in pounds per capita per year)			
	1917		1918		From Population in Col. No. 3		From Population in Col. No. 5		1917 to 1916	1918 to 1917	1918 to 1916				
Month (1)	Number (2)	Population (3)	Number (4)	Population (5)	1916 (6)	1917 (7)	1917 (8)	1918 (9)	(10)	(11)	(12)	1916 (13)	1917 (14)	1917 (15)	1918 (16)
Jan.		......	83	21,302,026	....	....	182,048	143,841	....	79	....	.....	....	205	162
Feb.	..	....	76	19,559,589	....	....	143,975	128,327	....	89	....	....	....	177	158
Mar.	..	....	77	20,243,103	....	....	154,799	154,486	....	100	....	....	....	183	183
Apr.	..	....	86	23,975,056	....	....	171,437	175,495	....	104	....	....	....	171	176
May	..	....	72	21,123,545	....	....	148,115	153,667	....	104	....	....	....	169	175
June	34	17,014,273	82	22,785,713	156,060	143,000	188,043	179,771	92	96	86	220	202	198	189
July	59	21,152,943	67	21,132,451	217,816	193,357	198,939	183,315	89	91	89	247	220	328	219
Aug.	69	21,792,365	69	20,276,331	243,771	225,927	192,727	174,057	93	90	77	268	249	228	206
Sept.	81	22,942,009	72	22,415,121	251,009	225,045	204,569	176,959	90	86	72	263	236	219	189
Oct.	83	22,365,024	74	22,764,743	224,893	208,742	198,241	169,074	92	85	74	242	224	210	178
Nov.	82	22,964,069			212,296	190,161	.....	.....	89		.	222	199	....	....
Dec.	78	22,371,922			190,280	165,910	.....	....	87	.	..	204	178	....	....
Total for year ending with April		...		26,034,685	.	....	2,609,134	2,388,932	....	90.2	....	....	....	200	183
Total for year ending with October		...	..	21,659,473	......	....	2,185,469	1,995,063	....	91.3	....	....	....	202	184
Total for period June to October, inclusive		21,053,323		21,674,872	1,093,547	996,072	982,519	883,176	91.1	90.0	78.5	249	228	218	195

NOTES—Due to failure to receive reports, evident errors, etc., the total population reporting has changed each month. The per capita figures given for 1916 (Col. No. 13) and in the first of the two columns headed 1917 (Col. No. 14) have been determined by using the population reporting during 1917 (Col. No. 3); those for 1918 (Col. No. 16) and in the last of the two columns headed 1917 (Col. No. 15) are based on the population reporting during 1918 (Col. No. 5).

For purposes of comparison with annual per capita productions, the figures given in columns Nos. 13, 14, 15 and 16 are the monthly per capita figures (production in pounds divided by population) multiplied by 12.

The relative amounts given in columns Nos. 10 and 11 have been determined by the equation—production in last year named is to production in first year named as 100 is to x. The relative amounts given in column No. 12 have been determined by multiplying the 1916 production by the 1918 population and the 1918 production by the 1916 population and applying the above equation.

such mixed collections was obtained, and it is doubtful, from the per capita figures reported, whether any attempt has been made even to estimate the garbage content of the total material collected. The data collected by the Statistical Division again emphasize the lack of uniformity in waste-production records.

The detailed figures on which Table I depend show 81 cities with reduced collections. The four showing the greatest percentage of reduction either collect combined wastes, or the validity of their records is questionable. Buffalo, N. Y., stands fifth on the list with a reduction of 29 per cent.; Chicago is 14th with a 25% reduction; Boston and Detroit show a 12% reduction. The remainder of the larger cities show reductions of less than 10 per cent. Of the cities showing a reduction of over 25 per cent., six collect garbage and their household wastes combined, or have poorly organized collection systems. The remaining seven cities are believed to have reasonably accurate figures, the reductions being 40, 33, 29 (4 cities) and 26 per cent.

Table II shows detail figures, covering the same periods as Table I, for certain larger cities separately collecting this garbage. It is rather significant that the relative figure of this table is 93.1, denoting a reduction of less than 7%, whereas Table I shows almost 10 per cent. This seems to bear out the idea that large reductions reported are due to decrease in wastes other than garbage.

Buffalo, which had a high percentage reduction, is omitted. The per capita figures for this city show 93 lb. for 1916-1917 and but 66 lb. for 1917-1918. It is felt that this per capita production is so low as to indicate that a large part of the garbage found some other outlet and was not reported with the city figures. Chicago and St. Louis have also been omitted. The data for St. Louis show a reduction of about 13%, the per capita figures being 98 and 85 lb., respectively. Private collectors operate in St. Louis to no inconsiderable extent; their operations increased materially with the increase in the price of pork, and have so reduced the amount of garbage handled at the reduction plant as to compel the operating company to advise the city of its intention to close the plant.

The omitted data on Chicago are very illustrative of the danger of reliance on per capita figures. The city reports show a tonnage of 124,496 in 1916-1917 and 93,235 in 1917-18. On a per capita basis this gives 100 lb. and 75 lb., respectively. While Chicago has always been credited with having a low per capita production, the figures used in such cases have invariably been based on the amount of material being collected by the city. As a matter of fact, these figures represent only such material as finds its way to the municipal garbage

TABLE II. GARBAGE COLLECTED DURING YEAR ENDING APRIL, 1918, COMPARED WITH COLLECTIONS FOR YEAR ENDING APRIL, 1917

City	Population	Tons Garbage 1916–1917	Tons Garbage 1917–1918	Pounds Per Capita 1916–1917	Pounds Per Capita 1917–1918	1917-18 Collections Compared with 1916-17, the Latter Taken as 100
Baltimore	593,000	37,915	24,685	128	117	91.5
Boston	781,628	52,650	46,335	135	118	88.0
Bridgeport	172,113	19,897	18,166	231	211	91.3
Cincinnati	416,300	40,692	34,103	195	164	83.8
Cleveland	674,073	59,708	55,466	177	164	92.9
Columbus, O.	220,000	20,393	17,295	185	157	84.8
Dayton	155,000	16,621	15,677	214	202	94.3
Detroit	750,000	72,785	64,270	194	172	88.3
Grand Rapids	140,000	8,678	7,359	124	105	84.8
Indianapolis	271,758	23,267	19,929	171	147	85.6
Los Angeles	600,000	51,062	47,345	170	158	92.7
New Bedford	118,158	10,162	8,774	172	148	86.3
New York	5,377,456	487,451	445,237	182	166	91.3
Philadelphia	1,709,518	101,678	114,160	119	134	112.3
Pittsburgh	579,090	73,758	72,612	255	251	98.4
Rochester	275,000	30,782	25,926	224	189	84.2
Toledo	220,000	23,971	22,180	218	201	92.5
Washington	400,000	46,293	46,732	232	234	100.9
Total	13,453,094	1,177,763	1,096,251	175	163	93.1
Total of 96 cities (from Table No. I)	26,034,685	2,609,134	2,388,932	200	183	90.2

plant, and practically no hotel, restaurant or lunchroom garbage is included. Reports from private collectors in Chicago show at least an additional 40,000 tons privately reduced during the year which ended last April. This alone is sufficient to increase the per capita figure from 75 to more than 100 lb. Even these figures do not take into account the amount of garbage hauled from the city and used for hog feeding, neither is included such garbage as is burned, an investigation of garbage collections in Chicago indicating that last July a population of over 300,000 was disposing in privately owned incinerators of its kitchen and table refuse.

Table III gives in detail collections during 1916, 1917 and 1918 for New York, Chicago, Detroit, Columbus and 16 of our larger cities having separate collection of garbage. The severe weather conditions of last winter show their influence on the amount of garbage collected and are the cause of some fluctuation in per capita figures. The surprisingly low figure for Chicago in May, 1917, is due to labor trouble at the plant, it having been necessary to dump a large part of the material collected during that month.

For convenience in comparing with annual figures, the monthly per capita figures in each of the tables have been given in terms of pounds per annum. The actual per month production can be obtained by dividing the given figure by 12.

It has long been recognized that the true measure of a conservation effort lies in the reduction of the grease content of the garbage rather than in its volume. Many of our vegetable foods contain a considerable percentage of material not at all suitable for human consumption when purchased. This must necessarily find its way into the garbage pail, and a season of cheap vegetables may increase garbage production even when conservation has been most carefully observed.

The data accumulated for the fertilizer administration include a very complete record of garbage grease recovery during several years past. These data, however, were obtained under Congressional authority, and detailed information cannot be made available. Such restrictions, however, do not apply to totals of production, etc. Table IV has been made up from this record and gives data for five municipal plants and for all plants handling garbage, whether municipal or privately owned. These comprise about 70 plants, in varying degrees of efficiency.

TABLE III COMPARISONS OF GARBAGE COLLECTED IN 1916, 1917 AND 1918 SEPARATELY FOR FOUR CITIES AND COMBINED FOR SIXTEEN CITIES

	New York (Population, 5,377,454)			Chicago (Population, 2,497,722)			Detroit (Population 750,000)			Columbus (Population, 220,000)			Total of 16 Large Cities, (Combined Population, 13,181,000)		
	1916	1917	1918	1916	1917	1918	1916	1917	1918	1916	1917	1918	1916	1917	1918
January	33,100	32,975	24,935	9,757	7,897	2,388	5,859	5,816	3,947	1,569	1,365	1,058	.....	81,850	63,579
February	29,800	26,399	22,350	8,063	5,904	4,347	5,123	4,756	3,734	1,475	1,019	1,062	....	70,418	59,992
March	31,980	29,995	29,283	8,585	5,936	6,051	5,549	4,860	4,408	1,502	1,040	1,328	....	70,627	73,805
April	34,600	31,692	33,650	9,310	6,182	6,222	5,735	4,802	4,373	1,566	1,219	1,317	....	74,861	78,127
May	45,350	36,602	37,422	11,177	2,990	7,434	6,572	5,357	4,888	1,910	1,177	1,389	.	82,286	86,558
June	48,099	44,628	39,800	12,826	8,386	8,374	6,595	5,733	5,809	1,865	1,262	1,212	113,796	103,952	89,033
July	52,173	49,295	41,550	14,302	11,239	9,503	6,407	6,318	6,319	2,388	1,674	1,356	122,782	111,523	98,355
August	53,368	51,545	41,209	16,093	12,583	10,079	7,032	6,636	6,969	2,690	2,176	1,696	133,314	121,073	106,290
September	48,934	45,903	37,422	14,774	12,142	9,268	7,222	6,786	6,686	2,285	2,123	1,509	127,643	115,583	97,418
October	44,639	42,786	32,835	12,462	11,259	8,141	6,635	6,608	7,004	1,900	1,778	1,291	117,382	110,873	92,584
November	39,299	35,551		9,663	8,967	6,882	5,796	6,042	6,328	1,476	1,287	1,236	103,163	92,456	81,008
December	34,691	28,739		7,280	6,661	6,285	5,907	4,996	.	1,236	1,052	1,176	92,449	83,980	......
Total	496,033	456,110	a400,456	134,292	100,146	84,974	74,432	68,710	b65,465	21,862	17,172	15,630	c810,529	1,119,482	d926,749

PER CAPITA PRODUCTION, BY MONTHS

In Terms of Pounds per Capita per Year
(Production per capita per given month multiplied by 12)

	New York 1916	1917	1918	Chicago 1916	1917	1918	Detroit 1916	1917	1918	Columbus 1916	1917	1918	16 Cities 1916	1917	1918
January	148	147	111	94	76	23	188	186	126	171	149	115	....	149	116
February	133	118	99	78	57	42	164	152	119	161	111	116	....	128	109
March	143	134	131	82	57	58	177	156	141	164	113	145	....	129	134
April	155	142	150	89	59	60	180	154	140	171	133	144	....	136	142
May	201	163	167	107	29	71	210	172	156	208	128	151		150	158
June	214	199	178	123	80	80	211	183	183	204	138	132	208	189	162
July	233	220	186	137	108	91	205	202	202	261	183	148	224	203	179
August	238	230	184	154	121	96	225	212	223	294	237	185	243	221	194
September	218	205	167	142	117	89	231	217	214	249	232	164	232	210	177
October	199	191	146	120	108	78	212	211	224	207	194	141	214	202	168
November	175	159		93	86	66	186	193	202	161	140	135	188	168	148
December	155	128		70	64	60	189	160		135	115	128	168	153	...
Average	185	170	a149	108	80	68	198	183	b174	199	156	142	c211	170	d154

RELATIVE AMOUNTS OF GARBAGE COLLECTED

that of the year last given being taken as 100

	New York 1917 to 1916	1918 to 1917	1918 to 1916	Chicago 1917 to 1916	1918 to 1917	1918 to 1916	Detroit 1917 to 1916	1918 to 1917	1918 to 1916	Columbus 1917 to 1916	1918 to 1917	1918 to 1916	16 Cities 1917 to 1916	1918 to 1917	1918 to 1916
January	100	75	75	81	30	23	99	68	47	87	78	67	..	78	..
February	89	85	75	73	74	54	93	78	73	69	.	72		85	..
March	94	98	92	69	102	71	88	91	79	69	...	88		104	..
April	92	106	97	66	101	67	84	91	76	78	...	84		104	.
May	81	102	82	27	249		82	91	74	62		73		105	.
June	93	89	83	65	100	65	87	101	88	68	96	65	91	86	78
July	94	84	80	79	85	66	92	100	92	70	81	57	91	88	80
August	96	80	77	78	80	62	94	107	99	81	78	63	91	88	80
September	94	81	76	82	76	63	94	98	93	93	71	66	91	89	76
October	91	77	74	90	72	65	100	106	106	93	73	68	94	83	79
November	90			93	77	71	104	105	109	87	96	84	89	88	78
December	83			92	94	86	85	.	.	85	90	95	91	..	
Average	92	a88	a81	75	85	63	92	b95	b88	78	91	72		..	

a November and December estimated. b December estimated c Total for seven months d Total for eleven months.

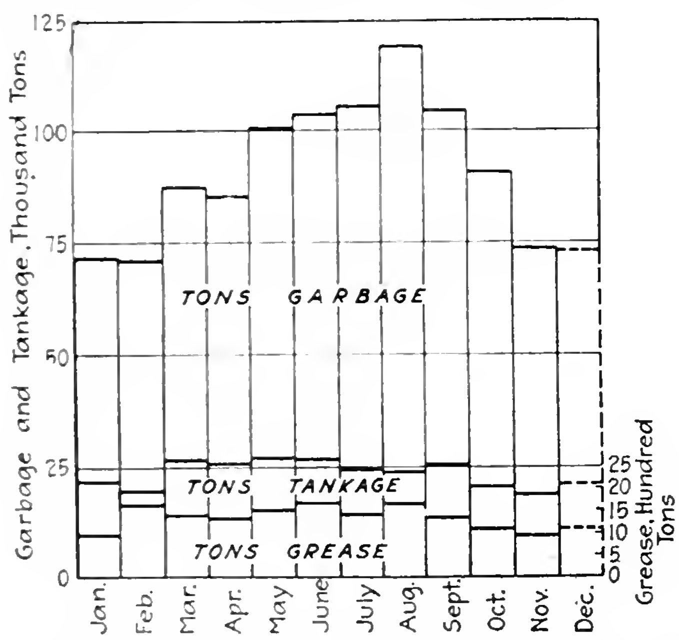
It will be noted from Table IV (see next page) that in both instances the amount of garbage treated during 1917 is greater than that handled during either 1916 or 1918. The amount of grease recovered decreased each year in the case of the municipal plants, while the total recovered by all plants was greatest in 1917. In spite of this increase in grease recovery, the yield per ton of garbage was less in 1917 than in 1916, the richness of the garbage decreasing each year. The average recovery per

TABLE IV. GARBAGE REDUCED, GREASE RECOVERED AND TANKAGE MADE—1916, 1917 AND 1918

	Total of Five Municipal Reduction Plants			Total of All Municipal and Privately Owned Reduction Plants		
	1916	1917	1918	1916	1917	1918
Tons garbage disposed of	177,555	194,514	178,302	1,026,764	1,275,447	1,118,000
Pounds grease recovered	9,550,390	8,561,454	7,348,131	69,051,340	78,127,027	56,338,000
Tons tankage produced	41,101	32,502	25,382	129,790	167,569	159,300
Pounds grease recovered per ton garbage	54	44	41	67	61	50
Pounds tankage recovered per ton garbage	464	334	284	253	262	286
Relative figures, 10 as base	1917 to 1916	1918 to 1917	1918 to 1916	1917 to 1916	1918 to 1917	1918 to 1916
Grease recovered	90	86	76	113	72	81
Grease per ton	81	93	76	91	82	75
Tankage recovered	79	78	62	129	95	123
Tankage per ton garbage	72	85	61	103	109	113

ton of garbage for all plants exceeds the recovery of the municipal plants alone. This is doubtless occasioned by the fact that the total figures include returns from plants handling only the better grades of garbage, plants in which the grease content runs as high as 8 and 10 per cent.

Relatively, the grease recovery per ton, or the richness of the garbage, shows a somewhat small drop. Comparing 1917 with 1916 this decrease equals 19% for the



GARBAGE REDUCED AND PRODUCTS RECOVERED IN 1918

municipal plants and but 9% for all plants. On a two-year basis—that is, comparing 1918 with 1916—the drop in richness is more pronounced, being 24% and 25% respectively.

For the municipal plants the relative volume of grease recovered is only 10% less in 1917 than in 1916, as against 19% decrease in richness. For all plants an increase is noted. On the two-year basis, 1918 compared with 1916, the decrease in volume recovered corresponds very closely with the decrease in richness, being equal (24%) for municipal plants, and 19%, as against 25% in richness, for the total of all plants.

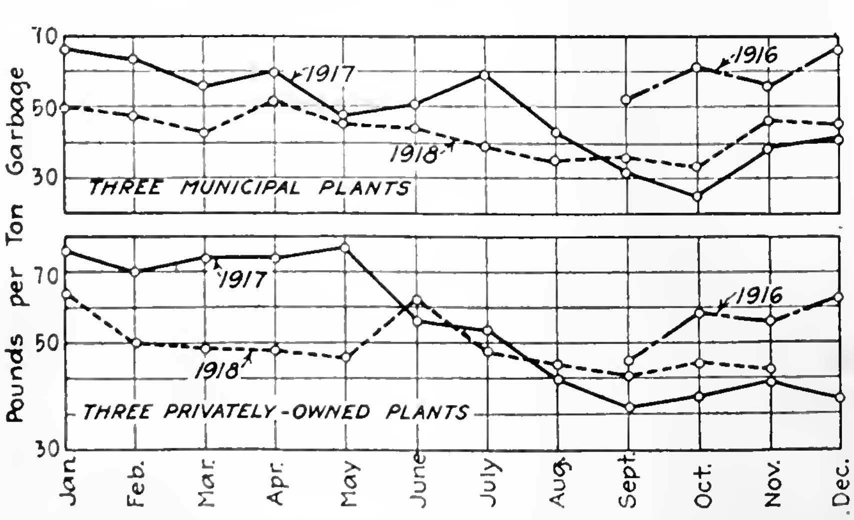
The figures for tankage recovery show surprising variation. The decrease in tankage per ton of garbage shown for the municipal plants can only be accounted for by the garbage having a greater percentage of moisture. This need not necessarily mean that a wetter garbage is being delivered, as an increase in the percentage of green material would naturally increase the moisture content and have the effect of decreasing the tankage yield. It will be noted that the volume of tankage recovered per ton of garbage is very high.

The rather low average tankage yield per ton of garbage for all plants is due to the poor recovery systems in effect at a number of such plants, and to the fact that in some instances tankage was fed to hogs while in a wet state or even pressed and used as fuel. As tankage became more valuable less wastage occurred, and it is to be noticed that the recovery increased each year.

In comparing recoveries during the periods which ended April, 1917, and 1918, collection data for which are covered in Tables I and II, the average grease recovery at five privately owned plants shows 50 lb. for the year which ended April, 1917, and but 37 lb. for the year which ended April, 1918. The reduction in richness equals 16% and the reduction in volume 17 per cent. For corresponding periods the average yield for the municipal plants at Chicago, Cleveland and Columbus was 52 lb. for the year which ended April, 1917, and 41 lb. for that which ended April, 1918. This is a reduction in richness of 21 per cent., the corresponding reduction in volume being 36 per cent. The fact that the richness in each case is higher for the municipal plants is rather surprising, each of the five privately owned plants considered having equipment equal to that of the three municipal plants named. It is believed that this difference can be accounted for by the fact that the municipal plants in every case actually weigh the material received, while in several of the privately owned plants which are considered the material treated is estimated.

A diagram shows the average grease yield per ton of garbage for three privately and three municipally owned plants. It will be noticed that in both cases the curve for 1918 begins well below that for 1917, and that the two gradually approach and finally cross. Even the last points of the 1918 curve, however, are considerably below the values for 1916.

While the curves of total production for each of these combinations of plants would show a decided break during the poor weather of last January, it is to be noticed that the January yield shows a considerable increase over that for December, 1917. The cause of this increase is probably due to bad weather, which



AVERAGE GARBAGE GREASE RECOVERY 1916-18
The three municipally owned plants at Chicago, Cleveland and Columbus are compared with three well managed privately owned plants.

caused less interference with collections in the downtown district, where richer garbage is produced, than in the outlying districts.

Curves covering the monthly tonnage reduced, the total tons of grease recovered, and tons of fertilizer tankage produced, are also given. (See diagram at the top of the next page.) Each of these curves properly ends with November, for, while blanks covering December's operations were sent out to all plants, no special effort was made to see that these were returned, and a number are still missing. The quantities handled and produced at such missing plants have been estimated and December quantities established. Such estimated quantities total 30,000 tons of garbage, 848 tons of grease and 3900 tons of tankage.

The general tendency toward conservation in food, fuel, metals, paper and other everyday commodities naturally makes the overwhelming tendency to utilize this so-called waste an outstanding feature of the year's changes in garbage disposal. Information received from various city officials indicates that no less than 40 cities of over 10,000 population have changed from some nonutilization method of garbage disposal to feeding of swine. The combined population of these 40 cities totals over 2,000,000, and their location ranges from California to New York.

In almost every instance where changes have occurred, disposal is being conducted under contract rather than by municipal forces. In one or two instances, municipal hog farms have been established, and in other cases the city has a number of feeders hauling the material collected, from some convenient central point, at a stipulated price per ton.

The year's changes from nonutilization methods to the reduction process for recovery of grease and fertilizer tankage total three, with a combined population of about 250,000. In each instance the plant established is being operated as a private enterprise.

Changes from utilization methods to nonutilization systems likewise number three, but in two of these instances the present method is due to financial difficulties, fire, etc., and these cities will very shortly be numbered among those utilizing.

The accompanying Table V gives a list of cities reporting to the Food Administration as having changed their system of garbage disposal to one of utilization. While the reported returns are official, it must be remembered that the city authorities reporting have been urged by the Food Administration to adopt utilization. It is consequently believed that in a number of instances only a portion of the garbage actually produced is being utilized. A start has been made, however, and these cities have committed themselves to a utilization method of disposal.

In addition to the tangible results indicated by the table just mentioned, there are, as further evidences of progress in garbage utilization, certain developments which should mean decreased garbage wastage during the coming year. Syracuse, N. Y., and New Orleans, La., have had garbage reduction plants authorized, and at Syracuse the plant is in process of construction; San Francisco, Cal., opened bids contemplating utilization on Jan. 20, one bid of $1.26 per ton having been obtained; Wheeling, W. Va., recently entered into contract for disposal by feeding; Norfolk, Va., Newark, N. J., and a number of other cities are considering propositions submitted to them by various corporations planning for disposal by feeding. In fact, a number of the replies being received by the Food Administration from cities not utilizing are very apologetic in tone. In a number of such cities it is reported that the garbage produced by hotels and larger institutions is being hauled away by farmers who have become interested in garbage feeding.

The amount of garbage still available for utilization is enormous, and the possibilities of further utilization of garbage include the following:

1. Due to poor separation, incineration, etc., in cities having reduction plants available, it is estimated that there are being wasted per annum 6,000,000 lb. of grease and 15,000 tons of fertilizer tankage.

2. Some 20 cities of over 100,000 population, and therefore large enough to support a reduction plant, are not utilizing their garbage. Their combined population exceeds 5,000,000, and it is estimated that 30,000,000 lb. of grease and 60,000 tons of fertilizer tankage are lost per annum. These cities, in addition, also destroy large amounts of paper, rags, etc., readily salvable.

3. The poor separation, etc., already mentioned affect the efficiency of garbage feeding farms to even a greater extent. Poor methods of handling are also very prevalent. Pork production could be increased approximately 100% by better handling in the household and on the farms.

4. Some 300 cities of between 10,000 and 100,000 population and totalling over 5,000,000 in population are wasting sufficient garbage to produce from 30,000,000 to 40,000,000 lb. of pork every year. In many instances these cities are also using fuel for disposal and wasting valuable waste paper, rags and other readily salable materials.

The year's changes from nonutilization methods mean that from 15,000,000 to 20,000,000 lb. of pork per annum will be produced from garbage formerly wasted. The changes to reduction should increase our garbage-grease production about 1,500,000 lb. per annum and our fertilizer tankage production about 3500 tons. It must be remembered that the addition of this amount of pork, grease and fertilizer will be accomplished without the use of any of our existing fats or other commercial commodities. They represent recoveries from a material formerly regarded as worthless, and wasted.

Whether the present attitude toward garbage wastage will continue, or whether the setting aside of war-time restrictions will mean a return to the old standard of

TABLE V. CITIES HAVING CHANGED FROM A NONUTILIZATION METHOD OF GARBAGE DISPOSAL DURING 1918

CHANGES TO FEEDING

Cal.	Alameda	Iowa	Des Moines	N. Y.	Oneonta
	Santa Cruz		Mason City	N. Car.	Wilmington
	Santa Jose	Kans.	Leavenworth	Ohio	Coshocton
Ill.	Bloomington	Ky.	Covington		Lima
	Cairo		Louisville	Ore.	Portland
	Moline	Mich.	Holland	Penn.	Altoona
	Peoria		Kalamazoo		Coatesville
	Rock Island		Owosso		Easton
	Rockford	Minn.	Brainard		Lebanon
	Springfield		Minneapolis	Utah	Salt Lake City
Ind.	Goshen	Miss.	Jackson	Wis.	La Crosse
	Logansport	Mont.	Great Falls		Madison
	South Bend	N. Y.	Cortland	W. Va.	Fairmont
			N. Tonawanda		

CHANGES TO REDUCTION

Fort Wayne, Ind.; Dubuque, Iowa; Reading, Pa.

quantity and quality of garbage, depends largely on how strongly the spirit of economy and conservation has impressed itself on the public mind. The general feeling throughout the Food Administration seems to be that at least a part of the lesson that has been learned will be slow in wearing off.

Probably the low level in garbage production has been reached, grease content certainly seems to have reached a level, and any further reports on the subject of utilization should show an upward trend of both production and grease curves.

The desire to utilize all possible materials will unquestionably carry beyond the present campaign for conservation. Far more is known of the values contained in so-called waste products than before the war. Probably no inconsiderable factor, as affects garbage utilization, will be the organizations now caring for the garbage accumulating at Army camps, practically all of which is utilized. As such camps are abandoned it is believed that the men interested in these ventures will turn their attention to obtaining the garbage produced in our cities. The number still not utilizing should promise them a ready opportunity to continue along the present line of their endeavors, and the coming year should show an even greater advance in garbage utilization than 1918 has shown.

Shallow Brick Stand Up Well On Cement-Sand Base

Patching Brick on Ramps of Pennsylvania Station, New York, Shows Them to Be Worn Nearly Through Without Breaking

THE capacity of shallow vitrified brick for standing up under heavy traffic, when laid upon a cement-sand bed, is exemplified in the ramps of the Pennsylvania Station at New York, where sections eight years old were recently replaced. Investigation showed that in places the brick had worn more than half through without the top surface being shattered, although sustaining a traffic uncommonly heavy, as shown by census. The construction of these drives was noted in *Engineering Record* of Oct. 9, 1915, p. 456, and a traffic census of them in the issue of July 8, 1916, p. 54. Following is a brief description of the original construction and the replacement that has been made.

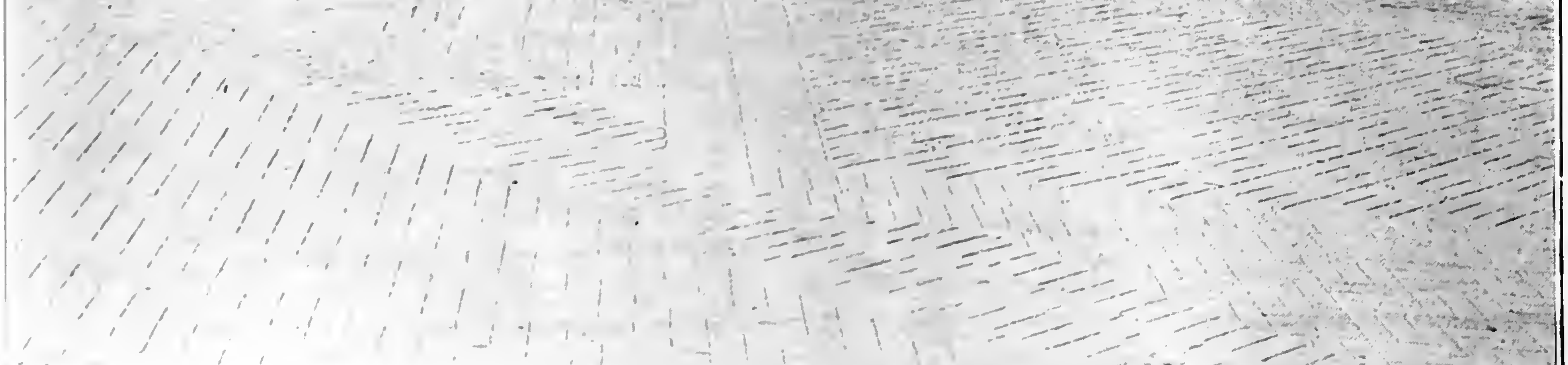
These ramps are the first pavements of any note laid in the monolithic or semi-monolithic type of construction. There had been isolated cases where brick had been laid in this manner, but there had generally been some features, such as subsequent covering with bituminous material, which made it difficult to determine the value of the construction. The ramps were laid in 1910, and when in 1914 or 1915 a controversy arose over monolithic construction, they were extensively cited as an example by those favoring that type.

To the present time there has been no information, except hearsay, as to the method of construction of these ramps, and those who favored the sand-cushion type of brick construction have expressed doubt as to the manner of laying. Now, however, the pavement having been opened, a complete description can be given.

The foundation of the pavements is of concrete and is tied in with the rest of the station. Upon this about 1 in. of cement and sand, mixed in the proportions of 1:3 and slightly moistened, was spread to form a bed for the brick. Clearfield fire-clay brick were used for the work, and were made in a special shape, being $7\frac{1}{4}$ x $2\frac{3}{8}$ in., $2\frac{1}{4}$ in. in depth. They were made without lugs, and all four surface corners were chamfered to give a hillside effect upon the grades and bring out the artistic figures in which they were laid.

Upon the cement-sand bed, the brick were laid "herring-bone" by hand, each block being bedded with a hammer to the proper elevation. A view of one of the ramps, showing the figures designed by the architect, is shown. In laying the brick care was taken to give spacing to allow for the penetration of the grout filler.

Heretofore it was supposed that the filler consisted of portland cement and fine sand, mixed in the proportions of 1:1, but examination of samples indicates that it was



BRICK WITH BEVELED EDGES LAID IN FIGURES TO GIVE ARCHITECTURAL EFFECTS

grouted with neat cement. This conclusion is also verified by statements of the contractor who did the original work and who has made the repairs. Even with the care taken to space the blocks and the use of pure cement filler, there were many jonts where the grout did not penetrate to the bottom. While the pavement was not worn through or shattered, with the exception of a few small spots, it was necessary to replace the brick at the entrance recently, on account of the repaving of 7th Ave., which necessitated a slight change in grade.

The driveways have been subjected to a tremendous traffic since being laid in 1910. The traffic census referred to above, taken in 1916, showed that 4,492 vehicles passed over the 33rd St. ramp in an average 24-hour period, while 3384 passed over the 31st St.

NEW BRICK PLACED UPON SMOOTH SURFACE OF OLD PAVEMENT SHOWS EXTENT OF WEAR

ramp. This traffic, in approaching the grade at high speed and setting the brakes, had gradually worn into the brick, as shown in the accompanying photograph, where a full-sized brick is placed on the unbroken surface. This wear was further increased by the use of sand and other means to overcome slipperiness after

NEW WORK MATCHES UP WELL WITH OLD SURFACE

the hillside effect had worn off. Examination of some of the brick which had been removed indicated that in some places even greater wear had occurred without shattering the brick. The surface at the point photographed was in excellent condition. The contention of

WHERE BRICK CONNECTED WITH NEW STREET GRADE EXTRA BED WAS NECESSARY

some that much thinner brick than is customary might be used upon monolithic and semi-monolithic types of construction is thought to be justified by the condition of these drives.

The recent replacement has been done in the same manner as the original work, but the brick are of a different make and are a deeper buff in color. The joint made with the old paving is shown in an illustration. Traffic was allowed on this surface three days after grouting, without any apparent injury, a specification which would have been considered very dangerous with the old sand-cushion type, most specifications requiring from 10 to 15 days, even with the new type.

Another view shows the extra cement-sand bed required to bring the driveways up to the new street grade. Unequal depths of sand bed were also thought dangerous in the old construction.

The work was done under the supervision of the Pennsylvania R. R. engineers, John C. Hendrickson, of New York, being the contractor for both the recent and the original construction.

Wisconsin Highway Engineer Reports Progress

A. R. Hirst, state highway engineer of Wisconsin, reports that the last quarter of last year was the best quarter in the amount of highway improvement completed.. This has been accomplished in spite of the fact that on Aug. 5 the United States Highways Council totally deprived highway construction of the principal materials used, such as cement and steel, except where priority orders had been approved. The commission had already cut down the amount of work to be done to about 40% of that previously contemplated. The total amount of construction for 1918, exclusive of Federal-aid projects, is estimated as follows: Grading, 640 miles; crushed-stone road, 110 miles; gravel road, 175 miles; concrete road, 38 miles; shale road, 25 miles; miscellaneous, 15 miles; a total of 1003 miles. Total state-aid expenditures are estimated at $2,400,000. The Federal-aid projects under construction, either by contract or day labor, total 87.36 miles, at an estimated cost of $788,300. These are in various stages of completion. Maintenance work under the new patrol system established last year has been proving very successful.

Omaha Track-Elevation Bridges Vary in Type to Meet Local Conditions

City Requirements and Topography Influence Designs—Steel and Concrete Spans Used, Some With Temporary Floors—Precast Concrete Drains on Ballasted Decks—Steel Girders Have Concrete Facing

FOUR types of bridge superstructure and different types of permanent and temporary bridge floors are included in a short stretch of track elevation on the Missouri Pacific R.R. at Omaha, Neb. This unusual variety and combination were necessitated mainly by the action of the city in making certain controlling requirements, through its engineering department. A sidehill location also introduced conditions influencing the design.

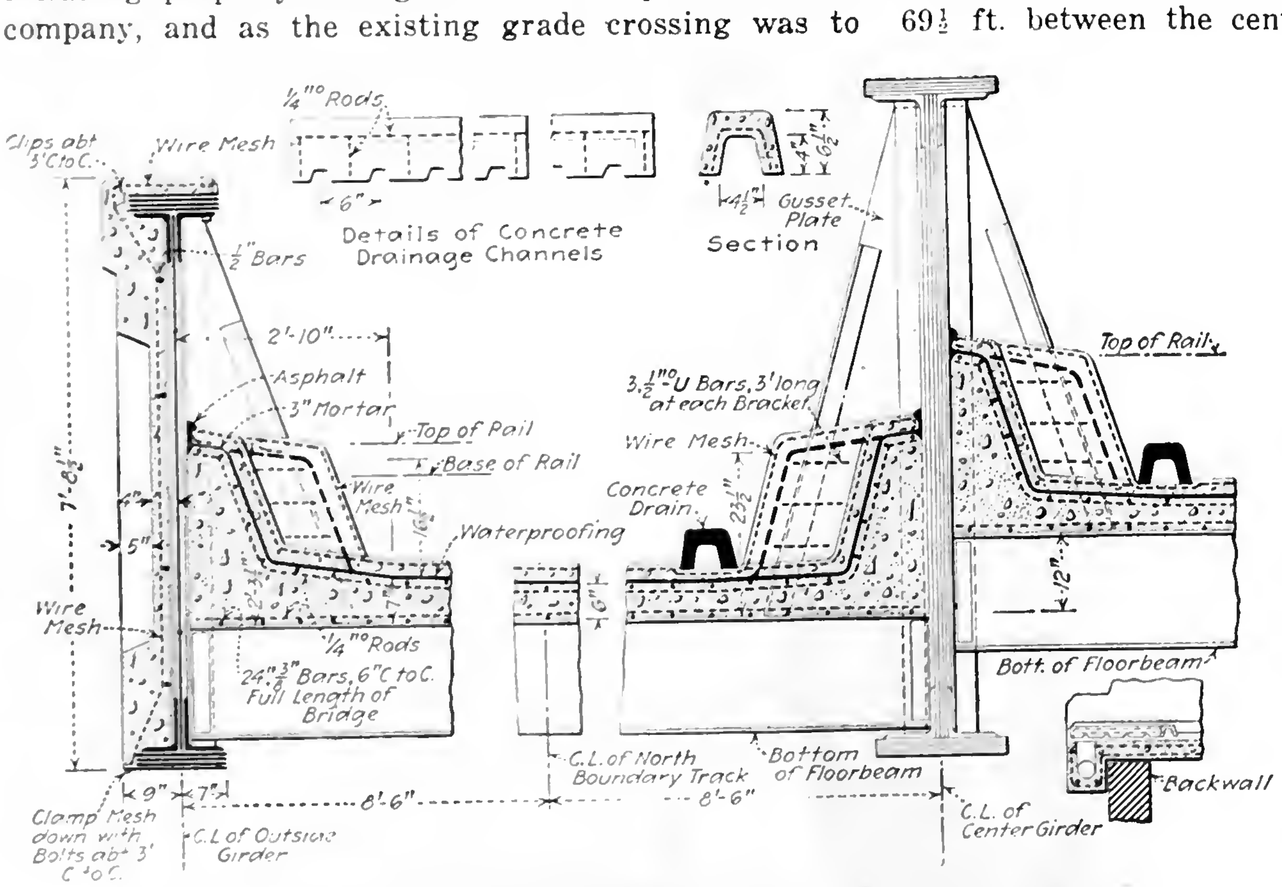
Of the three structures now built one is a steel single-span three-girder through bridge; the second is a steel single-span two-girder through bridge; the third is a three-span deck bridge having an I-beam central span flanked by concrete slab sidewalk spans. For the sake of appearance, paneled concrete facing is used on the outer or street sides of the steel girders of the first two bridges, while the third has concrete fascia girders. Ballasted decks are provided for in all cases, but, as the track elevation is to be extended later, two of the bridges have temporary, shallow, unballasted floors to provide for the grade of the present run-off inclines.

Alternative projects for elevation of the tracks and elevation of the streets were considered in the earlier stages of this problem for eliminating grade crossings, the latter plan being adopted as preferable when several streets were involved. On the west side of the city the Missouri Pacific R.R. crosses Dodge St., a main thoroughfare with a street-car line. About 10 years ago the city passed an ordinance requiring the company to build a viaduct to carry the highway and car tracks over the railroad. As the entire expense, including property damages was to be placed on the company, and as the existing grade crossing was to be left open after the construction of the viaduct, the company made objection. The matter was carried through the courts until in 1915 the United States Supreme Court gave a decision in favor of the city.

A demand for grade separation at adjacent streets had arisen in the meantime, however, and in view of this development an agreement was reached in 1916. This covered the elevation of the tracks for a distance including three streets, the elevation to be extended later as might be necessary. The cost of the work, as estimated at that time, while greater than that of the proposed viaduct for Dodge St., was less than the cost of viaducts at all three streets, which latter arrangement was undesirable from the city's standpoint. All expense had to be borne by the railroad in any case.

Conditions as to span and type of bridges were imposed by the city authorities in its approval of this new project, and several plans were submitted by the railroad before designs satisfactory to the city were perfected. Single spans were required in two cases, but intermediate bents were allowed for the third crossing. A headway of 14 ft. was required, this being considered ample for clearance of trolleys on the Dodge St. car line. All bridges are designed for ballasted decks, with E-55 loading and the Schneider formula for impact allowance.

Different levels of parallel tracks were required at the Dodge St. bridge in order to admit of carrying the slope of the street approach on the uphill side halfway under the bridge. This condition led to the adoption of a three-girder type of bridge having two independent decks at different levels. A single span of $69\frac{1}{2}$ ft. between the centers of end bearings provides for a 40-ft. roadway and two 13-ft. sidewalks. The depth of the outer girders is 7 ft. $0\frac{1}{2}$ in., while that of the middle girder is 8 ft. $4\frac{1}{2}$ in. These girders are spaced 17 ft. on centers and have framed between their webs the transverse 18-in. I-beams, spaced $18\frac{1}{2}$ in. on centers, on which the deck slab is laid. This reinforced-concrete deck slab is from 5 to 7 in. thick, covered with a four-ply waterproofing membrane of asphalt and felt, over which is a 3-in. protective layer of 1:3 mortar having wire mesh embedded near the top surface. Form boards were fitted between the top flanges of the I-beams, so that the slab does not extend below the tops of



DODGE STREET BRIDGE HAS THREE-GIRDER SPAN WITH DECKS AT DIFFERENT LEVELS

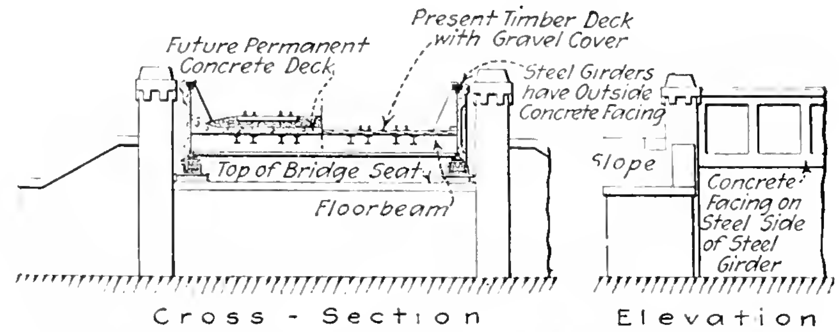
these beams. Blocks on top of the I-beams support the bottom reinforcing rods. The concrete is carried around the gusset plates, being reinforced here by horizontal stirrups or U-bars. Where the slab extends over the back walls of the abutments it rests on ⅛-in. zinc plates which permit of longitudinal movement in the expansion and contraction of the deck. The stone ballast is about 8 in. deep under the ties and is filled level with their tops.

In each deck the surface slopes toward a shallow longitudinal gutter near the central girder. In this is a precast concrete drain of inverted trough section, having slots in the edges to form inlets. This is in 6-ft. lengths, the two end lengths being closed at their outer ends. At one end of the deck is a 6-in. elbow in each gutter, opening into a precast concrete transverse drain inclosed in a rib under the end of the deck slab and lying behind the back wall of the abutment. This drain is inclined and has a screw plug at the upper end, to permit cleaning. At its lower end it discharges into a concrete downspout leading to a concrete drain on top of the footing, which in turn leads to a sewer catchbasin. These footing drains are used at all the bridges and extend the full length of the abutments and wing walls. They are slotted so as to take seepage coming through the earth fill.

Concrete masking or casing of the girders is for appearance only, and is applied therefore only to the outside of each outer girder. It has a thickness of from 4 to 9 in., and covers the top flange and web stiffeners, but not the bottom flange. The bottom cover plate extends 2 in. beyond the other plates and forms a shelf which supports the concrete and to which the reinforcing mesh is bolted. This mesh is wired to rods carried in holes in the outside web stiffeners. It is secured to the inner edge of the top flange by double-nut bolts, the lower nuts keeping it out of contact with the plates. Clips serve a similar purpose on the outer edge of the top flange.

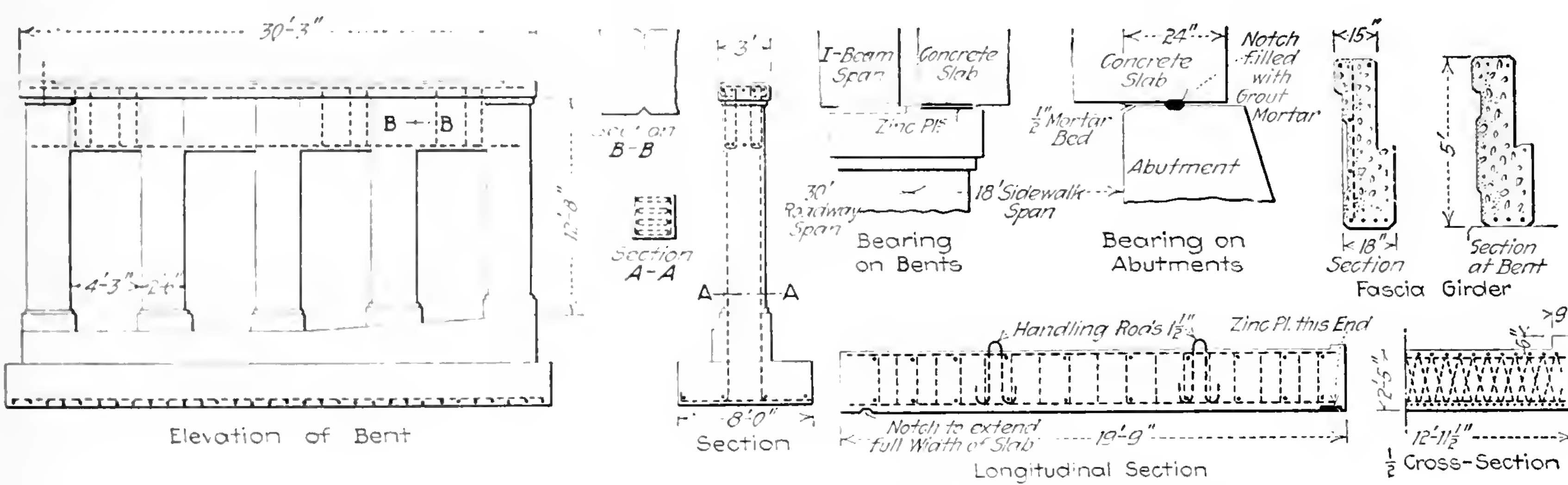
This masking concrete is a 1 : 2 : 3 mix, using a stone up to ¾ in., or sidewalk chips. It was placed in wood forms, and after their removal was finished by rubbing with carborundum bricks.

A single-span through-girder bridge is used also at Farnam St., with plate-girder floor-beams spaced 7 ft. on centers. In this case, however, there are only two girders, and these are almost 77 ft. between centers of end bearings, as the crossing is on a skew. They are 9 ft. 6½ in. deep and are masked with concrete, as described above.



FARNAM STREET BRIDGE HAS TEMPORARY TIMBER DECK TO KEEP RAILS AT LOW ELEVATION

Shallow floor construction of a temporary character is employed here, in order to keep the rail level as low as possible for the inclined run-off at the end of the track elevation. This floor has four 12-in. I-beam stringers under each track, carrying a solid deck of 6-in. transverse timbers to which the rails are spiked. Spaces between the tracks and between tracks and girders are closed with 3-in. plank. The whole deck is covered with No. 20 sheet iron and a 2-in. layer of gravel mastic. At such future time as track elevation may be extended over the next street, Leavenworth St., a concrete deck will be laid on the floor-beams and stringers, carrying ballasted track at normal grade.



DOUGLAS STREET BRIDGE COMBINES I-BEAM AND CONCRETE SLAB SPANS

An entirely different construction is employed for the Douglas St. bridge, as the city permitted the use of curb-line bents. This allowed the use of short spans, and the adoption, largely, of concrete. The bents are of concrete, having square columns spaced 6 ft. 9 in. on centers, supported on continuous footings and carrying cap girders.

For the roadway span, 30 ft. 1 in. between centers of bents, there are under each track four longitudinal 30-in. I-beams, designed to carry a concrete deck slab and ballasted track. At present they are covered with a solid 3-in. plank floor protected against cinders by a metal and mastic covering as at Farnam St. Bridge ties are laid directly on this floor, being secured to the I-beams by hook bolts.

Concrete slabs are used for the two sidewalk spans of 18 ft. 4¼ in. These were cast in place. Each span is composed of two slabs, 20 x 13 ft., 29 in. thick. Each slab is for a single track and has curbs on both sides to retain the ballast, which will be placed when the tracks are raised to grade. At present, bridge ties

are laid on six lines of 2 x 10-in. planks under each track, the planks being held in place by 2 in. of lean concrete filled between them. The ties are secured by bolts passing through outside guard timbers and anchored to the slab.

Expansion movements are provided for by ⅛-in. zinc plates embedded in the lower faces of the slabs and resting on similar plates in the cap girder of the bent. At the abutment the slab has a key registering with a groove along the top of the bridge seat, which is filled with grout and forms a key or anchor for the fixed end. The slab is made with a 1:2:4 concrete, and the bottom has 2 in. of 1:2 mortar. Its reinforcement consists of top and bottom bars with W-shaped stirrups extending the full width.

A continuous parapet slab or fascia girder of concrete extends the full length of the structure on each side, thus masking the span and deck construction. These girders are 5 ft. deep, with coping and paneled outer face. They rest on zinc sliding plates on both abutments and one bent, being anchored by dowel rods to the cap girder of the other bent.

All Foundations Are Wood Piles

The foundations of all of the bridges consist of wood piles driven to refusal, with a penetration of 20 to 35 ft. in black soil and spongy clay. These carry a load not exceeding 15 tons per pile. The concrete abutment and wing walls are of semi-gravity type, and are made with stone and of 1:2½:5 mix. The footing slabs were built first, with grooves and steel dowel rods in the top to bond with the walls. Reinforcing bars are placed in the bottom of the footings; also in the rear of the abutments and wings and in the back walls of the bridge seats. Expansion joints are made at the connections of the wings with the abutments. At the two steel bridges ornamental posts on the abutments conceal the ends of the girders.

Good appearance of the exposed surfaces of concrete was given by hand rubbing with carborundum blocks as soon as possible after removal of the forms. The part being rubbed was kept wet by sprinkling with a large brush, the rubbing and sprinkling being continued until the form marks disappeared and a film of cement was brought to the surface. This film was smoothed out or grained with a damp brush.

The grading, concrete and part of the track work were done by the List & Gifford Construction Co. The piledriving and steel bridge work, including the erection, the construction of concrete and timber decks and the concrete masking of girders, were done by the forces of the railroad engineering department. The design and the construction of the entire work were in the hands of S. L. Wonson, bridge engineer; W. R. Rhodes, assistant engineer, was in resident charge of construction. All the work was under the direction of A. E. Hadley and H. R. Carpenter, successively chief engineers of the Missouri Pacific R.R. The plans had to be approved by John A. Bruce, city engineer of Omaha.

The total estimated cost of the improvement was about $200,000, of which the cost of the three bridges, with their masonry and foundations, represented $80,000. Double-track fills form the remainder of the work.

Removing Algae from a California Irrigation Canal

Fixed Screens and Copper Sulphate Inadequate—Rotary Screen with Water Jet and Heavier Dose of Agent Used

By E. Court Eaton
Superintendent of the Lindsay-Strathmore Irrigation District, Lindsay, Cal.

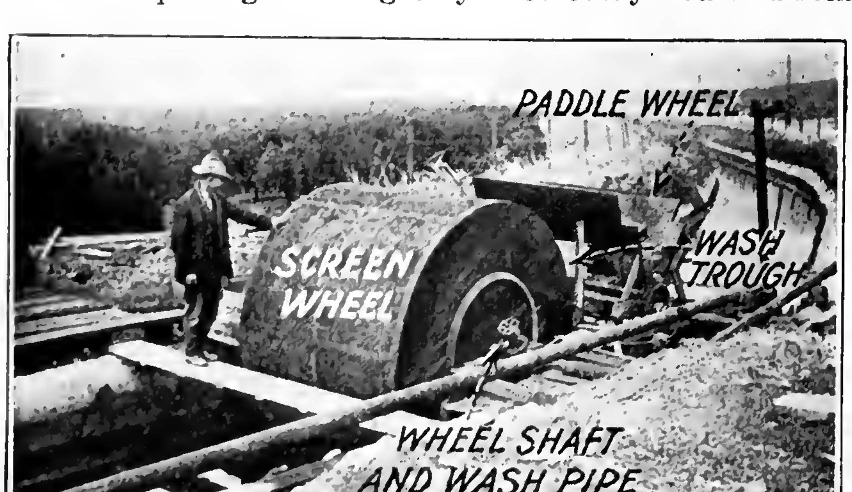
ALGÆ growths caused the Lindsay-Strathmore Irrigation District considerable trouble during the year just past, which was its first irrigation season. A brief description of the nature of these growths, and how they were overcome in large part by the use of screens and copper sulphate, may prove helpful to others.

The entire water-supply, which is obtained from wells, is carried through six miles of canal and six miles of rectangular flume, and then distributed to consumers through riveted steel pipe. All the water is metered. Even a few algæ are not permissible, as they would rapidly clog the meters or get into the consumers' service pipes, thus cutting down the flow through the hydrants and making it impossible to maintain service under uniform pressure.

The canal has a bottom width of 6.3 ft., a depth of 3.5 ft., side slopes of 1 to 1, and is gunite lined. While this is superior to a plastered lining, it has the disadvantage of leaving a rough surface which allows the algæ to grow and obtain such a hold as to reduce the velocity of the water. The flume, although also of gunite construction, was shot against forms, so that the surface exposed to the water is smooth, and comparatively little trouble with algæ has been experienced.

Water was first pumped into the canal early in April, 1918, and by the middle of May the growth had become so heavy that it began to fall off in large quantities.

Removable screens, having a ¼-in. mesh, were installed in the canal, and 0.8 lb. of copper sulphate per 1,000,000 gal. was introduced at the upper end of the canal. In spite of this, the growth so increased that by the end of May the length of time between cleaning of screens had decreased from 45 to 25 minutes. During June and up to July 20 there was less trouble, the screens requiring cleaning only once every hour. From



SCREEN WHEEL REMOVING ALGÆ FROM CANAL

this time on, however, the growth gave more trouble and up to Sept. 20 the screens were removed and replaced on an average every 15 minutes.

In August samples were taken for analysis and the results showed organisms as follows: Spirogyra, 4000

standard units per cubic centimeter; closterium, 20; penium, 40; raphidomanas, 100; amorphous matter, 1500. The predominating species was thus found to be the filamentous spirogyra, which could be killed in the continued presence of copper sulphate solution having a strength of 2.5 lb. per 1,000,000 gallons.

For the sake of convenience in operating, double this dose was introduced 12 hours of every day, commencing Sept. 15. Six days after this solution was applied, the rate of washing screens was reduced for two days to about once every hour. From Sept. 24 to 30 the rate was increased to about once every 20 minutes. Three days after the solution was introduced the algæ had commenced to die, turning brown in color, and in six days were practically all killed. The increase in cleaning screens during the latter part of the month was, of course, due to the dead algæ becoming loosened from the canal sides and falling off. From Oct. 1 to Dec. 18 little or no trouble resulted from this source, the screens requiring cleaning only once in 12 hours.

The copper-sulphate solution was introduced at a point about 20 ft. down from the beginning of the canal, and a striking indication is furnished here of the result of the treatment, for in this first 20 ft., which on account of the velocity of the water the solution does not touch, long "streamers" of the algæ are present, such as do not exist at any other point in the canal during treatment. A revolving $\frac{1}{4}$-in.-mesh screen driven by a water wheel placed in the canal was installed in an early attempt to do away with the expense of keeping a man continuously cleaning inclined stationary screens. The screen was revolved against the flow of the water in order to pick up the larger particles, which would otherwise have been rolled under it, and it was kept clean by jets of water flowing from the inside. The screen was partly successful. If made of steel with small clearances between the revolving and the stationary parts, thus preventing more of the algæ from going past the wheel it would be more satisfactory, but the principal difficulty experienced was the large quantity of water required to keep the screens clean, all of which had to be run to waste.

For dosing, a 9% solution of copper sulphate and water is mixed in a large wood tank and flows to a small orifice box alongside the canal, where the uniform head of solution is maintained over a $\frac{1}{8}$-in. orifice by means of a ball cock.

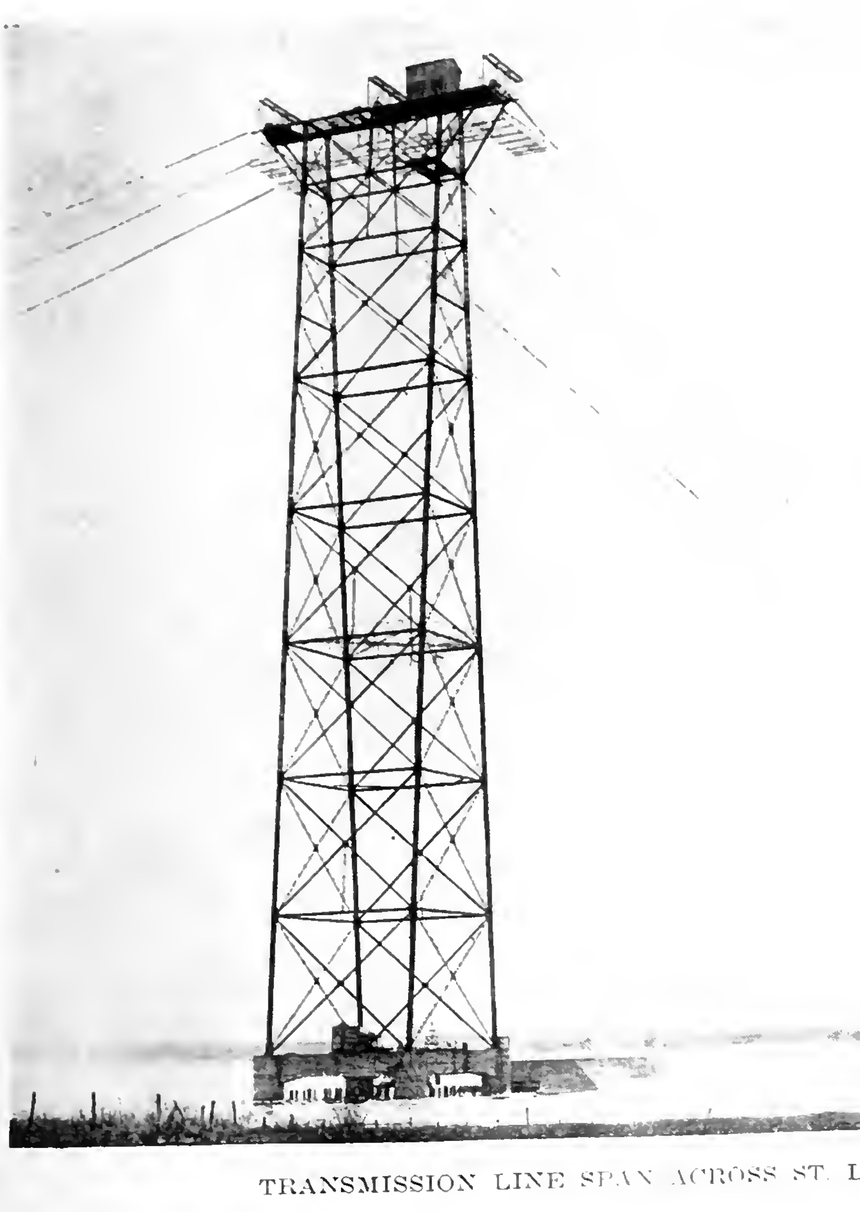
Transmission Line with 4801-Foot Span Over St. Lawrence

Longest Transmission Cable Span in World on Tower 350 Feet High Takes Place of Former Submarine Crossing

ACROSS the River St. Lawrence, about 20 miles from Three Rivers, the Shawinigan Water & Power Co. has just completed what is believed to be the longest transmission line span in the world. With a center span of 4801 ft. and anchor spans of 951 ft. and 571 ft., the total crossing is 6323 feet.

The line takes the place of an older submarine crossing, but has considerably greater capacity. It was adopted after an examination of several other competing locations, the first one of which was a three-span crossing with each span approximating 2200 ft. This simple span location, however, required considerably more land line and was also inaccessible at high-water and ice periods, so that both in cost and desirability the one-span crossing was more acceptable. There are three cables in the span, each of $1\frac{3}{8}$-in. diameter, of galvanized plough steel. Main cables were used as messengers, and the copper conductor wires were hung underneath, separated from the messengers by means of suspension insulators. The normal clearance above high water is 175 ft. The total weight of each cable is nearly 30,000 pounds.

Each end of the main span cable is attached to anchor span cables, and these anchor span cables run over the tower or large heavy double-groove sheaves 8 ft. in diameter, and are carried down to a point approximately 20 ft. from the anchor piers. At this point an equalizing arrangement is put in the line, and the load is transmitted from this point to the anchor by short straps of slightly heavier cable. Connections are in accordance with usual practice with suspension bridge cables and



TRANSMISSION LINE SPAN ACROSS ST. LAWRENCE IS NEARLY A MILE IN LENGTH

similar structures. Over the ends of the cables are placed massive steel bridge sockets having a tempered conical seat. The ends of the cables were broomed and carefully cleaned, and spelter was poured in between the wires and the sides of the seat.

The towers are of structural steel construction, and are 350 ft. high and 60 ft. square at the bases, the upstream and downstream faces tapering to a width of 14 ft. at the top. The tower foundation is made up of four circular reinforced-concrete piers 11 ft. in diameter placed on the corners of a 60-ft. square and connected by heavy reinforced-concrete beams 4 ft. wide by 8 ft. deep. These piers were sunk as hollow cylinders and afterward filled with concrete. The first 6-ft. lift of the cylinders was poured on a working platform and lowered in approximately 8 ft. of water down to the river bed, by means of 2-in. screws. The second lift, of approximately 6 ft., was then poured, and the cylinders were sunk by excavating inside with orange-peel buckets, but the lowering screws were left in place as a guide until the cylinders had reached a penetration of approximately 15 ft. From then on it was found unnecessary to use the screws. When a cylinder reached its full penetration of 40 ft. a plug of rich concrete was poured at the bottom and the inside was then filled with a leaner concrete.

The soil on which these cylinders rest on the north side is a very fine sand, on the south side a fine sand, clay and boulders. Test borings to a depth of more than 100 ft. did not show any rock. Probably rock would not be found until about 200-ft. depth was reached. In front of the foundations there are erected, as guard piers against ice, reinforced-concrete cribs filled with rock, carried up to an approximate level with the maximum recorded high water.

The erection of the cables was carried out under the direction of the engineering department by the construction forces of the company, under C. F. Saunders, general superintendent of construction. H. C. Huber was in direct charge of the job, with Thomas Burham as his assistant. The steel towers were erected by the Canadian Bridge Co. The design of the line was in charge of S. Svenningson, designing engineer of the company.

System Without Red Tape Makes Success of Day-Labor Road Maintenance

Ohio Highway Department Selects Superintendents for Ability to Accomplish Results—Employs Flexible Organization of Foremen and Patrolmen—Weekly Report Forms Show Exact Status of Each Job

FORCE-ACCOUNT maintenance and repair of Ohio roads have been used on account of the difficulty of obtaining reasonable contract prices under war conditions. System without red tape is the secret of the economic success of the plan. Reports and records are required as a certificate of results obtained, but are not permitted to pass in lieu of efficiency. "Horse sense" in the selection of superintendents has been another means of success. Technical knowledge of road-building is a requisite, but good judgment, experience, tact, and ability to get work accomplished, are equally fundamental requirements. Finally, success is clinched by a flexible organization of patrolmen, foremen and superintendents under the direction of resident and division engineers and subject to constant check and inspection by the officials of the State Highway Department. Output and quality of work are the only criteria which the department officials permit to count in passing on the performance of the repair and maintenance organization.

The procedure in organizing, directing and recording force-account operations is the conspicuous feature of the story of war-time maintenance of Ohio's state highways. Construction methods are not strikingly unusual and need no special consideration.

In every county in which the mileage of state roads warrants it, there is a definite organization for road maintenance and repair. Direct charge of field work is assigned to patrolmen, foremen and superintendents whose functions are as follows: Patrolmen are in charge of minor repairs on specified sections of road, and work alone or with one to six helpers; foremen are in charge of a gang of men, and work under the direction of a superintendent or a resident engineer; superintendents are in charge of large gangs such as would be required in resurfacing a road, or are in general supervision over several small gangs under foremen or patrolmen.

Superintendents are directly representative of the State Highway Department, but the resident engineer, who is the county representative, is their superior. Division or maintenance engineers, who work under the direction of the deputy commissioner and who have charge of many counties, direct the resident engineers.

A map of all the state roads in the county is in the resident engineer's office. On this map, original construction contracts are designated by mnemonic symbols. A maintenance section may embrace one or more construction contracts, or may be only a part of one construction contract; whichever be the case, the contract section symbols, combined or subdivided, designate the maintenance section in all correspondence, construction reports and other documents relating to the work. If, for example, a maintenance section embraces contracts A and B, it is designated as Sec. A-B; if it is a part of contract A, it is designated as Sec. A-1 or Sec. A-2.

Allotted a section for repair, the superintendent goes over the ground, determines the availability of labor and materials, and decides on the construction procedure. His duties, then, besides directing construction operations, include keeping records and making periodical reports; obtaining direct shipment of, receiving and salvaging equipment and materials; approving payments for labor and materials, and distributing expenditures.

Three records, kept by the superintendent, furnish

all information required by the highway department regarding work on any maintenance section.

The labor and rental of equipment are recorded in a time book. Each double page of this book carries a name column, date columns for 31 days, and total time, rate, amount and "remarks" columns. In entering a labor or rental item, it is designated by a symbol to indicate one of the five kinds of maintenance and repair to which distribution of cost is made. These symbols are those used in making weekly reports, as described in a succeeding paragraph. Notice that in recording time, rental of equipment is carried in the time book and is included on the payroll with labor. The time book is the first record.

All expenses incurred on the work are kept on the superintendent's cost-record sheets—one set for each maintenance section. These sheets are the superintendent's record of work done and his certificate of expenditures. All entries are made closely to date, as the sheets are the running account of the work, and are subject to call and inspection at any moment by the State Highway Department. The heading of the face of one of these sheets is reproduced; on the back are four columns for distribution of costs and a set of instructions for keeping the records. Note that both materials received and service rendered are entered, according to date. Thus, the amount of the biweekly payroll is entered on the date when the payroll is mailed to the office. So, also, entry is made of receipt of material and receipt of bill on the date received. If entries are made thus promptly and the sheets are periodically checked, any discrepancies, losses, injuries, etc., are caught and quickly rectified. Thus, the cost-record sheets are the superintendent's field bookkeeping system. When every column has been filled, he possesses a verified record of every expenditure and one that is available for any kind of cost analysis which the department may wish to make.

Check of the progress on each maintenance section is maintained by the department through weekly reports from the superintendent. These weekly reports are intended to be a complete record of all operations performed and material received. They are made in duplicate and are numbered serially. By means of mnemonic symbols, a great volume of information is recorded on a sheet. The symbols show cost distribution according to features and work items. Thus, 5 in the "hours" column followed by B-50 in the "nature of work" column means that five hours' work in painting a bridge is to be charged to bridges and culverts. Numerals indicate work items; there are 42 regular work items and 13 extra numbers for special items for which some job may call. Reproduction of a portion of the face of a weekly report sheet shows the manner of reporting labor. On the back of the sheet are columns for reporting materials received and a schedule of symbols.

Cost distribution is divided into four classes: Roadbed, surface, bridges and culverts, and equipment and superintendence. Under "roadbed" are included all expenditures incurred by the grading of roadbed, repairing shoulders and ditches, cutting brush or weeds, repairing underground drains and guard rails, removing débris from culverts, etc. Surface expenditures are all those applied to the metalled portion of the road. Expenditures for bridges and culverts need no explanation. Under "equipment," only expenditures for new equipment and tools are included; "superintendence" includes

Form M. & R. 3017—1919

Special Job No ....

When a special job number has been assigned any specific work, a separate sheet should be used for such work, and this number should appear on all bills and payrolls sent in for payment on same.

SEE INSTRUCTIONS ON BACK BEFORE MAKING ANY ENTRIES.
On this sheet should be recorded every item of expense chargeable to this section of road.

Superintendent's Cost Record Sheet For 19 ......

Maintenance and Repair of.......................................Road.

County.............................
I. C. H. No.............Sec.............
Sheet No.........of.........Sheets

Item No.	PARTIES FURNISHING MATERIAL OR SERVICE	MATERIAL RECEIVED OR SERVICE RENDERED	Date Ordered / Order No.	Car Initial and No.	Date Delivered	Unloaded Hour Date	QUANTITY Sup'ts. Report	QUANTITY Co.'s Statement	Invoice No. or Date of Invoice	COST Unit	COST Total	Date Invoice Approved	
1													1
2													2
20													20

..................................Superintendent, P. O. Address..................................

Form M. & R.—3034
ORIGINAL

OHIO STATE HIGHWAY DEPARTMENT
BUREAU OF MAINTENANCE AND REPAIR

WEEKLY REPORT OF MAINTENANCE AND REPAIR WORK

ON.......................................ROAD

County.............................
I. C. H. No.............Sec.............
SPECIAL JOB NO.............................
Type of Road.............................

No.	SERVICE RENDERED BY (Na	SERVICE RENDERED KIND OF SERVIC	RATE PER HOUR	MONTH / Day of Month: Sunday Hrs. Wkd	Sunday Nature of Wrk	Monday Hrs. Wkd	Monday Nature of Wrk	Tuesday Hrs. Wkd	Tuesday Nature of Wrk	Wednesday Hrs. Wkd	Wednesday Nature of Wrk	Thursday Hrs. Wkd	Thursday Nature of Wrk	Friday Hrs. Wkd	Friday Nature of Wrk	Saturday Hrs. Wkd	Saturday Nature of Wrk			REMARKS
1																				
2																				
3																				
20																				
21																				
22																				

Give a brief Statement of the kind and amount of work done during the week.

Submitted.............................., 19.......
By.............................
Title.............................
.................., ..., Ohio
P. O. Address R. F. D. or Street

the money paid for supervision. For example, if a foreman does some manual labor, only that part of his time given to actual supervision is charged to superintendence.

Tools and equipment are regarded truly as investments to be kept in repair and properly housed to prevent deterioration and loss and, when no longer serviceable, to be salvaged. This maintenance is the responsibility of the superintendent.

Strict account is required of all tools and equipment. Every article is marked by die or stencil; where the number of tools warrants, tool boxes are provided and, in important instances, tool houses are built. Tools are checked daily, and search for missing tools is required to be prosecuted to the limit. Loss is reported immediately to the department with a full account of the circumstances. In brief, men in the field are made aware that no carelessness will be countenanced.

It is required that tools and equipment be kept in good condition by cleaning, oiling and painting, and proper preparation and housing for storage. When broken and worn tools have accumulated in sufficient quantity they are condemned and sold by a representative of the department. If tools or equipment are moved from one county to another the superintendent lists the items on an inventory sheet, and mails this sheet to the department. If the superintendent is transferred, he reports to the department the character, number and whereabouts of all tools and equipment left by him. Only by making such a list and obtaining a receipt from the new custodian is the superintendent relieved from responsibility.

Form G 4040

IMPORTANT—A full explanation must be given of any discrepancy existing between the number of tools listed in Column No. 1 and Column No. 4. When tools are reported as having been transferred to someone else, receipt from the party receiving same must be attached to this report.

PROPERTY OHIO STATE HIGHWAY DEPARTMENT

INVENTORY OF EQUIPMENT

In Possession of.................................... Address....................................19......

Equipment is Located at....................................
(If necessary give location in "Remarks" column)

ITEMS		(1) On Hand ......19.... Time of Last Report	(2) Received or Purchased Since Last Report	(3) Transferred to .... Attach Receipt to This Report	(4) Now on Hand ....19....	(5) Held for Disposal Account Broken or Worn	(6) Condemned by	REMARKS
Adzes—R. R.	No. of							
Axes—Hand,	No. of							
Axes—Stone,	No. of							
Axes—Wood,	No. of							

At regular intervals, on demand by the department, inventories are made of all tools and equipment. The department furnishes a special folder sheet of five foolscap pages, on the sides of which the equipment items are printed, as indicated by the form reproduced in part.

Except in cases of emergency, no materials or tools are purchased otherwise than through requisition by the superintendent approved by the resident engineer. Requisitions are not merely perfunctory statements of articles required. Besides exact statements of the items, a statement is required of the purpose for which they are wanted. Route and destination and rate of shipment have to be stated. Finally, a list is required of firms, particularly local firms, interested in furnishing the articles. The department does the purchasing after competitive bids are received.

Emergency purchases are of two kinds, purchases of considerable quantities and purchases of small articles and supplies. In making larger purchases, the superintendent, after he has bought, makes out a requisition specifying the goods and explaining the reason for the emergency action, and sends this requisition to the department, which issues a confirming order to the concern from which the purchase was made. To purchase small articles, the superintendent makes out a field order in triplicate, one copy for the dealer, one for the department and one for his own records.

When material has been ordered by the department, a copy of the order is sent to the superintendent, and thereafter it is his duty to see that shipments come as ordered and are cared for promptly when received. Prompt unloading is demanded to reduce demurrage, and the occasion for every bill for demurrage has to be explained. The department is kept informed concerning materials received through the weekly reports previously described.

Salvage is insisted upon. Not alone surplus materials, but containers and scrapped tools and equipment are salvaged. It is required that barrels containing road oils be tapped, and the contents so drawn off as to leave the container intact. The salvage and return of cement sacks are watched carefully. In the same way, surplus material is assembled and stored for future use. All payrolls and bills for materials, equipment and supplies are paid directly by the state. The only exception is an occasional small purchase by the superintendent, for which he pays cash and is reimbursed by the state. Payrolls are made up and mailed on the 15th and last days of the month. They are duplicates of the time book, with columns for signatures of the men and for the officials vouching for and approving the figures. Individual warrants issued by the state for the men are sent to the superintendent for distribution. Bills for materials and supplies go to the superintendent, and are checked up against his cost record-sheets, stamped "approved" and returned to the department for direct payment. Heading the department operations is Clinton Cowen, state highway commissioner. A. H. Hinkle is deputy state highway commissioner, in charge of maintenance and repair.

Telephoned from Regular Desk Phone to Airplane

Communication between an airplane in the air and a regular telephone on the Washington city line was established for the first time Jan. 16 by the Army aëronautic corps. The two links of the line were the radiotelephone from the plane, which was flying over Bolling Field, outside of the City of Washington, to a small station on the field, and the city telephone system from Bolling Field to the the office of Major General Kenly, director of military aëronautics. Conversion of radio to direct wire communication was made automatically by an apparatus devised by Army officers.

Engineering Literature

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Road and Street Engineers' Vade Mecum

AMERICAN HIGHWAY ENGINEERS' HANDBOOK—Editor-in-Chief, Arthur H. Blanchard; Associate Editors, Charles J. Bennett, Harold S. Boardman, Mark Brooke, William H. Connell, Walter Wilson Crosby, Arthur W. Dean, Henry B. Drowne, Austin B. Fletcher, Henry A. Gardner, Prévost Hubbard, James F. Kemp, Nelson P. Lewis, Frederick K. Morris, Joseph Hyde Pratt, John R. Rablin, Francis P. Smith, George W. Tillson. New York: John Wiley & Sons, Inc. Leather; 4 x 7 in.; pp. 1658; illustrated. $5.

Professor Blanchard and his 17 associate editors, with their unnamed "collaborators," have produced a handbook which for scope and detail of treatment within one single specialized field of engineering will probably remain unexcelled for some time. The editor-in-chief says in his preface that the volume was designed as "a reference book which would include reliable and comprehensive information on all branches of highway engineering and related subjects which would prove useful to highway officials, engineers, chemists, contractors, and engineer-salesmen of highway materials and machinery." This aim seems to have been amply fulfilled. If there be anything lacking, the reference lists of books and periodicals at the end of each of the 29 sections point the way to finding it, while for the material given in the handbook itself the General Contents, the Contents at the head of each chapter, and the 78-p. index of some 8000 entries, serve as ready guides. Another noteworthy feature of the volume is its reprinting in full of a large number of standard tests and specifications.

A detailed analysis of the volume would fill columns. A general idea of its contents is afforded by the following regrouping of sections so as to bring together the work of each editor: First, the editor-in-chief, Arthur H. Blanchard, consulting engineer, New York City, is responsible for the useful terminology, both American and British, with which the volume opens, as also for the treatment of bituminous (1) surfaces; (2) macadam, and (3) concrete. To Harold S. Boardman, dean of the College of Technology, University of Maine, fell (1) mathematics, mechanics and structural materials and (2) highway bridges, culverts, retaining walls, foundations and guard rails. James F. Kemp, professor, and Frederick K. Morris, instructor, in geology in Columbia University, dealt with engineering geology. W. W. Crosby, consulting engineer, Baltimore, treated (1) preliminary investigations, (2) brick and (3) cement-concrete pavements. Henry R. Drowne, engineer Lane Construction Co., Baltimore, handled (1) surveys and office practice, and (2) planning roads and road systems. N. P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City, contributed (1) planning streets and street systems, and (2) financing highway improvements. Austin B. Fletcher, engineer, California Highway Commission, stands for grading, drainage and foundations. To Joseph H. Pratt, consulting engineer and secretary of the North Carolina State Highway Commission, was assigned earth and sand-clay roads; to Charles J. Bennett, state highway commissioner of Connecticut, gravel roads; to Arthur W. Dean, chief engineer, Massachusetts Highway Commission, broken-stone roads, and to Prévost Hubbard, chemical engineer, United States Office of Public Roads, bituminous materials. John R. Rablin, engineer, Metropolitan Park Commission of Massachusetts, covered dust palliatives, and Francis P. Smith, consulting chemical and paving engineer, New York City, sheet and rock asphalt pavements. George W. Tillson, [lately] consulting engineer to the borough president of Brooklyn, New York City, contributed (1) wood, and (2) stone-block pavements; (3) car tracks and pipe systems, and (4) comparison of types of roads and pavements. William H. Connell, engineering executive, Day & Zimmerman, Philadelphia, wrote (1) street cleaning, collection and disposal of city wastes and snow removal, and (2) organization and administration of highway departments. Mark Brooke, colonel of engineers, U. S. A., had charge of sidewalks, curbs, gutters and highway signs. Finally, the section on the preservation of materials used in highway structures was proposed by Henry A. Gardner, assistant director of the Institute of Industrial Research, Washington.

The volume contains many convenient tables and diagrams. Particular mention may be made of those giving external and skew distances for 25-ft. radii, arcs for 100-ft. tangents, and deflections for 100-ft. arcs. These should be very useful in compiling final staking-out notes, and also for preliminary locations, except that as for the latter the volume is too large and unwieldy for field work.

The bulkiness of the volume is in part due to an attempt to pack into a single volume as much as possible of every subject the highway engineer would ever wish to know about. The sections on mathematics, engineering geology, planning streets and street systems, and street cleaning and waste disposal, to name only four, contain material which but few highway engineers will ever have occasion to use. The paragraph describing an incinerator for mixed refuse sounds like the unrealized dream of an inventor. It certainly fails to give an idea of any incinerator ever put into common use.

The wonder grows how publishers of engineers' handbooks can continue to give increasing amounts of information prepared by specialists—in fact, nothing short of a whole series of monographs between one pair of covers—without doubling or trebling the price charged for the earlier reference works. May the time not yet come when the practice, like the street-car ride of almost unlimited length for a nickel, will break down of its own weight? Meanwhile, purchasers of handbooks need not complain, unless they would prefer less bulk at a lower price.

Formula Charting

Reviewed by ROBERT C. STRACHAN
Civil Engineer, New York

GRAPHICAL AND MECHANICAL COMPUTATION—By Joseph Lipka, Ph.D., Assistant Professor of Mathematics in the Massachusetts Institute of Technology. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth: 6 x 9 in.; pp. 264; illustrated. $4.

The author of this volume has produced a treatise that is admirable not only for its clarity of diction and logical sequence of ideas, but also because it sets before the general scientist and the engineer principles and processes of the greatest practical utility, which heretofore have not been easily accessible in their entirety. Those who were interested have found it necessary to gather from scattered sources the matter here brought together in a form adapted to the use of practitioners as well as students.

The English bibliography of formula charting is decidedly limited; much of the discussion on methods of forming empirical curves to fit experimental data must be searched out in the proceedings of scientific societies and the contents of scientific periodicals here and abroad; and of the many explanations of the well known slide-rule principle but few contain any attempt to link up that principle with more general conceptions.

Professor Lipka has brought between two covers a well executed presentation of all these related subjects. It should not be understood from this statement that the book is merely a compilation, for it is decidedly not, in the usual sense. The author has summarized and correlated the work of many others, intermingling an amount of his own that is by no means negligible.

In the opening chapter are set forth the elementary principles of the representation of functions by scales, followed by the extension of these principles to include the so-called Mannheim slide rule, the log-log slide rule and others; after which the author proceeds to the graphical solution of equations containing two or more variables, and thence to the subject of nomographic or alignment charts. Probably there is at present no other work in English in which this subject is treated with equal comprehensiveness. Runge, it is true, has devoted some attention to it in his "Graphical Methods," but in so perfectly generalized a fashion that his reader may easily fail to see its true bearing; while the excellent work of Professor Peddle is more restricted in scope.

Professor Lipka's method resembles quite closely that of Maurice d'Ocagne. His underlying theorems are demonstrated in full, and his charts worked out to completion. To many they will be a surprising revelation of the possibilities of graphical methods in enabling one to avoid the drudgery of numerical computation.

The formulas selected for manipulation are typical ones, and similar methods may be applied readily to many others which will suggest themselves to the reader, as bearing on his particular kind of work.

In the highly enlightening chapters on the building of empirical formulas, the interpreting of experimental data and graphical interpolation, the author enunciates the criteria by which to determine the species of curve giving the best representation of a given set of data, and shows in detail, for a large number of actual experimentation reports, the practical processes of deriving such curves and evaluating their constants. The author's well considered order of presentation now becomes apparent, for the reader will at this point realize that, however complicated may be the representative curve with which he has to deal, he is prepared to devise some form of chart by which its equation may be rapidly solved.

The final chapter contains a very lucid exposition of the principles of graphical and mechanical differentiation and integration, leading naturally to the description and analysis of the planimeter, the integraph and the differentiator with which the book closes.

At the end of each chapter are given problems, the solution of which will be of great benefit to students. The illustrations are numerous and well rendered, the typography is of a pleasing clearness. The index is proof that the author has not lost sight of the practical needs of the reader. The book deserves the highest success.

Bettering Municipal Government

OUR CITIES AWAKE: Notes on Municipal Activities and Administration—By Morris Llewellyn Cooke, M. E., Consulting Engineer, Formerly Director of Public Works, City of Philadelphia; With a Foreword By Newton D. Baker, Secretary of War, Formerly Mayor of Cleveland. New York: Doubleday, Page & Co. Cloth; 6 x9 in.; pp. 347; illustrated. $2.50.

Concerned largely with experiences in Philadelphia while the author was Director of Public Works in the reform Administration of Mayor Blankenburg, and drawing also upon the author's observations on business efficiency and municipal government before and since then, this volume contains much which should be a help and inspiration to those who wish to improve the municipal government of any city, large or small.

Owing to an apparently haphazard presentation of the many topics discussed, it is difficult to give, without undue detail, a clear idea of the contents of the volume. After a few pages about service to citizens and some observations on encouraging the people to make complaints, the book plunges into budgets and appropriations, then as suddenly takes up "contract jockeying" and "political assessments." Next came chapters on some phases of the framework of government, the science of management, and "The One Best Way." The chapter last named opens with remarks on "coöperation with the people," but deals mostly with standardization. Succeeding chapters take up public servants in general, the civil service, publicity and utilities. Then comes a chapter, entitled "The City as an Ally of Industrial Progress," which has to do with markets, civic centers, public parks and baths, business men's associations, commercial and vocational guidance, and other subjects. The two final chapters consider similar topics, and touch again upon some of the earlier ones.

The value of the book lies chiefly in its accounts and interpretations of the author's personal experiences as Director of Public Works and the knowledge thus gained of Philadelphia misgovernment under earlier administrations. Useful also are comments on some phases of scientific management and on the newer experiments in municipal government, such as the commission and manager plans. The discussion of civil service, under the heading "Finding the Man in Ten Thousand," is perhaps the most valuable part of the book—at least for the readers of this journal. The part of this chapter which considers the selection of

men for "$3000 plus" positions deserves wide attention. The most pungent chapter is "Our Utilities and Their Owners." Here the author says many sharp and some harsh things, most of which have at least some warrant in view of the extent to which utility exploitation has been carried in this country. Strong expressions and even some bias may be expected from any writer discussing utilities from the public viewpoint, but Mr. Cooke seems to show an unwarranted excess of bias, particularly toward engineers in general who have served on the side of the utility companies in valuation and rate cases. True, he points out that our whole system of expert testimony in court practice begets partisanship instead of a devotion to truth, but that does not warrant classing all who testify for utility companies as, by that fact, venial, any more than it warrants sweeping condemnation by the private interests of those who testify on the city's side, as has been done more than once by men who ought to be above such extreme partisanship.

The book has no index. This, and the fact that some of the chapters and the book as a whole are literary medleys, may seem surprising in a volume written by an exponent of scientific management, but the book does not pretend to be a scientific treatise, and despite its scrap-book tendency it is bound to have a salutary effect as a source of inspiration for better municipal government.

Utility Rates

REVIEWED BY FREDERIC P. STEARNS

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PUBLIC UTILITY RATE FIXING—By C. E. Grunsky, Eng. D., Consulting Civil Engineer, M. Am. Soc. C. E., President, American Engineering Corporation, President, California Academy of Sciences, Etc. San Francisco: Technical Publishing Co. Cloth; 6 x 9 in.; pp. 169; illustrated. $2.50.

A number of articles dealing with the problem of fixing public utility rates and with related matters, originally contributed to the *Journal of Electricity*, have been assembled in this volume. One of the articles, entitled "Fair Value and the Rate Base," was written by Capt. C. E. Grunsky, Jr.

To a large extent the book reiterates the views expressed by the author in his book entitled "Valuation, Depreciation and the Rate Base" (reviewed in *Engineering News*, March 15, 1917) and in other previous writings. As a rule, the changes made are not along the lines indicated by the most important court decisions and by the present practice of valuation engineers, public service commissions and progressive corporations.

The author makes frequent reference to his view that it is illogical to make value which results from earnings the basis of rates, and objects to the use by valuation engineers and public service commissions of "value" as a rate base, not noting that the so-called "value" used by them is not deduced from earnings but is obtained in nearly the same way as the author's rate base, the important difference being that the author would not deduct accrued depreciation.

He also gives prominence to the view "that accrued depreciation is not an element for consideration when rates are to be fixed," and that annual or accrued depreciation need not be determined. Instead of the latter, he would substitute in fixing rates an indefinite "replacement requirement," which is apparently a yearly sum for each plant unit that with interest would be sufficient to replace the unit at the end of its probable life, or, as an alternative, the amount actually required for replacement in a given year. To use his own words (p. 152), the replacement requirement "would have to be approximated on the basis of past experience, and would naturally be so distributed over a series of years, preferably in anticipation of the requirement, that rates once established would not have to be modified too frequently. It will be immaterial how the requirement is ascertained. Any method of procedure which will fairly approximate the desired result will suffice."

The importance of annual depreciation in determining rates is best indicated by an actual example. The Bell telephone system of the United States in 1917 earned, in round numbers, for depreciation $53,000,000, and for current maintenance $41,000,000. The depreciation item is larger than that for dividends. Were the telephone companies to accept the author's views in regard to replacement requirements as a substitute for depreciation, the amount to be earned for this item at the higher rate which the author has suggested would be many millions less than the present sum for depreciation, and at the lower rate by far the larger part of the item would be eliminated. In the latter case, it is sometimes asserted that as the depreciation is not collected as it accrues the future ratepayers are under obligation to pay it at a later date, but as the Supreme Court in the Knoxville case has ruled that "it is the duty of corporations to exact sufficient returns to keep the investment unimpaired," it is not likely that any such obligation would be recognized.

In regard to determining the annual return after having determined the rate base, the author deals at considerable length with the legitimate earnings on invested capital, holding that there should be a proper interest return and a profit, this profit to be made up of compensation to the owner of the property for hazard, for management, and as his share in the general prosperity of the community. He introduces the view that this profit should be a percentage upon the gross earnings and not upon capital.

There are chapters relating to the appraisal of real estate adapted for special use, to the determination of the value of real estate in eminent-domain proceedings, to the value of water rights, and to the rate of return, which contain decisions on some of these matters as given in San Francisco water-rate cases recently decided; also a chapter relating to the rate schedule.

Methods and Economics of Storing

STORING: Its Economic Aspects and Proper Methods—H. B. Twyford, Otis Elevator Co., Author of "Purchasing: Its Economic Aspects and Proper Methods." New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 196; illustrated. $3.50.

Intelligent storing bulks large in the success of manufacturing and mercantile operations. Numerous factors such as fluctuation in prices, rise and fall in demand and continuity of production, must be carefully integrated by the successful storekeeper. Besides these, the technique of storekeeping, such as storeroom location and equipment, storeroom appliances and accounting methods, must be known. Finally, the storekeeper must have a keen perception of the fact that storing is a

definite and important expense in the conduct of a business. Both the economics and the technique of storing are well presented in Mr. Twyford's new book.

Of the 12 chapters, three discuss the economics and outline the principles of storing. The fourth chapter presents the exceedingly important question of precise designation of stored articles by standard definitions and specifications. Five subsequent chapters discuss the location and arrangement of storerooms, storeroom equipment and appliances, and storeroom accounting and record-keeping methods. Organization of the stores department and the functions of the various employees are outlined in Chapter IX. The processes of receiving into and delivering from stores are described in the final two chapters. Nearly a hundred illustrations of equipment, appliances and bookkeeping and inventory forms add materially to the value of the volume.

A Great American Engineer

GEORGE WESTINGHOUSE: His Life and Achievements—By Francis E. Leupp. Boston, Mass.: Little, Brown & Co. Cloth; 6 x 9 in. pp. 300; illustrated. $3.

Since Smiles wrote his famous "Lives" sixty years ago, biographies of engineers have been few. Smiles wrote of British engineers. Except for sketches and two or three more ambitious attempts, the lives of American engineers have heretofore gone unrecorded. Hearty welcome, therefore, to Mr. Leupp's well-rounded and readable story of one of America's great inventors, engineers and captains of industry.

After touching on Westinghouse's boyhood, Army and Navy experience in the Civil War, and three months' uninterested trial of "the French and German languages, solid geometry, and English rhetoric, essays, and vocal training" at Union College, the author starts with Westinghouse's career as inventor and manufacturer—already foreshadowed by a rotary engine which he built before going to war. A car replacer, suggested by a tedious wait due to a train wreck, was his first commercial venture. With this he made and marketed cast-steel reversible railway frogs. Marvelous successes with the railway air brake, alternating current and other electric developments—lighting the Columbian Exposition, elevated-railway electrification, Niagara power—the introduction of natural gas, the gas engine and the steam turbine, are all told. A good idea is given of the variety and magnitude of Westinghouse's manufacturing operations and his masterful control of their organization and financing up to the receivership of the Westinghouse Electric & Manufacturing Co. in 1907. The home, social and other personal relationships of Westinghouse are briefly presented.

The book is addressed to the nontechnical reader, but its engineering detail is sufficient for most engineers who are not specialists. In his preface the author says:

> One day, let us hope, we may have from the pen of some well known expert in technology an adequate summary of what the whole world's industrial advancement owes to the work of the eminent inventor. The mission of the present volume is simply human. It will have been accomplished if it conveys to the young man of today a sense that his career will depend for success less on the splendor of its start than on the spirit in which he pursues it; far less on capital than on courage, on worry than on watchfulness, on "pull" than on perseverence.

Until the experts in technology, as Mr. Leupp calls them, find time and courage—and perhaps we should say gain skill—to write biographies, we shall have continued reason to be grateful to the Smiles and Leupps who portray the "human" side of engineers. May their tribe increase!

A South American On Retaining Walls

RETAINING WALLS: Based Entirely on the Theory of Friction —By Pedro J. Dozal, C. E., Escuela Nacional de Ingenieros de Mexico. Done into English by R. T. Mulleady, B. Sc. Eng. (Birmingham). The Author, Buenos Aires. Cloth; 7 x 10 in.; pp. 155; illustrated.

On the whole, this book is an earnest and sincere, though labored, attempt to analyze earth pressure. The author's basic method of attack is to determine, from some sliding wedge, the force component parallel to the plane of slip, or, in the author's terminology, the plane of condition. This component is in part neutralized by the frictional resistance along this plane of condition. The remaining part of the component is termed the "unbalanced force." The maximum value of this unbalanced force, and also the maximum value of its horizontal and vertical components, are determined by the ordinary processes of the differential calculus. In a "coherent" mass it is assumed that in addition to the frictional resistance there is also a shearing resistance along the plane of slip, and it is the aim of the analysis to find the plane of minimum resistance. The thrusts found are considerably less than those given by Rankine's and Coulomb's methods. The author ignores any frictional resistance between the wall and the earth.

Fundamentally, the author has failed to notice that the maximum wedge of displacement does not always produce the maximum thrust upon the wall. It is essential to find what impending wedge of displacement produces the maximum thrust upon the wall. This is done by the method given by Coulomb, with the elegant graphical scheme of Poncelet.

From the matter contained in the book, it appears that the author is unfamiliar with the large mass of modern literature on the subject. Levy, Boussinesq and Resal of France and Cain of America have compiled a vast amount of information on earth pressures covering every possible condition and making parallel comparisons with experimental data.

In his preface the author says that "no writer has investigated as to whether a plane cutting an homogeneous and strongly coherent solid receives any pressure from that solid." The facts are quite the reverse. The lateral displacement of solids due to vertical loading forms an important basis of the theory of elasticity and is given by the classic "Poisson's Ratio." Again, on p. 25, after an intricate explanation quite lacking in rigor, it is stated as proved that the surface of rupture for a coherent mass is a plane. Experiment easily demonstrates that such a surface is not a plane, and careful mathematical analysis has shown the same—see, for example, Resal, "Poussée des Terres," Part II, and Cain, "Earth Pressure."

Although the book is entitled "Retaining Walls," it is, like a number of other books unhappily so named, a dissertation on earth pressure, with a minute appendage on gravity masonry walls containing nothing

of novelty. The book in itself is interesting in its carefully developed algebraic analysis; however, it is universally conceded that the action of earth masses has exhausted the efforts of mathematical and engineering science, and it has been shown that when retaining walls fail they rarely do so because of faulty earth pressure theory but generally because of faulty wall or foundation details.

Municipal Ownership Under the Microscope

THE RESULTS OF MUNICIPAL ELECTRIC LIGHTING IN MASSACHUSETTS — By Edmond Earle Lincoln, M.A (Oxon.), Ph. D., Instructor in Economics, and Tutor in the Division of History, Government and Economics, Harvard University. Boston and New York: Houghton, Mifflin Co. Cloth; 5 x 8 in.; pp. 478; illustrated. $3.

In his painfully laborious study, which appears to be almost as painfully conscientious in its attempt at impartiality, Mr. Lincoln may be said to have put municipal ownership of electric-light plants in Massachusetts under the microscope. So minutely detailed are the facts and figures, and so many are the qualifications after a general conclusion has been drawn, that nearly 500 closely printed though typographically clear pages are filled.

There is no denying that the study is a valuable one, for besides the internal evidence there is the testimony that it won a $1000 prize which is not lightly awarded. Whether the same amount of effort, directed in some other of many possible channels of investigation, would not have proved more beneficial to humanity in general and to the author in particular—barring possibly the $1000 price—we shall leave to the judgment of the author—say a quarter century hence—with little doubt in our minds what his conclusion will be.

Not for the sake of contrast, but to throw light upon municipal ownership results, the author selected for comparative study privately owned plants of as nearly like character as feasible. This, he thinks, put private ownership to a disadvantage, because the smaller private plants are under a handicap as compared with the larger private plants. But if one looks beyond Massachusetts does not this argument work both ways? However, the study was—and that, too, for good and sufficient reasons—confined to Massachusetts, which enjoys the distinction of having begun state regulation of gas and electric lighting long before any other American commonwealth did, and which put the municipally as well as the privately owned plants under the control of the commission.

After a short introduction, the author presents a sharply critical survey of the literature on municipal electric lighting in the United States. We leave those castigated to defend themselves as best they can. Then comes an illuminating review of the work of the Massachusetts Gas and Electric Light Commission, and then an outline of the author's plan for his main task. The body of the book is devoted to minute analyses and comparisons of the recent physical and financial statistics of the 39 municipal and the 33 selected private plants, and to observations based on local personal surveys or examinations of some of the plants. The plants studied were divided, under each class of ownership, into those generating and those buying their current—the plants serving as mere distributors of current being a large percentage under each class of ownership. Each chapter has a series of numbered conclusions—a welcome and almost necessary feature in so detailed a volume, with its running conclusions and their qualifications. A chapter of general conclusions, 10 pages long, sums up the whole investigation. There are 18 pages of references and a statistical appendix of 44 pages.

The main conclusions of the author, while in many respects favorable to the municipal electric light plants studied, are adverse to municipal ownership. Whatever advantages the plan may seem to have produced in Massachusetts the author thinks are offset or nearly offset by disadvantages, and the consumers under private ownership have been so well protected by the Gas and Electric Light Commission that the risks of municipal ownership seem to the author to be quite unwarranted. These risks, he thinks, are looming up in the future, as the plants become older, and in view of the growing tendency for small plants to buy instead of generate their current.

The book would have been clearer and stronger had the author set up a few main standards before starting his general discussion, and consolidated and measured his multitudinous conclusions against them. Moreover, with all his infinite labor and pains, he has done little to show how the consumers and taxpayers directly concerned feel towards municipal ownership. Instead, he sets up his own dicta as to how they should or at least might feel. The balance against municipal ownership—if such it can be called—found by the author does not seem to be so large that the people of the 39 Massachusetts communities concerned might not gladly shoulder it for the sake of whatever satisfaction they may take in owning and managing their electric lights.

The officials and citizens of any community which is considering municipal ownership, whether of electric light or other utilities, or which is in doubt as to the wisdom of continuing to operate a given utility, might well read this book—following in most cases the author's suggestions for judicious skipping of much of the detailed discussion.

Finding and Recording Costs

COST ACCOUNTING—By J. Lee Nicholson, C. P. A., Instructor Cost Accounting, Columbia University, 1912-16; and John F. D. Rohrbach, C. P. A., Instructor Cost Accounting, Columbia University. New York: The Roland Press Co. Leather; 6 x 9 in.; pp. 576; illustrated. $6.

The demand for production cost figures and the improvements in accounting procedures have grown to such an extent in the past few years as to lead to the expansion of the senior author's "Cost Accounting, Theory and Practice," published in 1913. Besides describing the general methods of cost finding, factory routine, the summarization and control of cost records and the installation of a cost system, the author deals at some length with cost-plus contracts. He makes especial reference to the problems and difficulties that have arisen in interpreting the terms of the numerous Government contracts made during the war period, and their cancellation. He also includes a detailed discussion as to what may be chargeable to such contract work. There are separate chapters on materials, wage systems, labor reports and depreciation.

Publications Received

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN PROBLEMS OF RECONSTRUCTION: A National Symposium on the Economic and Financial Aspects—Edited by Elisha M. Friedman, with a Foreword by Franklin K. Lane, Secretary of the Interior. New York: E. P. Dutton & Co. Cloth; 5 x 8 in.; pp. 464; illustrated. $4.

APPLIED MECHANICS—By Charles E. Fuller, S. B., and William A. Johnston, S.B., Professors of Theoretical and Applied Mechanics, Massachusetts Institute of Technology. Vol. II, Strength of Materials. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 556; illustrated. $3.75 net, postpaid.

ATLANTIC INTRACOASTAL CANALS: Report of the Bureau of Foreign and Domestic Commerce on Deep Sea-Level Canals Connecting Massachusetts Bay and Buzzards Bay, New York Bay and Delaware River, and Delaware River and Chesapeake Bay. Washington, D. C.: Department of Commerce. Paper; 6 x 9 in.; pp. 139; illustrated.

BOARD OF PUBLIC UTILITY COMMISSIONERS: Statistics for 1917—Trenton, N. J.: The Commission. Paper; 6 x 9 in.; pp. 48.

Shows assets, liabilities and income accounts for privately owned steam and electric railways, and gas, electric, water and sewer companies, having revenues of more than $10,000 in 1917.

BUILDING CODE, STATE OF WISCONSIN, REVISED 1918—Madison Wis.: Industrial Commission of Wisconsin. Paper; 6 x 9 in.; pp. 120; illustrated.

This code was originally issued in 1914 and revised in 1915. The present edition contains "a few necessary changes," based on experiences of the past three years "in the requirements for fire protection, sanitation and structural safety in the construction of buildings in this state.

CENTRAL STATION HEATING: Its Economic Features with Reference To Community Service—By John C. White. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 23; illustrated. 5c. from Superintendent of Documents.

CONVEYANCE AND DISTRIBUTION OF WATER FOR WATER SUPPLY: Aqueducts, Pipe-Lines and Distributing Systems—A Practical Treatise for Water-Works Engineers and Superintendents—By Edward Wegmann, C. E., M. Am. Soc. C. E., American Water-Works Association, New England Water-Works Association. New York: D. Van Nostrand Co. Cloth; 6 x 9 in., pp. 663; illustrated. $5.

DRAFTING-ROOM METHODS—STANDARDS AND FORMS: A Reference Book for Engineering Offices and Draftsmen—By Charles D. Collins, M. Am. Soc. C. E. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 149; illustrated. $2.

EXTINGUISHING AND PREVENTING OIL AND GAS FIRES—By C. P. Bowie. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 50; illustrated. 20c. from Superintendent of Documents.

THE FOUNDATIONS OF NATIONAL PROSPERITY: Studies in the Conservation of Permanent National Resources—By Richard T. Ely, Professor of Political Economy in the University of Wisconsin; Ralph H. Hess, Associate Professor of Political Economy in the University of Wisconsin; Charles K. Leith, Professor of Geology in the University of Wisconsin, and Thomas Nixon Carver, David A. Wells Professor of Political Economy in Harvard University. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 378; illustrated. $2.

GASOLINE AND KEROSENE CARBURETORS: Construction—Installation—Adjustment—By Victor W. Pagé, M. S. A. E., Author of "The Modern Gasoline Automobile," "Automobile Repairing Made Easy," "Aviation Engines," etc. New York: The Norman W. Henley Publishing Co. Cloth; 5 x 8 in.; pp. 206; illustrated. $1.50.

This book will interest owners and drivers of automobiles and auto trucks because it is a practical treatise on fuel economy and deals comprehensively with the subject of kerosene for fuel.

HANDBOOK ON EMPLOYMENT MANAGEMENT IN THE SHIPYARD Dealing with Modern Methods and Practices of Employment Management. Bulletin II, The Employment Building. Philadelphia, Pa.: U. S Shipping Board Emergency Fleet Corporation. Paper; 8 x 10 in.; pp. 29; illustrated.

HEALTH ALMANAC FOR 1919—Compiled by R. C. Williams, Assistant Surgeon, U. S. Public Health Service. Prepared by Direction of the Surgeon General. Washington, D. C.: U. S. Public Health Service. Paper; 6 x 9 in.; pp. 13; illustrated.

IOWA ENGINEERING SOCIETY: Proceedings of Annual Meeting held at Waterloo, Feb. 20-21, 1918 Iowa City, Iowa: The Society. Paper; 6 x 9 in.; pp. 169; illustrated. 50c.

JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS: Proceedings, Nov., 1918—Boston, Mass.: S. Everett Tinkham, Secretary and Librarian. Paper; 6 x 9 in.; pp. 35; illustrated. 50c.

LOGARITHMS OF HYPERBOLIC FUNCTIONS TO TWELVE SIGNIFICANT FIGURES—By Frederick E. Pernot and Baldwin M. Woods. Berkeley, Cal.: University of California. Paper; 7 x 10 in.; pp. 170.

The range covered by these tables is from 0.000 to 2.000, with a tabular interval of 0.001. For the entire range the sinh, cosh, and tanh are given. For the first quarter of this range—namely, up to 0.500—values of log sinh x/x and log x/tanh x are given, also to the interval of 0.001. Other high-precision tables of hyperbolic functions do not give figures below 0.500, and thus an essential need is provided for by the present work. An introductory text explains the method of calculating the tabular values.

METHOD OF LEAST SQUARES APPLIED TO ESTIMATING ERRORS IN COAL ANALYSIS—By J. D. Davis and J. G. Fairchild. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 36; illustrated. 5c. from Superintendent of Documents.

MINERS' SAFETY AND HEALTH ALMANAC, 1919—Compiled by R. C. Williams, Assistant Surgeon, U. S. Public Health Service. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 48; illustrated.

Among other subjects, takes up communicable diseases and general health of miners, water-supply, garbage and sewage disposal and has seven pages on sanitary privies, with illustrations. 5c. from Superintendent of Documents.

MUNICIPALITIES AND COUNTIES OF CALIFORNIA: Annual Report for 1917 of Financial Transactions. John S. Chambers, State Controller, Sacramento, Cal.: The Controller. Paper; 6 x 9 in.; pp. 219.

NATIONAL BRICK MANUFACTURERS' ASSOCIATION: Report of 32nd Annual Convention—Indianapolis, Ind.: The Association. Paper; 6 x 9 in.; pp. 192.

NATURAL GAS: Its Production, Service and Conservation—By Samuel S. Wyer, Columbus, Ohio. Washington, D. C.: Smithsonian Institution. Paper; 6 x 9 in.; pp. 67; illustrated.

PROBLEM OF STREET CLEANING, ROCHESTER, N. Y.: Report Submitted to the Mayor and to the Commissioner of Public Works. Rochester, N. Y.: Rochester Bureau of Municipal Research, Inc. Paper; 6 x 9 in.; pp. 133; illustrated.

This thoroughgoing study of local street-cleaning methods and needed reforms follows a similar investigation and report on snow removal, and will be followed in turn by a report on refuse collection. The street-cleaning study was made by John T. Child, assistant engineer, working under James W. Routh, chief engineer of the bureau named, and the report was written jointly by the two and finally edited by L. E. Snyder, director of the bureau. It is a good example of the excellent work being done by the best bureaus of municipal research.

THE REGULATION OF PRIVATE WATER COMPANIES IN NEW YORK CITY—By Delos F. Wilcox, Ph.D., [lately] Deputy Commissioner of Water-Supply, Gas and Electricity, City of New York. New York: The Author. Paper; 6 x 9 in.; pp. 24.

RECREATION USES ON THE NATIONAL FORESTS—By Frank A. Waugh, Collaborator; 1918. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 43; illustrated.

REPORT OF WATER RIGHTS BRANCH OF THE DEPARTMENT OF LANDS, PROVINCE OF BRITISH COLUMBIA, for 1917. The Hon. T. D. Pattullo, Minister; William Young, Comptroller. Victoria, B. C.: The Department. Paper; 7 x 10 in.; pp. 58; illustrated.

A report on water power and water-supply in the several districts of the Province of British Columbia; including a table giving revenue for the year and records of precipitation from various meteorological stations. The appendices give a list of 270 power sites of 500 hp. and over, of which 30 are wholly or partially developed, 93 sites applied for, and 147 known and unstaked; also instructions on how to acquire license to take and use water. There are also included data useful in measurement of water and the design and operation of water-supply structures.

THE SAFETY MOVEMENT IN THE IRON AND STEEL INDUSTRY, 1907-17—By Lucian W. Chaney and Hugh S. Hanna. Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 299; illustrated.

TABLES AND OTHER DATA FOR ENGINEERS AND BUSINESS MEN—Compiled by Charles E. Ferris, B. S., Professor of Mechanical Engineering, University of Tennessee. Knoxville, Tenn.: The Author. Leather: 3 x 6 in.; pp. 230; 50c.

SEWAGE DISPOSAL—By Leonard P. Kinnicutt, Late Director Department of Chemistry, and Professor of Sanitary Chemistry in the Worcester Polytechnic Institute; C. E. A. Winslow, Professor of Public Health in the Yale School of Medicine and Curator of Public Health in the American Museum of Natural History, New York, and R. Winthrop Pratt, Consulting Engineer, M. Am. Soc. C. E. Second Edition, Rewritten. New York: John Wiley and Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 547; illustrated. $4.

THE SHIPBUILDING INDUSTRY—By Roy Willmarth Kelly, Director, Harvard Bureau of Vocational Guidance, Author of "Hiring the Worker," and Frederick J. Allen, Assistant Director, Harvard Bureau of Vocational Guidance, Author of "The Shoe Industry;" with an Introduction by Charles M. Schwab. Boston and New York: Houghton, Mifflin & Co. Cloth; 6 x 9 in.; pp. 303; illustrated. $3.

STATE ENGINEER OF WYOMING: Report for 1917-18—By James B. True, State Engineer, Cheyenne, Wyo.: The Author. Paper; 6 x 9 in.; pp. 256.

Material on surface waters of Wyoming, with gaging records, occupies 154 pages.

STATISTICS OF COMMON CARRIERS: A Preliminary Abstract Dec. 31, 1917—Washington, D. C.: Bureau of Statistics. Paper; 9 x 12 in.; pp. 75.

SUMMARY OF SOLDIER SETTLEMENTS IN ENGLISH-SPEAKING COUNTRIES—Elwood Mead, Consulting Engineer, U. S. Reclamation Service. Washington, D. C.; Department of the Interior. Paper; 6 x 9 in.; pp. 27.

WAR ADMINISTRATION OF THE RAILWAYS IN THE UNITED STATES AND GREAT BRITAIN—By Frank Haigh Dixon, Professor of Economics, Dartmouth College, Chief Statistician, Bureau of Railway Economics, and Julius H. Parmelee, Statistician, Bureau of Railway Economics [Preliminary Economic Studies of the War, Carnegie Endowment for International Peace]. New York: Oxford University Press. Paper; 7 x 10 in.; pp. 155. $1.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Proposes Definition of Engineering

Sir—During some committee work, drafting a proposed registration law for the State of Michigan, it appeared desirable to include a definition of the term "Engineering." The writer submitted the following:

"Engineering is the ingenious application of the principles of science to the economical production and use of materials and energy."

It was suggested that the word "ingenious" was insufficient and that "judicious" should be coupled with it.

Would you like to try this definition on your readers?

E. M. WALKER.

Michigan Central R.R. Station, Detroit, Mich.

Honor American Engineer by Election To L'Institut de France

Sir—In your issue of Jan. 16, 1919, p. 162, there appeared a short notice concerning the election of Dr. J. A. L. Waddell to L'Institut de France in the Académie des Sciences. In view of the fact that he is the first American practicing engineer ever taken into that scientific body, or even into the Institute itself, and that the election was stated by high French authority to be intended as "a new expression of the gratitude which we (the French people) owe to your great nation," it seems to me that the occurrence is worthy of more than a perfunctory or passing notice.

Few Americans recognize that the French Academy of Sciences is the most select body of scientific men in the world, and that admission to its ranks is truly the highest honor to which any scientific man can attain. As proof of this, I repeat the fact stated in your notice that the resident membership is limited to 66 and the corresponding membership to 116. One could compile from its roster a long list of the world's best known scientists who have lived during the past 125 years, such as: Sir David Brewster, the Scotch physicist; Robert W. Bunsen, the chemist who invented the gas burner that bears his name; Sir William Crookes, the famous English physicist; James Dwight Dana, the well known American scientist; Charles R. Darwin and Sir George H. Darwin, father and son, of worldwide fame; Sir Humphry Davy; Sir Michael Faraday; Sir Edward Frankland, the well-known scientist; Asa Gray, the former dean of American botanists; Herman L. F. von Helmholtz, the eminent German physicist; Sir William and Sir John Herschel, father and son, the famous English astronomers; Baron Friedrich H. A. von Humboldt, the explorer; Thomas Henry Huxley, the English physicist and writer; Lord Kelvin (previously Sir William Thomson) the great Irish scientist; Samuel P. Langley, the American aëronautical expert; Pierre S. de Laplace, the prominent French astronomer; Count Ferdinand de Lesseps, the canal builder; David Livingstone, the African explorer; Elie Metchnikoff, the Russian physician; Fridtjof Nansen, the Arctic explorer; Louis Pasteur, the eminent French chemist, and James Watt of steam-engine fame.

I therefore take the liberty of bringing to the notice of your readers the great compliment which has been conferred upon the American nation, the engineering profession of this country, and one of its well known members.

JOHN LUNDIE,
Consulting Engineer.

New York.

These Engineers Also Served

Sir—In this post-bellum period, when War Department and other Government officials are bestowing crosses, honors and "lime wash," and each and every department or branch of the "service" is being boosted for its efficient and marvelous contribution toward the victory, I bespeak your attention and offer a word in behalf of those *engineers who did not wear a uniform*, but who contributed their energy and brains to the common cause.

The results accomplished in the production of camps, cantonments, Army and Navy bases, warehouses, and war industry plants, are in no small measure attributable to the patriotic and untiring efforts and energy of civilian engineers, who have for the past twenty months devoted their time and organizations to the Government's needs.

For a civilian to fit himself into a military organization, where red tape and ancient civil-service methods delayed the machinery, required no small amount of adaptability and an unlimited amount of resourcefulness and diplomacy. The problem was made all the more difficult because of the fact that many of the Government contractual officers were men recently commissioned from civil life, who in turn were equally ignorant of the operation of the newly constructed war machine.

It is to the everlasting credit and renown of the civilian engineers that they met the situation squarely and produced results. From rodmen and draftsmen to supervising and consulting engineers they one and all worked toward a common end, and it is for these, unhonored and unsung, who wear no service stripes or insignia, but who did their bit, I write these lines.

These same men will now be turning their thoughts and energies toward the country's construction and industrial problems, and with the same adaptability, ripened by experience, they will meet the new problems and solve them.

P. H. NORCROSS.

Washington, D. C.

A Fair-Compensation Form of Contract

Sir—Considerable discussion has appeared in the columns of your paper regarding different types of fair-compensation contracts. It may, therefore, be of interest to some of your readers to take note of a type of contract on the basis of which bids were asked recently by the Sebastian bridge district, Fort Smith, Ark., for a reinforced-concrete bridge across the Arkansas River, to cost approximately $550,000.

The bridge district first asked for a lump-sum bid

based on certain quantities with unit prices to be used for additions or reductions in such quantities. As an alternative, the board also asked for a bid as follows: Under item 1 the contractor should name a lump sum to represent the total cost of the work, including fair overhead, administrative charges, freight, transportation of men, labor cost, material cost, etc.; second, an additional sum to cover the contractor's profit and the use of all machinery required for the proper execution of the work.

It was further stipulated that any saving effected in item 1 would be split 50-50 between the contractor and the bridge district. In the event of the cost being in excess of the first item, the second item, or fee, would be penalized for such excess up to an amount equal to two-thirds of such fee.

This gives the contractor every incentive for economical work on a profit-sharing basis; gives the owner every right to assume that a reasonable loss might occur, as against the original estimate, without affecting the cost to him, and also protects the contractor from loss due to unforeseen contingencies, as he can so work out the fee item that he will still receive enough to compensate him for depreciation of outfit and use of money.

This form of proposal was worked up by Hedrick & Hedrick, consulting engineers, of Kansas City, Mo.

N. F. HELMERS,
Siems, Helmers & Schaffner, Contractors.
St. Paul, Minn.

Engineers' and Artisans' Pay

Sir—With further reference to the matter of engineers' salaries in comparison with those of other skilled artisans, the following announcement by the local unit of the bricklayers, masons and plasterers' union, published in a local newspaper, may be of interest:

"On and after Apr. 1, 1919, the scale of wages of this union shall be $1.25 per hour, excepting on all hollow-tile and cement-block work, which shall be at the rate of $2 per hour, excepting partitions, which shall be at the rate of $1.25 per hour. All concrete construction and other artificial masonry shall be under the direct supervision of a member of the B. M. & P. I. U."

Transitmen on municipal work here, competent to act as inspectors, receive $100 per month.

J. H. GILES,
City Engineer.
Pocatello, Idaho.

Hand Hammering of Concrete Forms Not New

Sir—Referring to the editorial in *Engineering News-Record* of Jan. 23, 1919, p. 169, entitled, Hammering Forms a Useful Development in Concrete," I wish to say that while mechanical hammering of forms in order to improve density of concrete may be a new idea with the shipbuilders, the use of hand hammers for that purpose is not new.

In the construction in 1907 of the U. S. Grant Hotel, at San Diego, Cal., then considered the largest reinforced-concrete building in the world, a special "mallet gang" was organized, with orders to keep up a continual hammering against forms while the concrete was being placed; particularly against the form for the exterior of the building, which was all of concrete in elaborate detail. It was only by hammering that we could successfully fill all moldings and eliminate the air bubbles on the wall surfaces which left unsightly holes.

In the construction of the Timken office building in San Diego the next year, we used this same method with particular success in placing concrete for the many office partitions. They were of concrete 2 in. thick, reinforced with ¼-in. steel rods. It was only by continual hammering that we could insure a complete permeation of concrete in the narrow forms.

The writer makes no claim to having introduced this method on these buildings, with which his connection was that of superintendent for the architect. In his own mind he has always given credit for the idea to the organization of Carl Leonardt, contractor for the U. S. Grant Hotel building 12 years ago. CARL REGER.
Morgantown, W. Va.

Shall We Have a Trade Union of Professional Engineers?

Sir—That the wages of engineers have lagged behind those of tradesmen because of lack of organization, as R. N. Atherton sets forth in his letter on p. 201 in your issue of Jan. 23, few will question. But is the remedy one of expediency through a union affiliated with the American Federation of Labor? Is engineering a trade to be classed with the "other trades?" Most engineers consider engineering a profession, and feel that as members of the profession there is no place for them in the ranks of organized labor.

The outstanding characteristic of union labor is selfishness. It tries to get what it wants by threats, intimidation, the application of force, and exhibits its force by strikes. A professional man is one who makes his living by means of education, primarily by the exercise of mental rather than physical effort. In addition, altruism is one of his characteristics. Furnishing a background to the more immediate and personal need of wages is the constructive work that calls for imagination, and, above all, service to the public, to one's fellow men. These are the problems of a profession.

The engineering profession is at the point of choosing the kind of organization it will have for collective effort. The American Institute of Architects, the American Medical Association, the bar, and the Chamber of Commerce are the types engineering organization will parallel. Such is the American Association of Engineers.

It is proper here to say that the efforts of the American Association to raise the pay of the technical engineer in railroad employ have been successful, much beyond our early hopes. New schedules have been put into effect on many roads, and others will follow. An assistant secretary was employed Feb. 1 to devote his time to the railroad field. A conference of railroad men will be held in Chicago Mar. 17 to discuss problems of an economic nature affecting their welfare.

Engineers must do a little housecleaning in order to be a profession, as did the doctors in eliminating the quacks. The answer is licensing. The American

Association of Engineers has been active in licensing and will devote most of the next issue of the *Monad* to this subject. After the housecleaning—after the standards of the profession are raised—we can give attention to the many constructive social problems challenging our best endeavor.

Since your correspondent invites engineers to join the union, it would seem proper that this new business organization of professional engineers should be brought to their attention through your columns. The choosing can be safely left to the individual engineer.

C. E. DRAYER,
Secretary, American Association of Engineers.
Chicago, Ill.

High Authority Restricts the Engineer

Sir—Referring to your editorial "Not Only by Their Works Shall Ye Know Them," in *Engineering News-Record* of Jan. 30, 1919, p. 215: Governor Smith has ample precedent for his disregard of the engineer in the new state reconstruction commission. Read President Wilson's reply to the suggestion of the Engineering Council that an engineer be appointed on any prospective national reconstruction commission: "You may rest assured that I realize what a service engineers can render in reconstruction problems from time to time."

You will note the emphasis of "can" and "from time to time." As permanent members of such a commission they are not to be considered.

St. Marie's, Idaho. M. S. PARKER,
Consulting Engineer.

Using Series of Uniform Loads To Obtain Maximum Stress

Sir—The principle of the diagram for fixing the position of a series of uniform loads to produce maximum stress, described by Mr. Christensen in your issue of Dec. 26, 1918, p. 1193, was discovered and applied by the writer in computing the stresses in a spandrel braced two-hinged arch, while associated with Mr. Christensen in work on the Niagara River Bridge.

A careful check was made of stresses obtained from an equivalent uniform engine load with those from corresponding wheel loads computed with the transparent scale described by Dr. Steinman in *Engineering Record* of Apr. 24, 1915, p. 517. The computation of stresses from wheel loads with Dr. Steinman's scale was found to be extremely tedious when compared with the use of the writer's diagram in connection with Mr. Christensen's equivalent uniform loading. The time required by the former method was fully four times as great since, owing to the curved and irregular shape of the influence lines, no criterion is available for determining the position of the train to produce maximum stress. This must be determined in practically all cases by trial.

A comparison of results obtained from Dr. Steinman's "Chart of Equivalent Uniform Loads" (see *Engineering News* of Apr. 22, 1915, p. 780), with those from Mr. Christensen's loading, for several examples of curved influence lines, varying in length from 230 to 600 ft., indicates that the errors resulting from the use of Dr. Steinman's chart are approximately double the errors resulting from the use of Mr. Christensen's loading. The maximum error found by the former method was approximately 5 per cent., while with the latter method it was about 3 per cent., compared with results from corresponding wheel loads. With either method it is necessary to compute the influence areas accurately and the amount of labor and the chance for mistakes are practically the same.

In designing long-span structures with curved or irregular influence lines, the loading and diagram described by Mr. Christensen may be used with facility equal to that of any other method heretofore employed; the results more closely approximate those determined from wheel loads than with any other method, and the time required is only a small fraction of that required in using wheel loads.

J. H. FLYNN,
Superintendent of Construction, Burroughs Adding Machine Company.
Detroit, Mich.

Camp Sanitation in India

Sir—The article by Harry N. Jenks in your issue of Jan. 23, 1919, on sanitation at the Namtu camp of the Burma Mines, Ltd., is of much interest to me and doubtless to others with experiences in the Far East. For many years in all parts of the Far East under British control, where large or small bodies of coolie labor have been employed, sanitary regulations similar to those described by Mr. Jenks have been rigidly enforced.

Some years ago I had much to do with coolie labor (Malabar or Tamil), and saw these regulations in full operation and was held responsible for their enforcement. Full reports have to be made to the Government authorities, and assessments periodically paid to the "District Medical Aid" for the upkeep of the local hospitals and dispensaries and of the district European doctor (medical officer in charge) and his very capable native or Eurasian local assistants. I can truthfully say that the coolie "lines" or quarters on all construction operations were cleaner than many of the streets of Philadelphia are today.

To most people in the United States, India is a sealed book. Few knew of its teeming millions of industrious workers, skilled in all manner of crafts and arts for many ages. It is an interesting part of the world for an engineer to visit. He will find colossal reminders of magnificent engineering works—full evidence of a very high order of civilization and constructive capacity—in India, Ceylon and Burma.

Mr. Jenks mentiones the native contractors. I have had native masons, Tamils from Madras, and men from Canara and elsewhere, do the best of work. My experience with carpenters, chiefly Singalese, has been equally satisfactory, and the native blacksmiths and machinists of various other races "caught on" very quickly. Common coolie labor usually works on a task system. Everything is done by the job.

Mr. Jenks' article is very interesting. To those who have been in the Far East and have not yet been able to cast off its fascinating spell it is like a memory of old times.

GEORGE HARPER.
New York City.

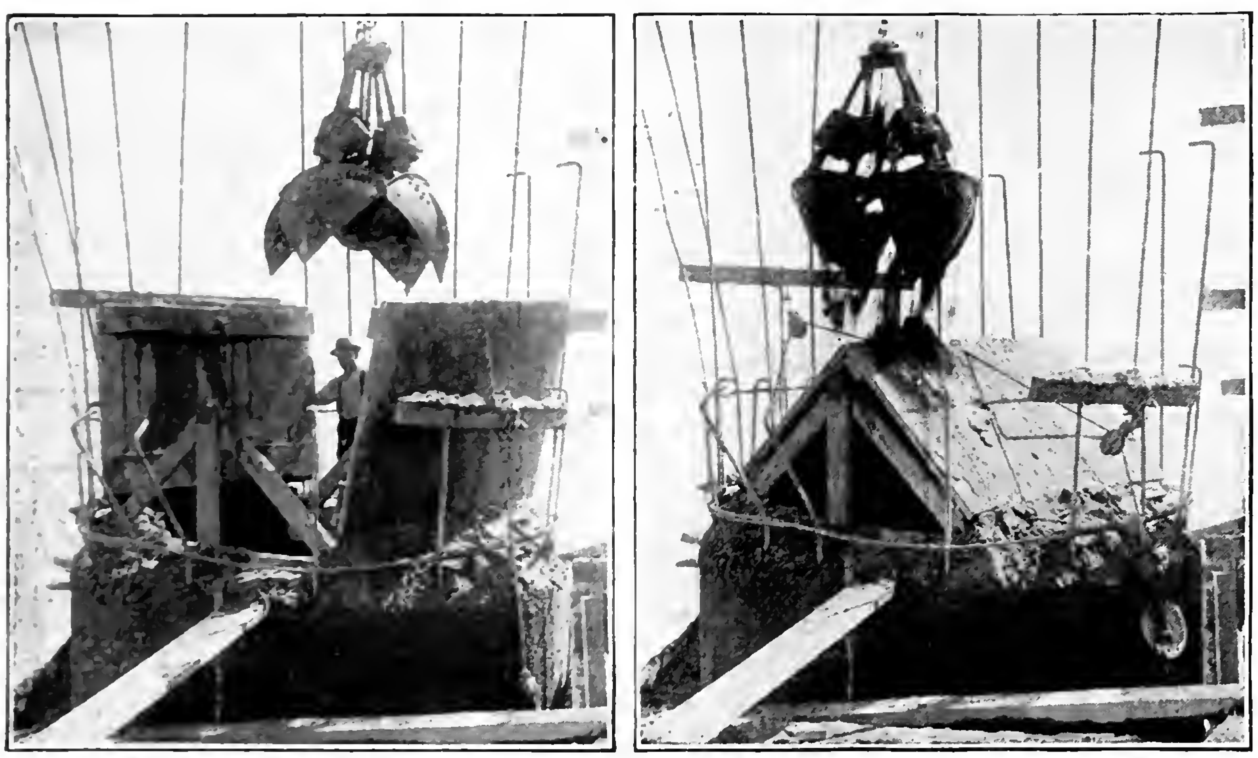
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Trap Door Aids in Excavation of Cylinder Foundation for High Tower

SPOTTING a clamshell bucket in the comparatively narrow opening of a concrete cylinder foundation is no easy job in the prevailing high winds of the St. Lawrence. As shown in the accompanying view of the tower foundations of the new 4801-ft. transmission line over the St. Lawrence River, recently built by the Shawinigan Water & Power Co. (described on p. 383 of this issue), difficulty was avoided by the construction of a trap door with inclined sides which avoided any movement of the derrick boom.

The device was invented by the foreman of the work, Thomas Burham. Before the trap door was put on, the excavating procedure was, first to spot the derrick boom right over the cylinder, then to lower the bucket, pick up a load, and dump the material by swinging the derrick. On account of the high winds always encountered in the valley, it was found rather difficult for the hoist runner to stop the boom directly over the opening, but by means of the trap door it was possible to keep the boom guyed in the same position during the excavation of one cylinder. All that was necessary was to lower the bucket, pick up the load, close the trap door, and dump the material directly on top of the door. It would then by gravity slide off and deposit itself around the cylinder. The doors were then opened and the procedure was repeated.

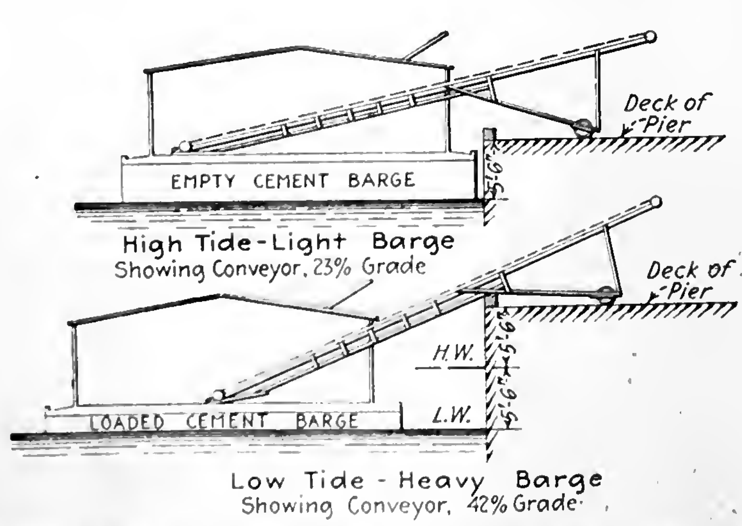


TRAP DOORS ALLOW BUCKET TO DIG IN CYLINDER AND TO DUMP CLEAR

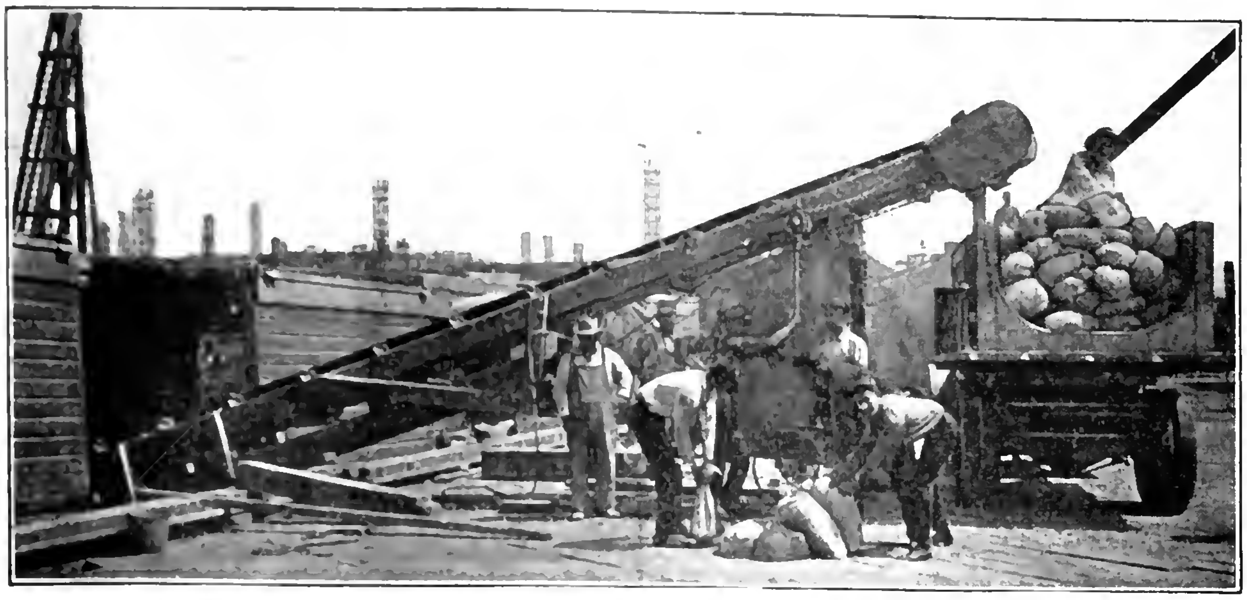
Other Articles in This Issue of Interest to Contractors:

Special Belt Conveyor Saves Time in Unloading Cement Barges

CEMENT was rapidly unloaded from barges at the South Brooklyn Army supply base by means of a specially designed belt conveyor. The special truck body shown in the illustration held about 110 bags, and could be filled in from 8 to 10 min. A battery of six of these machines, which is shown in operation in an article on p. 366 of this issue, was kept busy in the height of the construction season unloading sufficient cement to supply the mixing plants. Being substantially constructed and supported under the engine box with wheels, it could be easily moved from one location to another, according to the places where the boats docked. The length of the device was 45 ft. There were 22 upper rollers, about 6 in. in diameter, 6 return rollers 6 in. in diameter and two end rollers of about 16-in. diameter. The belt which traveled over the rollers was 24 in. wide. A 10-hp. gasoline motor supplied the power. A 15-hp. motor is recommended for this work, so as to increase the speed on steep grades. The truck body shown was originally constructed to haul bulk cement which it was originally intended to use on this job. As this was not found practicable, the trucks were used for bagged cement. The interiors were shaped, made narrower at the forward end and lined with sheet steel, so that when the truck



DEVICE GIVES CLEARANCE AT HIGH AND LOW TIDE



TRUCK BEING LOADED FROM SCOW WITH BELT CONVEYOR

ended up all cement would flow readily from the body.

As stated, this type of body was designed for bulk cement and was used on only a few trucks. Bagged cement dumps readily from ordinary boxes.

Six men were required to throw on the bags at the lower end of the conveyor, while one man arranged the bags on the trucks. When it was necessary to move, these were sufficient to pick up the initial end and wheel the device to the new location. The sketch shows how clearance was obtained at high and low tide and with loaded and empty barges.

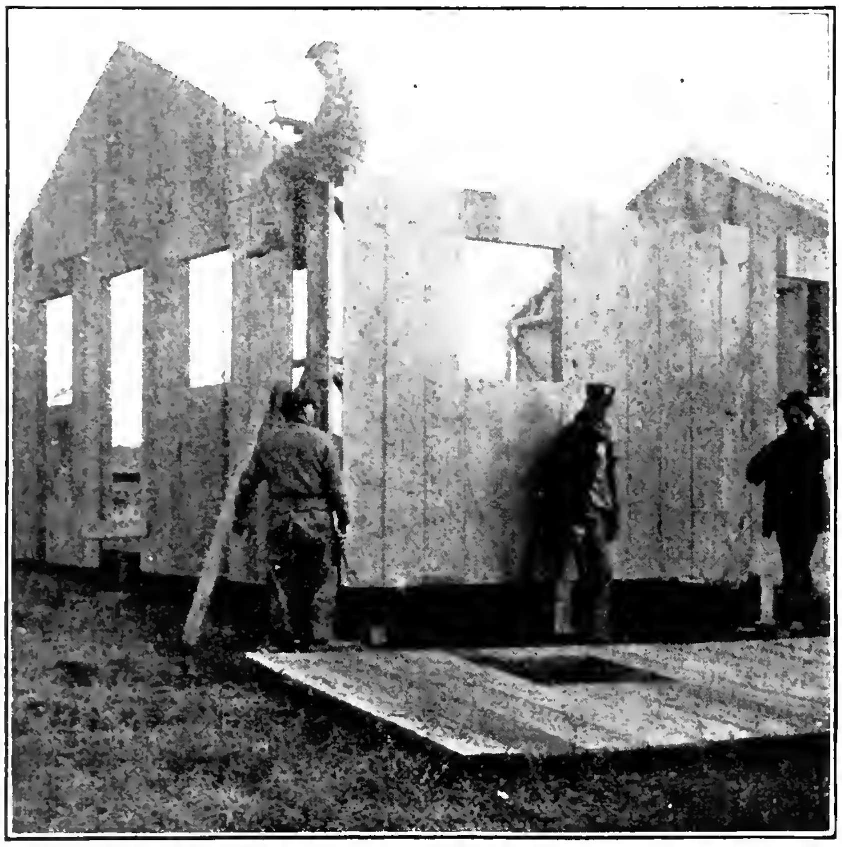
The work was done under the supervision of the Construction Division of the Army. Brig.-Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut.-Col. H. F. Crocker is constructing quartermaster, and Maj. George Perrine, Quartermaster Corps, National Army, is directly in charge of this part of the work.

The general contractor is the Turner Construction Co., of New York City, of which A. C. Tozzer is executive manager.

Quantity Production of Officers' Huts By Erection of Framed Units

CONSTRUCTION of 698 huts, 20 x 20 ft., for the extension to Camp Custer, was facilitated by the erection of ends and sides as completely framed units. A sample hut was built, and a duplicate was made of each piece of lumber entering into the building. These duplicates were set aside as patterns and jigs were set up from them, so that all the cutting for the huts was done at a mill centrally located. Platforms, later used as hut floors, were erected and made into templets for framing the four sides. When framed, the hut sides were piled like on like, and tractor-hauled wagons took four sides as a load to the hut site. Foundation gangs built the floor platforms. Then the erection gangs set up sides and ends and placed the roof, all lumber for which had been cut to dimensions at the mill. This operation completed the outside of the building, except doors and windows. Finishing gangs completed the buildings. The Camp Custer extension was constructed by the W. E. Woods Co. contractors, of Detroit, Mich., under the direction of Maj. T. A. Leisen, constructing quartermaster, and Samuel A. Greely, supervising engineer.

SIDES AND ENDS FRAMED ON TEMPLET PLATFORMS



SIDES AND ENDS ERECTED AS FRAMED UNITS

Costs at Los Angeles Municipal Asphalt Plant

During the fiscal year which ended June 30 the municipal asphalt plant at Los Angeles turned out 634,-860 cu.ft. of mixture, according to the annual report of the Engineering Department of the city. This covered nearly all the standard asphaltic surfacings, and the cost per cubic foot ranged from 13.03 to 15.88c., the average being 15.6c. These figures represent an increase in cost over those of 1916-17 of approximately 19%, which is attributed to higher prices of labor and material. The plant was designed and built by the Engineering Department, and the cost, including additions to the original structure and equipment, amounts to $28,625.

NEWS OF THE WEEK

New York, February 20, 1919

Associated Contractors Appoint Acting Secretary

At a meeting of the Executive Committee of the Associated General Contractors of America, held in Washington, Feb. 10, it was decided to engage G. W. Buchholz, recently works manager for Fred T. Ley & Co., Inc., New York City, as acting secretary of the association, with the duties of executive manager. William A. Davis, recently of the War Labor Board, was selected to act as organization manager to assist the secretary.

Would Reimburse Contractors For Their War Losses

Minnesota cities of more than 50,000 population will be authorized to reimburse contractors on municipal work for losses on account of war conditions, if a bill that has been introduced in the legislature becomes law. While general in character, the bill is aimed to make good the losses said to have been incurred by the contractor for the new concrete reservoir for the water department of St. Paul. (See *Engineering News-Record* of Jan. 9, 1919, p. 96.) This contract was awarded for $247,000 about four months before the war. It is said that the company figured on labor at $2.25 per day, but had to pay $4 before the work was finished, and had to meet a corresponding increase in prices for materials. Under the city charter of St. Paul the city could not reimburse the company for such losses. The bill is backed by the city authorities of St. Paul, and has been indorsed by the building trades labor organizations of the city.

Dealers, Not Manufacturers, Lower Cement Prices

In the "Construction News" Section of *Engineering News-Record* of Jan. 30, 1919, p. 51, last column, it was stated that portland cement in New York had been reduced from $4 at dock in cargo lots to $3.45. It was not made clear, however, that this reduction was made by the dealers and not by the manufacturers. The price of cement at the mill remains the same; the reduction is a reduction in profits which the dealer is content to take.

Owners Refuse Government Offer For Cape Cod Canal

Pursuant to recent legislation, the Secretaries of War, Navy and Commerce have met and considered the desirability of the Government purchasing the Cape Cod Canal. As they decided that the purpose was desirable, the next step was for the Secretary of War to negotiate the purchase. Accordingly, after investigation and appraisal, he offered the owners $8,250,000 for the property. This offer was declined, and, still pursuant to the law, the Secretary of War then asked the Attorney General to begin condemnation proceedings.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western Zone, 63 E. Adams St., Chicago.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Meyers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

No Federal Public Works Department Bill This Session

According to a note in the Washington papers, Senator Kenyon of Iowa has abandoned hope of getting through this session of Congress his bill providing for an emergency department of public works. In lieu of this bill he has introduced a bill to create a joint Congressional executive commission of six to inquire into existing methods of financing the construction and acquisition of homes within the reach of people with modest means.

John Fritz Medal Awarded to General Goethals

The John Fritz Medal Board of Award Committee, composed of representatives of the four national engineering societies, at its annual meeting on Jan. 17 awarded the John Fritz medal to Maj. Gen. George W. Goethals.

Government Surplus Building Material Small

Inventories of All Army Construction Projects Show Relatively Little That Cannot Be Absorbed

Building material on hand for Government work will probably not become available for private use in any great quantity, nor will its disposal cause much disturbance of the market. The War Department has just made an analysis of the surplus material in the hands of the Construction Division—which has probably 90% of all building material in the department and certainly the greater part of all material held by the Government—and as a result announces that most of the surplus will be absorbed in other Government work. The inventories, as of Dec. 31, are divided into the following main groups: Lumber, plumbing and heating, electrical material and equipment, cement, wallboard, millwork, roofing, screening, etc.; miscellaneous building material, steel, nails, bolts, nuts and washers, building hardware, paints and oils, railroad material, paving material, piling and poles, raw material, fencing, belting, cable, etc.; chain, dynamite, caps, etc.; fuel, hose, harness, etc.; lanterns, flashlights, etc.; rope, and miscellaneous. The total cost to the Government of the above materials is approximately $12,000,000. In addition, there are construction equipment, office equipment, small tools, etc., amounting to approximately $3,500,000.

Large quantities of the material are being consumed inside the War Department, the Construction Division alone having made, since Dec. 31, 800 transfers of materials which were declared surplus at one project or another, transferring them to some project where work was being completed. Approximately $2,000,000 worth of building material has been absorbed in this manner, and the transfers still continue.

The War Department is making no purchases where material can be obtained from some other project. The largest single item in the above summary is lumber, representing approximately one-half the total. A contract for this has been made with the producers, and it will be distributed to the market at market prices.

At each of the 476 Army projects there is a constructing quartermaster, who will make sales of his own surplus under general instructions issued from the director of sales. This means that the majority of this surplus will be absorbed in the particular locality in which it is situated.

Annual Convention of Engineering Institute of Canada

Standardization of engineering parts and the electrification of railways were subjects of technical interest at the annual convention of the Engineering Institute of Canada, held in Ottawa, Feb. 11-13, with an attendance of about 300 members, including several prominent engineers from the United States. The war accomplishments of Canadian engineers and the development of munition work in Canada were outlined by the president, H. H. Vaughan, of Montreal, who stated that the institute was represented overseas by 960 of its members, being 36% of the total.

"Standardization in Engineering" was the subject of a paper by Capt. R. J. Durley, chief of the Division of Gages and Standards, Imperial Munitions Board, who described the work of standardization in engineering parts carried on in England and the United States. He urged international standardization, especially in airplane parts.

A long and interesting discussion on the subject of good roads followed a paper on the subject by Capt. J. Duchastel, who advocated an appropriation of $50,000,000 by the Federal Government to aid the provinces in constructing highways of national importance. Dr. Ira S. Hollis, representing the American Society of Mechanical Engineers, delivered an address in which he expressed the cordiality of the relations between the United States and Canada, and A. D. Flinn, secretary of the Engineering Council, discussed "International Affiliation of Engineers."

The principal feature of the third day's proceedings was the presentation and discussion of papers on the topic of "Railway Electrification," by John Murphy, Ottawa; W. G. Gordon, transportation engineer of the Canadian General Electric Co., Toronto; F. H. Sheppard, director of heavy traction, Pittsburgh, Penn., and Comfort A. Adams, president of the American Institute of Electrical Engineers. This subject was treated comprehensively, presenting the advantages in the adoption of electrical equipment by the railways.

The new officers elected include Lieut. Col. R. W. Leonard, St. Catharines, Ont., president; Walter J. Francis, Montreal, and D. O. Lewis, Victoria, B. C., vice presidents.

Engineer Heads Housing Bureau

L. K. Sherman, of Chicago, has been made director of the Bureau of Industrial Housing and Transportation of the United States Department of Labor, succeeding Otto M. Eidlitz, who has resigned. Mr. Sherman is a sanitary engineer who has been connected with a number of the public works in and around Chicago, notably the Chicago Sanitary district. He has been serving as assistant chief engineer of the housing bureau throughout the war.

Canadian Government States Federal Road Policy

Plan Described at Meeting of Eastern Ontario Good Roads Association—Other Convention Action

Announcement of the Federal road policy of the Canadian Government was made by a representative at the annual meeting of the Eastern Ontario Good Roads Association, held at the Chateau Laurier, Ottawa, Feb. 4 and 5. The national, and even the international, importance attached to this Government statement made it one of the outstanding features of the meeting.

In giving out the information at the annual dinner, the Hon. Dr. J. D. Reid, Federal minister of railways and canals, whose portfolio includes the Department of Highways, stated that of the 250,000 miles of highways in the Dominion of Canada 200,000 miles are third-class roads leading from the farm to the market; 40,000 are second-class roads leading from the larger centers to smaller market centers, while the remaining 10,000 miles are first-class roads connecting the larger centers of population in the provinces.

The Dominion Government, according to Dr. Reid, agrees to pay an amount toward the cost of first-class roads which will be fair and reasonable. No definite statement regarding the amount was made, but it is believed that it will be either 40 or 50% of the total expenditure. The Hon. Gideon Robertson, minister of labor, suggested that in laying out work care should be exercised that the highways be near larger centers of population where unemployment exists.

In discussing the Federal announcement, the Hon. Findlay McDiarmid, minister of public works and highways for the Province of Ontario, stated that it would result in his department designating a greater mileage of provincial highways and would mean more rapid construction. Ontario had passed suitable legislation two years ago. There had been criticism in certain quarters regarding trunk-highway construction under present conditions, and he asked whether the convention favored delay. A negative answer appeared to be unanimous. He said that if ever a progressive program was justified it is now, and it would be the endeavor of his department to build the roads in such a way that they would meet future as well as present demands.

Since its formation in July, 1918, the Good Roads Association has promoted 195 miles of provincial highways, and 331 miles of county provincial highways have been arranged for. This system will connect Ottawa and Prescott, Ottawa and Kingston and Ottawa with the Quebec Highway leading to Montreal.

Nearly 300 delegates were registered during the convention, and the officers elected were as follows: President, Nelson D. Porter, Ottawa; secretary-treasurer, W. Y. Denison, Ottawa.

Highway and Truck Appropriations Agreed to by Conferees

Conferees of the United States Senate and House have agreed upon the Post Office Appropriation Bill, including $200,000,000 for Federal aid to highways and $300,000 to continue experiments with motor-truck transportation of parcels post mail matter. The bill also increases the number of roads to which Federal aid may be applied.

Michigan Plans Extensive Highway Improvements

A bill has been passed by both houses of the Michigan legislature, providing for submitting to the voters, a constitutional amendment which will allow the issue of $50,000,000 in highway improvement bonds. An election for this purpose will be held early in April. Various state farmers' organizations, together with the Grange, have passed resolutions approving of the amendment.

It is proposed to complete a system of about 5000 miles of roads. Roughly speaking, this will comprise two north and south main lines from the southern boundary to Lake Superior, with the necessary cross-connecting lines to reach every county in the state. Arrangements are being made to introduce immediately laws to carry out the plan, if the people approve of the amendment. If present plans materialize the funds will be raised by taxation, each county paying a certain percentage of the cost of the highways within its boundaries, while the remainder will be paid by the state as a whole.

Highway Bond Issue Approved by Minnesota Legislature

Practically unanimous approval of the plan to submit to the people an amendment to the state constitution, providing for a bond issue to construct a definite state highway system, was given recently by both houses of the Minnesota legislature. There were only 10 votes against the plan—three in the Senate and seven in the House—and they were all cast by members of the Nonpartisan League, apparently for political reasons. A complete description of the proposition was given in *Engineering News-Record* of Dec. 26, 1918, p. 1199. The amendment, which provides for the issue of not more than $100,000,000 in bonds, will be submitted to the people at the general election in 1920.

Building Officials Have Meeting

Men responsible for the administration of building laws met at the fifth annual Building Officials' Conference, held at Pittsburgh Feb. 6-8, 1919. A joint session of the conference and the National Brick Manufacturers' Association was held Feb. 7.

The placing of responsibility for safe building construction and a proper compliance with laws and ordinances formed the chief topic of discussion. It was generally agreed that effort should

be made to place that responsibility. The outcome of the discussion was the adoption of the following resolution:

Resolved, that it is the sense of the Building Officials' Conference that for the better protection of the public against unsafe and illegal building construction, suitable legislation should be enacted by which building operations shall be restricted to architects, engineers, builders, superintendents of construction or others who have by proper evidence shown their ability or capacity for undertaking such building operations, and on whom individual responsibility for the safe prosecution of the work and a compliance with the laws relating to buildings can be placed; and

Resolved, further, that the secretary of this organization be directed to furnish, at the request of any member, copies of this resolution for presentation to legislative bodies in support of such legislation.

Rudolph P. Miller, New York, continues as chairman of the conference and F. W. Lumis, superintendent of buildings, Springfield, Mass., is secretary.

Philadelphia Lets Contract for Big Pier

Philadelphia is the first big city actually to let a public works contract of any size. On Feb. 14 the Department of Wharves, Docks and Ferries opened bids for the construction of the Kenilworth St. pier on the Delaware River, a modern freight pier of the well-known Philadelphia type. Eleven contractors made tenders of remarkable closeness, considering the times. On Feb. 17 the contract was awarded to the F. W. Mark Construction Co., of Philadelphia, the low bidder, at $908,000.

The itemized bids are given in the pages of the "Construction News" section. Throwing out two in excess of $1,500,000, the remaining nine bids varied a maximum of $173,000 from the average, with seven bids less than $83,000 above the low bid.

The work comprises 200,000 cu.yd. of dredging, 800 tons of riprap, 30,000 tons of gravel and stone fill and 11,200 sq.yd. of paving.

Contract for Seven Miles of 72-Inch Steel Water Pipe To Be Let

Bids for furnishing and laying 34,590 ft. of 72-in. riveted steel pipe to duplicate the present water-supply conduit between the Boonton reservoir and the Watchung tunnel (near Upper Montclair) are wanted by Jersey City, N. J., until Mar. 25. The work was advertised in 1918, separate bids for furnishing and laying the pipe having been invited, but war conditions prevented letting contracts. Michael I. Fagen is director and Charles A. Van Keuren is chief engineer of the Department of Streets and Improvements, and Clyde Potts, New York City, is consulting engineer for the work.

More Engineers Get High Military Honors

Made Grand Officers of the Legion of Honor and Receive Distinguished Service Medals

High military honors were awarded to several engineer officers in Washington Feb. 13, when General Collardet, the French military attaché, formally presented decorations of the Legion of Honor, previously decreed by President Poincaré, and Secretary of War Baker, in the name of President Wilson, decorated nine American Army officers and two civilians with the Distinguished Service Medal.

Five officers were made Grand Officers of the Legion of Honor, including Maj. Gen. Henry Jervey (previously colonel, Corps of Engineers), Maj. Gen. George W. Goethals and Maj. Gen. William C. Gorgas.

Distinguished Service Medals were formally presented to a number of officers by Secretary Baker. The recipients of the medals included the following:

Brig. Gen. R. C. Marshall, Jr., chief of the Construction Division, for "his zeal, judgment and exceptional administrative ability in the Construction Division of the Army, which enabled serious difficulties to be overcome and the construction necessary for a great army to be provided."

Brig. Gen. Robert I. Rees, chairman of the committee on special training and education, for "his initiative and breadth of vision, to which were largely due the successful measures for training enlisted men for special services and the establishment of the Students' Army Training Corps."

Brig. Gen. William H. Rose, in charge of the Engineer Depot, who "while in charge of the Engineer Depot was charged with the system of purchase of supplies. His exceptional ability, judgment and resourcefulness are apparent in the efficient solution of the many difficult problems involved and in the success attained in supplying the vast quantities of engineering supplies to the Army overseas."

Distinguished Service Medals were also conferred on Guy E. Tripp, "who, as chief of the Production Division of the Ordnance Department, and later as assistant chief of ordnance, displayed fine technical ability and broad judgment in systematizing methods and practices, resulting in the efficient cooperation of industries producing articles of ordnance for the Army," and Edward R. Stettinius, "who, as Director General of Purchases for the War Department, Second Assistant Secretary of war and special representative in France of the Secretary of War, in connection with the procurement of munitions for the American Expeditionary Forces, rendered conspicuous services. His broad vision and splendid judgment have been of the greatest value to the success of the military program."

St. Louis Garbage Will Be Fed To Hogs for a Year

The garbage of St. Louis will be fed to hogs during the year beginning Feb. 15, 1919. Meanwhile, the Board of Public Service will prepare specifications, on broad lines, under which bids for disposal will be invited. During the present year the garbage from the outlying districts will be sold by the city to a number of hog raisers in St. Louis County, the city delivering the garbage at various stations within the city limits and the hog raisers agreeing to pay 25c. a ton for stated amounts. All the remaining garbage collected by the city will be bought by Guy Caron, Little Rock, Ark., for 25c. a ton, and will be delivered by the city to a hog-feeding farm to be established by the contractor within 50 miles of St. Louis. The city agrees to deliver a minimum of 150 tons in three days, and Mr. Caron agrees to take any amount in excess of the minimum. It is estimated that during the summer season the deliveries will be as high as 100 tons per day.

Transportation from the city to the Caron farm will cost the city from 25c. to 40c. a ton, according to the location finally chosen. Thus, for one-half to one-third of its garbage the city will get 25c. a ton, delivered, while for the remainder disposal will cost it from nothing to 15c. a ton. It is estimated that under the worst contingencies the average net cost of disposal for the year will be 5c. to 10c. a ton, which under favorable conditions there may be a small revenue to the city.

Until recently the city paid the Indiana Reduction Co. 87c. a ton for disposal by reduction, the contractor transporting the garbage, at its own cost, from loading docks in the city to its plant. This contract expired Sept. 1, 1918. The company then took the garbage without cost, the city towing it to the reduction works at an estimated cost to it of 20c. a ton. Under an option, the company cancelled this contract, the cancellation to take effect Feb. 15, 1919. All of the foregoing figures are exclusive of the cost of collection.

Portland Grain Elevator Settles During Construction

Settlement of the municipal grain elevator being built at Portland, Ore., has halted work on the structure while studies of the foundation conditions are being made. The building is of concrete, 155 x 111 ft. in plan and 85 ft. high. It is founded on a heavy concrete mat resting in turn on wooden piles 50 to 60 ft. long. It is estimated that these piles are now taking about 60% of their ultimate load. They were designed for a safe load of 25 tons per pile, and some of the piles were loaded with 40 tons without settlement. So far the observed settlement has been about 12 in. and is decreasing. It is not quite uniform, the floor being 4 in. out of level.

Proposes Extensive New York Port Scheme

Before the New York-New Jersey Port and Harbor Development Commission, Feb. 13, Gustav Lindenthal, New York consulting engineer, explained an extensive scheme for the development of the terminal and transportation facilities of the Port of New York which he proposes. The plan calls for a belt railroad in New Jersey tying together the railroads there and connecting with Staten Island, Long Island and Manhattan Island by bridges and tunnels. There would be a classification yard in the New Jersey meadows accessible to all railroads and to motor trucks, from which local freight to Jersey City and Manhattan could be distributed; a multiple-track, high-level bridge across the North River, an elevated railroad connecting with the bridge and paralleling the river water front in Manhattan, with freight and passenger stations and market halls distributed along its length. There would also be tunnels under the river near Battery Place, which would provide circulatory movement of trains to and from the New Jersey side. Further developments would be a tunnel under New York harbor, connecting the present Greenville yard of the Pennsylvania and the Bay Ridge yard of the Long Island, a union station in Manhattan Island for all of the railroads coming through New Jersey, connection via moving platform in a tunnel between all of the north and south rapid-transit lines and the belt-line railroad, and a tunnel connection between the river tracks of the New York Central and the tracks of the other divisions of the same railroad.

The plan proposed is but one of many which have been presented to the commission. It contains features similar to those proposed by William J. Wilgus and by Ernest P. Goodrich some years ago. The estimated cost of the project, not including river-front improvements and shipping piers, would be about $211,000,000.

Money for the California Land Settlement Board

For an extension of the work of the California Land Settlement Board, described at length in *Engineering News-Record* of Dec. 5, 1918, p. 1014, an appropriation of $1,000,000 from current revenue and a bond issue of $10,000,000, available two years hence, are proposed. It is expected that bills to those ends now before the legislature will be enacted. Dr. Elwood Mead, Berkeley, Cal., is chairman of the board.

Bills Call for Power Surveys

Requests for two appropriations for special investigations and report on the power supply have been made by Secretary of the Interior Lane. One of these asks an appropriation of $50,000 for a survey of the power resources all over the United States. This proposed appropriation is embodied in the Sundry Civil Bill. If approved, the work would be done by the Geological Survey. The other request is for an appropriation of $200,000 for a report on the power supply for the industrial region of the northern Atlantic seaboard, extending in general from Boston to Washington. If approved, this work would be done by the Geological Survey and the Bureau of Mines in coöperation. The request for the $200,000 appropriation has been approved by the Secretary of the Treasury and has been forwarded to Swagar Sherley, chairman of the House Committee on Appropriations.

Minnesota Engineers Meet In Joint Sessions

The annual meeting and banquet of the affiliated societies of the Minnesota Joint Engineering Board was held in St. Paul, Feb. 13. It was attended by over 200 representative members of the eight societies affiliated under the board. The speakers of the evening were Edward A. Filene of Boston, director of the Chamber of Commerce of the United States and member of the League to Enforce Peace committee, now touring the country with Ex-President Taft; L. C. Fritch, vice president and chief engineer of the Chicago, Rock Island & Pacific Ry., who spoke on the railway problem; Oscar Hallam, associate justice of the Supreme Court of Minnesota, who delivered an address on "The American Engineer"; W. L. Darling, director of the American Society of Civil Engineers, who spoke on the work of the Development Committee and the engineer's relation to public affairs, and Dwight E. Woodbridge, consulting mining engineer of Duluth.

Before the banquet a business meeting of the board was held at which two delegates from each of the affiliated societies were present and discussed various organization schemes which had been presented by the Engineers' Society of St. Paul, the Engineers' Club of Duluth, the Engineers' Club of Minneapolis and the Minnesota Section of the American Institute of Electrical Engineers.

There was a surprising unanimity of opinion that the Joint Board should continue as a joint board along the lines on which it had already been organized, with the exception that the membership of each society should be increased to three. As the board is organized at present, there is one member from each society, and the work of the board has increased to such a point that each member is carrying too much load. With 24 members, the work can be divided and much more effective service rendered. This body voted to make this change in the organization, and it was concurred in by the Joint Board in business session; this change in its constitution will be immediately presented to the various societies for confirmation.

Isolation Is Problem of North Dakota Engineers' Society

Although no bond issue for good roads is in sight in North Dakota, that state in 1918 put under construction more mileage bearing Federal aid than did neighboring states, according to J. E. Kaulfiss, assistant state highway engineer, who addressed the North Dakota Society of Engineers at the recent meeting held at Valley City. He stated that outside of towns and cities all road improvements consist of grading, shaping, weed extermination and bridge and culvert construction, which will be useful when surfacing becomes financially possible. County work, previous to the establishment of the State Highway Department in 1917, was carried out on the basis of $900 per mile, but already, by common consent and request of counties, the state has increased this to $1500. Of the 350 miles put under construction last season, one-half is complete. Funds and plans will be available for at least an equal mileage this year.

The surfacing of roads has not yet received any serious consideration, but Mr. Kaulfiss was of the opinion the demand would come sooner than most people expected, because of the fact that the state heads the list of persons per automobile, 9.3, with Nebraska next at 9.5. With another bumper wheat crop and unprecedented high prices, the farmers' demands will inevitably be in the direction of good roads all the year round.

In the address of the president, E. J. Thomas, professional difficulties due to isolation and the impracticability of having any but annual meeting activities were emphasized. Authorization was given for a committee to work out if possible some coöperative scheme with the American Association of Engineers whereby service might be rendered throughout the year. Prof. R. H. Slocum, who made the proposal, was of the opinion that a mutually beneficial arrangement could be effected. "Publicity for the Engineer and How to Get It" was the subject of an illustrated talk by W. W. DeBerard, who held that too few engineers utilized the opportunities for publicity of the work of the profession. Licensing of engineers and surveyors was discussed, and the question of standardized fees received attention, but no action was taken.

The officers elected for the coming year are J. A. Jardine, president; Miss E. M. Jack, city engineer, Williston, and R. M. Stee, vice-presidents; W. H. Robinson, state engineer, librarian; Prof. E. F. Chandler, University, secretary. Fargo won the contest for the meeting place next year.

Flood-Control Survey of the River Colorado Proposed

A survey of the Colorado River with a view to flood control is provided for by a bill now before Congress. The bill directs the Secretary of War to

make "a preliminary examination" of the river "with a view to the control of its floods in accordance with the provisions of an act to provide for the control of the floods of the Mississippi River and of the Sacramento River in California," approved Mar. 1, 1917.

Oregon Engineers Discuss Legislation

At the annual meeting of the Oregon Society of Engineers held in Portland on Feb. 3, a spirited discussion of the bill for registering professional engineers, now before the legislature of Oregon, was participated in by nearly everyone present. When a vote was called for, however, the majority was not willing to express a definite opinion for or against such legislation.

A bill abolishing the offices of county surveyor and roadmaster, and creating the office of county engineer in place of them, was indorsed by the society.

The election of officers resulted as follows:

President, John W. Cunningham, of Baar & Cunningham, consulting engineers; third vice president, to serve three years, O. Laurgaard, city engineer of Portland; treasurer, Henry M. Morse, consulting engineer; secretary, Orrin E. Stanley, sewer engineer, Department of Public Works, Portland; directors, to serve three years, Philip H. Dater, district engineer, United States Forest Service, Portland; O. A. Kratz, chief of the Bureau of Construction, City of Portland, and Herbert Nunn, state highway engineer, Salem.

Chief Engineer of Expeditionary Forces Gets Medal

Maj. Gen. William C. Langfitt, chief engineer of the American Expeditionary Forces, received the Distinguished Service Medal from General Pershing on Jan. 18 at headquarters, Services of Supply, at Tours. The decoration was conferred personally by General Pershing, the award being made for efficient conduct of the engineer department's work.

Notes from the Field

In the agitation for higher compensation levels there is danger that many will draw the conclusion that they will get higher pay when the levels go up, despite the quality of their services. Such a conclusion would be unsound. The higher the salary, the stricter the scrutiny in employing and retaining men. Moreover, there will always be the lower grades, no matter how high the general level may be raised. The rewards will go to the good draftsman, the good inspector, the good assistant engineer. The man who is just scraping through, giving an indifferent service, is going to remain in the lower ranks, while his more competent, reliable and conscientious brethren will get the increased compensation.

Take a case recently under observation. An engineer had been advanced in a year's time from the $3000 to the $4300 salary class, though for 10 years his salary had hovered around the $3000 mark. It was conceded that the cost of living and change of work warranted the increase. As a $3000 man no fault was found with his services. He had exercised relatively little initiative; the man above made the decisions.

In the $4300 class his work was subject to much more severe scrutiny. He had reached the class where initiative is demanded. He was expected "to come through big," and he failed.

It was not the employer's hope that he could get the assigned work done for less than $4300, but he knew that he could get mighty good men for $4000, and his duty to himself and his company demanded that he buy the best brains obtainable for the money available.

What applied in this case applies generally. No matter how the general compensation levels may rise, only those will rise with them who have corresponding capacity. The lower grades will always remain, as they do in medicine and the law. They will be filled by those less well prepared, less careful, less faithful.

Only those will rejoice in the coming day who are prepared to earn the higher compensation.

The incident related above suggests also that while it is easy to get a job, the hard part is to hold it. E. J. M.

Council Urges Engineers for Reconstruction Committees

The chairman of the Engineering Council, J. Parke Channing, has sent to Governor Smith of New York and to all other Governors letters in which, after reviewing the serious situation in which many technical engineers now find themselves because of the cessation of work by private enterprise in engineering construction, says:

"Even if it is wise to defer actual construction till prices are more favorable, there is a wonderful opportunity now to make plans for the future." The letter urges the appointment at once of a reconstruction committee, a proper proportion of whose members shall be engineers of prominence, or, if such a committee has already been appointed, that carefully selected engineers be added to its membership, and continues:

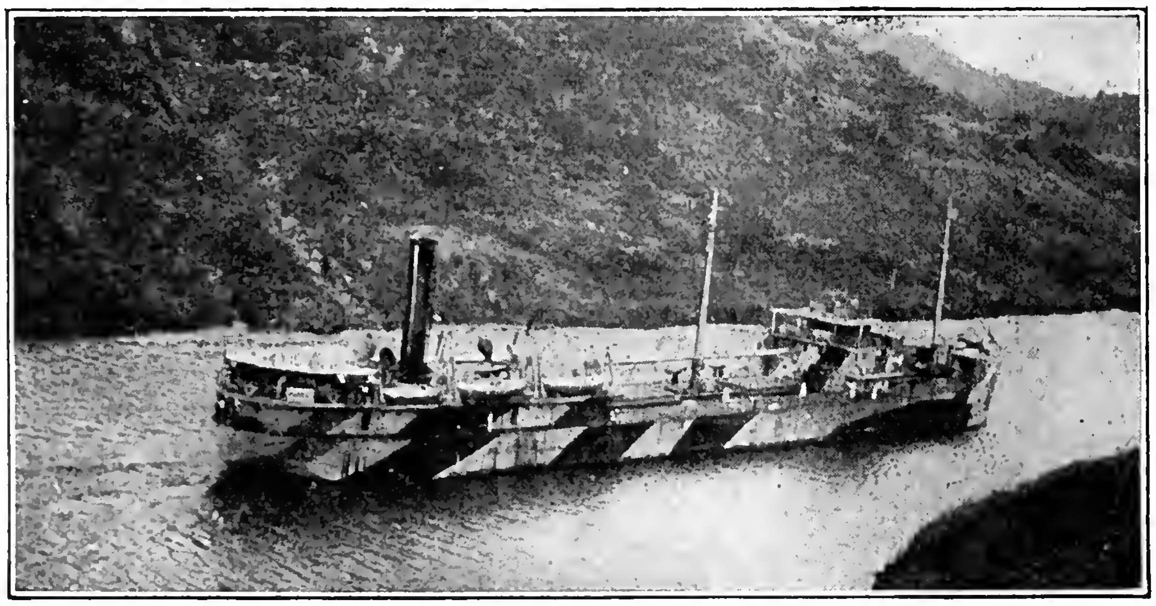
"Highways, schoolhouses and other public buildings, water-works, sewerage systems and public utilities are among the public works which may be planned according to the needs of the state and its communities. Engineers are especially fitted to advise on projects of these kinds. It is suggested that even if at the present time lowest prices for materials and minimum wages may not yet prevail, it will in the long run be an economy to the state to utilize now the professional talent and labor available in making plans for the future, and in executing work which may be urgent."

Record Number of Students

As a result of the war, the Massachusetts Institute of Technology has more regular students than it ever had before at this time of year. The precise number is 1944—this in spite of the fact that practically the whole of the senior class has already been graduated by reason of special courses.

Two Noted Engineering Achievements

The concrete freighter "Faith" passing through the Culebra Cut of the Panama Canal on its way north last fall. The photograph has been withheld until now by the censor.



General Black Heads Federal Port Commission

Maj. Gen. William M. Black, chief of engineers, United States Army, has been made chairman of the Port and Harbor Facilities Commission of the United States Shipping Board, succeeding Edward F. Carry of Chicago, who recently resigned. General Black will continue to perform his military duties in addition to those devolving upon him in his new position. The Port and Harbor Facilities Commission is engaged in the study of the ports of the United States with a view to recommendations as to methods which will increase the use and economy of such ports. It has been in existence for six months or more, but has not as yet presented any public report.

Hydraulic Turbine Casing Breaks and Floods Power Plant

On Feb. 17 the cast-iron scroll case in the upper section of one of the hydraulic turbines in the Wachusett dam power station at Clinton, Mass., broke suddenly, leaving an opening about 12 ft. square. Before the flow could be shut off the escaping water had flooded the power station 4 ft. deep and pretty thoroughly destroyed the movable contents. The generating units themselves were not seriously damaged and require little except drying to put them in service. The total damage is estimated at $5000.

The break was caused by the sudden closing of a wicket gate, presumably by a governor. The flood prevented the operation of the hydraulic gate, and a watchman had to go to the top of the dam and shut off the flow by operating the hand gates in the upper chamber. This took about a half hour. Fortunately, all switches were pulled before the men left the power house, so the only damage was by the water.

The dam is a part of the Metropolitan Water Supply for Boston and the surrounding district.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION; 150 Nassau St., New York City; Feb. 25-28, New York City.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The Minnesota Surveyors and Engineers' Society gave a prominent place to a discussion of matters of legislation, at the annual meeting held at St. Paul Feb. 12-14. It was pointed out that resolutions passed by the society during the state legislature assembly had had apparently little effect, indicating personal effort with legislators by engineers as being the best means of bringing action in matters of interest to the engineering profession. Among the reports of committees were those on drainage, highways, and municipal engineering. The following officers were elected for the year: President, Harvey S. Dartt, city engineer, Mankato; vice-president, R. W. Acton, engineer of roads, St. Louis County, Duluth; secretary, C. H. Stewart, Department of Public Works, St. Paul, and treasurer, William C. Fraser, municipal engineer, St. Paul.

The Canadian Engineering Standards Association has been incorporated, with headquarters at Montreal, for the purpose of coördinating efforts of producers and users in the improvement and standardization of engineering materials, and promoting the general adoption of standards in connection with engineering structures. The incorporators are Sir John Kennedy, consulting engineer; Dr. Robert F. Ruttan, professor of chemistry; Dr. John B. Porter, professor of mining engineering; Richard J. Durley, engineer, and Henry H. Vaughan, engineer, all of Montreal.

The Vermont Society of Engineers will hold its annual meeting at Burlington, Mar. 12.

The Iowa Engineering Society was addressed by Edmund T. Perkins, president of the National Drainage Congress, on "Government Land Reclamation," at the 31st annual meeting held at Muscatine, Feb. 19-20. Clifford Older, chief highway engineer, Division of Highways, Illinois, read a paper entitled "The Story of the Illinois $60,000,000 Bond Issue Campaign." The afternoon of the first day of the meeting was devoted to the sessions of the sections on drainage engineering, highway engineering and municipal engineering. The subject of standard fees was discussed.

The Dallas Chapter of the American Association of Engineers elected the following officers at the recent annual meeting: President, A. A. Matthews; vice-presidents, Hart Vance and A. P. Denton; secretary, S. J. Treadway.

The Rochester Engineering Society was addressed Feb. 10 by Lieut. Roger D. DeWolf, U. S. N. R. F., U. S. S. "Nevada," who spoke on "Experiences with the Grand Fleet." At the meeting Feb. 14 William H. Earle, assistant superintendent of gas manufacture, Rochester Railway & Light Co., spoke on "Modern Methods of Gas Manufacture."

The Montana Institute of Municipal Engineers held its annual meeting at Helena, Jan. 20-22. Reconstruction problems constituted the general topic. The following officers were elected for the coming year: President, John D. McLeod, Helena; vice-president, Willis H. Ellis, Butte; director, Carl C. Widener, Bozeman; secretary-treasurer, Arthur E. Lamb, Helena. The annual meeting of the society for 1920 will be held in Butte.

The Yakima (Wash.) Engineers' Club elected the following officers at the recent annual meeting: President, T. A. Noble; vice-president, J. O. Greenway; secretary-treasurer, A. L. Strong.

The Engineers' Club of Trenton held a meeting Feb. 13 which was addressed by William H. Burr, who spoke on "Important Features in the Development of Concrete Work."

The Engineers' Club of Philadelphia will conduct an excursion to the Ordnance Proving Grounds, Aberdeen, Md., Feb. 20, for the purpose of inspecting various pieces of ordnance used in the war. Dr. Edward Chiera, University of Pennsylvania, will speak on "The Problem of the Adriatic," at the weekly luncheon of the club on Feb. 25.

The Engineers' Club of Boston elected the following officers at the annual meeting held Feb. 10: President, Charles T. Main; vice-presidents, Charles L. Edgar and Charles L. Gagnebin; secretary, L. S. Cowles; treasurer, Frederic H. Fay.

The Montreal Branch of the Engineering Institute of Canada held a meeting Feb. 20, at which J. L. Busfield spoke on "The Construction of the Canadian Northern Railway Tunnel at Montreal." At the meeting Feb. 27 R. M. Wilson will speak on "The Effect of Ice on Hydro-Electric Plants."

The Louisiana Engineering Society was addressed by Maj. A. M. Shaw on "The Construction Division of the Army," at the meeting held Feb. 10.

Personal Notes

George J. Ray, chief engineer of the Delaware, Lackawanna & Western R.R., is now acting as engineering assistant to A. H. Smith, regional director of railways under the United States Railway Administration, with headquarters in New York City. L. L. Tallyn, division engineer at Scranton, is acting as chief engineer during Mr. Ray's absence.

Maj. B. J. Lambert, Engineers, U. S. A., has received his discharge from the service and has returned to the professorship of structural engineering at the State University of

Iowa. He was commanding officer of the 3rd Battalion, 23rd Engineers (Highway) from December, 1917, to September, 1918, after which he served as bridge engineer for the First Army.

COL. JAMES P. JERVEY, Engineers, U. S. A., who recently returned from active service with the 79th Division, has been appointed United States engineer at Wilmington, Del.

DAVID A. HARTWELL, recently engaged on work at Newport News, Va., for the United States Housing Corporation and the Emergency Fleet Corporation, has been appointed commissioner of public works and city engineer of Fitchburg, Mass., Mr. Hartwell previously served the city as assistant city engineer for three years; for twenty years as city engineer, and for seven years as chief engineer and superintendent of the sewage disposal division.

MAJ. H. AUSTILL, 20th Engineers, who recently returned to this country, has received his discharge from the service and has returned to his former position as bridge engineer, Mobile & Ohio R.R., at Mobile, Ala.

LIEUT. L. C. DODGE, Engineers, U. S. A., Office of Director General of Military Railways, Washington, D. C., has been discharged from the service and entered the bridge department of the Baltimore & Ohio R.R., with headquarters at Cincinnati.

EDWARD S. WALSH, Brooklyn, N. Y., has been appointed deputy superintendent of public works of New York State under Lewis Nixon, who was appointed superintendent of public works, as mentioned in *Engineering News-Record* of Jan. 16, p. 166.

COL. C. H. MITCHELL, Intelligence Department, British Army, has been appointed dean of the faculty of applied science and engineering, University of Toronto, succeeding W. H. Ellis, resigned.

CAPT. E. L. STAPLETON, Gas Defense Division, Chemical Warfare Service, United States Army, has received his discharge and has become associated with Willard C. Brinton, consulting engineer, New York City.

CHARLES E. KIMBALL, who for a number of years served as manager of the machinery department, Harris Bros., Chicago, has been appointed to a similar position with the American House Wrecking Co., Chicago.

GEORGE L. NASON, Engineers, U. S. A., has received his discharge from the service and has returned to his office in the Endicott Building, St. Paul, Minn., to resume the practice of landscape architecture and engineering.

CAPT. STEUART PURCELL, Quartermaster Department, U. S. A., has been appointed division engineer in charge of highways under G. F. Weighardt, city highways engineer of Baltimore.

CHARLES W. WHITTLE has been appointed assistant engineer, alley and footway division, highway engineer's department, of Baltimore.

J. L. CUMMINGS, acting bridge engineer, Mobile & Ohio R.R., Mobile, Ala., has been appointed division engineer of the Mobile division, with headquarters at Meridian, Miss.

S. W. CHILES, contracting engineer, Bethlehem, Penn., has gone to Santo Domingo to become resident engineer of construction work under A. J. Collett, director general of public works under the United States Military Government.

EDWARD A. LAMBERT, recently construction engineer for the Procter & Gamble Co., Cincinnati, has joined the staff of Fletcher-Thompson, Inc., industrial engineers, Bridgeport, Conn.

LIEUT. WALTER L. LEWIS, 136th Artillery, who recently returned from France, has received his discharge from the service and has resumed his work in the engineering department of the Great Northern Railway.

W. C. FAWCETT and KARL L. ROTHERMUND, Wheeling, W. Va., have become associated under the firm name of Fawcett & Rothermund, consulting engineers.

S. F. RYAN has been appointed division engineer, St. Louis division, Mobile & Ohio R.R., with headquarters at Murphysboro, Ill.

EARLE J. HEWIT, formerly with the Illinois State Highway Department, has become assistant engineer in the Department of Highways, State of Tennessee.

A. F. BROWNLEY has been appointed assistant engineer, sewerage division, highway engineer's department of Baltimore.

OBITUARY

LIEUT. COL. HIRAM J. SLIFER, 21st Engineers (Light Railway), died in France Feb. 3. He was born in 1857 and was a graduate of the Polytechnic College of Pennsylvania. He had been engaged in railroad work since 1880, when he became assistant engineer in the construction of the Mexican National Ry., and was later engaged in construction and maintenance work with the Pennsylvania R.R. and the Chicago & Northwestern Ry. as division engineer until 1898, when he became division superintendent for the Chicago & Northwestern, and afterward general superintendent, Central division, Chicago, Rock Island & Pacific Ry. From 1905 to 1907 he was engaged in special work as steam-railway expert for the J. G. White Co., of New York. In 1907 he went to Panama as assistant to the president of the Panama R.R., remaining there until he joined the Chicago Great Western as general manager in 1909, resigning two years later to engage in private practice.

MAJ. C. S. NOBLE, veteran of the Spanish-American War, and lately with the Y. M. C. A., died recently in Tours, France. For a number of years he was engineer for Oregon City, Ore., later becoming associated with the State Highway Commission. He resigned from the highway commission to go to France last autumn.

OSCAR MOORE LANCE, who for 23 years was general manager, Spring Brook Water Supply Co., Wilkes-Barre, Penn., died recently at Kingston, Penn. He was graduated from Lehigh University in 1872, and was for many years superintendent of the three public utility companies of Plymouth, Penn. He became general manager of the Spring Brook Water Supply Co. in 1896, at the time of its formation.

DANIEL B. BANKS, consulting engineer, Baltimore, who had charge of the planning and construction of the high-pressure fire-service system of that city, died Feb. 7. He was born in 1864 and received his education at Princeton University. His first engineering experience was as a rodman on the Shenandoah Valley R.R. and with the Baltimore & Ohio R.R. In recent years he specialized in water-supply work.

E. H. JACOBS, construction engineer and superintendent of distribution lines, Western States Gas & Electric Co., Stockton, Cal., died in that city recently. He went to Stockton seven years ago to undertake the laying of the new underground conduit system, having previously been engaged in work in San Diego under H. M. Byllesby & Co., with whom he had been associated in Chicago.

LUTHER P. FRIESTEDT, president of L. P. Friestedt Co., contractors, Chicago, and of the Friestedt Underpinning Co., New York, died at Los Angeles Feb. 5, at the age of 59. He was engaged in the construction business during all of his working life. He was the inventor of the form of steel sheet-piling known by his name.

Material-Handling Machinery Association

Manufacturers Form Organization — Port and Terminal Problems to Receive Particular Attention

Notices have appeared in this journal of the steps being taken to form an association of manufacturers of material-handling machinery. The preliminary organization work has now been completed, a committee on membership is engaged in recruiting the charter membership, a secretary-manager has been selected and has entered upon his duties, and a preliminary plan has been outlined for the work of the association.

Result of War Taught Lessons

The impetus to form the Material-Handling Machinery Manufacturers' Association, the name of the new body, came in part from the lesson which the war taught as to the benefits to the country and to the manufacturers from mobilization in a strong trade association, and in part from suggestions made, by the Department of Commerce and the Shipping Board. These two Government agencies, realizing the need for more efficient operation of railway terminals and ports, urged the manufacturers to get together in order that they might the more efficiently attack these difficult problems, and that the Government in its studies might have available in get-at-able form the combined talent of the handling-machinery industry.

In general, the lines of work—technical, educational, promotional, etc.—will parallel those of other trade associations, but the nature of the problems will require more extensive technical committee work than is customary in such bodies. In one particular the proposed work presents an unusual phase. Since material-handling problems are found in every industry, relations will be cultivated with existing trade associations. These organizations will be asked to appoint committees on material handling which will meet with corresponding committees of the Material-Handling Machinery Manufacturers' Association. Thus the material-handling problems of the various industries will come before broadly representative committees of material-handling experts. Already several of these coöperating committees have been arranged for.

Officers and Members

The active conduct of the association's work will be in the hands, as secretary and manager, of Zenas W. Carter, formerly commissioner of the Associated Metal Lath Manufacturers, and previously field secretary of the Granite Paving Block Manufacturers' Association. The officers of the association are: President, Calvin Tomkins, formerly commissioner of docks, New York City; vice-president, J. A. Shepard; treasurer, Lucian C. Brown; directors, Mr. Shepard, Mr. Brown, R. W. Scott, F. W. Hall, William Clark, J. C. Walter, C. M. Watson and Fred Stadelman. Four additional directors are to be chosen when the charter membership is completed.

The following companies have come together in the work of forming the organization and are now constituting themselves a membership committee to complete the charter membership of the association:

The Watson Elevator Co., Edward F. Terry Mfg. Co., the International Conveyor Corporation, Rownson, Drew & Clydesdale, Inc., New Jersey Foundry & Machine Co., Hayward Co., Elwell-Parker Electric Co., Sprague Electric Works, Otis Elevator Co., Manning, Maxwell & Moore, Inc.; Robins Conveying Belt Co., Michener Stowage Co., New York City; Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.; Brown Portable Conveying Machinery Co., Chicago, Ill.; Karry-Lode Industrial Truck Co., Long Island City, N. Y.; Whiting Foundry Equipment Co., Harvey, Ill.; Wellman-Seaver-Morgan Co., Cleveland, Ohio; Alliance Machine Co., Alliance, Ohio; Alfred Box & Co., Inc., Philadelphia, Penn.; Meade-Morrson Mfg. Co., East Boston, Mass.; Alvey-Ferguson Co., Cincinnati, Ohio; Heyl & Patterson, Inc., Pittsburgh, Penn.; American Hoist & Derrick Co., St. Paul, Minn.; Cleveland Crane & Engineering Co., Wickliffe, Ohio; Clyde Iron Works, Duluth, Minn.; Ohio Locomotive Crane Co., Bucyrus, Ohio; Northern Engineering Co., Detroit, Mich.; Electric Controller & Mfg. Co., Cleveland, Ohio.

Offices have been opened at 35 West 39th St., New York City.

Head of War Labor Policies Board Resigns

The chairman of the War Labor Policies Board, Felix Frankfurter, has tendered his resignation to the Secretary of Labor. The board will go out of existence in a few weeks, its activities having come to an end with the close of the war. The executive officer of the board, George L. Bell, will go to New York to become the impartial chairman of a permanent board of arbitration to be organized to handle labor disputes. Mr. Frankfurter was formerly a professor in the Harvard Law School. He has not announced his future plans.

American and Italian Engineers to Promote Public Works

An association has recently been formed known as the "Societa Itala-Americana di Studi i Lavori Publici," in which American engineers and business men are joining with Italian engineers and bankers to study and promote public works in Italy. The society was incorporated in Rome by interests representing the American International Corporation of New York and the Banca Italiana di Sconto of Italy.

The president is Senator Guglielmo Marconi, the inventor of the wireless telegraph, and the directors are the Marquis de Solari, Sig. Angelo Pogliani (managing director of the Banca di Sconto) Maj. James F. Case, H. Nelson Gay and F. Lavis.

The objects of the new company are the study of opportunities for the coöperation of American and Italian interests in the promotion of trade, and the prosecution of public works and other projects of an engineering and construction nature. The movement represents a step toward a better understanding and coöperation between the two countries.

Business Notes

The Victor L. Phillips Co., of Kansas City, has taken over the complete line of "Rex" mixers and pavers for the eastern half of Missouri and also the entire states of Kansas and Oklahoma.

Westinghouse Church Kerr & Co., engineers and constructors, 37 Wall St., New York, announce that they have opened an office in the Western Indemnity Bldg., Dallas, Tex., in charge of A. W. Nichols.

The Epping-Carpenter Pump Co., of Pittsburgh, Penn., announces that Theodore R. Hermanson, formerly with the Harrison works of the Worthington Machinery Corporation, has been appointed works manager.

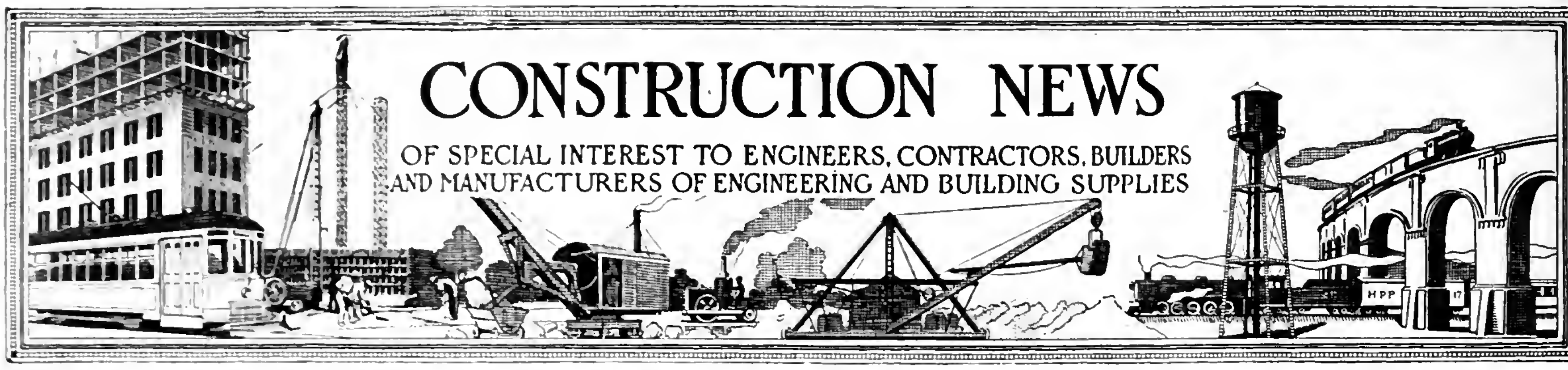
Trade Publications

The Oshkosh Mfg. Co. of Oshkosh, Wis., announces that its 1919 catalogue of contractors' equipment is ready for distribution.

The Independent Pneumatic Tool Co., of Chicago, Ill., has issued a folder describing the Thor Universal Electric Drill. Specifications and illustrations are given for nine different types of machine.

The Lakewood Engineering Co., of Cleveland, Ohio, has issued bulletin No. 25, entitled "Flat-Wheel Haulage Systems." It is an $8\frac{1}{2}$ x 11-in. 23-p. pamphlet illustrating and describing the company's storage battery trucks and the Lakewood trailers for industrial hauling.

The Westinghouse Air Brake Co., of Pittsburgh, Penn., has recently established a house organ known as "Wabco News." It is an 8 x 11-in. 22-p. magazine issued monthly, and is known as the official journal of the employees of the Westinghouse Air Brake Co., and associated interests.



PROPOSALS

For Proposals Advertised See Pages 65-69 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Feb. 25	East Chicago, Ind. Adv. Jan. 30.	Jan. 30
Feb. 28	Clarksburg, W. Va. Adv. Jan. 30.	Jan. 30
Feb. 28	Akron, O. Adv. Feb. 13 and 20.	Feb. 20
Mar. 7	Pembroke, Ont.	Feb. 6
Mar. 18	Wyandotte, Mich.	Feb. 20
Mar. 25	Jersey City, N. J.	Feb. 20

SEWERS

Feb. 25	Columbus, O.	Feb. 13
Feb. 25	St. Louis, Mo.	Jan. 30
Feb. 27	Detroit, Mich.	Feb. 20
Feb. 27	Seal Beach, Cal.	Feb. 20

BRIDGES

Feb. 24	Eureka, Cal.	Feb. 20
Feb. 25	**Sneedville, Tenn.**	**Feb. 13**
Feb. 25	Grand Forks, N. D.	Feb. 20
Feb. 28	Thomaston, Conn.	Feb. 20
Feb. 28	New Canaan, Conn.	Feb. 20
Mar. 3	Bisbee, Ariz.	Feb. 6
Mar 4	Lewisburg, W. Va. Adv. Feb. 13 and 20.	Feb. 20
Mar. 5	Holdenville, Okla.	Feb. 20
Mar. 23	Buckhannon, W. Va.	Feb. 13
Apr. 16	Ottawa, Ont.	Feb 20

STREETS AND ROADS

Feb. 24	Middlebourne, W. Va. Adv. Jan. 23 to Feb. 20.	Jan. 30
Feb. 24	San Diego, Cal.	Feb. 20
Feb. 24	California	Feb. 20
Feb. 24	Fairmont, Minn.	Feb. 20
Feb. 24	Dallas, Tex.	Feb. 20
Feb. 25	Abilene, Tex.	Feb. 20
Feb. 25	Baltimore, Md.	Feb. 20
Feb. 25	Ft. Dodge, Ia.	Feb. 20
Feb. 25	New York, N. Y.	Feb. 20
Feb. 26	Ohio	Feb. 20
Feb. 26	Indianapolis, Ind.	Feb. 20
Feb. 28	Harrisburg, Ark.	Feb. 20
Feb. 28	Connecticut	Feb. 20
Feb. 28	Starkville, Miss.	Feb. 20
Feb. 28	Cornwall, Ont.	Feb. 20
Mar. 1	Shreveport, La.	Feb. 13
Mar. 3	Indianapolis, Ind	Feb. 6
Mar. 3	Marshall, Minn.	Feb. 13
Mar 3	Cathlamet, Wash.	Feb. 20
Mar. 3	Portsmouth, Va.	Feb. 20
Mar. 3	Charleston, Miss.	Feb. 20
Mar. 4	De Kalb, Miss.	Feb. 20
Mar. 4	Augusta, Ga. Adv. Feb. 13 and 20.	Feb. 20
Mar 4	Ripley, W. Va.	Jan. 23
Mar 4	Indianapolis, Ind.	Feb. 6
Mar. 5	Alexandria, Minn.	Feb. 6
Mar 5	San Diego, Cal	Feb. 20
Mar 6	Fairmont, W. Va. Adv. Jan. 30 to Feb. 20.	Feb. 6
Mar 7	Eldorado, Ill. Adv. Feb. 13 and 20.	Feb. 20
Mar. 10	New Iberia, La	Feb. 20
Mar. 18	St. Louis, Mo	Feb. 20
Mar. 31	Lockport, N Y.	Feb. 6
Apr 7	Moulton, Ala.	Feb. 20

EXCAVATION AND DREDGING

Feb. 24	Fairmont, Minn.	Feb. 20
Feb 28	Windom, Minn.	Feb. 20
Mar 4	Garner, Ia	Feb 20

Bids Close		See Eng. News-Record
Mar. 11	Rochester, N. Y. Adv. Feb. 13 and 20.	Feb. 20
Mar. 13	Tyler, Minn.	Feb. 6
Mar. 19	Carthage, Ill.	Feb. 20
Mar. 19	Quincy, Ill.	Feb. 20
Apr. 8	Hollandale, Miss.	Feb. 13

INDUSTRIAL WORKS

Feb. 24	Brooklyn, N. Y.	Feb. 20
Feb. 24	Woodhaven, N. Y.	Feb. 20
Feb. 25	New York, N. Y.	Jan. 30
Mar. 4	Thiells, N. Y.	Jan. 16
Apr. 1	Sioux City, Ia.	Jan. 16
Mar. 5	Baltimore, Md.	Feb. 20
Mar. 19	Brooklyn, N. Y.	Feb. 20
Mar. 20	La Crosse, Wis.	Feb. 20

BUILDINGS

Feb. 21	Phillipsburg, O.	Jan. 30
Feb. 24	Norwood, O.	Jan. 23
Feb. 24	Cincinnati, O.	Jan. 30
Feb. 24	Cleveland, O.	Feb. 13
Feb. 24	Far Rockaway, N. Y.	Feb. 20
Feb. 25	St. Louis, Mo.	Feb. 13
Feb. 28	Brooklyn, N. Y.	Feb. 20
Feb. 29	Brooklyn, N. Y.	Feb. 20
Mar. 1	Cloquet, Minn.	Jan. 30
Mar. 1	Cloquet, Minn.	Feb. 13
Mar. 1	Mountain Iron, Minn.	Jan. 30
Mar. 1	Duluth, Minn.	Jan. 23
Mar. 1	Duluth, Minn.	Feb. 6
Mar. 1	Firebaugh, Cal.	Feb. 20
Mar. 3	Rockport, Ill.	Jan. 23
Mar. 3	Brooklyn, N. Y.	Feb. 20
Mar. 4	Utica, N. Y.	Feb. 13
Mar. 4	Wards Island, N. Y.	Feb. 13
Mar. 4	Winnipeg, Man.	Feb. 20
Mar. 15	Culver, Ind.	Dec. 26
Mar. 15	Duluth, Minn.	Feb. 13
Mar. 14	Humboldt, Ariz.	Feb. 20
Mar. 14	Dallas, Tex.	Feb. 20
Mar. 17	Johnstown, Pa.	Feb. 20
Mar. 18	Esquimalt, B. C.	Feb. 20
Apr. 2	New York, N. Y.	Jan. 23
Apr. 10	Newaygo, Mich.	Feb. 6
Apr. 15	Newark, N. J.	Feb. 6

FEDERAL GOVERNMENT WORK

Feb. 24	Addition to Dispensary—Spec. 3780—Rockaway, N. Y.	Feb. 6
Feb. 24	Piping and Equipment—Spec. 3759—New York, N. Y.	Feb. 6
Feb. 24	Dredging—Spec. 3774—Chatham, Mass.	Feb. 6
Feb. 24	Wells and Pumps—Spec. 3577—North Ft. Worth, Tex.	Feb. 6
Feb. 24	Fuel Oil Storage Plant—Spec. 3631—Mare Island (Vallejo P. O.) Cal.	Jan. 30
Feb. 24	Grand Stand and Bleachers—Spec. 3795—Hampton Roads, Va.	Feb. 20
Feb. 24	Cooling Pond—Spec. 3700—North Ft. Worth, Tex.	Feb. 20
Feb. 24	Dredging—Spec. 3579—Ft. Lafayette, N. Y.	Feb. 20
Feb. 25	Jetty Work—Sabine Pass, Tex. Adv. Jan. 30 to Feb. 20.	Jan. 23
Feb. 27	Plumbing — Martinsburg, W. Va.	Feb. 20
Mar. 1	Foundation and Rip Rap—Baltimore, Md. Adv. Jan. 16.	Jan. 16
Mar. 1	Dredging—Superior, Wis.	Jan. 16
Mar. 3	Barracks — Spec. 3728 — Fire Island, N. Y.	Jan. 30

Bids Close		See Eng. News-Record
Mar. 3	Barracks—Spec. 3733—San Diego, Cal.	Feb. 13
Mar. 3	Hospital—Baltimore, Md.	Feb. 13
Mar. 3	Post Office—Walden, N. Y.	Feb. 6
Mar. 3	Sidewalks—Washington, D. C.	Feb. 20
Mar. 7	Lavatory Annexes — Shiprock, N. M.	Feb. 13
Mar. 7	School and Assembly—Hall—Wahpeton, N. D.	Feb. 13
Mar. 10	Argon Production Plant—Spec. 3800—North Ft. Worth, Tex.	Feb. 20
Mar. 10	Structural Shop—Spec. 3691—Mare Island, Cal.	Feb. 20
Mar. 10	Railroad Extension—Spec. 3727—Ft. Mifflin, Pa.	Feb. 13
Mar. 10	School and Assembly Hall—Rapid City, S. D.	Feb. 20
Mar. 11	Dredging — Philadelphia, Pa. Adv. Feb. 6 and 13	Feb. 13
Mar. 12	Enlarging Levees — St. Louis, Mo. Adv. Feb. 13 and 20.	Feb. 20
Mar. 12	Boathouse, etc.—Charlotte, N. Y. Adv. Feb. 13 and 20.	Feb. 20
Mar. 19	Post Office, etc., Woodward, Okla.	Feb. 20

MISCELLANEOUS

Feb. 25	Flooring—Willard, N. Y. Adv. Feb. 13 and 20.	Feb. 20
Feb. 26	Repairing Fenders — Newark, N. J.	Feb. 20
Feb. 26	Rebuilding Ferry Racks—New York, N. Y.	Feb. 20
Feb. 26	Distributing System—South Boston (Boston P. O.), Mass. Adv. Feb. 13 and 20.	Feb. 20
Feb. 26	Paving Materials—Detroit, Mich.	Feb. 20
Mar. 1	Bridge Material—Chariton, Iowa	Feb. 20
Mar. 1	Piles, etc.—Blythe, Cal.	Feb. 20
Mar. 3	Dock—Seattle, Wash.	Feb. 20
Mar. 3	Miscellaneous Supplies — Hamilton, Ont. Adv. Feb. 13 and 20.	Feb. 20
Mar. 4	Road Material — Newark, N. J.	Feb. 20
Mar. 3	Riprap—Shakopee, Minn.	Feb. 20
Mar. 5	Road Oil and Tar—Clayton (St. Louis P. O.), Mo.	Feb. 20

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

N. Y., Oswego—City voted $150,000 to be added to existing appropriation of $345,-000 to develop water power. W. A. McCaffrey, supt. water-works.

N. J., Newark—City sold $500,000 bonds for water supply system in Wanaque River watershed and $300,000 bonds for extending water supply system in Pequannock River watershed. M. R. Sherrard, city engr. Noted Jan. 30.

Pa., Blairsville—See "Buildings."

Pa., Mt. Holly Springs—Holly Clay Co. having plans prepared building water supply system. About $20,000. Gannett, Seelye & Fleming, 204 Locust St., Harrisburg, engrs.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, FEBRUARY 27, 1919 — Number 9

Scientific Advance of the Irrigation Art

IRRIGATION as an art guided by science is progressing. Week before last we published an article giving some of the results of a series of studies on seepage and the duty of water. It appears from a very practical article on algæ removal from irrigation canals, printed last week on p. 382, that scientific observations were made on the kinds of algæ which caused the trouble dealt with. Moreover, one reason why it was necessary to reduce algæ was because they clogged the meters which have been installed on this particular project. Certainly, the science of irrigation is progressing when water for crops is sold by meter measurement and an attack against algæ is directed with the aid of the microscope.

Concrete Shear Tests Should Be Continued

IN SPITE of a number of tests, most of them of long standing, knowledge of shear in concrete is in a most unsatisfactory state. There seems to be little doubt that existing permissible safe values are much too low and that in some kinds of design, particularly in deep beams, this restriction operates with considerable hardship. The series of tests inaugurated for the Emergency Fleet Corporation by the Bureau of Standards, some of which are described by Mr. Slater on another page, went far enough to promise valuable results, not only in the matter of shear, but also in many other properties of concrete. Unfortunately, however, they cannot be continued under the same auspices. The Bureau of Standards is willing and anxious to take up certain lines of this work where it was left off, but it lacks sufficient funds to continue the investigation. It would be shortsighted policy on the part of Congress to refuse the few thousand dollars that are necessary for this work, which, if continued as already begun, should result in a great saving in concrete design. Technical societies and individual engineers might well interest themselves to the extent of writing to their Congressmen urging the necessary expenditure.

Problems of the Profession and the Local Association

FOR some years the movement toward local grouping of engineers has been progressing more or less, under the impetus of the natural need for such grouping, as well as through the efforts of men who saw the importance of this development for the expression of professional interest. The larger national societies have made various advances in local organization, the Engineering Council is studying the matter, and in addition a new association formed essentially as a focus of local groups has come into being. There is a healthy competition between these directive agencies of local organizations which promises well for the progress of the movement. On the subject of the pressing need for active local organizations, independent of the means employed, such comments on the needs of engineers as Mr. Finley's, represented by the extracts on p. 363 of last week's issue, address themselves to all engineers without regard to affiliation. The separated extracts we reproduced, culled from an informal speech, are not to be judged as forming a logical exposition of the profession's situation. They do, however, center unmistakably on the question of better organizing the profession, and point toward the dual purpose of helping the engineer and of enabling the engineer to help the public—his community. Those who know the problems of professional existence and who have learned by their own bitter experience the need for applying the engineering mind to public matters more than has been done in the past will value Mr. Finley's message.

How to Get Local Publicity

RARELY if ever has any engineering society been so lavishly treated by newspapers as to have from five to nine columns per day given up to its papers and meetings, in addition to having the news syndicated and sent to all newspapers of the state. Yet this was done last week by the Muscatine *Journal* during the two-day annual meeting of the Iowa Engineering Society. For six consecutive days previous to the meeting half-column articles about the meeting appeared, and a welcoming editorial contained these significant words: "Reconstruction is the vital responsibility which faces the nation today. Here the engineer is peculiarly qualified to assume a leadership. We must look to the engineer for leadership in the important national and communal projects which contemplate an extension of the opportunities of service." This was the news-peg on which much of the publicity hung. Back of this almost unbelievable result lies a story of a publicity campaign that every engineering society should take to heart. A central committee was coached by an old newspaper editor who handed out simple, usable rules, taking the mystery out of publicity. News-pegs, the importance of strong introductory paragraphs, and other "first aids" to the engineers in publicity, were explained to the committee. It is important to note that this committee then proceeded to bring its influence to bear on the local en-

gineers, not directly on the editor, to whom the members of the committee were total strangers. In the last analysis actual flesh-and-blood contact must be made. The more human it is the better the result. It is said that a certain Muscatine engineer got the better of the editor in a recent fishing contest; at least, it is certain that they go fishing together and know the best holes. Engineering publicity in that city becomes therefore only a question of producing articles, for an understanding has already been reached. The problem of getting engineering publicity in Iowa is well on the way toward solution, and the immediate undertaking, a sustained publicity campaign on the engineers' registration bill, should energize the local engineers into action, thus making a vital link in the publicity chain heretofore largely neglected.

Civilians Did Army's Construction Work in the United States

THIS entire country—and, indeed, all countries participating in the world war—took a keen interest in the performance of the group of men who so speedily built the 32 training camps for the United States Army. The rapid growth of these camps was spectacular and made a deep public impression, but full explanation has never been widely circulated that it was the civilian engineers and contractors of the nation, rather than a regular Army organization, which accomplished this modern miracle. Undoubtedly, it was one of the notable achievements of our military establishment and one of the substantial factors in the winning of the war. As the construction of these camps at a cost of $200,000,000 approached completion, it was preëminently wise for the War Department to have placed, as it did, all subsequent work for the Army in the United States in the hands of the Construction Division.

An account of the wide scope of work, representing about $1,000,000,000, undertaken during the year and ending with the armistice, is given on p. 416. It comes from an engineer who has been one of the Construction Division's technical advisers since the early days of the war, and who has had even better opportunities to view the work as a whole than those closely engaged in the various parts of the program. Not only does the kind and amount of this work interest engineers, but the type of the organization furnishes in particular a just source of pride to civilian engineers. It is significant that there were not more than three regular Army officers connected at any time with the organization—barely enough to guide the huge performances in conformity with Army regulations. Whether or not the men who "did their bit" so effectively wore the uniform of the Army matters not—the outstanding feature of it all is that the rich, practical experience of over a hundred of the most active engineering and contracting concerns in the country was embodied in the organization.

By the untiring, skillful, devoted work of these engineers and contractors, in city, village and wilderness, all over the United States, there arose, as though by magic, camps, munition plants and warehouses. The work of the civilian engineers set free the all-too-few military engineers to win laurels on the fighting fronts of France, the place of their heart's desire. It should always be remembered with gratitude that those who remained in America, in the Construction Division and on other assignments, also served their country.

Internal Fissures in Steel

ANOTHER step forward has been made in our knowledge of steel through the study of "snowflakes," discussed at last week's meeting of the American Institute of Mining Engineers. The new knowledge is, like numerous other items of scientific and practical progress, a byproduct of war activities.

Flakes, interior defects that show as white, rough-textured patches on the fracture, and that apparently destroy the ductility of the metal, occurred with such frequency in the production of shell and cannon steel during the past year or two that, for a time at least, they were almost an epidemic disease. They affected alloy steels, chiefly nickel steel, and in some instances they led to serious failures of machine parts made of this material. But there are reasons for thinking that causes similar to those responsible for flakes in nickel steel may account for some unexplained troubles of much more widely used grades of steel.

Studies at the Bureau of Standards by H. S. Rawdon demonstrated flakes to be minute internal cracks or fissures in the steel. Various facts revealed by the microscope showed that these cracks originated at the time the metal was in the ingot, and probably were due to ingot peculiarities. However, other facts, brought out in discussion, suggested that snowflakes may also be produced at later stages in the history of a piece. It appears that the mechanical or thermal treatment of the metal at a time when it is going through a structural change which makes it temporarily weak is responsible for producing the minute cracks. The question of how flakes originate is by no means fully cleared, but enough has been accomplished to assure further progress. It is within reason to conclude that the facts now being accumulated will lead to methods of preventing or avoiding flake trouble.

So far as yet appears, these flakes concern only metal of the highly special grades used for crankshafts and for guns. But there is the prospect that the studies made have direct bearing on the quality of steel railway rails, and if this should prove true it will give the snowflake question a far wider interest, and probably constitute its main importance. If the most dangerous and elusive defect of rails, the transverse-fissure defect, can be brought under control, railway safety will be increased.

For six or seven years the transverse fissure has been the leading problem in rails. It is a particularly dangerous defect because it does not reveal itself until the rail has broken. Despite extensive investigation and no end of discussion, nobody has yet succeeded in finding what starts transverse fissures, though it seems certain that some local deficiency of quality must have existed at the nucleus of the slowly growing detail fracture which characterizes the transverse fissure.

Microscopic and chemical studies of all kinds failed to show any condition at the nucleus of transverse fissure different from the conditions in the normal rail

metal. Now, however, the snowflake of gun steel, and the discovery that a microscopic crack is responsible for it, throws sudden light on the nature of the transverse-fissure defect. M. H. Wickhorst, who has been studying rail defects for some years in the interests of the American Railway Association, identifies the two defects as strikingly similar and quite probably the same. Careful research will be needed to establish the identification with certainty; nevertheless, it unquestionably supplies for the present a working hypothesis of pronounced value, one which will be a new point of departure in rail study.

It has long seemed likely that progress in our knowledge of ordinary steel would be assisted in a most important manner by the study of high-carbon and special steels. Because of the larger number of variables which these steels contain, their sharply differentiated structure and their wide range of physical and structural modifications, they afford a vastly sharper picture of what goes on in the metal, though at the same time a more intricate and confusing one. The relatively dull aspect of the conditions existing in low-carbon steels, on the other hand, makes more difficult the discovery of physical peculiarities. If, then, the investigation of snowflakes has already reacted on rail study, it may also prove to have a bearing on some of the questions surrounding the structural steels. Should the parallelism of flake and transverse-fissure phenomena be established definitely, it would furnish a new demonstration of the essential unity of steel study.

Outlets Govern Land Reclamation by Drainage

LAND reclamation by drainage requires broader consideration from the viewpoint of finding adequate outlets through the larger elements in the natural drainage system, if it is not to be restricted to small local operations. This may mean extensive stream regulation, extending over two or more states and requiring interstate agreements if not Federal action. How extensive are the areas sometimes involved may be illustrated by Illinois and Indiana examples cited by Edgar A. Rossiter in a paper read before the recent drainage congress in Chicago.

In Illinois the Kaskaskia River passes through 25 counties and has 42 or more tributaries, with a combined drainage area of about 5800 square miles. Each of the 42 tributaries contains a catchment area sufficiently large for the organization of a drainage district, but under present laws no two catchment areas may join in one district, and without doing so full drainage development is impossible. Interstate or Federal action is necessary in the case of the Kankakee River, which drains 54 townships having a total area of 1,046,000 acres in Illinois and 74 townships with 1,695,000 acres in Indiana. Indiana cannot obtain relief until a large interstate drainage district is formed or the Federal Government acts in deepening the Kankakee River. When once the Kankakee River is deepened, the tributaries such as the Iroquois and Yellow Rivers, with creeks approximately 150 in number, will be able to drain this 3,000,000-acre watershed.

The examples described, Mr. Rossiter declares, are typical of every inland river in the Mississippi Valley and also of many of the rivers of the Eastern states. This being so, it is evident that both state and Federal action will be required if Secretary Lane's plan for reclaiming swamp and overflowed lands, now being studied in detail by engineers working under the United States Reclamation Service, is to be realized. Many of the state legislatures now in session should take these matters into immediate consideration, with a view to passing needed remedial measures before they adjourn.

Meeting Problems in Sewer Location

THAT not all the sewage need be pumped has been overlooked in laying out the sewerage systems of some of our seacoast towns. Where the grade is slight and a gravity flow is hard to get, owners of low-lying areas are wont to endeavor to force the decision to a low-level system of trunk sewers for the entire city, delivering to a pumping plant. The popular cry is for a system to serve all areas, making no "discrimination against sections which happen to be slightly lower than other portions of the city." Unfortunately, the political aspect of such situations often beclouds the real problem to the extent that a feasible middle course is not sought.

No such mistake was made in planning improvements recently effected in the system at Santa Barbara, Cal. Two sections of the city were so low that, if they were served by a gravity system, tidal waters would back up into the trunk lines so that discharge into the ocean would occur only during low tide. In fact, in the original system installed to serve the lowest portions of the city, this condition had existed for years, constituting a continual source of annoyance. In planning the recent extensions and improvements to the system, the usual suggestion of a common sump, with a pumping plant to handle the total sewage flow, located somewhere along the ocean front, was proposed to the engineers. They dismissed this, undertook to find a more economical solution, and succeeded. The new system has a comparatively high level outfall which discharges above high-water line and a small part of the sewage has to be pumped up to the main trunk sewer. The trunk lines of the old system serving the low waterfront section of the city were not disturbed, but were tapped by a new line draining inland. This line leads to the other portion of the town, where a small area was below the level that could be served by an outfall above high water. At this second low area a small pumping plant was installed to lift the effluent from both low areas into the new gravity line. A system was thus laid out successfully with a pumping plant just one-tenth the size that would have been required to handle the total sewage of the city. The saving in the cost of operation alone, as compared with that of a pumping plant to handle the total sewage flow, would pay the interest on a $60,000 investment. The entire cost of the extensions and improvements was only about $30,000.

It is by such planning and saving as this that the engineer justifies his professional existence. If the lesson could be borne home to the city fathers of many a community, much good money would be saved.

Operating a Hydraulic Dredge Under Difficulties

After Old Spoil Banks To Drainage Canal Had Slipped, This Type of Excavator Was Only One Available To Dig Out Log-Filled Earth in Channel

By Albert S. Fry
Morgan Engineering Co., Memphis, Tenn.

Hydraulic dredges are not as a rule used to excavate stiff clay material which is filled with stumps, logs and vegetable débris, but a combination of circumstances made this type of digger the best available for some reconstruction work on a cutoff channel of the Bogue Phalia Drainage District in Washington County, Mississippi, where old spoil banks had slipped into the channel. The dredge was nearby and could be had, and, besides, it was the only type of equipment which would insure getting the excavated material far enough back of the banks to prevent a recurrence of the slips.

The channel was originally constructed by a dipper dredge in 1914 and 1915, with a bottom width of 70 ft., an average width of 15 ft. and side slopes of 1 to 1. The excavated material was deposited in spoil banks on either side of the channel, leaving a berm 15 ft. wide between the top of the excavated slope and the channel side toe of the spoil bank. The material, as it was deposited, formed a bank from 12 to 18 ft. high and from 60 to 90 ft. wide on the bottom.

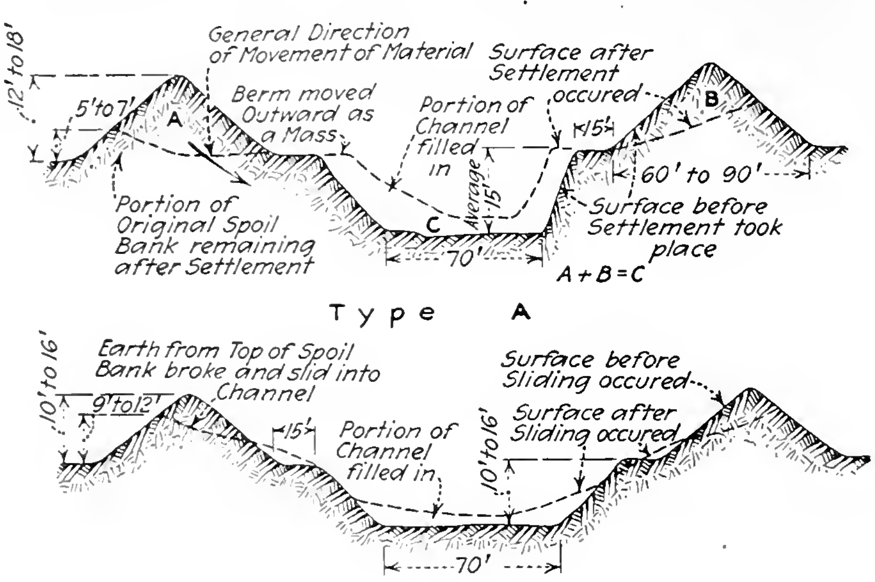
The channel lies for several miles in the bed of an ancient lake, now dry. This lake bed was a cypress brake when the channel was dug through it. At the eastern end of this ancient lake bed the channel empties into an existing lake, through which for about a mile no excavation was necessary. Going out of the lake, a channel was excavated for about a mile and a half to an outlet in another lake, which in turn emptied into a river.

Within about six months after the original excavation, earth movements occurred in the spoil banks that resulted in filling in the channel for a distance of about a mile below the lake and for about the same distance above. These movements were of two distinct kinds.

The Two Kinds of Movement

The first kind, which began about a quarter of a mile above the lake and extended for about three-quarters of a mile further upstream, is designated as type A in the accompanying diagram showing the character of the movement. The greater part of both spoil banks settled down, resulting in a crowding in of the sides and a pushing up of the bottom. The great weight of the spoil bank pressing downward on the original earth under the spoil bank resulted in this earth below the original surface giving way along some plane of rupture and forcing the material into the channel. At the place of greatest movement scarcely 50% of the original area of the channel prism remained. Along some portions of the channel the restriction was greater than at others. One noteworthy and remarkable feature of this movement was the fact that the entire berm moved bodily outward along both sides of the channel, the outer margin of the berms lining up as evenly after the movement as before. The earth comprising the berm at the surface, and for some depth, must have moved outward as a mass. Stumps in the earth on the berm were absolutely undisturbed by the movement.

Another peculiarity about the settling of these spoil banks was that it occurred only along the banks of



TWO TYPES OF BANK SLIP ON DRAINAGE CANAL

three-quarters of a mile of the channel, whereas along some four and a quarter miles where the excavation and spoil banks were of the same or even somewhat greater size no movement took place. Borings taken preceding the excavation, and an examination of the spoil banks after excavation, disclose no difference in the character of the material excavated. The weight of the spoil banks could have been no greater than elsewhere. As a matter of fact, some of the banks which settled were smaller than some which did not, and hence must not have had as great weight. For unknown reasons, less cohesion between the soil particles must have existed along the banks which settled than along those which did not.

The second type of spoil-bank movement occurred in the mile below, and for a quarter of a mile above, the lake, and is shown as type B in the diagram. In this case the high, steep spoil bank ruptured and slid into the channel and onto the berm, carrying with it into the channel a part of the berm. Where large spoil banks are deposited by dipper dredges, such earth slides are not uncommon, especially if the excavation is through earth upon which has been growing cypress or tupelo gum. In this case, the channel had been dug through a cypress swamp. Earth slides of this nature are ascribed to the excessive weight and steep side slopes of the spoil banks resulting from the concentration of the material due to the limited spoiling capacity of the machinery.

The cutoff channel had been designed to carry flood waters that would otherwise overflow and damage valuable agricultural lands. It was therefore a matter

WOODEN PONTOONS SPECIALLY BUILT TO CARRY SPOIL PIPE

CUTTER HEAD OFTEN CLOGGED

of immediate importance to redredge the channel so that it would have the capacity for fulfilling its intended purpose. It was found that about 116,000 cu.yd. of material would have to be taken out.

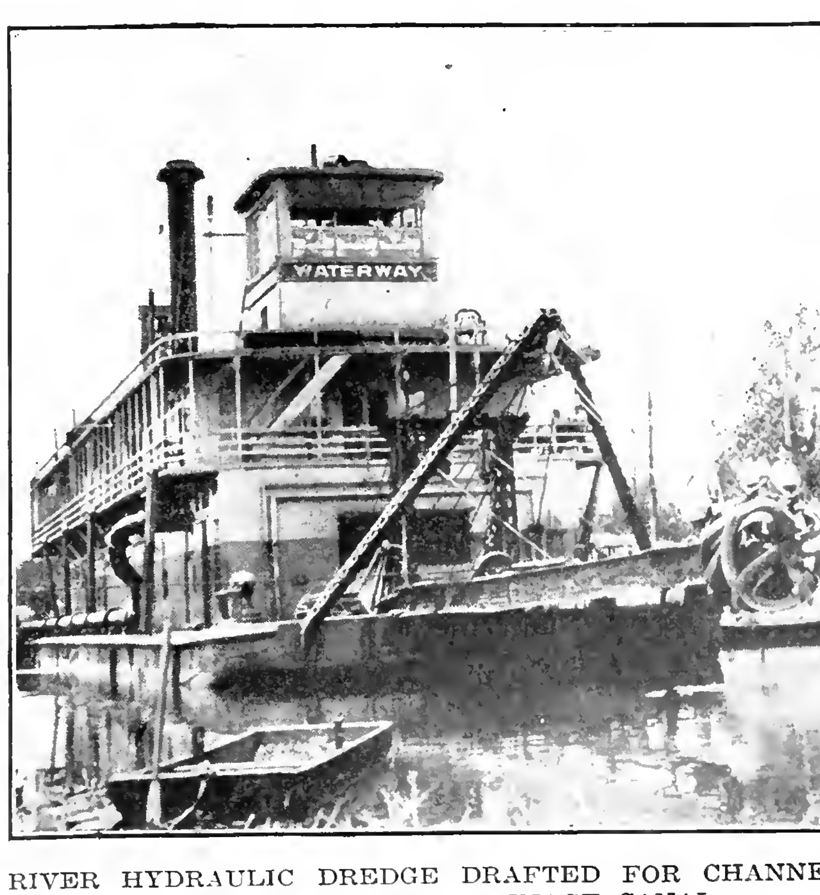
Selecting the equipment to do the work offered a considerable problem. The dipper dredge that had made the original excavation had been removed from the work. To install another dipper dredge, or a dragline or cableway excavator, of a size adapted to the work, would have been costly. Furthermore, these types of excavators were looked upon with disfavor in the present case because of their limited capacity for spoiling material, for it was not desired to trust any great concentrated weight of spoil bank on material that had already moved in the manner described.

The cutoff channel empties into the Sunflower River, a navigable Government stream, and it so happened that a United States Government hydraulic dredge, the "Waterway," was just finishing some Government work in the vicinity of the mouth of the filled-in channel. Negotiations were entered into which finally resulted in the renting of the dredge by the Drainage District to do the redredging. It was recognized from the outset that the excavation, which consisted of stiff clay or gumbo soil in which were many buried logs and stumps, was far from ideal for a hydraulic dredge, and that the costs of the work would be higher than for ordinary hydraulic dredging. However, the hydraulic dredge was immediately available, and by hydraulic dredging the excavated material could be spoiled over a wide area, so that all danger of recurrence of the earth slipping would be averted. These factors more than overbalanced the difficulties which it was anticipated would be encountered in doing the work by hydraulic dredging.

The "Waterway" is a stern-wheel steel-hull dredge, 163 ft. long and with a beam of 37 ft., a depth of 7 ft., and a draft between 3 and 4 ft. The centrifugal dredging pump is driven by a nonreversing triple-expansion engine, 10, 16, 26, by 12 in. The pump runner is 50 in. in diameter. Steam power for operating the dredge is furnished by two horizontal Mississippi River type boilers. The suction head is equipped with an eight-blade spiral cutter head 4 ft. 9¼ in. in diameter. Leading from the pumping engine, which is near the bow of the boat, are discharge pipes of 16-in. diameter which terminate, one on each side of the boat, some 10 ft. above the level of the lower deck. The discharge can be turned into either pipe as desired.

When the dredge operates in large streams or rivers, for which operation it was designed, a line of floating discharge pipe connects onto the discharge pipe from the pump, these floating pipes being supported by steel pontoons which float alongside and back of the boat. But the Bogue Phalia channel was not wide enough to allow the dredge to operate with the pontoons floating alongside the boat, so it was necessary to modify the discharge equipment before excavation could begin. By a special pipe arrangement, the starboard discharge pipe was joined with a line of pipe clamped at the outer edge of the starboard guard on the boiler deck of the dredge. At the stern of the boat a special "down-and-out" offset pipe connected the pipe on the deck with the floating line.

The steel pontoons and discharge pipe used by the "Waterway" in river work were also too large to permit of their use in the channel to be redredged, and



RIVER HYDRAULIC DREDGE DRAFTED FOR CHANNEL CLEARING WORK IN DRAINAGE CANAL

wooden pontoons, 13 ft. long by 7 ft. wide by 2 ft. deep, were built to carry a line of floating pipe in sections 16 ft. long. The floating pipe was connected by rubber sleeves 24 to 36 in. long. To connect with the floating line, shore pipe in 16-ft. sections with telescope joints was provided.

MATERIAL WAS MOSTLY DELIVERED IN LUMPS

Another preliminary which had to be undertaken was the construction of a dam across the lower end of the channel, to maintain a sufficient stage of water for operation of the dredge. This dam consisted of two lines of rough Wakefield piling driven about 25 ft. apart, and supported by a system of round piles which were braced from one to another horizontally and diagonally. To tie the sheeting together, 1¼-in. steel tie-rods were used. Between the piling, an earth fill was placed by the dredge itself. A crown was eventually put on by wheelbarrows after the hydraulic fill had settled. The dam was about 100 ft. long, and during the course of the work withstood a maximum head of 14 feet.

In the filling of the dam, a blowout occurred downstream which resulted in a sinking of the fill within the dam. To prevent further trouble from blowouts, material was pumped in to form an earth fill against the lower leaf of the dam. This was successful and no further blowouts occurred, although some trouble was experienced at a later time from slipping of the earth fill below the dam, due to the water being drained away from the lower side of the dam. Some short sheetpiling driven near the toe of the fill proved effective in preventing further slipping.

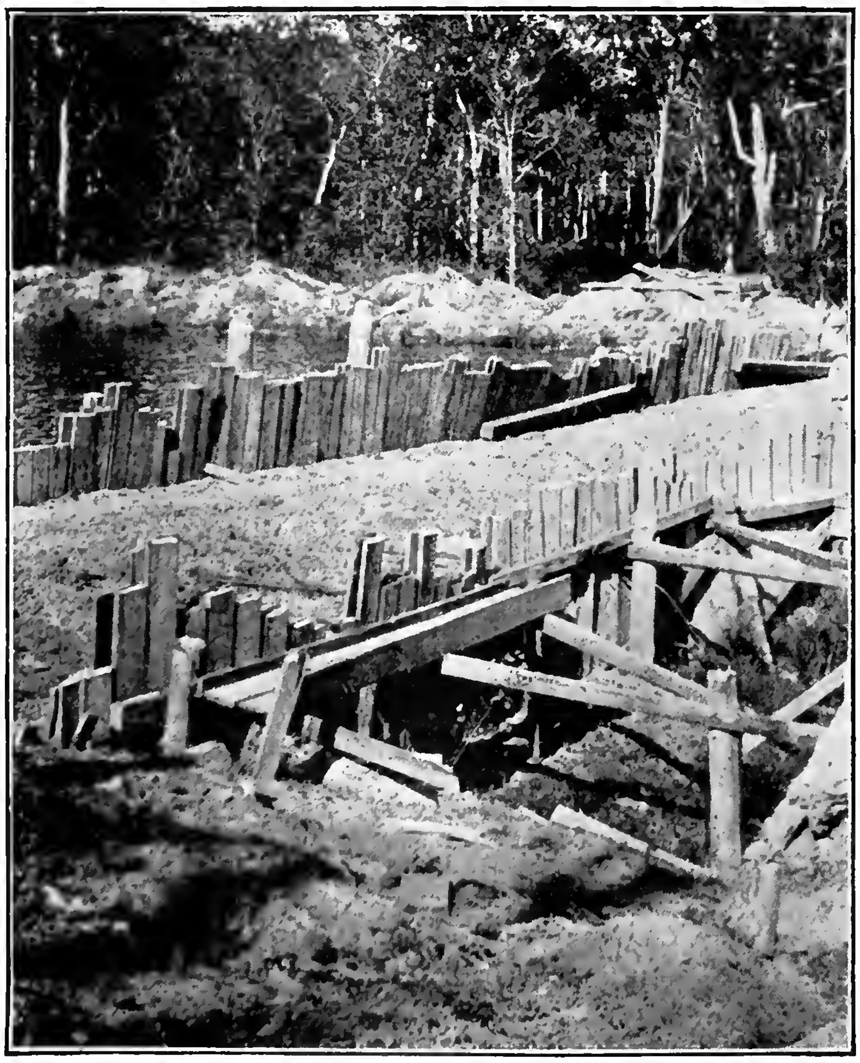
While the work was being carried on, the water pressure against the dam, combined with the settling of the material in the dam, caused the upstream sheeting to lean downstream. As a safety measure to guard against further movement, cables were attached to each end of the sheeting about 15 ft. from the ends of the dam, the cables leading upstream to trees along the bank. These cables were not called into play, however, as the sheeting did not move after they were in place.

Some seepage developed along the tie-rods, but this was stopped by ramming and puddling material around the rods.

Around one end of the dam, a spillway to carry away the flow in the main channel was blasted and dug through the existing spoil bank into an adjacent slough, returning to the main channel by a similar ditch through the spoil bank below the dam. Considerable trouble was experienced with this spillway, as the water cut badly into the spoil bank nearest the dam and threatened to wash out the end of the dam. Sacks filled with earth were first used to stop the cutting, but these were only partially successful, as the current proved strong enough to wash away many of the sacks. Wing dams or breakwaters, made of brush in combination with sacks, proved to be the best means of holding the spillway channel from cutting.

After the excavation work was completed, the temporary dam was removed, so that the dredge could return to the Sunflower River.

The excavation work was performed in two shifts of eight hours each, one working from 4 a.m. until noon, and the other from then until 8 p.m. Each shift consisted of an engineer, a leverman, an oiler, a water tender, a stoker, and from six to 10 deck hands. The captain of the boat superintended operations, being assisted by a mate. A pilot made up the remainder of the crew, excepting the cook, the laundress and the cabin boy. In addition to the dredge crew, a shore gang of from 10 to 12 men was required to blast and remove logs and débris ahead of the dredge. Considerable difficulty was experienced in keeping full crews, owing to the drafts of the Army and the general spirit of unrest



TEMPORARY DAM BUILT TO MAINTAIN ENOUGH WATER TO FLOAT DREDGE

caused by the war. This condition no doubt had its effect on increasing somewhat the cost of the work.

The excavation required the removal of material from the bottom and sides of the channel. In the digging position, the boat was held steady by a central spud just in front of the stern wheel. By means of a cable passing over sheaves on the ladder frame and stretched across the channel ahead of the boat—this cable being anchored at each end to a dead man laid in trenches on the banks—the boat was swung across the ditch on an arc of which the spud was the center. Raising and lowering the cutter head ladder provided the vertical movement necessary. Ordinarily, the dredge could perform the excavation entirely across the ditch from one anchoring of the spud, but in some places, where excavation was heavy and work was carried close in to the bank, two set ups were necessary.

The material that had to be excavated presented a difficult task for a hydraulic dredge. The original excavation had been almost entirely through wooded country, and the logs and slashings on the right-of-way for the channel had been piled beneath the spoil banks. When the slides occurred, much of this débris, together with stumps, was carried along with the material that encroached on the original channel section. The material itself was a stiff clay or gumbo soil.

Preceding the dredge excavation, the shore gang blasted out and removed as many of the buried stumps and logs as was possible. This task was surrounded with difficulties. The logs and débris that had been under the original spoil banks formed a matted mass that was extremely hard to remove. It was impossible to blast all of the logs and stumps, and many remained which had either to be "nosed" out by the cutter head or chewed up by it.

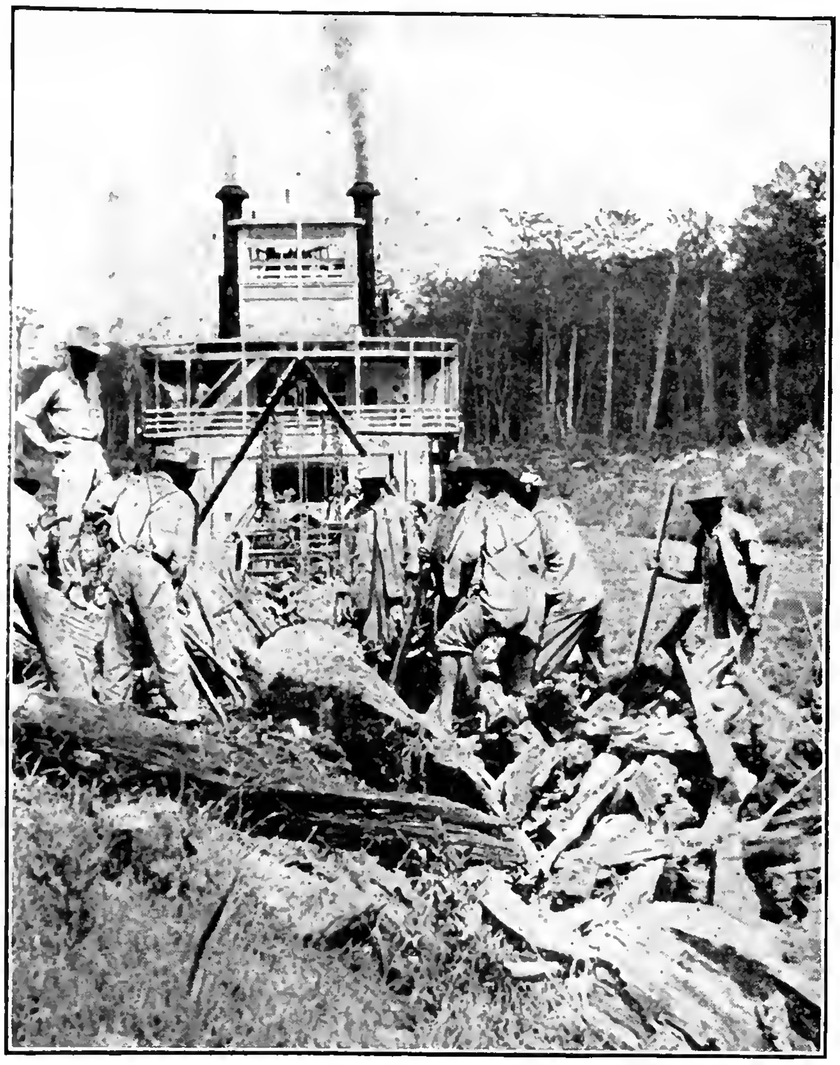
Floating ahead of the boat was usually a thick mass of chunks, made up for the most part of heavy pieces of stump or logs mixed in the material. These chewed-up pieces of logs and stumps, together with chunks and roots, gave endless trouble from plugging up the pipe line, and delayed the work considerably. The trouble from floating chunks was finally mitigated to a large extent by clearing these out of the way by means of a floating boom. The boom consisted of short pieces of logs held together by a cable. With a boom of this kind, the chunks could be worked to the rear of the dredge and then held against the bank by the fastening of the ends of the cable to the bank.

During part of the digging a great many cypress stumps, knees and roots were encountered, and no difficult excavation can be imagined for a dredge of the "Waterway" type than cypress stumps, knees and roots.

The material itself also gave trouble, the nature of which can be seen from the view of the clogged cutter head. The stiff character of the digging resulted in the clogging of the cutter head so that it had to be cleaned at intervals by the deck hands with bars and shovels. Removing this material from the cutter head usually required from 20 min. to an hour. By reversing the cutter-head engine at full speed, the material could be shaken loose in about 4 min., but this method was very hard on the machinery and had to be abandoned for that reason.

The excavated material was pumped through the floating line of discharge pipe to the line of shore pipe. In order to discharge the material behind the existing spoil banks, trenches in which to lay the pipe had to be dug and blasted by the shore gang in advance of the dredge. These trenches were made along one side of the channel only as all of the material was spoiled along one side.

When excavation was started after the shore pipe was laid in a new trench, the floating line was formed in a half circle from the stern of the boat to the shore connection. As the dredge moved ahead, the floating line straightened out until it formed nearly a straight line from the stern to the shore-pipe connection. Either more pontoons of floating pipe would then have to be inserted in the line, or the shore line would be moved forward. Usually, a movement of 200 to 300 ft. forward was made before shifting the shore line.



ILLUSTRATING THE KIND OF MATERIAL THAT HAD TO BE REMOVED

The head pumped against varied from 8 to 15 ft. When the floating line was short, this head did not cause any trouble, but when the floating line stretched out to 300 or 400 ft., only frequent flushing and alertness to forestall buckling at the rubber sleeve joints would prevent a plugged discharge pipe.

Apparently, but little of the dredged material was discharged in solution. The spoil consisted principally of balls of mud ranging in weight from a few ounces to several pounds. This material assumed a slope of about 15 or 20 to 1, and where the original spoil bank was low, and the redredging heavy as a consequence, the material formed a continuous well drained deposit wherever the lines of shore pipe were not spaced more than 200 ft. apart.

Repairing the main spud, which was broken twice,

constituted the chief item of repairs that were made during the work.

After it broke the first time, a 70-ft. gin pole was rigged on the bank of the channel to replace the spud, the timbers for the gin pole being cut out of the nearby woods. The spud itself is about 40 ft. long. A green elm stick cut out of the woods was used for replacing the first spud. After a couple of weeks' service this broke. The gin pole had not been taken down after the first new spud had been put in, so the second was put in without much difficulty. For this spud a seasoned gum timber was used. This proved serviceable, and no further trouble was experienced with the spud.

At the close of the job it was necessary to replace some of the principal parts of the cutter-head engine which had worn out during the work, due to the hard service performed by the engine.

Progress and Cost

Records were kept during the entire period of operation of the dredge. The dredge was on the work a total of 141 days, of which 120 were working days, Sundays and holidays being excluded. Of the working days, 12 were occupied in modifying the discharge equipment, filling in the dam and making repairs, leaving a total of 108 days when dredging was done. A total of 116,400 cu.yd. was excavated at an average rate of 1080 cu.yd. per day of 16 working hours.

Delays consumed 30% of the total available dredging time. These delays were of three general classes. Necessary operations of the boat, such as moving the boat, moving, extending or repairing the discharge line, and adjusting machinery, comprised 13% of the total time consumed.

The character of the material excavated caused delays for removing snags, chunks, roots or other débris which lodged in the cutter head, the suction line or the discharge line, and which took up 10% of the total time. Major repairs delayed the work 7% of the time.

It had not been expected that the cost of the work would compare favorably with usual hydraulic dredging costs, owing to the difficult conditions under which the work was done. The cost of the work, excluding supervision, engineering and overhead charges, was 41.7 c. per cubic yard. This was made up of the following items:

A. Preparatory and Incidental Work		
1. Additional equipment and preliminary work	$0.054	
2. Dam and spillway	.038	
3. Clearing and grubbing	.031	
4. Passage through bridge	.004	
5. Transferring boat to river after work was completed	.020	$0.147
B. Dredge Operation		
1. Rent	$0 084	
2. Labor	.070	
3. Subsistence	.037	
4. Coal	.056	
5. Supplies	.009	
6. Repairs	.010	
7. Incidentals	.004	.270
		$0.417

In connection with these costs, it must be borne in mind that the work was done during the summer of 1917, and that materials and labor had not reached the high figures which they did several months later.

The entire work was carried out under the supervision of the Morgan Engineering Co., of Memphis, the direction and planning of the work being done by Ned H. Sayford. T. P. Anderson was resident engineer and Capt. R. N. Ferguson, of the dredge "Waterway," superintended the dredging operations.

Civil War Price Trends Compared With Those Today

Judging By Past, Prospect Is That High Prices Will Continue—Should Not Retard Immediate Building

By Morris Knowles
President, Morris Knowles, Inc., Engineers, Pittsburgh, Penn.

PRICE movements in the next few months and years will have a serious effect on all construction activities; more than that, the expectation of lowering prices is one of the leading causes of the present lack of construction. As a result of a study of numerous factors that go to make up prices, and particularly of the periods following previous American wars, especially the Civil War, it seems to the writer that the trend of prices probably will not be downward as rapidly as some hopeful minds indicate.

The question of whether prices will fall soon, how far they will go down, and how rapid that decline will be, are problems which cannot be accurately solved. And any assumption which can possibly be made as to the probable trend of prices during the next few years may be shown in the future, when one can gaze with a perfect hindsight upon the past, to have been nothing short of a wild guess. However, it has been the practice of engineers and those accustomed to plan for the future not to be fearful of later condemnation in making estimates. It has been the practice of the engineering profession to gather all data which affect the particular problem at hand, to study the effect of such conditions in the past, and to apply the expected results of similar conditions to the future Then the future can be projected and predicted, with the imperfect vision which all men must have of the events of tomorrow.

No Index Numbers for Construction Material

One of the best means of measuring the trend of prices is that of "index numbers," which are the sums or averages of the prices of a number of commodities referred to a given year as a base, usually noted as 100. However, no standard index numbers exist for engineering construction. There is shown in Fig. 1 a diagram comparing Dun's index numbers of 200 commodities, with a curve of index numbers made up from a study of about 25 construction materials. The diagram shows that while the relation between the general index numbers and an engineering index number for construction work is not exactly the same, for all years they would probably vary in their trend quite closely, and, therefore, general index numbers may be used in a general way for this purpose of studying the trend of construction prices. Fig. 2 shows curves of index numbers for the periods before, during and after the Napoleonic and the Civil Wars, and also from 1884 to date. These are arranged so that the peak in each case coincides with 1918, which is considered the peak of the present war. It will be noted from this diagram that it was

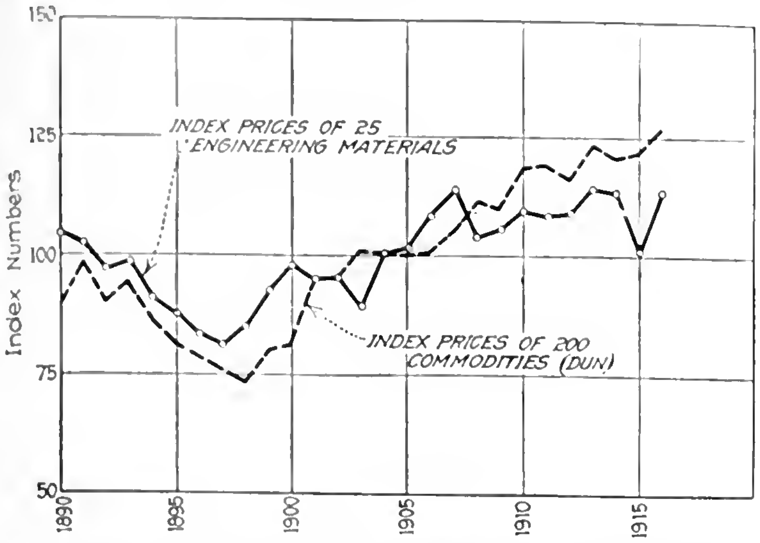


FIG. 1. PRICES OF GENERAL COMMODITIES SHOW ABOUT SAME TREND AS INDEX COSTS OF BUILDING MATERIALS

generally many years after the wars before the prices recovered completely from their increase. After a study of the trend of prices following previous wars and considering the conditions which have obtained at those times, it is believed that the curve which can be applied to American conditions as seen today is that of our Civil War in 1860-65. Even in this case, comparisons must be made with extreme care, and subject to many modifications. After the Civil War it was not until 1878 that the price level was as low as it was in 1860, or a period 13 years after peace was declared.

In order that we may intelligently apply the experience of 1865 to that of 1918 and the years following each, it is necessary to consider the economic conditions which existed at that time as compared to those of the present; and a word concerning each may be advisable, without attempting to discuss intimately all the data used in reaching conclusions.

It may appear, first, that the change in prices following 1913 was considerably greater than the corresponding change following 1860. However, this is more apparent than real. The difference is lessened when it is considered that the Civil War occurred during a period of falling prices and the present war occurred during a period of rising prices, so that the angle of the change of direction of the two curves is probably about equal.

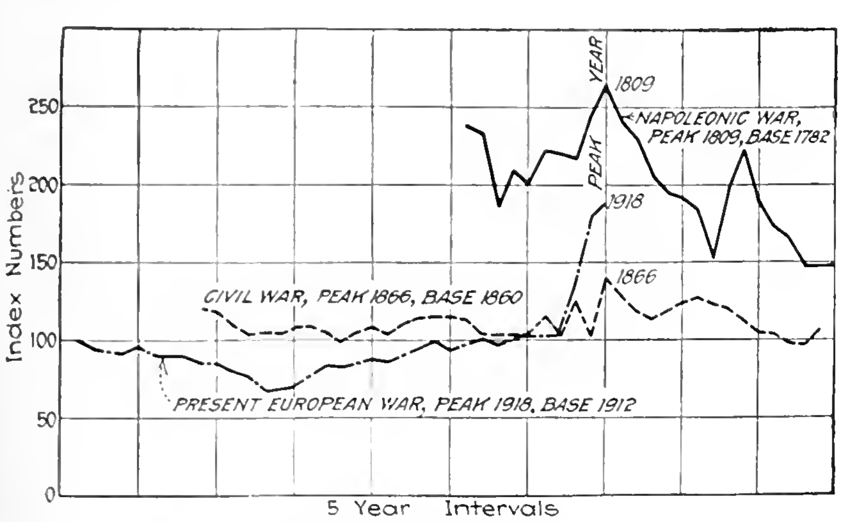


FIG. 2. COMPARISON OF INDEX PRICES FOR PERIODS DURING AND FOLLOWING RECENT WARS

Data as follows: Napoleonic War—Jevons. Civil War—United States Bureau of Labor. Present War—United States Bureau of Labor.

One of the important factors in the trend of prices is the labor market, and although statistics are not very accurate as to the amount of labor that has been withdrawn from ordinary pursuits during the war, yet from those data which are obtainable, as compared with the figures during the Civil War, it is indicated that probably a greater percentage of labor was withdrawn for actual military service during the Civil War than during this war. But the interference with the supply of labor today is far greater than it was during the Civil War. While the men withdrawn for military service constitute a smaller proportion of the population than they did for armies of the Civil War, "the men behind the men behind the guns" are many times as numerous, and there may be much difficulty in readjusting these men to a peace basis, if lower wages are to be offered. Interference with immigration has been far greater during the present war and is likely to continue longer after its close. Sufficient data on the participation of women in industry are not available for comparison of the two periods.

The diversion of capital to distinctively war industries has been on a vastly greater scale in the present war, and the process of restoring it to peace industries at the end of the war will be proportionately slower and more costly than in 1865. The absence of free land, on which to set to work the returning soldiers and the laborers released from war industries, will greatly increase the difficulties due to readjustment.

The nature of the foreign trade of this country at the outbreak of the European war has brought to it an amount of gold far in excess of its normal share of the world's supply. On the basis of this gold, the amount of paper money in circulation also has increased. It is this increase in money, reinforced by similar increase in credits in bank loans, which has been one of the most influential factors in the present price situation.

Owing to abnormal conditions prevailing in the countries in which the larger part of the trade with the United States has been carried on in the past, there is but slight prospect that normal conditions of money and credit will be restored, or that the trade balance will be reversed by sending gold abroad to pay for goods. It is probable that the present trade balance will prevail for some time.

As modern industrial society has abandoned the individualism of the middle of the past century, the new practice of coöperation of producers and regulation by governmental authorities will tend to stabilize prices and retard their movements in either direction, upward during the war, and, it is expected, downward after the war. Price-fixing has been recognized for a long time among public utilities, and the recent experience during the war may lead to continued governmental action along the same lines as regards food and other essential products.

The import tariff will also be used, as it has been used in the past, to protect the high prices existing in America, and as labor is organized and will relinquish its present high rates very slowly, it is probable that this factor, together with the tariff, will be used for a long time to help maintain the present high price level. Any expectation that a fall in prices, even due to panic conditions (unless unusually severe) will result in a return to anything like those which obtained prior to the war, will evidently result in false hopes. Witness the panic

of 1871-1873; while producing a small lowering in prices, it did not bring them to anything like the level which obtained in 1861 or again in 1878 to 1880.

In view of these conditions—namely, upward trend of prices previous to the war, difficult labor conditions, immobility of capital, foreign trade balance, price-fixing and the protective tariffs—it is believed that the period of high prices will continue for a longer time after the period of the present war than it did after the Civil War. If panics and the like are to be averted, with other unrestful and undesirable economic conditions, public works should be started, rather than that we should sit tight and wait for prices to come down, in the hope that this reduction in prices will be very soon. It is doubtful if such reduction will occur within the near future to any marked degree, unless factors other than the economic conditions now prevailing come into play.

The Construction Division of Our Army

A Description and Interpretation for Engineers and Laymen of a Great Organization and the Works It Built—On Nov. 11, 1918, Some 1480 Civilian Engineers Were Putting Through a $1,200,000,000 Program

By George W. Fuller
Consulting Engineer, New York City

UNFORTUNATELY, most members of the engineering profession fail to record adequately their work so that it may take its proper place in the mind of the layman. This could not be more strikingly evidenced than by the fact that there is just being completed an engineering work probably unequalled in the history of the world, but which, as regards the organization doing it, has left so little mark on the mind of the average person that its very existence is almost unknown. When the armistice was signed in November, 1918, 1480 constructors—engineers in the broadest use of the term, and not in its military sense—were wearing the uniform of the United States Army and under the name of the Construction Division were carrying through a building program involving $1,200,000,000, marvelous in its extent and doubly wonderful in the speed and comparative economy of its execution.

The Panama Canal took 10 years to build and cost about $375,000,000. The work of the Construction Division of the Army in one of the early months alone amounted to almost twice the volume of work done in any year at Panama, not only in money expended. but in materials handled, and this, too, at a time when men and materials were most difficult to procure and when transportation facilities were frequently paralyzed.

Many persons who have knowledge of the performance of any part of this building program, seem to be, through the confusion of the work of the military engineer and that of the Construction Division, under the general impression that this work was done by the Corps of Engineers of the United States Army. It should be clearly set out that the Corps of Engineers during the world war was charged almost exclusively with construction work in France while, on the other hand, all of the construction work fof the Army in this country has been and is under the direction ot the Construction Division of the Army, which was also responsible for the design and operation of all cold-storage and refrigeration plants in France.

Civilian Engineering

To appreciate better the immense value of the civilian engineer in this building program, a clear distinction should be made between the duties of the military engineer and those of the Construction Division. The training and practical experience of the military engineer have been along the lines of pre-war fortifications—trench digging, field bridging, mining, sapping, military railways, and other activities generally classed as combatant work. The Construction Division of the Army is that bureau of the War Department which is charged with the entire construction work of and for the Army in the United States, including the Hawaiian Islands, the Philippines, Alaska, Porto Rico, and the Canal Zone. This includes not only the design of the projects, but the procurement of the necessary materials and labor and the supervision of the work itself as regards construction, operation and maintenance. This work calls for men of wide experience in commercial building projects, men who are familiar with the most up-to-date methods of modern planning and building construction in all its phases, including the operation and management of public works and utilities.

Only Three Regular Officers in Division

The Construction Division is a combination of the civilian engineer, the architect, the town planner and the builder, dealing almost entirely with problems similar to those met in the usual lines of construction work carried on during times of peace. An interesting fact bearing on this is that throughout its existence the Construction Division has not had connected with it more than three officers of the regular Army out of a total commissioned personnel of 1485.

The work of the Construction Division of the Army commenced in May, 1917, under the name of the Cantonment Division of the Quartermaster General's Office. The problem at that time was the building of 32 camps and cantonments for the new National Army and Federalized National Guard. Upon the completion of this work in the fall of 1917, the Secretary of War decided that it would be for the best interests of the Government to consolidate all construction work of the Army in this country under one responsible head, that of the Cantonment Division.

The construction projects were necessarily scattered throughout the whole United States, involving problems of transportation not only of materials but also of the necessary workmen.

At one time 200,000 men were employed in the field alone. The work, exclusive of maintenance and repairs, included about 530 operations at 450 different and

widely separated locations. On many projects transportation and living facilities were utterly lacking and required the building of roads and railroads and the providing of living accommodations for the workmen before actual construction could start. In other cases not only was this true, but it was necessary first to clear sites for the work in what were practically forests.

The housing accommodations comprised about 40 large camps and several hundred minor projects, providing accommodations for about 2,250,000 men. In connection with the large camps and the smaller projects as well, in addition to the housing, there were provided the necessary supplementary buildings and utilities. In the case of the major camps practically a complete city was built, including roads, walks, electric lights, water-supply, sewers, sleeping quarters, mess halls, lavatories, theaters, post-offices, store buildings, telephone and telegraph offices, power houses, laundries, storage buildings, hospitals, stables, garages and ice plants.

Army bases, interior posts, expeditionary depots, warehouses, terminal piers, wharves and docks have been constructed along most modern lines and on an hitherto unequaled scale. The areas total 27,502,300 sq.ft. of warehouses and pier sheds and 2,176,000 sq.ft. of open sheds, giving a grand total of substantially 30,000,000 sq.ft., or 690 acres, of storage space. The magnitude of this total can best be conceived by considering that it equals a building 70 ft. wide and 80 miles long or about equal in length to the distance from New York to Philadelphia. Most of the warehouses are of reinforced concrete. These figures do not include miscellaneous warehouses or magazines, or those at camps, or used exclusively by the Ordnance Department. Adjacent to the terminal piers and docks there are completed or well advanced 39,000 lin.ft. of wharves, equivalent to 7.4 miles, for loading ships. This wharfage provides generally for channels with a depth of 35 ft. at low tide and is sufficient to berth 65 ships at one time on the basis of 600 ft. in length of wharf per ship.

There have been built about 844 miles of railroads, exclusive of local trestles, etc., and about 1061 miles of roads, of which a large percentage are of concrete.

The hospital section has built or reconstructed buildings to accommodate 121,000 patients' beds, and in addition has provided quarters for about 12,000 nurses, 24,000 enlisted personnel and 4000 doctors. As in the case of camps, on many hospital projects it was necessary to install all utilities, such as sewers, water, gas, electricity, roads and railroads. To picture the extent of hospital construction, it may be said that if all these Army hospital capacities were consolidated there would result a population about equal to that of Worcester, Spokane or Memphis.

Work for Ordnance Department

For the Ordnance Department alone, there have been built more than 7,933,000 sq.ft., or 181 acres, of industrial and storage buildings, about 7000 lin.ft. of docks and about 3,250,000 sq.ft. of magazines. The work for the Ordnance Department and the Chemical Warfare Service has aggregated a cost of about $150,-000,000, of which the following is a brief description:

Six artillery proving grounds, of which the largest, at Aberdeen, Md., contains about 38,000 acres and has cost about $15,000,000. These proving grounds are used to test all guns, from trench mortars to railway mounts and the 16-in. coast-defense guns, as well as for testing ammunition of all kinds, including the various types of gas shell. They are provided with steel and brick machine shops equipped with electrically driven machinery, including overhead cranes, etc., for assembling and repairing artillery.

Seven ammunition storage depots, of which the largest, at Raritan, N. J., contains over 90 fire-resisting magazines, has a storage capacity sufficient for nearly $400,000,000 worth of explosives and cost about $12,-000,000. Most of these depots are provided with extensive dock facilities and from 20 to 30 miles of railroad sidetracks.

Various fire-resisting buildings of steel, brick, reinforced concrete and hollow tile, together with miscellaneous machinery, were provided at nine of the permanent Government arsenals, which are scattered from New England and the Atlantic coast to California and Texas. There is no uniformity in the requirements of this permanent arsenal construction but in several cases it has run into considerable money. At Watervliet, for example, it included a steel and concrete machine shop about 250 x 600 ft. in plan and other buildings of like character, which added about 4000 employees to the manufacturing force at that point.

Nine Ammunition Assembling Plants

Nine plants were built for assembling ammunition, etc., including shell-loading plants for fixed ammunition, bag-filling plants for loose ammunition, two cartridge factories, one plant for loading aërial bombs and one for manufacturing incendiary bullets. Several of these installations cover three or four square miles, with 300 to 500 separate buildings in one plant and 30 to 40 miles of sidetracks, besides power station, machinery and equipment of all kinds. Much of this machinery, and to a large extent the operating buildings themselves, have had to be designed especially for their purpose.

Twenty chemical manufacturing plants, with their buildings, facilities and equipment, for the manufacture of T.N.T., picric acid, tetryl, toluol, sulphuric acid, phosphorus, mustard gas, tear gas, sodium cyanide and liquid nitrogen, were built. These plants cost from $1,000,000 to $13,000,000 each, and in most cases included housing facilities for the operating forces, as the plants were necessarily isolated.

The Edgewood arsenal, at Edgewood, Md., includes a plant for producing chlorine and other gases, many times larger than any other in the world, an extensive gas-shell filling plant, fire-resisting barracks, two hospitals, a 600-ft. dam and reservoirs, and a 20,000-kw. power station, costing in all about $25,000,000.

Various factories or factory additions were built for the manufacture of Liberty motors, tank tractors, automatic pistols, etc., and various laboratories and experimental stations.

The work of the Construction Division, summed up briefly, has covered such diversified projects as camps, cantonments, wharves, docks, forts, arsenals, great port

terminals, reserve storage warehouses, hospitals of all sizes and description, aviation fields, proving grounds, embarkation camps, engineer camps, gunnery schools, housing, lighters, power plants, factories, additions to manufacturing plants, munition plants, and special new plants, for the production of nitrates, phosphorus, T.N.T. and miscellaneous acids, gases and explosives.

Relations with Other Branches of Service

By the autumn of 1917 the necessity for munition plants, for aviation fields and training schools, quartermaster storage depots and terminals, for powder plants and magazines, for factories, as well as special camps and training schools, was most urgent throughout the country. Every bureau of the Army had developed or was attempting to develop an organization for the construction work required by the program of its own particular activities. This resulted in competition between the various bureaus, not only in the markets for labor and materials, but also in the field of experienced builders, engineers and other similar technical men. There arose in these bureaus constructing organizations and engineering departments whose work it was naturally impossible to coördinate, and there resulted the inevitable loss in efficiency.

The combining of the building activities of the War Department thus became necessary, quite naturally, and, each bureau having its own organization, there also arose the need for a decision as to which bureau should be charged with the construction program on this side of the Atlantic.

The Cantonment Division at this time included officers principally from the Quartermaster Corps, as well as others from the Ordnance Department, the Corps of Engineers and the Signal Corps. This condition was due to the fact that very early in the war the entire commissioned personnel allotted to the Quartermaster Corps was exhausted, and those in charge of building up the Cantonment Division requested that the men selected by them from civil life should receive commissions in other corps, where commissions were available, and then that these men be transferred to the Construction Division. Although an understanding of the procedure makes it clear that such men of the Signal Corps, for instance, as well as those of the other corps, were not trained in the special work of the bureaus in which they were commissioned, but were essentially Cantonment Division men, nevertheless, various bureaus have been inclined to feel that they were perhaps partly responsible for the remarkable achievement of the Cantonment Division. And there has been a desire on the part of other corps to be charged with the responsibility for this construction work.

Between the Construction Division and the several bureaus of the Army for which work was being done there existed a most friendly and helpful spirit. All were concerned principally in expediting the work, and each lent to the other every assistance which would be of value in winning the war. In the case of the Signal Corps there were certain specialized types of construction wherein the men of the Signal Corps could probably benefit by experience in these specialized activities —as, for example, in the construction of balloon and airplane sheds—and these special building activities were not at that time taken over by the Construction Division.

The Construction Division sprang from the Construction and Repair Branch of the Quartermaster General's Office which, when this country became a participant in the world war, was composed of three regular Army officers with a force of 20 clerks and stenographers and about as many engineers, architects and draftsmen. The cantonments were built without making substantial demands on the Engineer Corps for reserve officers, as they were built essentially by civilians, many temporarily in uniform and most of them coming from 41 previously established engineering organizations and 61 contracting organizations. The design of the original cantonments, as regards general plan, was carried on in the Washington office where, up to July 1, 1917, there was only one Engineer Reserve officer. Among the original constructing quartermasters for the 16 cantonments, there was no Engineer Reserve officer, while at the 16 National Guard camps eight of the constructing quartermasters were Engineer Reserve officers.

The Construction Division has reported direct to the Chief of Staff since February, 1918, and it is essentially a part of the Office of the Chief of Staff; in that respect it is substantially on the same footing as any other department or corps of the service. The Army appropriation bill provides funds for the Construction Division through the Quartermaster General's Office, although the latter has no jurisdiction over these funds. It seems unfortunate that in the rush of its crowded program of work the Construction Division did not take the necessary steps to adopt a distinguishing insignia and thus establish in the mind of the public the individuality to which it is so abundantly entitled.

Growth and Development

The organization of the Construction Division, formerly the Cantonment Division, has been a matter of general growth and development, as its duties have broadened. From the four original branches of construction, engineering, materials and accounting, the division has been divided into seven branches as follows: (1) Building division, which supervises the construction of projects and keeps in touch and directs the constructing forces in the field from the Washington office and through its various supervisors; (2) engineering division, which is charged with the responsibility of the preparation of plans and estimates, and establishes and lays down the fundamental engineering principles, standards and requirements for the work; (3) contracts division, which deals with the preparation and execution of contracts and other legal matters connected with the work; (4) procurement division, charged with the mobilization and procurement of materials and the inspection of these, where necessary, at the source; (5) administrative division, charged with the keeping of necessary records, both in regard to labor and personnel, clerical routine, files and similar work; (6) accounting division, in charge of the accounts and expenditures on the projects, the examination of the field records and accounts; (7) maintenance and repair division, or, more popularly, the operation and maintenance division, which has charge of all main-

tenance as well as the operation of utilities of military posts and camps, and also the operation of similar units at all the projects handled through the Construction Division.

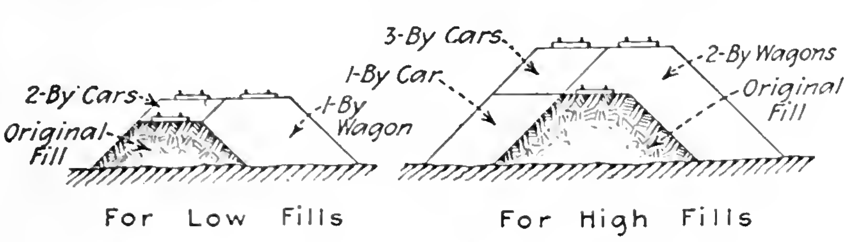
The building and the maintenance and repair divisions control the field work; an understanding of the activities of these divisions will, therefore, involve a complete understanding of the whole construction machine. Further comment will be made later on these two subdivisions, more particularly the maintenance and repair division, with the organization and work of which the writer has been familiar during the past year.

Dump Cars and Wagons Enlarge Railway Fills

Lack of Timber Excludes Use of Trestles for Filling—Work Trains Operate on Main Line—Sinkholes Cause Trouble

IN WIDENING and raising fills for double-tracking and grade reduction on the Cleveland-Indianapolis division of the Cleveland, Cincinnati, Chicago & St. Louis Ry., in 1918, practically all the material was borrowed, there being few cuts because this part of the line traverses an elevated plateau. The borrow pits were mainly shallow and wide, because the general ground level is flat and the drainage is poor. Yellow clay, the principal material in these pits, was hard to excavate, but would slack after exposure. Beneath this was a stiff blue clay affording good foundation for structures. Shrinkage allowance in the fills was about 5% with scraper and dump-wagon work, and usually 10% for the large fills made by dump cars, although in the latter case it was sometimes increased to 20% for soft material.

Earthwork was handled in various ways, depending upon the quantity at each location. Light fills were made mainly by slip scrapers and leveled with road graders handled by teams. Some large fills were made by slip



TWO METHODS OF RAISING AND WIDENING FILLS

and wheeled scrapers, because the subcontractors had this type of equipment. Elevating graders and dump wagons were employed also on large fills, one contractor using teams, and another using steam traction engines, to haul the graders. Most of the heavy work, however, was done with steam shovels served by 12-yd. dump cars in 10-car trains which were operated on the main line by the contractor's 47-ton engines. These cars were dumped by hand, the material being leveled by a large spreader car propelled by a 60-ton locomotive furnished by the railway, as the contractor's engines were too light for this service.

In raising the grade on the old alignment by means of dump wagons, if the fill was comparatively low a side fill was first made alongside the existing work up to the limits of the final section, as shown by the drawing. When this had settled the new construction track was placed upon it, and the fill was widened and brought to grade by dumping from cars on this track.

With high fills, however, the old fill was first widened by dump wagons. With the running track detoured, the second step was to widen the old fill on the opposite side and bring it up to the new grade, by dump wagons. The third step was to widen the new fill by dump cars, bringing the first part of this fill up to final grade. Dumping from temporary trestles was the method planned originally for making the heavy fills, but as the necessary timber could not be obtained the methods described had to be adopted.

When time had been allowed for the fills to settle, the roadbed was graded and finished, and the track was laid on this subgrade, the rails and ties being distributed from the running track. Gravel trains with center-dump cars ran over the new track and deposited the ballast, the track being then raised by jacks and the ballast shoveled under the ties. A second layer of gravel was deposited in the same way and leveled by a plow on the rear car, after which the track was dressed to final surface and line. All the work trains operated entirely under flag protection and not on train orders, being required to keep clear of regular trains.

Trouble With Sink Holes

Three sink-holes caused trouble with the side-dump fills east of Union City. Soundings taken by the valuation engineers of the Interstate Commerce Commission in 1917 showed layers of cinders and gravel ballast extending to a depth of 38 ft., but no soundings have found the bottom of the wet, black, peaty muck of the sinkholes. As the filling was deposited along the old bank the black soil would rise in a ridge beyond it, sometimes to a height of 10 or 15 ft. above the normal level of the ground. Further movement developed also at a distance of 200 to 300 ft. from the fill. The settlement did not appear to affect the old bank, except that the latter was sometimes shifted out of line, and new material had to be placed on the rear side to hold it in position. The new fill, however, would drop 5 or 10 ft. over night, slipping down the slope of the old bank. Raising the dump-car track on a rough clay fill, after such a drop, was slow and tedious. It was expected that from 20,000 to 50,000 cu.yd. in excess of the original estimate would be required in each case, or about 100% increase in quantity. These sinkholes delayed the work somewhat, as the running track could not be shifted to the new fill, but it was planned to discontinue dumping clay and use cinders, until a stable fill was secured.

The concrete materials were distributed by the railway, which hauled sand, stone and gravel in its own 20-yd. air-operated side-dump steel cars, thus avoiding the use of gondolas or other regular freight cars and also permitting rapid dumping and clearing of main track without interference with train movements. The structures were mainly concrete boxes and culverts of cast-iron and concrete pipe, with a few short girder spans. The old National Turnpike crosses at one of the sinkholes, and will be carried by a reinforced-concrete undercrossing or subway 24 x 14 ft. formed as a massive monolithic structure. Pile foundations will

be provided, using 40-ft. piles and following these with others if they do not reach solid ground.

The Walsh Construction Co., Davenport, Iowa, had the general contract and did all steam-shovel and dump-car work with its own forces, under E. K. Hayes and W. I. Shillito as superintendents. Subcontracts were let for scraper and dump-wagon work, and all concrete work was sublet to the Cleary-White Construction Co., Chicago. Both native and foreign laborers were employed by the Walsh Co., with separate accommodations at the camps, as the foreigners prefer to do their own cooking. These men were mainly Bulgarians, Austrians, Greeks and Macedonians, but they worked together without much trouble. The pay for common labor was $4 per eight-hour day.

The work was under the direction of C. A. Paquette, chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry. W. C. Kegler was district engineer, with F. N. Johnson as resident engineer on the section from Marion to Bellefontaine, and T. E. Earle as resident engineer from Ansonia to Winchester.

Successful Operation of the State Water Code of Oregon

Shows a Saving in Time and Water to Irrigator—Function of State Water Board, State Engineer and Water Master

By Percy A. Cupper
State Engineer, Salem, Ore

Since a number of Western states propose to enact or amend water codes during the present legislative session, a review of the Oregon code and operations under it may be of value, especially as it is generally conceded that this is the most successful code now in force.

Viewed from ten years of successful operation of the Oregon water code, it is difficult to understand why its enactment was so long delayed. In fact, it now seems strange that when provision was originally made for a definite record of land titles, no such provision was made for a definite record of water-right titles. When our constitutions were framed and early laws enacted, the fact that water for irrigation was worth more than the land itself was not generally recognized.

The result of our inadequate water-right records, or their total lack, is clearly seen in the way the courts have been compelled to decree imaginary water rights, or rather imaginary water. The courts cannot be held responsible for the lavish manner in which they bestowed water upon one of two litigants in a proceeding notwithstanding the fact that a large part of the available supply was covered by prior appropriations. Definite information as to the available supply and the amount covered by prior appropriations or the amount necessary for the needs of the litigants has in most cases been conspicuous by its absence. It is no wonder, then, that years of litigation between various water users on a stream has resulted in hopeless confusion of rights, while each new appropriation adds to the confusion.

The Oregon Water Code performs three distinct functions:, (1) The determination of all existing rights; (2) the definite record of new appropriations, and (3) the distribution of water to the water users in accordance with their respective rights.

In Oregon the determination of water rights is made by the State Water Board, consisting of the State Engineer and the superintendents of the two water divisions into which the state is divided. The State Engineer is required under the statute to secure certain physical data relative to the amount of water available in the stream under adjudication, the amount actually applied to the lands or other use, and the capacity of the various ditches. In addition, he is required to prepare a map showing the number of acres in each 40-acre tract that are irrigated. Too much emphasis cannot be laid upon the necessity of securing accurate and reliable data under this provision of the statute. Experience has shown that obtaining accurate and reliable data during a period covering one or two irrigation seasons, making a complete analysis of the same and presenting the results obtained in the form of a report embodying definite recommendations, will not only serve as a basis for the findings of the board, but will eliminate the taking of many hundred of pages of testimony, and, if fairly and impartially performed, will generally be acceptable to the water users.

The formality of court proceedings is eliminated in so far as practicable. The water users are permitted to come in and file their claims, and, in fact, are assisted in preparing the same if they so desire. In other words, those in charge of the adjudication work with the water users in an effort to have the claims presented so as to represent the actual conditions. The maps prepared by the State Engineer are available at the hearings, and the claims are checked with the map. If they do not correspond, arrangements are made to make further investigations and adjust the discrepancies. If claims are filed to which other claimants have objections, an opportunity is afforded to contest them, and testimony may be offered before the superintendent.

It may be added here that in these water-right determinations an effort is always made to conform the findings of the board to the general practice of irrigation on the stream, providing such practice does not involve a wasteful use of water to the extent that it cannot be justified as a beneficial use.

It may be said, therefore, that primarily the advantage of a water-right determination by the State Water Board lies in the fact that it may on its own initiative obtain any and all information which may be necessary or desirable in arriving at a determination of the relative rights of the respective water users on a stream or stream system. It determines all of these rights at one and the same proceeding, and therefore, has an opportunity of considering the relation of the various rights to each other.

Water-Right Certificate and Follow-Up System

It would be of little value to determine all existing rights if every new right that was initiated injected an element of uncertainty into the water-right situation, thus creating dissensions and opening the way for litigation. The Oregon water code provides for the initiation of water rights by the filing of applications in the office of the State Engineer and obtaining a permit thereon. Upon satisfactory proof that the water has been completely applied to the proposed use, a water-

right certificate is issued, as in the case of water rights which have been adjudicated by the state water board. However, it is obvious that if, after a permit was issued no further steps were taken to determine what progress was being made and the state engineer's office simply awaited the submission of final proof, it would soon be impossible to determine whether or not many of the permits were in good standing. For this reason a follow-up system has been adopted in Oregon whereby each permit holder files a report each year on a form attached to the permit, and in case no such report is filed he is notified by post card.

Double Purpose of Follow-Up System

This follow-up system serves a double purpose:

1. It keeps the records in the office of the State Engineer up to date, and an examination of these records indicates which permits are in good standing, and this in turn is of value in determining the amount of available water which may be appropriated by those desiring to initiate subsequent development. Without this follow-up system the records of water rights would soon be in the same chaotic condition that characterized water-right records prior to the enactment of the water code. That is to say, the records would merely show the filings that had from time to time been made, and would not indicate whether or not the rights had been perfected or were in good standing.

2. The follow-up system prevents the permittee from inadvertently allowing his rights to lapse through failure to begin the work within the time specified in the permit, or to prosecute the same with reasonable diligence, as required by the statute.

It is the duty of the administrative office having charge of the development of our water resources to assist in every practical way those who are endeavoring through their own efforts and expenditure of capital to develop these resources. It is the duty of those officials, and the water code offers to them a wide opportunity to work with those engaged in this line of development. Particularly is this applicable to the man who is endeavoring to irrigate his own holdings, which are generally small. It is in this that the follow-up system, by which the State Engineer's office keeps in touch with the status of permits, is of real service to the appropriator.

There is a marked distinction between a water right and water. It is essential that an adequate record of water titles be maintained, but it is also essential that the water users actually receive the water to which each is entitled. No water code would be complete unless it provided the necessary machinery for the actual delivery of water to those entitled to its use. The past history of irrigation has repeatedly shown that a man may have a prior right to the use of the water of a stream and yet be unable to secure water for the irrigation of his land, notwithstanding the fact that subsequent appropriators had an adequate supply. Injunctions sometimes have afforded the necessary relief, but are totally inadequate in cases where the distribution of the waters of a large stream is complicated by many diversions and users of water.

The Oregon water code provides for the appointment of a water master with full authority to distribute the water in accordance with the findings of the board or the decree of the court. The water master is allowed considerable discretion, however, in preventing the wasteful use of water. When the flow of a stream is not sufficient to reach a prior appropriator far down the stream, or it requires an excessive amount of water to provide him with that to which he is entitled, the water master either permits a subsequent appropriator higher up the stream to use the water or installs a rotation system whereby the entire flow of the stream is turned down for a short period of time to the prior appropriator, thereby eliminating much of the waste which would otherwise occur. By the use of discretion and diplomacy the water master is not infrequently able to make what would otherwise be an inadequate supply serve the entire district.

Irrigator's Time and Water Both Saved

It is a well known fact that much of the irrigator's time in the past has been taken up with a vain endeavor to prevent his neighbor from destroying his dam and taking the water to which he was, or thought he was, entitled. In fact, that has been a serious hindrance in many irrigation communities, and has led to much litigation and even to bloodshed. Not alone is the irrigator saved the time that it requires to protect and repair his dam and headworks, but also much time is saved by the distribution of water by rotation, which the water master encourages wherever practicable. It was very difficult indeed under the old plan for two or three neighbors to coöperate to the extent of using the water in turn, thereby irrigating their land in much less time and at much less expense. This was not due entirely to the inability of the neighbors to coöperate, but was due to a large extent to the fact that each water user felt that he would jeopardize his legal right to the use of the water unless it was used continuously throughout the irrigation season. This fear of legal complications is entirely eliminated under the Oregon water code, and it is an easy matter to show the water user the advantage he will gain by using the water by rotation.

It may be said, therefore, that distribution of water under the direction of a water master saves time, water and litigation.

At the time of the enactment of the Oregon water code considerable objection was encountered from large interests which apparently felt that their rights would be jeopardized by the state's supervision over its water resources. However, it now appears that this objection has entirely disappeared, and practically all water users find that through the administration of the water code they receive a real benefit.

The Oregon water code has served as a model for similar statutes in a number of our Western states. It is the only statute of the kind that has been passed upon and upheld by the Supreme Court of the United States.

I believe the Oregon water code and the irrigation district law are the two greatest assets which Oregon has in its irrigation development. The irrigation district law has placed irrigation as an enterprise on a sound business basis; this has been demonstrated by the results which have been obtained since its enactment. The water code makes it possible for a man with a water right to determine the exact nature and extent of that right, to record the same, and to secure actually the water to which he is entitled.

Shipping Board Protects Health of Shipyard Men

Sanitary Engineers Control Water and Food Supply, Housing, Sewerage and Garbage—Abate Flies and Mosquitoes

RECOGNITION of the health and contentment of workmen in the shipyards as a factor in the rapid output of vessels led the United States Shipping Board to create a department of health and sanitation, which was placed under an officer who received a free hand in carrying on the work as he saw fit. In a paper presented before the sanitary engineering section of the American Public Health Association, at its recent meeting in Chicago, this special work was reviewed by Lieut. Col. Philip S. Doane, director of the department.

A fundamental difficulty was encountered in the fact that shipyard employees are not under direct control, like soldiers and sailors, and are not obliged to carry out orders, while shipyard managements were so fearful of losing men that they would not issue orders likely to be objectionable to the men. Furthermore, while sanitary measures could be carried out without much trouble in the 11 yards operated by the board, the condition was very different in the other 160 yards working under contracts. None of these contracts calls for specific sanitary equipment, and only a few call for maintenance of sanitary and hygienic conditions. The shipyard health department, therefore, had to use diplomacy and to act largely in an advisory capacity, but Colonel Doane pointed out that in very few instances have the shipyards failed to follow out suggestions for improvements.

Sanitary engineers and medical officers were civilians, as no Army officials could be spared, and the major part of the work fell upon the engineers. To improve water-supplies, toilets and sewerage and other sanitary facilities, it has been necessary to have men constantly on the ground to assist and advise the engineers of the yards. As most of the yard employees live in neighboring cities and towns, the shipyard health department has endeavored to protect their home environment, with the assistance of local and state health authorities. Insanitary restaurants outside the yards have been condemned and replaced by restaurants conducted in a sanitary manner under the supervision of the local health officials.

Water-supply received special attention. Colonel Doane states that a thirsty man will drink, regardless of signs or instructions, "any water that is wet." Therefore, the policy adopted was that only pure drinking water should be supplied for washing and that outlets from industrial or fire protection mains should be of such type as to make it impractical or inconvenient to drink from them.

The importance of fire protection makes a dual system of mains the usual practice, and these were frequently connected, the only protection to the drinking water mains being a single gate valve. These connections have been mainly eliminated, and those absolutely necessary have two check valves with devices for frequent testing. Drinking water was at first distributed by buckets and common drinking cups, but the department has succeeded in having bubbler fountains installed in many yards.

Lavatories have been a source of much controversy. Methods of disposal of excreta and sewage are many in the average shipyard, owing to the waterside location, and the department's recommendations depended largely upon the character of the waterway at each yard. Care has been taken to secure collection of garbage in closed containers and its proper disposal. The collection and disposal of manure, and keeping the yards clear of refuse matter, have been included in the work.

Mosquito elimination was an important branch of the work, as the yards are often in proximity to swampy areas and the men must work in night shifts. The swamps have been drained and oiled. Flies were recognized as carriers of disease, and were trapped and destroyed, while measures were taken to control their breeding places. Eradication of vermin in barracks and living quarters introduced some problems, and at certain yards methods were adopted to solve them.

No public health officers was maintained by the City of Bath, Me., where there were two shipyards, and it was found that impure milk and meats were being delivered there. The city had no funds for such an official, but agreed to give all necessary authority if the department would pay the salary. A sanitary engineer, therefore, has acted as health officer for six months. He has secured pure milk and food supplies and has also improved general sanitary conditions.

The care of the thousands of men engaged in the construction of the barracks, hotels and houses for the shipyard employees has been another special branch of work. At Wyandotte about a thousand men were made ill by drinking water from the Detroit River, which Colonel Doane calls "diluted sewage." A temporary disinfecting plant was installed and a campaign was conducted to get the inhabitants to vote a bond issue for filters. This has been carried, although local opposition at first made this seem impossible.

The protection of the sailors also comes under the direction of the health department, which will supply each vessel with medicine chests and first-aid equipment. In the classes of instruction there will be a course on the use of this equipment. Colonel Doane's paper expressed high appreciation of the efficiency of the sanitary engineers' work.

Sewage-Treatment Project for Calumet District

A sanitary drainage district in the Calumet region of Indiana, to embrace the four industrial cities of Gary, Hammond, Whiting and East Chicago, having a combined population of about 150,000 is proposed. The sewage of these towns is now discharged through the Calumet River into Lake Michigan. The plan is to treat the sewage and reserve the flow so it will pass through the new Sag channel to the Chicago Drainage Canal. The sewage-collecting system of each city would remain under local control, but would deliver the sewage to a central or joint plant for treatment before its discharge into the river. No definite plans or estimates have been made and enabling state legislation will be required. C. B. Tinkham, Hammond, Ind., is head of a joint legal commission representing the four cities.

Comparison of Various Existing and Proposed License Laws

Form Suggested by Joint Committee of National Societies in 1915 Used as a Basis in Several States. Many Societies Are Working on Legislation

ENGINEERING societies in several states—Ohio, Minnesota, Wyoming, Iowa, Kentucky—have legislative committees at work on the preparation of engineers' license laws, and the subject is so important that various existing and proposed laws have been examined with the object of bringing together the principal features, for purposes of comparison. The states which now have laws regulating the practice of engineering or of surveying are Wyoming, Louisiana, California, Illinois, South Dakota, Idaho and Florida. Of the many states where licensing has been proposed, or where new laws are being advocated, those here considered are Pennsylvania, Indiana, California, Colorado, and Michigan.

The significant features of these bills are here given for comparison with the corresponding provisions in the suggested standard form of law to license all classes of engineers, as proposed in 1915 by a joint committee of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, the Society of Naval Architects and Marine Engineers and the American Institute of Consulting Engineers. None of these societies, however, has given its official sanction to the committee bill, which in turn was modeled after a proposed bill written by a committee of the American Society of Civil Engineers in 1911.

The features which are here considered, in order, are: 1, Definitions, and scope of bills; 2, enabling clauses for permission to practice; 3, boards of engineering examiners; 4, qualifications of candidates, notice of examinations; 5, total fees for certificates, granting certificates without examination; 6, revocation and reinstatement, and 7, penalties, exemptions from application.

Definitions and Scope of Bills

1. The various laws differ in defining the practice of engineering and in their scope, as follows:

Joint Committee, Proposed 1915—A person practices professional engineering who practices any branch of the profession other than military engineering, including the design and supervision of construction of: Public and private utilities such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, wet docks, dry docks, ships, barges, dredges, cranes, floating docks and other floating property; steam engines, turbines, internal combustion engines and other mechanical structures; electrical machinery and apparatus, and works for the development and transmission or application of power; mining operations, processes and apparatus for carrying out such operations; municipal, irrigation, water-supply, sewerage, drainage, industrial, sanitary, hydraulic and structural works, and other public or private utilities or works which require such experience and technical knowledge as are required for admission to examination. It provides that this enumeration shall not be exclusive, and exempts contractors as follows:

"The execution as a contractor of work designed by a professional engineer, or the supervision of the construction of such work as a foreman or superintendent for such contractor, shall not be deemed to be the practice of professional engineering."

Wyoming, Passed 1907—Limited to engineers and surveyors who perform any field work preliminary to the preparation of an application for permits to use the water of the state, or who shall make surveys or do engineering work relative to the utilization or use of water.

Louisiana, Passed 1908, Amended 1914—Applies to civil engineers and surveyors only.

California, Passed 1909—Requires all county surveyors, or candidates for that office, to be licensed land surveyors.

Illinois, Passed 1915—Provides for licensing of structural engineers and was intended to relieve the disability which the Illinois law for licensing architects imposed upon them. Any person engaged in the designing or supervising of the construction, enlargement or alteration of any structures, other than buildings, or any part thereof, for others, and to be constructed by persons other than himself, shall be regarded as practicing structural engineering. By structures is meant all structures, other than buildings, having as essential features foundations, columns, girders, trusses, arches, and beams, with or without other parts, and in which safe design and construction require that loads and stresses must be computed and the size and strength of parts determined by mathematical calculation based upon scientific principles and engineering data. Certain structures designed solely for given engineering purposes, even though they may be buildings as defined in the act for licensing architects, are included in the term structures as defined. But it is stated that the act shall not "prevent any person, mechanic, or builder from making plans or specifications, or supervising the construction, enlargement, or alteration of any structure or building which is to be constructed by himself or his employees, and for his own use."

South Dakota, Passed 1913—Provides that county surveyors must be licensed, and that no survey is legal except when made by a licensed surveyor.

Idaho, Passed 1915—Licenses surveyors, and provides that no survey of land, plat or subdivision shall be legal unless made by a licensed surveyor.

Florida, Passed 1917—The definition of professional engineer in this law, which took effect Jan. 1, 1918, follows verbatim the Joint Committee bill, but it exempts persons acting as public officers for the state, county, or municipality on work where the estimated cost is $1000 or less. In all other provisions, except as noted

hereafter, this act duplicates the Joint Committee bill. Of the foregoing laws, the Florida act alone applies to all classes of engineers, while of the following proposed laws those for Pennsylvania, Colorado and California would include all engineers. Two states, Indiana and Michigan, have proposed bills to license architects and engineers under the same act.

Pennsylvania, Proposed 1914—This act was developed in preliminary form by a commission, appointed by the Governor of Pennsylvania, consisting of four members of the American Society of Civil Engineers and one member of the American Society of Mechanical Engineers. The introduction states the object to be: "To protect safety, life, health, and property by regulating the surveying, the designing, the supervision of construction, the operation and the maintenance of certain public and private works herein defined, providing a method of enforcing this act and providing penalties." The term "professional engineer" is defined to mean any person who practices professional engineering or any branch other than military engineering, including the designing or general supervision of construction or of the operation and maintenance of public or private works, such as railroads, railways, bridges, highways, canals, harbors, improvements to rivers and other streams, lighthouses, docks of all kinds, vessels of all kinds, dredges, cranes; also of appliances for the generation of power by stream, combustion, or electricity, or works for the development, transmission, or application of power; the design or general supervision of mining operations, or of the appliances, machinery, and apparatus connected therewith; also of municipal works of all kinds, the impounding and distribution of water for any purpose, sewerage, drainage, industrial, sanitary, hydraulic or structural works. The board shall determine from time to time what other branches shall be included in the foregoing enumerations.

Indiana, Proposed 1918 — Licenses architects and structural engineers, to include any person engaged in the planning, designing, or supervision of the erection, enlargement, or alteration of buildings or structures, or any part thereof for others, and to be constructed by persons other than himself. But draftsmen, students, clerks, or superintendents and other employees of those lawfully practicing as architects or structural engineers under licenses, are exempted. A similar provision to that in the Illinois law is made to exempt owners who build their own structures.

California, Proposed 1919—The definitions in this act, which has just been introduced into the state legislature, follow the Joint Committee very closely. It adds that the practice of professional engineering involves the control of forces of nature and the utilization of materials and these forces for the the benefit of man, and that certificates of practice will permit the holder to offer his services in consultation, in investigations, and for research work. It also adds telegraph and telephone systems and plants for the distribution of steam, water, gas, and other elements, and for heating and ventilating, to the list of mechanical structures. It includes the examination of mining properties and supervision of mining and metallurgical operations, and those of the oil industry. The execution as a contractor is exempted as in the case of the Joint Committee law.

Colorado, Proposed 1918-1919—Would define an engineer, without specific details, as a person who is engaged in the practice of the profession of engineering in any of its branches, except military engineering.

Michigan, Proposed 1919—Two bills have just been introduced into the legislature:

1. For the certification of engineers engaged as principals in "the design and erection of structural work for buildings and bridges; the measurement of streams; the location, design, and supervision of construction and maintenance of dams, river and harbor improvements; highways, railways, navigation canals, drainage and irrigation works, garbage-disposal plants, public sanitary systems, public water-works and municipal paving; and the making of surveys relating to property, political and geographical boundaries."

2. The other act provides for the registration of architects and engineers, although any person who has been qualified to use the title "registered architect" under the existing act may continue to use such title until Jan. 1, 1921.

Permission to Practice

2. The enabling clauses for permission to practice vary as follows:

Joint Committee—No person shall practice professional engineering without having first been duly and regularly registered, nor shall any person be permitted to testify or be accepted as qualified as an expert witness in professional engineering matters, unless duly registered; and every map, plan and drawing required by law to be certified or approved by a professional engineer shall be so certified by a regularly registered engineer.

Wyoming—This law, which is limited to engineers and surveyors having to do with the use of water, as above mentioned, requires that candidates must belong to one or more of the following classes: (1) Land surveyors, (2) topographic engineers, (3) hydraulic and hydrographic engineers, (4) construction and designing engineers, (5) administrative irrigation engineers.

Louisiana—Provides that any person, before entering the practice of civil engineering or surveying, must present to the Board of Engineering Examiners a diploma from an engineering college or school of good standing, such standing to be determined by the board, or shall pass a satisfactory examination before the board. Certificates must be recorded in the office of the clerk of the district court of the parish in which the applicant resides.

California—Three methods of licensing are contained in this law: By examination; by recommendation of three licensed surveyors; by the possession of a diploma from almost any technical school, the Board of Examiners being the judges as to the reputability of the school.

Illinois—After six months from the taking effect of the act, it shall be unlawful to practice structural engineering in the state without a license or to advertise or display a card or sign therefor.

South Dakota—According to this law no survey is legal except that made by a licensed surveyor.

Idaho—No survey of land, or plat or subdivision shall be legal unless made by a licensed surveyor, and all

surveys made under the authority of the state, or any county, town, city or village within the state, must be performed by a local surveyor. If the result of the examination of any applicant is satisfactory to a majority of the Board of Examiners, the applicant receives a license to practice structural engineering in the state, this license containing the full name, birthplace and age of the licensee.

The proposed laws which contain enabling provisions are:

California—After July 1, 1920, no person shall practice professional engineering without having first been duly and regularly registered.

Michigan—The first bill provides that after Oct. 1, 1919, before engaging as principal in any one or more of the branches of engineering specified, an applicant must qualify by examination in one or more of these specified branches, and the board shall certify all engineers qualifying under this section; the other bill provides that no person shall use the title "registered architect" or "registered engineer," or any variation of the same, or use any word, letter or device to indicate that the person using same is so registered, after 90 days subsequent to the passage of the act, without being registered in accordance therewith. Certificates shall indicate the character of work for which the registrant is qualified.

State Board of Engineering Examiners

3. Nearly all the bills provide for a board of examiners, generally either of nine or five members, as follows:

Joint Committee—A State Board of Engineering Examiners shall consist of nine members, to be appointed by the Governor, the first appointments to be made at three regular intervals, as specified, the regular term of office thereafter to be six years. The Governor may remove any member for misconduct, incapacity or neglect of duty. Each member shall be a professional engineer of at least 10 years' active experience and recognized standing in his profession, shall be at least 35 years old, and shall have been a resident of the state for at least one year immediately preceding his appointment. Except the first appointees, each member shall also be a registered professional engineer.

The members shall serve without compensation except for traveling and other necessary expenses. The board is entitled to the services of the Attorney General, and can compel the attendance of witnesses, and may take testimony and proofs pertaining to all matters within its jurisdiction. The board shall appoint a secretary, not a member of the board, but who shall possess the qualifications required for members thereof. The secretary shall hold office during the pleasure of the board and receive a specified annual compensation. The board shall hold at least six stated meetings each year, and special meetings as its bylaws may provide. At meetings held solely for the examination of candidates for registration, three members shall constitute a quorum. At all other meetings, a majority shall constitute a quorum. The board shall have power to employ clerks and other employees, and to rent offices as may be necessary to the proper performance of its duties.

The Board of Examining Engineers in Wyoming consists of the State Engineer and two engineers of thorough training and experience, appointed by the Governor and serving without compensation.

Louisiana—The Board of Engineering Examiners consistes of five members, three of whom shall constitute a quorum, all required to be practicing civil engineers or surveyors in good standing. Members are appointed by the Governor for a term of six years, from a list presented by the Louisiana Engineering Society; the Governor has the right to remove any or all members for inefficiency or neglect of duty, and to fill the vacancies occurring in the board from names recommended by the same society.

Illinois—The State Board of Examiners of Structural Engineers is composed of five members, one a professor in the civil engineering department of the University of Illinois, and the others structural engineers of recognized standing, of not less than 10 years' practical experience, and practicing as structural engineers in Illinois. The regular term of office is four years, and candidates are appointed by the Governor. A secretary receives a salary fixed by the board, not to exceed $1,500 per annum, together with traveling and other expenses. The members of the board receive the sum of $10 for each day actually engaged in the performance of their duties, together with legitimate expenses. Three members constitute a quorum. The board's rules and regulations for the examination of applicants must be published at least twice in one engineering journal of general circulation in the state, and one daily newspaper, together with the name and address of each officer. At least two examinations are held each year.

South Dakota and Idaho—Applications for licenses are made to the State Engineer, who alone has power to grant licenses to practice land surveying.

Florida—The State Board of Engineering Examiners consists of five members appointed by the Governor, three of whom are civil engineers, one a mining or electrical engineer, and the other a mechanical engineer or naval officer. The regular term of office is four years, and the Governor may remove any member for misconduct, incapacity or neglect of duty. Each member of the board must be a professional engineer of at least 10 years' active experience, of recognized good standing in the profession, at least 35 years of age, and have been a resident in the state for three years immediately preceding his appointment. Each member must be registered as a professional engineer, and be also a member in good standing of a recognized engineering society.

Members serve without compensation, except traveling and other necessary expenses. The board is required to hold at least two regular meetings each year and has power to employ clerks and other employees and rent offices, as may be necessary, for the proper performance of its duties.

The proposed bills provide for examining boards as follows:

Pennsylvania—The State Board of Examining Engineers would consist of nine members appointed by the Governor, each member serving for a term of six years except those first appointed, of whom three shall be appointed for two years, three for four years, and three for six years. Each member of the board shall be a professional engineer of at least 10 years' active experience, and have the qualifications demanded of the

highest grade membership in one of the four national engineering societies, and must be at least 35 years of age, having been a resident of Pennsylvania at least five years immediately preceding his appointment. After the first appointees, the members must be registered professional engineers.

They shall serve without compensation, except expenses actually incurred in the performance of duty. The secretary is a member of the board, he is appointed by it and holds office during the pleasure of the board, and shall receive an annual compensation of $3600. The board shall hold at least six stated meetings annually in Harrisburg, five members to constitute a quorum.

Indiana—The State Board of Examiners of Architects and Structural Engineers would be composed of five members, not more than three of whom shall be of one political party, two shall be architects and two shall be structural engineers, and one shall be neither an architect nor a structural engineer. All shall be residents of Indiana, in good standing, and the professional members shall have been engaged in independent practice for at least five years. The regular term of office shall be five years. Appointments are to be made from a recommended list of five architects and five structural engineers from the Indiana Society of Architects and the Indiana Engineering Society, respectively, except the member who is neither an architect nor a structural engineer. Regular meetings shall be held in January, April, July and October of each year; three members shall constitute a quorum. The board is to adopt rules and regulations for examinations and publish the same in one daily newspaper in Indiana at least twice. Examinations shall be held at least twice each year.

California—Provides a State Board of Engineering Examiners in accordance with the Joint Committee bill, the first appointments to be made for two, four and six years.

Colorado—The Governor appoints a State Board of Engineer Examiners, composed of five members, legal residents of the state, who have been engaged in the practice of engineering at least 10 years. The State Engineer is ex officio the fifth member of the board Members of the first board receive a certificate of appointment to entitle them to a license. Successors are appointed for a term of four years from a list of five nominees elected by the licensed engineers acting in a general assembly called for this purpose in January next preceding the expiration of the terms of any members. The State Engineer acts as secretary and treasurer.

Members shall serve without compensation other than necessary expenses, to be paid from the special "Engineer Examiners' Fund" obtained by the fees derived from the operation of the act.

Michigan—(1) The board shall consist of three representative engineers who have been residents of the state not less than five years and engaged in one or more of the specified branches of engineering not less than 10 years. After Oct. 1, 1919, only registered engineers are eligible. The Governor shall appoint one member from the upper peninsula, one from that portion of the southern peninsula lying north of the Michigan base line and one from that portion of the state lying south of the Michigan base line. The terms of office shall be six years. Members are to receive $25 per day, with expenses. (2) The other bill provides that the Governor shall appoint a board of five examiners, composed of two architects and three engineers, who have been in active practice of their professions as principals for not less than 10 years, and who are otherwise qualified, one of them to be from the upper peninsula. Not more than one engineering member shall belong to any one of the five major classes of engineers—civil, mining, mechanical, electrical, and chemical. No person shall be appointed except upon the indorsement of not less than 25 practitioners of recognized standing in the profession he is to represent. The regular term of office is five years. Meetings are to be held twice each year. Members of the board receive no compensation, except actual expenses.

Qualifications of Candidates—Examinations

4. In specifying the qualifications of candidates and providing for examinations, the various acts require:

Joint Committee—Admission to examination is allowed to any candidate who pays a fee of a sum to be specified and submits evidence satisfactory to the board that he is more than 21 years of age, is of good character, and has been engaged upon engineering work for at least six years, during which period he has had charge as principal or assistant for at least one year; or that he is a graduate from an engineering school of recognized reputation and has been engaged upon engineering work for at least four years, having had charge as principal or assistant for one year. Scope of examinations and methods of procedure shall be prescribed by the board; examinations may be either oral or written, or partly oral and partly written. The secretary of the board shall notify each candidate of the result of his examination.

Wyoming—The board may satisfy itself by conducting examinations or by investigation of the records, training and experience of those who desire to qualify. The moral character of the applicant is investigated, and no license is issued to one who is incompetent, dishonest, intemperate or addicted to any habit that would, in the judgment of the board, render him an unsafe employee.

Louisiana—A satisfactory examination, for which a fee of $10 is required, shall be passed upon the following: For surveying—geometry, trigonometry, land surveying, practical use of instruments; for civil engineering—the same as for surveying, and in addition thereto, natural philosophy or physics, including practical problems in design and construction. The applicant must be 21 years of age, of good moral character, and possess at least a fair primary education.

South Dakota—Requires a $15 fee to become a candidate, $5 to be returned if the candidate fails to pass the examination. Any practicing surveyor of 10 years' experience, with testimonials satisfactory to the State Surveyor, receives a certificate without examination.

Idaho—The application shall be referred to a member of the Board of Examining Surveyors, who will make such examination as to the applicant's fitness for license as he may deem necessary, certify the result to the State Engineer, and the latter will then notify the applicant.

Illinois—Examinations shall be held according to rules of the board, a majority constituting a quorum, or by a committee of two or more members elected and appointed by the board. These examinations are conducted by written or printed interrogatories, in whole or in part, and each applicant must sustain "a satisfactory examination in the design and construction of buildings and structures according to scientific principles and with special reference to strength and safety; the strength and properties of various building materials; the principles of theoretical and applied mechanics; the ability of the applicant to apply his knowledge to ordinary requirements of structural engineering, and in such other matters and subjects as the board may require."

A fee of $20 is required of the applicant, who must submit proof, by affidavit or otherwise, that (a) at the time of taking effect of the act he was actually engaged in the practice of structural engineering in the state and did not apply for a license without examination, in which case the applicant shall be entitled to an examination without regard to the number of years he has practiced; or (b) that within 10 years next prior to his application he has practiced structural engineering in some state or territory of the United States or some foreign country for not less than six years, during at least two full years of which he shall have been in responsible charge of work as principal or assistant; or (c) that within 10 years next prior to his application he has pursued a course of study and training in the theory and practice of structural engineering covering at least the subjects above enumerated, for a period of not less than six years in the employ or under the supervision of practicing structural engineers, during at least two years of which he has been in charge of work in designing or construction, in the employ or under the direction of such engineers. Graduation from a school or college of engineering considered to be in good standing by the board, having a course of study not less than four years, during at least thirty weeks each year, shall be credited two years upon the six-year period. The board may adopt rules in its discretion for the case of students who have pursued the course of instruction but were not graduated from schools or colleges of approved standing.

Provisions for qualifications of candidates and examinations in proposed bills are as follows:

Pennsylvania—Qualifications for applicants are prescribed similar to those in the Joint Committee bill.

Indiana—Any person of good moral character over 21 years of age, upon payment of a fee of $20, shall be entitled to an examination. Examinations for architects shall have special reference to the planning, designing and construction of buildings or structures, and their sanitation, and include a test of the candidate's knowledge of the strength of materials and their properties, with special reference to their strength and safety, and of his ability to make practical application of such knowledge in the ordinary professional work of an architect, and in the duties of supervisor of mechanical works in a building or structure; also such other subjects as the board may require from time to time. Examinations for structural engineers shall have special reference to design and construction of buildings or structures according to scientific principles as above; the principles of theoretical and applied mechanics; the ability of the applicant to apply his knowledge to ordinary requirements of structural engineering; also other subjects as the board may require.

California—Same as the Joint Committee bill.

Colorado—Examinations shall be given to the candidate only in that branch of engineering in which he is proficient, as set forth in his application. The board has authority to summon any engineer holding a license to assist in preparing for and conducting examinations of candidates, such engineers being remunerated, at not to exceed $10 per day, in addition to necessary expenses. The board admits to examination any candidate who pays a fee of $10, is a citizen of the United States more than 25 years of age, of good moral character, and who has been actively engaged in the practice of engineering at least 10 years in the employ of practicing engineers. Each complete year as a student in an engineering school of recognized reputation shall be credited as one year of practice. During six years he must have been in active responsible charge of engineering work. Responsible charge is held to mean the actual supervision and direction of engineering work requiring the exercise of initiative, judgment and independent decisions, and may be performed in the capacity of either principal or assistant.

Michigan—(1) Applicants for examination must satisfy the board that they have had not less than six years of practical experience in one or more branches of engineering as specified, or shall have been graduated in engineering from a recognized school or college of engineering, and have had in addition not less than two years of practical experience. After Oct. 1, 1919, practical experience means work performed as a subordinate under the supervision of one or more certified engineers; (2) The second bill provides that the board shall adopt rules and regulations for the examination and classification of candidates for registration, and the issuance of certificates thereto. Any person of legal age and good moral character, upon payment of a fee of $10, may apply for examination.

Total Fees—Certificates Without Examination

5. The total fees for certificates, and provisions for licensing upon the passage of the act, and for licensing engineers from other states without examination, are as follows:

Joint Committee—Upon receipt of an additional fee, amount to be specified, the board shall issue to any applicant who has passed the examination a certificate of registration which authorizes the applicant to practice engineering. The board shall examine requirements for registration in other states, territories, and countries, and record those which it believes has standards not lower than those provided for the state. Persons holding certificates of such states are to be registered upon payment of a specified fee.

Provision is made for registration without examination by issue of certificate before a specified date to any candidate who has practiced professional engineering at least 10 years immediately preceding the date of application, and has had charge as principal or assistant for at least two years.

Wyoming—A fee of $5 is required before the issuance

of a license, which license is signed by the president of the board and attested by the secretary under his seal.

Louisiana—Persons practicing civil engineering or surveying in the state before the passage of the act are allowed 90 days to register with the clerk of the court of the district in which they reside. The Board of Examiners must publish annually in February a complete list of registered civil engineers and surveyors in a daily paper of the City of New Orleans, this list being received as evidence in court that the names it contains are duly registered. The annual fee is $3 for civil engineers and $1 for surveyors if paid before Feb. 1, but $10 and $5, respectively, after that date.

Illinois—If the result of the examination is satisfactory, the applicant receives a license to practice structural engineering, upon payment of the further sum of $30. Any person who could show that he was a resident of the state and engaged in the practice of structural engineering on the date of the taking effect of the act, is entitled to a license without examination, provided such application be made within six months after the taking effect of the act, and a fee of $50 be paid. Also, for a fee of $50 the board may issue without examination a license to practice to a structural engineer who has been licensed under the laws of any other state or territory, or foreign country, provided it appear to the board that the requirements in such countries were equal to those prescribed in Illinois, and that such countries would afford a like privilege to structural engineers who hold Illinois licenses. The Secretary of State is to receive a fee of $1 for the recording of each license filed for record. Every licensed structural engineer shall have a seal, the impression of which must contain the name of the engineer, his place of business, and the words "Licensed Structural Engineer—State of Illinois," with which he must stamp all plans, drawings and specifications issued by him for use in the state.

Idaho—License is issued to a successful candidate upon submitting to the State Engineer a $500 bond, $5 fee and official oath. The bond must be a surety company bond. Under the provisions of this statute all persons who are graduates of a course of civil engineering from the University of Idaho may receive a license without examination, upon their own application.

Florida—The additional fee prescribed, as in the Joint Committee bill, is $10. Provision is made for engineers from other states also, as in the Joint Committee bill, the fee being $25. For this same fee, $25, practicing engineers received certificates before Dec. 1, 1917.

The provisions in various proposed laws are:

Indiana—Required, fee of $30 and certificates allowed to be issued to engineers who can show that they were engaged and in good standing in the practice of architecture or structural engineering on the date of the passing of the act, provided such applicant should show that he was in good repute in the practice of his profession. A certificate may also be issued without examination, upon payment of a fee of $50, to an architect or to a structural engineer licensed under the laws of any other state or territory, or of any foreign country, provided it appears to the board that such places have requirements for license equal to those required in Indiana.

California—Certificates of registration are issued upon payment of an additional fee of $20, and the provisions for registering outside engineers and those who are practicing engineering at the time of the passing of the act, are similar to the requirements of the Joint Committee bill.

Colorado—Successful candidates receive certificates upon payment of a fee of $5. Those engaged in the practice of engineering at the time of the passage of the act are entitled to a license without examination upon payment of $15, provided that they have made such application within six months after the taking effect of the act.

Michigan—(1) For each initial certificate the fee is $10; for each subsequent annual renewal of certificate, issued by the board upon request of certified engineers, the fee is $5. Up to Oct. 15, 1919, the certificates are issued by the board upon a sworn statement of the applicant setting forth in full his training and experience and showing that he has been engaged as a principal in engineering for a period of not less than two years prior to Sept. 30, 1919. The board may permit engineers of other states and of foreign countries to engage as principals within the state when they present credentials showing that they have qualified for such work under appropriate laws of their own states or governments; (2) The other bill provides that in addition to the fee of $10 paid for certificate, a fee of $2 must be paid each year for the issuance of a renewal certificate. Any person engaged in the practice of engineering as a principal under the title of engineer before the passage of the act, having presented proof of competency and good character, may secure a certificate to use the title "registered engineer." Provision is made to permit architects and engineers of other states and foreign countries to practice architecture and engineering when they present credentials as in the case of bill (1).

Revocation and Reinstatement

6. Provisions for revocation and reinstatement are made as follows:

Joint Committee—Provides that the board may revoke a certificate of registration for fraud or deceit in practice or in the obtaining of the certificate or for the conviction of crime. Proceedings for revocation shall be begun by filing with the board written charges against the accused. These charges may be preferred by any person or corporation, or the board may on its own motion direct its secretary to prefer charges. The board shall designate not less than three of its members a committee to hear and determine said charges at a time and place to be fixed by the committee, and a copy of the charges shall be served upon the accused or his counsel at least 10 days before the date fixed. A two-thirds vote of all the members of the board shall be necessary for revocation. The board may reissue a certificate of registration to any person whose certificate has been revoked only after the expiration of one year from the date of the revocation, and for reasons which the board shall by a two-thirds vote of all its members determine to be satisfactory.

Wyoming—Licenses may be revoked if the character of the work or the moral fitness of the holder be judged as insufficient.

Louisiana—Licenses may be revoked upon conviction of immoral conduct before any competent court, and if the renewal license fee is not paid before Feb. 1 of each year.

Illinois—Any license may be revoked by a four-fifths vote of the State Board of Examiners for gross incompetency, or recklessness in the construction of buildings or other structures, or for fraudulently affixing seal to plans, drawings or specifications, or for any dishonest practice on the part of the holder, or for fraud in obtaining the license or practicing without payment of the annual license renewal fee. Provision is made for the holder to have at least 20 days' notice of the charge against him, of the time and place of the meeting of the board for the hearing and determining of such charge. The Circuit Court judges receive power to compel the attendance of witnesses upon the deliberations of the board. After one year, the board receives power to reinstate a petitioner according to its own rules and regulations, but it may require the petitioners to submit to an examination. A majority vote of the board is sufficient to reinstate.

Idaho—The State Engineer shall revoke surveyors' licenses upon the recommendation of a majority of the Board of Examiners for: (1) Failure to keep in force and effect the bond filed with the State Engineer; (2) gross incompetence, or fraudulent, dishonest, or unprofessional conduct on the part of the licensee in the conduct of his professional business.

Pennsylvania—Provides for revocation upon proof of fraud or deceit in obtaining registration, or in the practice of professional engineering; conviction of the crime of perjury, or larceny, or embezzlement or false pretense, or robbery, or burglary, or bribery, or corrupt solicitation, or forgery. It requires one month's written notice of the time and place of hearing, and the decision is not valid except by the vote of at least six members of the board. Reinstatement is allowed one year after revocation, provided six members of the board shall approve.

Indiana—Provides for revocation of license by a majority vote of the board, for incompetency or recklessness in the design of buildings or structures, or for dishonest practice or practices on the part of the holder. Twenty days' written notice is required. After the expiration of six months a person may have a new license issued to him, upon satisfactory evidence of proper reasons for such reinstatement and upon payment of $15. Dishonest practice is defined as follows: (1) To be guilty of fraud or misrepresentation in obtaining the license; (2) to conspire or attempt to conspire with any other person to violate the building or sanitary laws, and (3) to give or accept any valuable consideration as a bribe.

California—Exactly similar to the Joint Committee bill.

Colorado—The board shall receive power to inquire at any time into the identity of a person claiming to be a licensed engineer, and may revoke the license by a four-fifths vote in case the practitioner is guilty of any fraud or deceit in his practice, or is guilty of fraud or deceit by which he was granted a license, and if he is incompetent.

Michigan—(1) The board may revoke certificates for incompetence or dishonesty; (2) the other bill provides for revocation after 30 days' written notice and after a hearing, upon proof that the certificate was obtained by fraud or misrepresentation or that the holder has been guilty of malfeasance or gross incompetency in practice.

Penalties—Exemptions from Application

7. Penalties for violation, and exemption from the application of the laws are provided as follows:

Joint Committee—Violation by practicing without complying with requirements of the act is classed as a misdemeanor. The act, it is stated, shall not apply to any professional engineer working for the United States Government, nor employed as an assistant to a professional engineer registered under the act, nor to any engineer coming from without the state and employed therein until a sufficient time, prescribed by the rules of the board, shall have elapsed to permit registration—provided that before practicing within the state he shall have applied for the issuance to him of a certificate of registration and shall have paid the fee prescribed for admission to examination. The bill also suggests that a specified appropriation should be made for the use of the board for the payment of salaries and expenses under the act.

Louisiana—Violators of the act shall be fined not less than $25 nor more than $100, or they shall be imprisoned not less than 30 nor more than 90 days for each offense, by any court of competent jurisdiction. This does not apply to engineering departments of the United States, nor to civil engineers and surveyors of other states and territories when in actual consultation with registered civil engineers or surveyors of Louisiana, nor to any civil engineer or surveyor of the state actually practicing his profession before the passage of the act.

Illinois—Provides that any person guilty of the violation of its provisions shall be punished by fine of not less than $10 or more than $200 for each and every offense. It applies to structural engineers only.

Florida—Similar to the Joint Committee bill, and further provides that it shall not apply to any architect registered by Florida under the provisions of the act creating a State Board of Architecture.

The proposed bills contain the following penalties:

Pennsylvania—Any person shall be guilty of a misdemeanor who shall violate any provisions of the act, and upon conviction thereof he shall be sentenced to pay a fine not exceeding $1000 or undergo an imprisonment not exceeding one year, or both. The exemptions in application are prescribed as in the Joint Committee bill.

Indiana—Provides that after six months from the date when the law becomes effective it shall be a misdemeanor, punished by a fine of not less than $10 or more than $500 for each and every offense, for any person to practice architecture or structural engineering in Indiana without a license, or put out any sign, or card, or other device. The board shall cause the prosecution of all such persons violating the act.

California—Precisely similar to the Joint Committee bill.

Colorado—Violation is punished by a fine of $500 or by imprisonment of not more than six months, or both. It provides that nothing in the act shall be construed

to limit the rights, privileges and duties of architects licensed to practice under the architects' license law in Colorado.

Michigan—(1) Any person who fails to comply with the provisions of the act shall be ineligible for appointment or election to any state, county, township, city, village or other public office, where the duties involve one or more of the branches of engineering specified. Any person who engages in these branches of engineering except under a certificate shall be subject to a fine of $100 for the first offense, $500 or imprisonment for one year, or both, in the discretion of the court, for each and any subsequent offense. Plans, specifications, and estimates for all public work involving engineering must be prepared by certified engineers; (2) The other bill provides that any violation of its provisions shall be a misdemeanor, punishable for the first offense by a fine of not more than $100, and for subsequent offense by a fine of not more than $500, or imprisonment for not more than one year, or both. This act would repeal the act providing for the registration of architects, and all moneys remaining in the state treasury as a separate fund shall be transferred to a corresponding fund provided for by the new act.

Tests Show High Shears in Deep Reinforced-Concrete Beams

Preliminary Studies Made For Emergency Fleet Corporation's Concrete Ship Work Point to Desirable Higher Safe Units Than Those Now Permitted

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PUBLISHED tests of reinforced-concrete beams have shown shearing strengths in the neighborhood of 100 to 150 lb. per square inch for beams with no web reinforcement, and seldom exceeding 300 lb. per square inch for beams with the most effective web reinforcement. Based on these tests, standards for design have been formulated and widely accepted which allow generally about 40 lb. per square inch working stress in shear for a beam with no web reinforcement, and a maximum of around 6% of the compressive strength of the concrete for beams having the most effective web reinforcement. Recent tests made for the Emergency Fleet Corporation in connection with the design of concrete ships indicate that for deep beams, at least, these values are much too small.

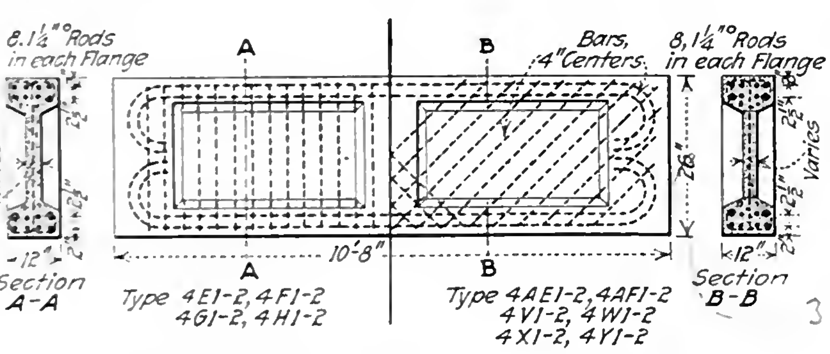


FIG. 1. TWO TYPES OF DEEP BEAM TESTED IN SHEAR
See table on p. 432 for further dimensions

For determining web reinforcement the following formulas have been almost universally adopted: $T = Vs/jd$ (for vertical stirrups); $T = \frac{2}{3} \times 0.7\ Vs/jd$. In which T = total load carried by one stirrup;

V = total shear on the section considered;

s = spacing of stirrups in the direction of the axis of the beam;

jd = moment arm of the resisting couple.

The maximum spacing of stirrups generally has been limited to values ranging from about $\frac{3}{4}\ jd$ to as much as jd.

The most obvious difficulty in designing a reinforced-concrete ship under existing standards was early found to be that of securing sufficient shearing strength without an undue weight of concrete in the shell. This led to the carrying out of a series of tests on beams designed to meet as far as practicable the conditions existing with a ship in service. The test beams were relatively deep compared to the span. The web thicknesses used (generally 3 or 4 in.) were such as seemed practicable for a ship. The heavy flanges used were necessary to enable sufficient longitudinal reinforcement to be used to carry the bending moment when a high shearing stress was present. At the same time, they may be considered to represent conditions which occur at the gunwale and at the bilge where there are large concentrations of reinforcement.

Heavy pilasters at the load-point and at the supports were necessary to prevent crushing of the web, due to the concentrated load at these points. From the phenomena of the tests it is apparent that an appreciable portion of the load was carried directly by the frame action of the heavy pilasters and flanges which were built monolithically with the beam. This portion of the load would not go to increasing the shearing stress in the web, and for an accurate measurement of the shear in the web it is necessary to make a correction for this load. However, the effect of the heavy frames in a ship will be somewhat analogous to that of the pilasters in the test beams. In structures other than ships (such as girders for railway or highway bridges), where high working stresses in shear would be advantageous, there usually will be present features which are analogous to the pilasters of the test beams.

The first series of tests for the Concrete Ship Section of the Emergency Fleet Corporation was carried out at the Pittsburgh laboratory of the Bureau of Standards. Thirteen beams 4 ft. 4 in. high and 18 ft. 6 in. long, and one beam 10 ft. high and 22 ft. long were tested in this series. These tests afforded a basis for concluding that the high working shearing stresses used in the design of the first Government concrete ship were safe. Also, as a result of these tests, tentative standards for shear design for concrete ships were drawn up. However, certain features needed more thor-

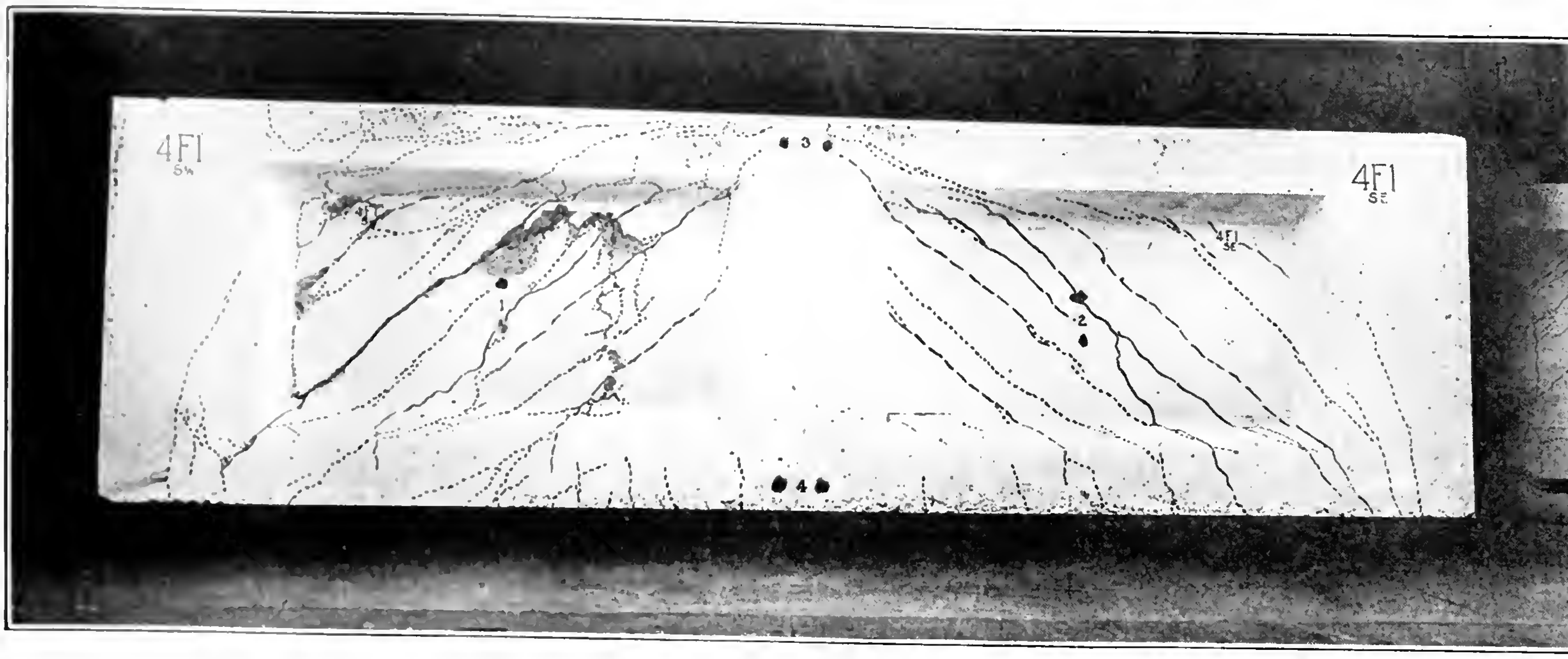


FIG. 2. SHEAR CRACKS IN DEEP CONCRETE BEAM TESTED FOR CONCRETE SHIP WORK
Solid lines cracks under 400 lb. per square inch shear. Dashed lines cracks under 800 lb. per square inch shear. Dotted lines cracks under maximum load

ough examination, and a second series of tests was laid out which covered a much wider range of conditions than those involved in the Pittsburgh specimens.

This second series of tests was carried out in the Fritz Engineering Laboratory at Lehigh University, Bethlehem, Penn. The full use of this laboratory, without charge, has been given to the Emergency Fleet Corporation for this work, and the university officials have coöperated freely in making the work successful.

These beams were 10 ft. 8 in. long and 36 in. deep, 12 in. wide at flanges and of varying web thickness. All the beams were of I-shaped cross-section, with eight 1¼-in. round bars for longitudinal reinforcement in the top and in the bottom. The form of the beams and the manner of reinforcement are shown in Fig. 1. The reinforcing bars were of steel rejected from shrapnel manufacture, and had a yield-point stress of approximately 60,000 lb. per square inch. All the web reinforcement was of round bars of the sizes given in the accompanying table. They were spaced at distances of 4 in. in a direction normal to the axis of the bar in all cases. They were hooked over the longitudinal reinforcing bars at the top and at the bottom of the beam, but were not welded in any instances. The beams were tested at an age of about 60 days, and 8 x 16-in. control cylinders made with the beams were tested at the same time. The strengths of the control cylinders are shown in the table.

Fig. 2 is a view showing the appearance of a typical beam after failure. The cracks in the beam were painted to make them visible in the photograph and to distinguish these occurring at different loads. The cracks shown as solid lines were present when the shearing stress was 400 lb. per square inch. The dashed lines represent cracks at 800 lb. per square inch shear, and dotted lines those at the maximum load carried by the beam. The holes in the concrete were made to expose the steel for purposes of strain-gage readings. Due to the painting of the cracks in Fig. 2, their prominence is exaggerated; that this is so is indicated in Fig. 3, a view of beam 4F2. This beam is a companion specimen of 4F1, shown in Fig. 2. The photograph was taken at the end where failure occurred and without first having the cracks painted.

Fig. 4 shows the observed stresses, center deflection and average widths of the largest cracks for a typical beam. In this diagram tension stresses were plotted upward and compression stresses downward. The numbers on the curves refer to gage lines shown in Fig. 2. Gage lines 5 and 6 were in positions corresponding to the positions of gage lines 3 and 4, respectively, but were on the opposite side of the beam.

Fig. 4 gives an idea of the behavior of a typical beam during the test. Attention is called to the regularity of the curve showing maximum crack widths. The first point on this curve indicates the first measurement of crack width. The dotted line indicates the origin for this curve and does not indicate the crack width for loads below the first point.

The deflection shown is larger than is accounted for by flexure alone. This will be seen if the stresses for gage lines 3 and 5, and 4 and 6, all of which were on reinforcing bars, be reduced to unit deformations and applied in the deflection formula:

$$D = 0.833 \frac{l^2}{d} (e_c + e_s)$$

in which D = deflection
l = span
d = vertical distance between measurements
e_c = unit deformation in upper bars
e_s = unit deformation in lower bars

An examination of G. A. Maney's article in the "Proceedings" of the American Society for Testing Materials, 1914, p. 311, shows the substantial correctness of this formula for beams in which the shearing deflection is negligible. The indication is that the high shearing stress developed and the opening of diagonal cracks had an important effect on the deflection.

Test results for a few of the beams of this series are given in the table. The shearing stresses given in the table are based on the assumption that all the load was carried by flexure of the beam as a whole, and, consequently, that all the shear passed through the web of the beam. This must be somewhat in error, because with

TABLE SHOWING RESULTS OF TESTS OF REINFORCED-CONCRETE BEAMS

Beam No.	Web Reinforcement: Type	Web Reinforcement: Diameter of Bar, In.	Web Thickness, In.	Maximum Load Lb.	Deflection at Maximum Load, In.	Cylinder Strength, Lb. per Square Inch	Stress at Maximum Load, Lb. per Square Inch: Shear	Tension In. Stirrups Obesrved		Tension, In. Longitudinal Bars: Observed	Tension, In. Longitudinal Bars: Computed	Crack Width at 400 Lb. per Square Inch Shear
4E1	Vert.	[illegible]	3.16	360,800	0.41	6,020	1,963	43,400	....	38,000	35,350	0.002
4E2	Vert.	[illegible]	3.44	317,000	0.33	5,930	1,563	38,600	....	33,000	31,100	0.005
4F1	Vert.	[illegible]	2.91	340,600	0.37	5,800	1,985	50,000	....	32,000	33,400	0.003
4F2	Vert.	[illegible]	3.22	303,000	0.33	5,610	1,649	55,800	....	32,000	29,700	0.007
4G1	Vert.	[illegible]	3.19	306,300	0.36	5,370	1,630	......	Y.P.	34,000	30,000	0.009
4G2	Vert.	[illegible]	3.12	270,400	0.36	5,730	1,470	......	Y.P.	27,000	26,500	0.007
4H1	Vert.	[illegible]	3.25	256,800	0.34	5,120	1,340	......	Y.P.	28,000	25,200	0.009
4H2	Vert.	[illegible]	3.53	261,500	0.33	6,730	1,257	......	Y.P.	30,000	25,600	0.009
4J1	None	..	3.00	168,000	0.26	4,930	949	......	....	13,000	16,450	0.026
4J2	None	...	3.34	187,500	0.30	5,820	952	......	....	19,950	18,400	0.022
4V1	Diag.	[illegible]	3.31	419,900	0.32	4,720	2,150	......	Y.P.	41,000	41,100	0.001
V42	Diag.	[illegible]	3.00	433,200	0.32	5,520	2,470	......	Y.P.	40,900	42,400	0.001
4W1	Diag.	[illegible]	3.34	337,600	0.30	4,840	1,715	......	Y.P.	30,000	33,000	0.001
4W2	Diag.	[illegible]	3.09	370,500	0.38	6,180	2,060	......	Y.P.	33,000	36,350	0.001
4X1	Diag.	[illegible]	3.38	313,500	0.34	4,340	1,575	......	Y.P.	28,000	30,650	0.007
4X2	Diag.	[illegible]	3.00	330,000	0.29	5,860	1,880	......	Y.P.	28,100	32,300	0.001
4Y1	Diag.	[illegible]	3.34	261,100	0.32	5,040	1,325	......	Y.P.	23,500	25,600	0.004
4Y2	Diag.	[illegible]	3.03	268,700	0.28	5,420	1,520	......	Y.P.	33,000	26,350	0.003
4AD1	Diag.	[illegible]	0.00	148,300	0.40	4,460	.....	......	Y.P.	25,000	14,500	....
4AE1	Diag.	[illegible]	2.06	258,000	0.20	4,650	2,120	......	Y.P.	19,500	25,300	0.001
4AF1	Diag.	[illegible]	4.25	306,300	0.24	4,380	1,225	......	Y.P.	33,500	30,000	0.002
4AG1	None		0.00	77,600	0.49	5,540	.....	......	....	20,000	7,600	....
4AG2	None		0.00	65,000	0.45	5,860	.....	......	....	24,000	6,350	....

For cases in which the stress in the stirrups had passed the yield-point it is so indicated in the table by the initials Y.P.

the monolithic construction of the beam the flanges and pilasters would act as a frame to some extent independently of the beam structure, and would carry loads which did not have to pass through the web in shear. The amount of this error is not known, but it seems that it cannot be more than the total load carried by a beam like 4AG1 and 4AG2, and it probably is somewhat less. In these beams the web was entirely absent and the loads were carried by frame action alone. To carry load by the frame action of the flanges and end pilasters relatively large deflection is necessary. This is indicated by the large amount of deflection at maximum load given in the table for beams 4AG1 and 4AG2. When the web is present, deflection is prevented to a certain extent by the shearing stresses set up in the web, and the load carried by frame action must be correspondingly less. In later tests, measurements will be made in an effort to determine how much of the shear passes through the web.

The observed stresses in the reinforcement at maximum load, as given in the table, are in most cases greater than were indicated by the strain-gage readings. Usually, after the maximum load was reached the yielding of the beam was so rapid that the load fell off and the stresses were relieved. This is illustrated in Fig. 4, which indicates that the stress in the longitudinal reinforcement increased progressively up to the load just before the maximum but that it had decreased at the maximum load. For such cases the load-stress curves were produced to obtain the most probable stress value for the maximum load.

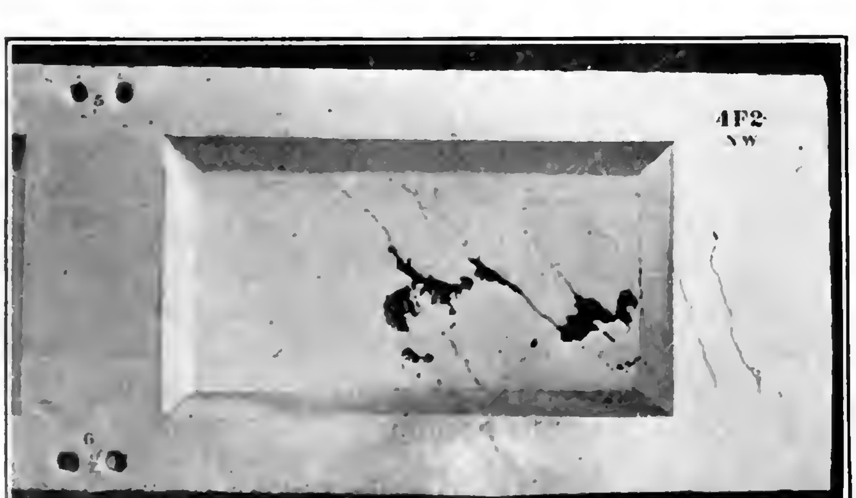


FIG. 3. SHEAR CRACKS IN BEAM UNDER MAXIMUM LOAD

Up to the time of this report, about 85 beams in all had been tested. This investigation was designed to cover the conditions met in ship practice, and, besides

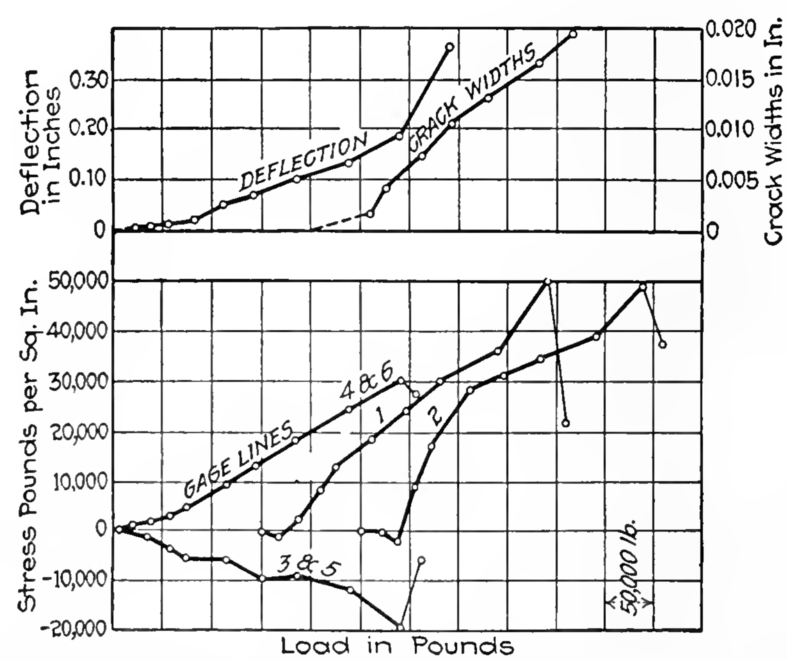


FIG. 4. VARIATION IN DEFLECTION AND CRACK WIDTHS WITH LOAD AND STRESS

the results given in this article, involves beams with longitudinal reinforcement in the web and beams with diagonal compression reinforcement. Expanded metal also was used as web reinforcement in certain of the test beams. Although certain important conclusions are suggested by the test results already obtained it is not the purpose of this article to discuss generally the significance of the results. The investigation is incomplete, and later results may cause important modifications of present indications. One fact which stands out, however, is that with beams of this type larger shearing stresses could be used safely than those which are recognized in standard building regulations. In order to establish the safety of increasing the allowable shearing stresses in general practice, the investigation needs to be extended along lines which in this series of tests have scarcely been touched. This extension should

determine the effect of (a) variation in spacing of stirrups; (b) variation in ratio of depth to span of beam; (c) variation in strength of concrete used; (d) variation in depth of embedment of stirrups for anchorage; (e) variation in amount of longitudinal reinforcement.

Considering these results in relation to general practice in reinforced concrete, it does not seem unreasonable to expect that the establishment of shearing strengths of reinforced-concrete beams for the variety of conditions enumerated will mark a distinct step in advance in the application of concrete to buildings and bridges where now the limitations in shearing strength either prevent its use entirely or seriously handicap economical design.

A continuation of these investigations by the Emergency Fleet Corporation cannot be made, but plans are under way for a larger investigation by the Bureau of Standards, to give information on the subjects enumerated in the preceding paragraph. Such an investigation adequately conducted will be expensive. While funds are not now in sight for the carrying out of the entire program, efforts are being made to secure the financial support that is necessary to do justice to this important subject.

The Angle as a Beam

Section Moduli for Angles of Various Sizes in Various Positions Tabulated for Comparison

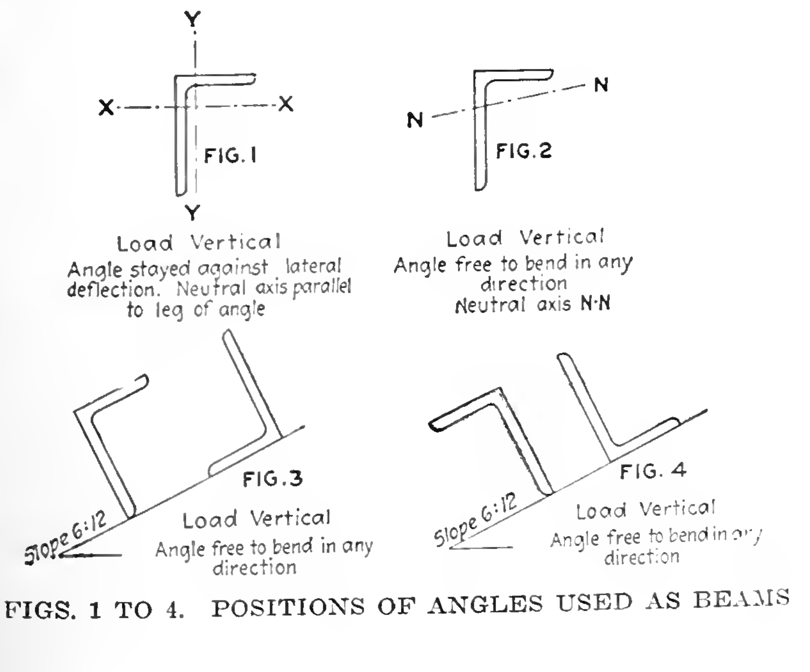
By R. Fleming
American Bridge Company, New York City

VALUES for the section modulus of various angles in the positions shown by Figs. 1, 2, 3 and 4 are shown in the accompanying Table I.

The common method of calculating the strength of an angle beam with load normal to one of the legs is by substituting the values of I and c, taken from the manufacturers' handbooks, in the flexure formula, $M = fs = f(I/c)$ and solving for f. This, however, assumes that the neutral axis is parallel to one of the legs and that the angle can deflect only in a vertical direction. The Carnegie "Pocket Companion" and other handbooks give tables of allowable uniform load on angles as beams. In all cases it is stated that the tables are based on the neutral axis parallel to one of the legs. From the columns headed Fig. 1 and Fig. 2 in Table I it will be noted that the section moduli and therefore the allowable normal loads for angles used as beams free to bend in any direction are about 75% of those for angles stayed against lateral movement.

TABLE I. VALUES OF SECTION MODULUS FOR POSITIONS OF ANGLE SHOWN IN FIGS. 1-4

Angle, Inches	Fig. 1	Fig. 2	Fig. 3	Fig. 4
2 x2 x$\frac{1}{4}$	0.25	0.18	0.26	0.17
2$\frac{1}{2}$x2$\frac{1}{2}$x$\frac{1}{4}$	0.39	0.31	0.42	0.28
3 x2$\frac{1}{2}$x$\frac{1}{4}$	0.57	0.44	0.65	0.39
3$\frac{1}{2}$x2$\frac{1}{2}$x$\frac{1}{4}$	0.75	0.56	0.89	0.47
4 x3 x$\frac{5}{16}$	1.24	0.93	1.43	0.79
5 x3$\frac{1}{2}$x$\frac{5}{16}$	1.93	1.48	2.30	1.25
6 x4 x$\frac{3}{8}$	3.32	2.50	3.98	2.02



FIGS. 1 TO 4. POSITIONS OF ANGLES USED AS BEAMS

The most frequent use of angles as beams is for purlins on sloping roofs. Textbooks do not mention that purlins set as shown in Fig. 3 are stronger than when set as in Fig. 4. It is evidently taken for granted that a designer should know this without being specifically told by a textbook. Yet, either through ignorance or to suit local conditions, purlins are sometimes set as shown in Fig. 4. They are so shown in a number of handbooks. By consulting Table I it may be seen that the purlins of Fig. 4 have but 51% to 67% of the strength of the purlins of Fig. 3. Table II is given for reference. The

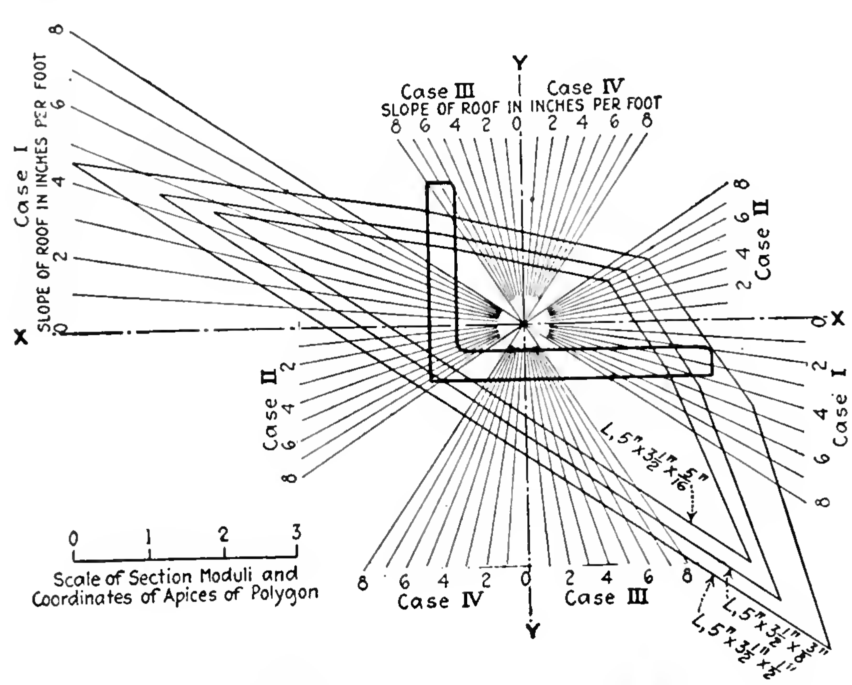


FIG. 5. DETERMINATION OF SECTION MODULI FOR THREE ANGLES BY S-POLYGONS

TABLE II. SECTION MODULI OF ANGLE PURLINS AT RIGHT ANGLES TO ROOFS; LOADING VERTICAL

Angle, In.	Slope of Roof in Inches per Foot: 0	1	2	3	4	5	6	7	8
2 x2 x$\frac{1}{4}$	0.18	0.19	0.20	0.21	0.22	0.24	0.26	0.29	0.31
2 x2 x$\frac{3}{8}$	0.27	0.28	0.29	0.31	0.33	0.35	0.37	0.40	0.42
2$\frac{1}{2}$x2 x$\frac{1}{4}$	0.30	0.31	0.33	0.35	0.38	0.41	0.44	0.46	0.49
2$\frac{1}{2}$x2 x$\frac{3}{8}$	0.40	0.42	0.45	0.48	0.52	0.57	0.61	0.65	0.69
2$\frac{1}{2}$x2$\frac{1}{2}$x$\frac{1}{4}$	0.31	0.32	0.33	0.35	0.37	0.39	0.42	0.45	0.48
2$\frac{1}{2}$x2$\frac{1}{2}$x$\frac{3}{8}$	0.42	0.44	0.46	0.49	0.52	0.55	0.60	0.64	0.68
3 x2$\frac{1}{2}$x$\frac{1}{4}$	0.44	0.46	0.49	0.52	0.56	0.60	0.65	0.69	0.74
3 x2$\frac{1}{2}$x$\frac{3}{8}$	0.64	0.67	0.71	0.76	0.82	0.89	0.95	1.00	1.06
3$\frac{1}{2}$x2$\frac{1}{2}$x$\frac{1}{4}$	0.56	0.59	0.64	0.70	0.76	0.83	0.89	0.96	0.84
3$\frac{1}{2}$x2$\frac{1}{2}$x$\frac{3}{8}$	0.84	0.89	0.96	1.04	1.14	1.22	1.29	1.37	1.19
4 x3 x$\frac{1}{4}$	0.75	0.80	0.86	0.93	1.02	1.11	1.18	1.26	1.27
4 x3 x$\frac{3}{8}$	1.11	1.18	1.26	1.35	1.47	1.58	1.70	1.81	1.76
5 x3$\frac{1}{2}$x$\frac{5}{16}$	1.48	1.55	1.66	1.80	1.96	2.12	2.30	2.39	2.06
5 x3$\frac{1}{2}$x$\frac{3}{8}$	1.76	1.86	1.99	2.15	2.34	2.52	2.71	2.80	2.42
6 x4 x$\frac{3}{8}$	2.50	2.66	2.87	3.10	3.41	3.70	4.00	3.64	3.17
6 x4 x$\frac{1}{2}$	3.30	3.52	3.79	4.10	4.52	4.84	5.18	4.65	4.09

angles are assumed to be set as in Fig. 3. It may be mentioned that the section moduli in both tables, except those for Fig. 1, have been scaled from carefully drawn "S-polygons." Three of these polygons are shown in Fig. 5. The coördinates of the apices are taken from the late Professor Waterbury's "Stresses in Structural Steel Angles." Case I is for the angle turned as in Fig. 3, Case II as in Fig. 4, and Cases III and IV as in Figs. 3 and 4, with the short leg at right angles to the rafter. The *shorter* distance from the origin of coördinates to the perimeter of the polygon should be used as the section modulus for each slope.

Shipyard on New Orleans Canal For Building "Unsinkables"

Range of Mississippi River Stage Determined Location—Work Started When Navigable Water Was Five Miles Away—Fabricating Shop a Group of 35-Foot Working Bays—Tractors Haul Material to Berths

WHEN the Foundation Co. drove the first piles for its New Orleans shipyard in the spring of 1917 the nearest navigable water was five miles away. Since then, dredges working on the new industrial canal for the City of New Orleans have cut a channel to the shipyard site, and before the first vessel is ready to start on her trial trip the canal will be open to deep water.

The location of a yard at New Orleans involved conditions differing widely from those in other parts of the country. The Mississippi River has a range of over 20 ft. in elevation making it unsafe to cut through the levee for launching ways. Lake Pontchartrain, on the other hand, has a depth of only 9 ft., which is, of course, insufficient for large-sized vessels. Advantage was therefore taken of the ship canal, from the river to the lake, which the city is now building for industrial development. A lock near the river bank will maintain the canal at the level of Lake Pontchartrain. The ordinary variation in the lake is only 2 or 3 ft., due to the small tide in the Gulf of Mexico, though after exceptionally heavy storms there may be a variation of as much as 8 ft. An excellent shipyard site is also provided beside the wide turning basin at about mid-length of the canal.

The property developed by the Foundation Co. is on the west bank of the basin, adjoining a built-up section of New Orleans. As electric cars provide quick access to the center of the city, no housing problem for labor is involved. The yard is served by the Public Belt R.R. and is supplied with water and electricity from the city systems.

The size of the turning basin will permit end launching of the hulls, which has advantages over side launch-

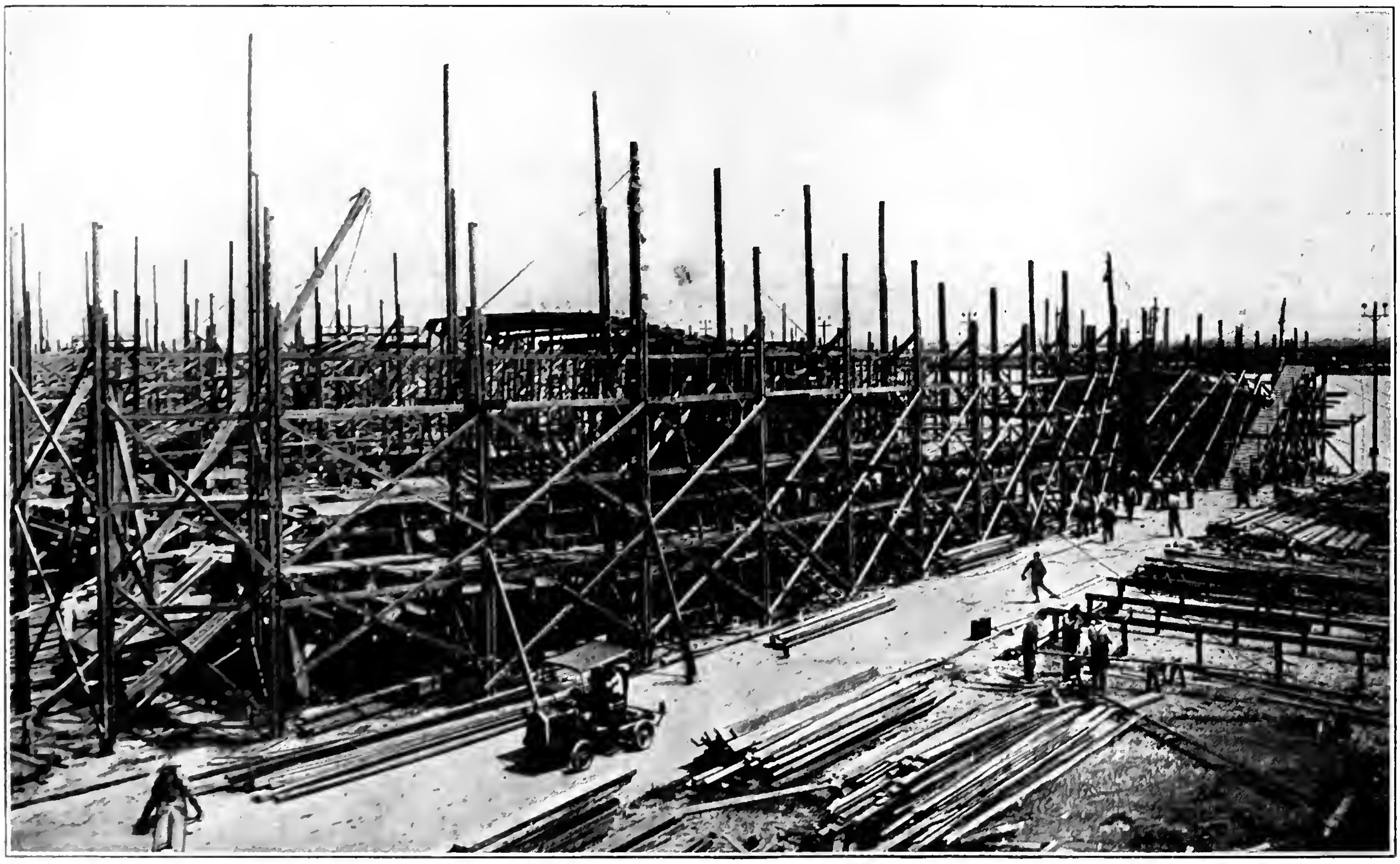


FIG. 1. SHIPYARD BEFORE COMPLETION OF DERRICK TOWERS; A FLEET OF TRACTORS LIKE THAT IN FOREGROUND DOES MOST OF YARD HAULAGE

ing in economy of water front and ease in handling material. There is ample space also, for laying up vessels to be fitted out.

Plate Yard Served by Locomotive Cranes.—Raw steel is brought into the yard (see the plan, Fig. 2) on a standard-gage railroad track, and is distributed in the storage yard so that plates are near one end of the plate-and-angle shop, and angles and shapes near the opposite end. Steel is unloaded from the cars and stored by locomotive cranes. These cranes also load the material on small cars and push them into the ends of the plate-and-angle shop, where the material is handled by an overhead traveling crane.

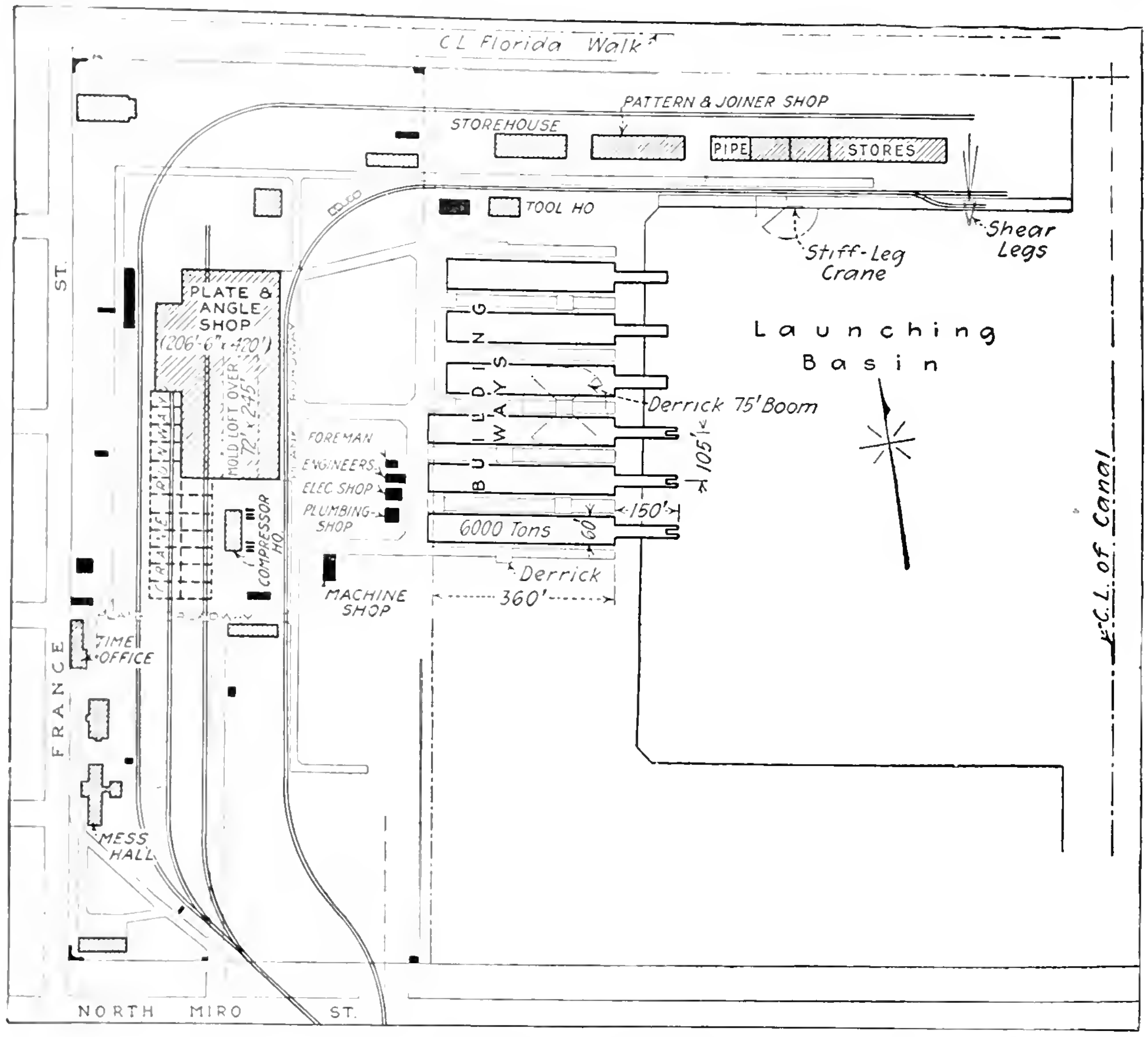


FIG. 2. PLAN OF YARD—FIVE END-LAUNCHING WAYS; LARGE STORAGE SPACE BETWEEN SHOP AND WAYS

The plate-and-angle shop is located just far enough back of the building ways to leave ample space for the storage of fabricated material before erection in the hulls. It is a timber-frame building (Fig. 4) 206 x 350 ft., with post spacing 24 ft. by 35 ft. The roof is of sawtooth construction, with provision for ample lighting of the interior. The sides are not covered below the bottom chords of the trusses, except around the north end, where the machine-shop equipment is located.

Fabricating-Shop Layout—A craneway runs along the entire length of the west side of the shop and extends beyond it 315 ft. over the steel-storage yard. It carries a five-ton electric traveling crane of 60-ft. span. The crane handles raw stock coming into the building from either end, loads material on working skids from cars, or places it so that it can be picked up by one of the two-ton hand cranes which extend along the nine small transverse bays along the east side of the shop.

In the 60-ft. bay of the shop, where raw steel is received, are the layout skids for plates, angles and shapes. The furnaces are in a leanto at one side. Each cross-bay, Fig. 3, is laid out to handle a separate class of work, and contains the tools necessary for the operations to be performed.

The northerly bay, between columns 1 and 2, is inclosed, and forms the machine shop. South of it, the bay between columns 2 and 3 is devoted to forging; it contains the hand forges, a small annealing furnace, and hammers. The next three bays, between columns 3 and 6, are for working angles and frame stock, and contain the angle and beam shears, punches and benders. The remaining five bays contain the plate shop equipment. Its principal punching units are five 30-ft. Lysholm plate tables, operated in conjunction with 36-in. and 60-in. vertical punches. From these punch tables, plates are worked ahead to the radial countersinking and drilling machines and to the 30-ft. plate bending rolls at the east side of the building, between columns 6 and 7.

Tractor Haulage System—The yard was originally laid out with railroad tracks running to the shipways. Locomotive cranes were to be provided, so that cars could be unloaded either at the storage piles or at the ways. This method was abandoned later, however, and a tractor system substituted.

Five small gasoline tractors, manufactured by the S. K. Prescott Co., Seattle, Wash., provide the motive power. These tractors, one of which can be seen in the view, Fig. 1, are equipped with a 22-hp. four-cylinder Ford motor; they weigh 2800 lb., and can travel from three to 20 miles an hour. A number of four-wheeled trailers are also provided.

A system of plank roadways is built through the plate-and-angle shop and around the yard, so that tractors and trailers can carry materials to any point where they are needed. Light pieces are loaded and unloaded by hand; heavy pieces are loaded at the shop by the two-ton overhead cranes, and are unloaded at the storage piles by small stiffleg derricks conveniently located. When fabricated work is taken directly to the ways, the trailers are unloaded by the tower derricks.

Tower Derricks—Material is handled at the building slips by tower derricks. These consist of timber towers 32 ft. square, ranging from 35 to 48 ft. high, the 48-ft. towers being near the head of the ways. The yard plan, Fig. 2, indicates their position with respect to the

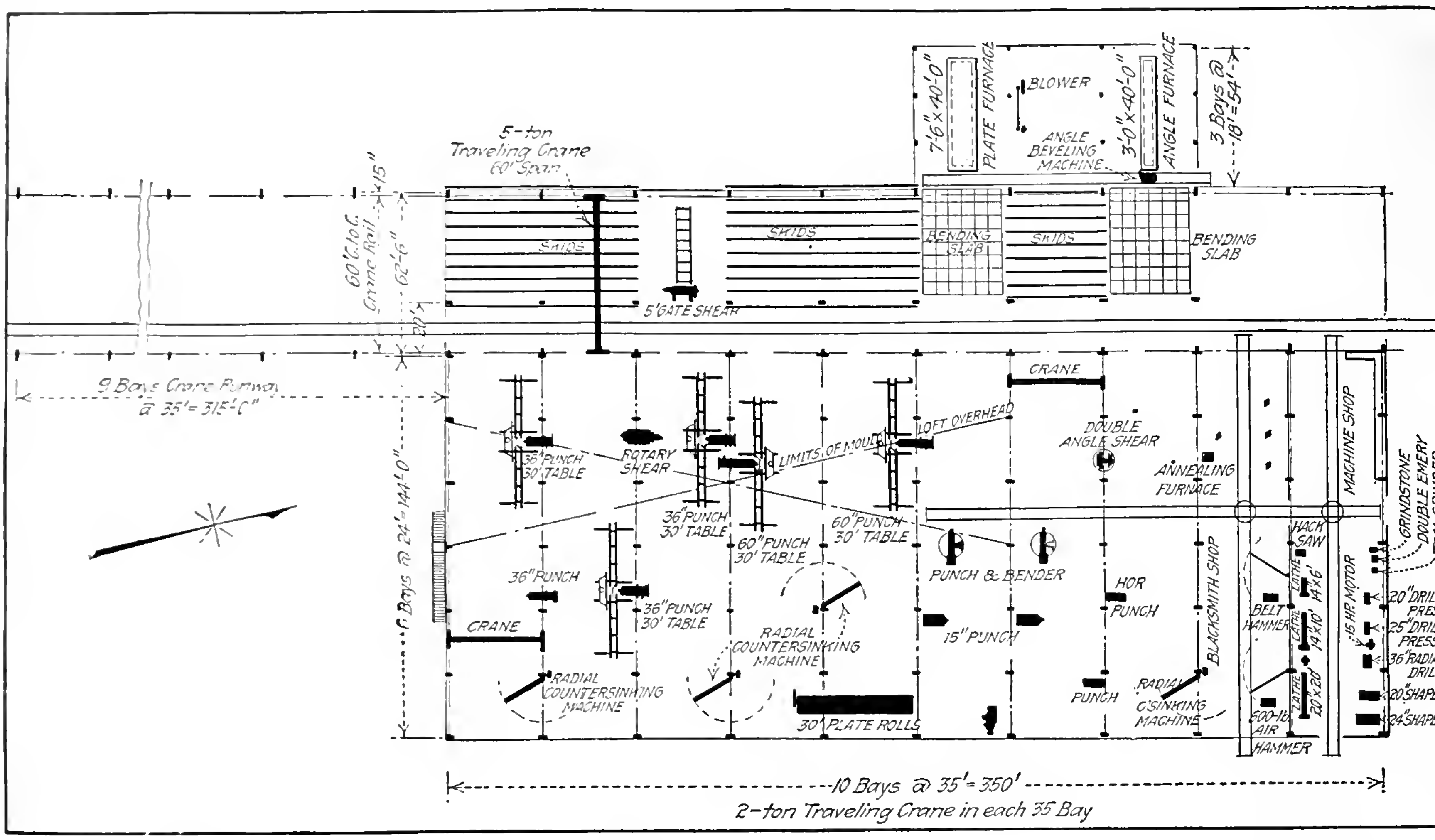


FIG. 3. MATERIAL ENTERS WIDE LAYOUT BAY OF SHOP AND MOVES THENCE CROSSWISE ALONG ANY OF NINE FABRICATING AISLES

slips. Each tower carries a Terry standard steel derrick with 75-ft. boom, having a capacity of five tons at 75 ft. or 15 tons at 45 ft. The derrick is not fixed on the tower, but is set on a turntable. This device allows the mast to be swung to four different positions, so that the derrick can cover an area nearly 100 ft. in radius, and yet has the advantages of the speed and lightness of a shorter boom.

Wharves along the side of the launching basin serve in fitting out the hulls. A 10-ton derrick is set up on one of these wharves, and a 65-ton shear leg on the other wharf. The buildings used in fitting out the vessels, such as the joiner shop, the sheet-metal shop, the electrical shop, the pipe shop, and the storehouse for fittings, are all located conveniently to the wharves. Standard-gage railroad tracks and planked roadways for motor trucks are provided for the delivery of materials. From these shops, fabricated materials will be delivered to the wharves by motor tractors.

Timber Shear-Leg Derrick—The shears have a lifting capacity of 65 tons, sufficient to permit handling a Scotch boiler of the size to be used in these vessels, from the flat-car to the hull. A canvass of the derrick manufacturers developed the fact that none of them had standard designs for such a derrick; in fact, the few derricks of this type built have been largely designed and assembled by the owners. The engineers of the Foundation Co. therefore designed their own shears. Economy and ease of obtaining parts in the open market received first consideration.

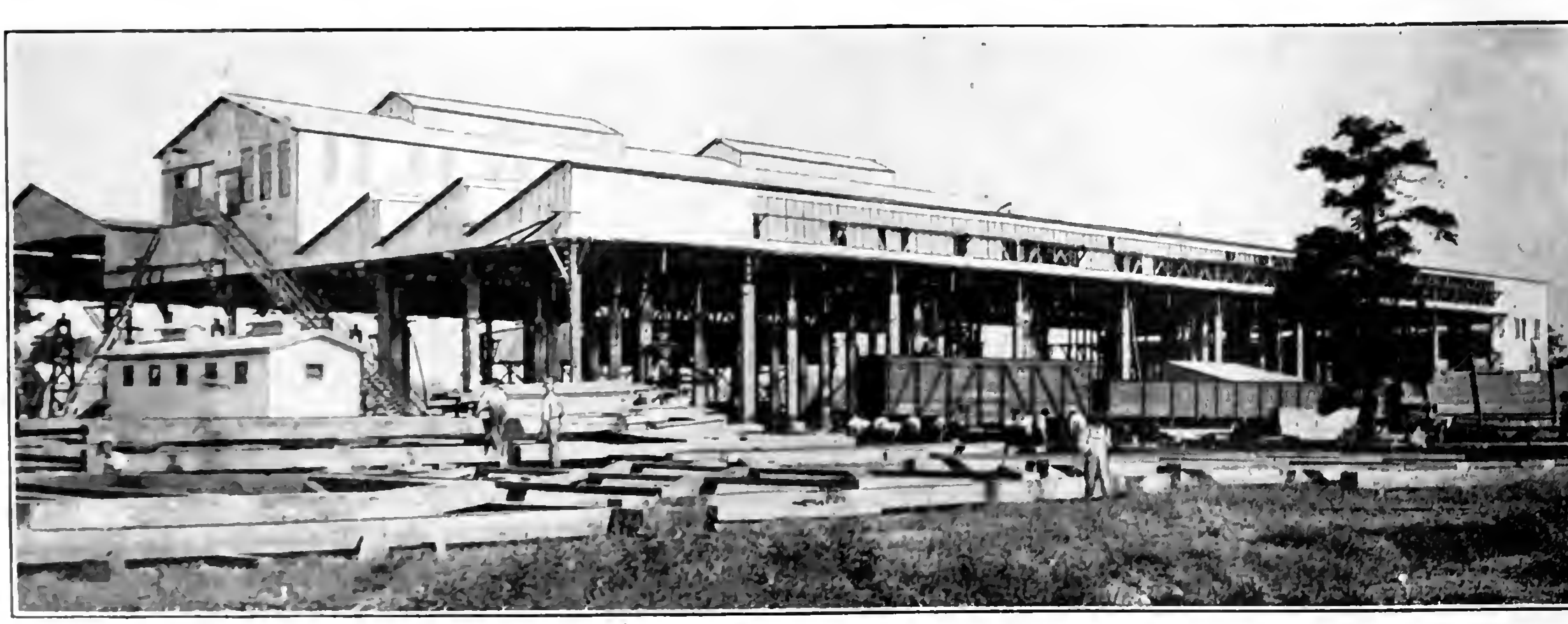


FIG. 4. TIMBER-FRAME FABRICATING SHOP WITH OPEN SIDES

The machine comprises a vertical A-frame or mast 99 ft. high, and a tilting A-frame or boom 99 ft. long, each leg of which was built of four pieces of 12 x 12-in. long-leaf yellow pine, bolted together and spliced with steel plates, as shown in Fig. 5. Instead of having the usual backstay of timber or steel, the mast is guyed fore and aft by means of 1¼-in. plow-steel cable, the forward guys being attached to the wharf construction at the water's edge, while the back guys are carried 100 ft. to the rear of the mast and anchored to concrete blocks built on pile foundations.

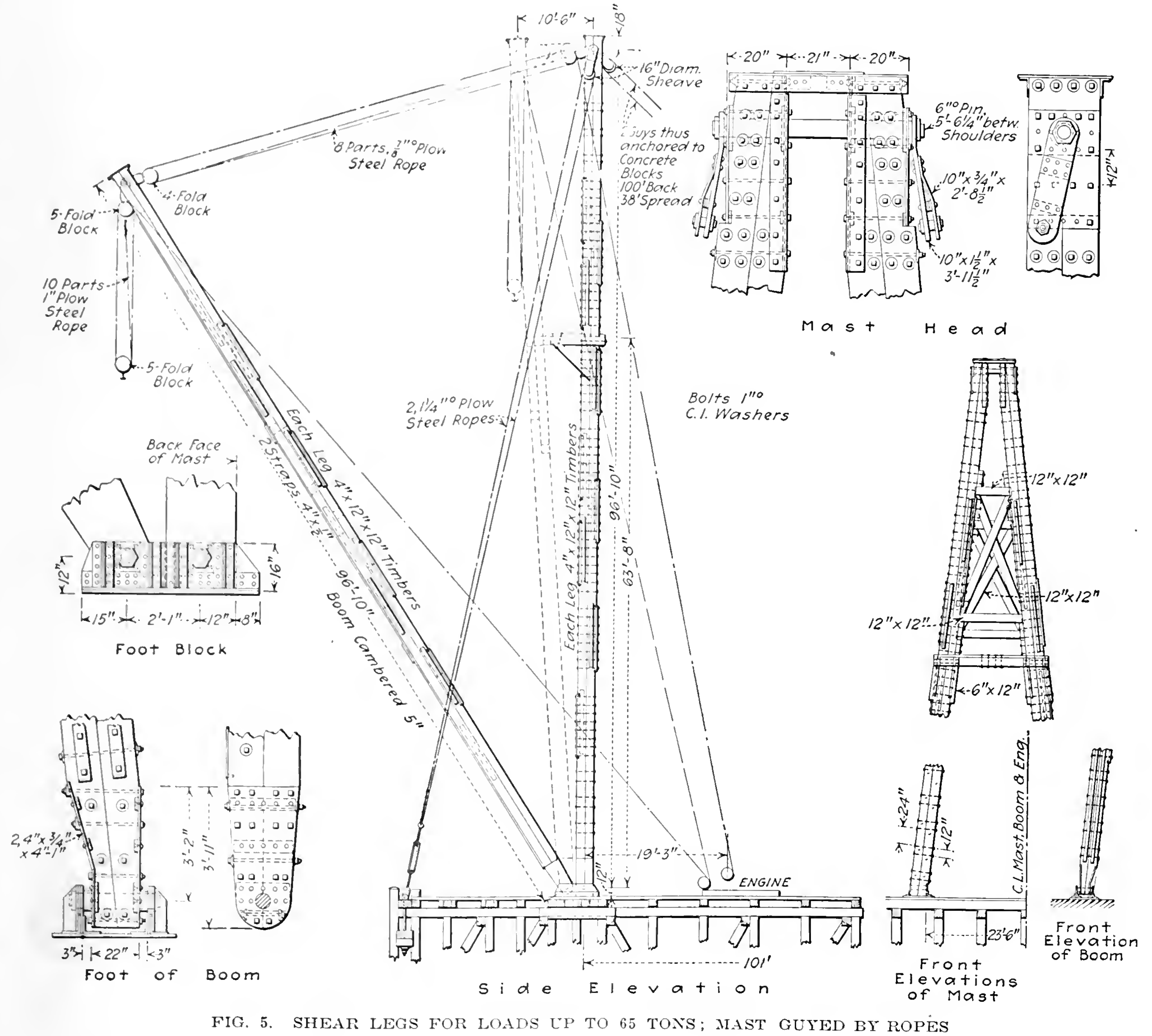


FIG. 5. SHEAR LEGS FOR LOADS UP TO 65 TONS; MAST GUYED BY ROPES

The mast and boom heads and foot blocks were built of standard structural shapes. The whole framed structure was so designed that the rough timber and structural steel could be delivered to the shipyard, and be fabricated and erected; the exception to this being the pins through the mast and boom heads and foot blocks, which were purchased already fabricated. All blocks, shackles, cables and cable fittings were stock material purchased in the open market. The hoisting engine is a double-drum electrically driven machine having the capacity to hoist 14,000 lb. 100 ft. per minute.

Motor-generator sets to furnish current for crane and derrick service are located in the compressor house, situated near one end of the plate-and-angle shop, whence it can furnish air to shop and ways with minimum length of distributing lines. Motor-driven air compressors of 4500 cu.ft. per minute capacity are installed in the compressor house.

At present there are three building ways, but space has been left and the whole layout arranged so that five additional ways can be installed. There is also room for the construction of a complete repair yard with drydock facilities.

The Foundation Co. is building at this yard for the French Government five 4250-ton dead-weight capacity steel cargo steamers of the "Le Parmentier" "unsinkable" type.

Unlike previous designs, which involve modifications of a standard cargo steamer, the "Le Parmentier" design makes a radical departure from usual forms of ship construction, as will be noted in the sketch, Fig. 6. In external appearance the vessel resembles whaleback steamers, but its cross-section is in the form of two circles side

by side, connected above and below by curved segments.

The hull consists of two parallel cylinders 20 ft. in diameter, arranged horizontally side by side and connected by transverse water-tight bottom and deck. The cylindrical form not only gives maximum strength, but also provides double inner longitudinal walls to localize flooding of the hull if the outer skin is ruptured. The

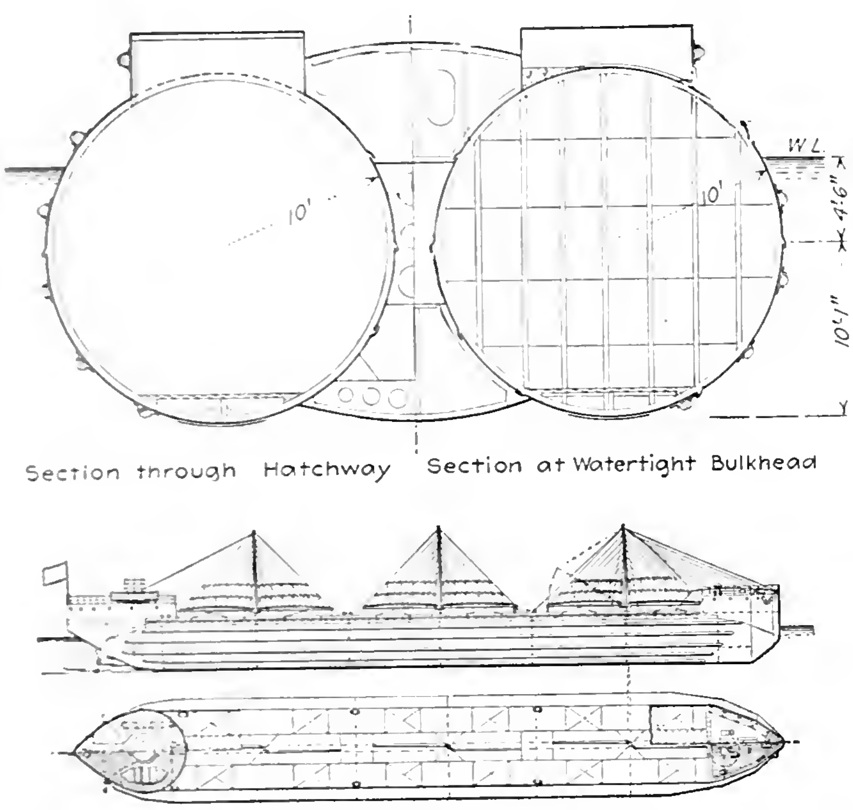


FIG. 6. FRENCH "UNSINKABLE" SHIP, "LE PARMENTIER" TYPE BUILDING AT NEW ORLEANS

entire hull is stiffened and receives further protection from flooding by seven transverse water-tight bulkheads, which divide the hull into 24 separate compartments.

The steamers now under construction are 328 ft. 4 in. long over all; 46 ft. 5 in. in beam, and 16 ft. 1½ in. in maximum draft. The propelling machinery will consist of twin triple-expansion 700 hp. engines, designed to give the vessel a speed of approximately eight knots, loaded. Steam will be supplied by Scotch boilers fired with oil fuel.

As one complete power plant is installed in each half of the hull, the vessel can be brought into port even though one side has been completely flooded.

According to the present schedule, the first hull will be launched soon, and will be completely equipped ready for service in the latter part of the summer.

The New Orleans yard is the largest of the three steel shipbuilding plants controlled by the Foundation Co.; the other two being at Savannah, Ga., and Port Huron, Mich.

The Foundation Co.'s experience in shipbuilding began in July, 1917, when it laid the keel of a 3500-ton Ferris-type ship for the Emergency Fleet Corporation. Since then it has completed 40 wooden auxiliary schooners and 15 cargo-steamer hulls, with a total deadweight capacity of 169,000 tons—a greater production than is credited to any other wooden shipbuilding organization in the country.

Franklin Remington is president and John W. Doty is vice-president of the company. Construction is under the supervision of C. A. D. Bayley and Bayly Hipkins, vice-presidents in charge of shipbuilding on the Atlantic and Pacific Coasts, respectively. H. J. Deutschbein is general manager and Cox & Stevens are the consulting naval architects of the company.

Motor Truck Costs Much Higher Than Generally Assumed

Data Collected by Motor Truck Association Show High Average Operation Expense — New Cost System To Be Recommended

OPERATION cost for motor trucks was the subject discussed at a recent informal meeting of the Motor Truck Association of America, the purpose being to start investigation and determine a proper cost-accounting system. It was asserted that many published costs are much too low and work injury to contractors and haulage companies basing charges upon them, and putting the stigma of overcharge upon those who place their charges high enough to meet actual conditions. As a basis for the investigation, the cost for a five-ton gasoline truck shown in detail in Table I was submitted by one of the largest operators of trucks in the East.

TABLE I. COST PER DAY OPERATED FOR FIVE-TON GASOLINE UNIT BASED ON 50 MILES PER DAY PER TRUCK AND 300 DAYS PER YEAR

	Amount	Totals
Direct Charges		
Driver	$5.00	......
Tires, based on present cost of tires (guaranteed basis)	3.00	......
Oil, grease, kerosene, graphite, etc.	.50	......
Gasoline, 3½ miles to gallon = 14 gallons @ 25c. per gallon (average)	3.50	$12.00
Indirect and Overhead Charges		
Depreciation, 20% on $6,000 investment	4.00	
Interest, 6% on $6,000 investment	1.20	
Insurance, averaged at $450 per year	1.50	
Garage, rental, upkeep, etc., $300 per year per car	1.00	
Maintenance, minor repairs, supplies, tire chains, tools, lamps, springs, spark plugs, equipment, etc. (estimated)	1.00	
Overhaul, complete, pro-rated, $600 yearly	2.00	
License fee	.20	
Body upkeep, repairs and painting	.30	11.20
Supervision, based on 10% of above costs		2.32
Lost time—time lost in repairs, no work, weather, or other causes 20% of total less gas, tires and oil, etc., $7		3.70
Total cost per day operated		$29.22

with the suggestion that it be sent out to all truck operators, requesting them to criticise it and submit their own costs for the information of the association.

The table is based upon actual experience; it is assumed that the truck makes 50 miles per day and works 300 days per year. The direct charges are accumulating only while the truck is under operation, while the indirect are those which are accumulating whether the truck runs or not. Supervision includes all office expenses, stationery, printing, advertising, office help, telephone charges, outside men, etc. The cost of mechanical garage equipment, power, spare parts, etc., with interest on the same, and depreciation, is included in the amount charged to maintenance and overhaul.

Average operating conditions as to load were used in compiling this table. Up to the present time these have equaled a full load one way or, for a 50-mile day, transportation of 125 ton-miles at about 24c. per ton-mile. The costs are actual, no profit being included to cover risks, etc.

Table II gives the costs as sent in by six trucking

companies in answer to the inquiry. The averages shown in the last two columns include the figures in Table I.

In considering the returns, it will be noted that many of the differences are in such elusive items as overhead, supervision, and lost time. The averages in the last two columns were obtained by adding the amounts together and dividing by the number of reports on that item. The average total cost per day, while somewhat less than the suggestion sent out, in the main agrees very well. In sending out the suggestion, it was not thought that there would be agreement within several dollars, but it was believed that a much higher cost would be shown than is generally supposed.

TABLE II. ANSWERS RECEIVED ON THE INQUIRY SENT OUT, USING THE SAME ITEMS AND BASIS FOR FIGURES

	A	B	C	D	E	F	Average	
	Amt.	Amt.	Amt.	Amt.	Amt.	Amt.	Amt.	Total
Direct Charges								
Driver	$5 00	$5 20	$5 00	$5 00	$5 17	$5.50	$5 13	
Tires	3 00	3 75	2 00	2.00	2 00	3 00	2 68	
Oil, etc	30	.	.30	50	25	25	.35	
Gasolene	3 00	4 00	3 50	4 65	2 08	3 75	3.50	
								$11.66
Indirect Charges								
Depreciation	$3 50	$4 19	$3 60	$3 40	$3 67	$4 00	$3 77	
Interest on Investment	1 20	1 26	1.08	1 22	1 10	1 00	1.15	
Insurance	1 50	2 54	1 26	2.10	.86	.50	1.47	
Garage	1 00	1 20	1.00	1 00	89	1 00	1 01	
Maintenance	50	.	.50		1 00		75	
Overhaul	1 33	2 75	1 80	1 60	2 00	3 00	2 07	
License	17	27	20	20	.20	.20	20	
Body upkeep	25	.	.30	.10	.40	...	27	
								10.69
Supervision	50	2 93	2 05	1 90		.	1 90	1.90
Lost Time	2 20		1 67	3 40	2 50	1.97	2.57	2.57
Total	$23 45	$28 09	$24 26	$27 07	$22 12	$24 17	..	$26.82

The figures as given apply particularly to operation of trucks in large fleets, such as those employed by the interurban haulage companies. They were furnished by companies operating out of New York City.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Kansas Engineering Society Advocates Standardized Fees

At the recent annual meeting of the Kansas Engineering Society great interest and activity among the members were manifest in connection with a more closely organized movement to improve the remuneration for engineering services. A resolution was passed providing for an appeal to the four great national societies and the Engineering Council, asking that they act in unity by (1) providing a practicable plan for the registration and proper classification, according to character of services, of all professional engineers and their assistants; (2) arranging a standard nomenclature to designate the various capacities in which engineers and their assistants serve; (3) adopting, after careful study, a scale of fees and of salaries for the young men of the profession, in such forms that it can be used by all local organizations of engineers throughout the nation in their efforts to secure a fair comparative compensation in accordance with the value of services rendered, and (4) providing a standing committee to coöperate with all local organizations of engineers in matters pertaining purely to compensation.

The Kansas Engineering Society, according to the resolution, pledges its allegiance and support to the national societies in the measures they may develop to supply these urgent needs for placing the profession of engineering on a proper plane of industrial equity.

Straw Ballots to Arouse Civic Interest

One of the methods used at the Feb. 7 meeting of the Chicago Chapter of the American Association of Engineers to awaken in its members a sense of their duties as citizens was a straw ballot on the five candidates seeking nomination in the mayoralty primaries. Five additional "yes-and-no" questions were answered as follows: Replies to the number of 121 favored political action along practical lines to further the objects for which the association was formed. One was against it. A unanimous vote was polled on the question: "Are you willing to pledge your support to the candidate for mayor of Chicago and for alderman in your ward who by his record and in his public utterances shows himself most favorable to the objects sought by our organization?" Of 115, 20 indicated that they were not registered voters, but 13 of these said they would try to register. Party affiliations indicated 80 Republicans, 26 Democrats, 3 Socialists and 9 independents.

Northwest Association Considers Technical Publicity

At its bimonthly meeting Jan. 28 the Northwest Association of Members of the American Society of Civil Engineers heard W. W. DeBerard, Western editor of *Engineering News-Record* in an address on "Technical Publicity," illustrated by lantern slides. In the discussion which followed C. W. Tubley, mechanical engineer, stated that until hearing the address he had never understood what could be accomplished by publicity, and that he was a convert to the idea. A leading consulting civil engineer, L. P. Wolff, proposed that the American Society should set aside $100,000 annually for publicity work, $50,000 to be paid to five writers to furnish engineering articles for the daily and Sunday papers, and the balance for expenses of inaugurating and maintaining the work. Another engineer spoke of the attitude of newspaper editors, saying that it was impossible to get reporters to write engineering articles in an intelligent manner and that it was also impossible to get engineers to do so from the newspaper man's point of view.

Minnesota Senator Asks Engineers' Help in Framing Drainage Bill

Frank statements were made by a Minnesota state senator who appeared before the St. Paul Engineers' Club, Jan. 24, to the effect that a proposed drainage bill drawn by an attorney had so many faults it should have been drawn by engineers in the first place. As

it was, he asked their assistance in amending the bill. This is being undertaken by a process of careful study and discussion, first at the club's regular meetings. The conclusions of these deliberations were referred to the Minnesota Surveyors and Engineers' Society meeting, Feb. 12-14. If unified action is secured, the whole matter will be put in the hands of the Minnesota Joint Engineering Board for presentation to the legislature. Thus all classes of engineers will have a chance to know how it may affect them.

This method of putting the same proposed legislation through these different organizations will tend to popularize the bill and arouse interest in it by a large number of engineers; also, the bill finally will go to the legislature in a form commanding unanimity of engineering opinion and from a body representing practically all the organized engineers of the state. It is an example of democratic society service to the public worthy of emulation elsewhere.

Duluth Engineers Recognize Public Service Responsibilities

Practically all organizations of engineers have based their constitutions on the idea of service to engineers and "the advancement of engineering knowledge and practice and the maintenance of a high professional standing among members." It is refreshing, therefore, to read the following from the constitution of the recently formed Duluth Engineers' Club. It indicates the awakening of the engineers in the Northwest to their civic responsibilities and to their duty of service to those members of the community outside of the profession:

"The name of this corporation shall be the Duluth Engineers' Club; its general purpose is to create an instrument by which united action can be obtained by the members of the engineering profession in Duluth and vicinity; to serve the community, state and nation better than in the past; to raise the standards of the profession and the ideals of the individual, to make the profession more worthy of consideration by the community; to awaken among engineers an interest in all civic matters in general, and particularly in regard to matters for which the engineer, because of his training, should feel a peculiar civic responsibility; to make the community aware of the service the engineering profession is prepared to render; to add to the scientific knowledge relating to engineering; to increase social intercourse between members of the profession, and in general for uplift of the community, the profession and the individual."

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Deterioration of Burlap in Waterproofing

Sir—The writer read with considerable interest the letter in your issue of Feb. 6, 1919, from A. H. Rhett, commenting on an article by H. T. Welty, engineer of structures of the New York Central R.R., published in your issue of Dec. 12, 1918, p. 1081. The instance given of the successful use of a single layer of untreated burlap is interesting, but "one swallow does not make a summer." I do not think that Mr. Rhett carried the chemical investigation of the destruction of burlap in a waterproofing course sufficiently far to reach the correct conclusion.

It is undeniably true that there is a marked percentage of sulphur in coal-tar pitch and a lesser percentage in asphalt, and it is also conceivable that this sulphur reacted, to some extent, against burlap. However, the presence of a sulphur content in asphalt or coal-tar pitch is not the reason why burlap should be excluded from a waterproofing system, nor is it the reason why a cotton fabric is considered by engineers, generally, as the preferable membrane.

Reference to any standard work on industrial organic chemistry will show that burlap is chemically a combination of lignin and cellulose chemicals; that it is the most perishable of all vegetable fibers; that even the small amount of moisture in the air will cause it to deteriorate very rapidly, and, finally, that this rate of deterioration is greatly increased where the moisture carries alkali. Inasmuch as the waterproofing is to be placed on an alkali surface and is to be covered over with a body of alkali materials, all water which reaches the waterproofing course must contain alkali, and if a pinhole is left in the top swabbing of the waterproofing agent, water will reach the burlap and, as the latter is intensely hygroscopic, will be drawn indefinitely through the blanket, rotting large sections.

There appears to be also a serious misunderstanding as to the object in saturating a waterproofing membrane. It is not, as Mr. Rhett asserts, for the purpose of securing a thorough bond between the fabric and the compound. Inasmuch as burlap with its wide-open mesh will permit the ready passage of compound through the fabric and the consequent sealing of one layer with another through the open mesh, it is possible to secure a good bond in the blanket as a whole and consequent compactness. The object of saturation is, entirely, preservation; so that if, as is very apt to happen in practice, an imperfection is left in the final swabbing coat whereby water can reach the membrane directly, the membrane will be protected from rot or from the lateral translation of water by capillary attraction.

To refer back to the most frequent cause of the deterioration of burlap in a waterproofing blanket, we find that the burlap fiber is naturally extremely brittle. In its manufacture into yarn, to be subsequently woven into fabric, this fiber is treated by long immersion in a combination of oils, consisting of a small percentage of sperm oil, the balance being the cheaper vegetable oils indigenous to the Far East. When the burlap fiber, through this treatment, has become thoroughly impregnated with these oils, the oils are squeezed out and the fiber is turned into yarn and subsequently into fabric. These oils are a solvent for both coal-tar pitch and asphalt. Moreover, they are volatile. When the

hot compounds are applied to the burlap, part of the oil is volatilized and what remains is gradually, through the processes of time, absorbed by the waterproofing compound. The burlap is thus reduced to its original condition of extreme weakness and great fragility.

For these reasons the writer is convinced that Mr. Welty is absolutely correct both theoretically and practically in advocating the use of a cotton fabric, as against one made of jute. J. B. W. GARDINER.

No. 18 E. 41 St., New York City.

How Building Is Promoted in Huntington

Sir—In connection with the articles you have been publishing on methods of encouraging building, I would like to outline the scheme, which we call the "Huntington, Ind., Plan," that has proved successful in this city. As a testimonial to the workings of the plan, I might say that statistics showed that in Huntington, a city of 20,000 population, there were more new houses built last year, in proportion to the population, than in any other city in Indiana.

One year ago several of our progressive builders, supply dealers and lumbermen organized what we called the Huntington Community Development Club. The organization was made up of the lumber dealers, building-supply dealers, hardware merchants, plumbers, electrical contractors, sheet-metal contractors, furnace dealers, furniture dealers; in fact, any class of people in our community who were interested in the sale of material entering into the building of a modern home. We elected a president, secretary and treasurer and an advertising committee. Our plan was to have each member subscribe a small amount toward a fund to be used for educating our people to the fact that they should build homes now. We used full-page space in our two daily papers, and the result, we are confident, was that we encouraged a great many people to build homes, which were badly needed in our city at that time and are still just as badly needed.

The plan worked out so well and we had so good a reputation last year that we have reorganized our committee again this year and have added a number of other firms to our list, including real estate dealers and building contractors, such as carpenters, masons and cement contractors. In raising our fund we have no amount larger than \$25 and nothing less than \$10. This gives us a fund of between \$500 and \$600, which we will invest in full-page space in our two daily papers. You can readily see that this is a very small expense to any one of the firms interested, but on the whole it will amount to fine publicity in increasing the interest in building conditions in our own locality.

The advertisements refer simply to general building conditions, and do not advertise any one particular commodity. We had some mighty fine "copy" in our last year's campaign, and I think we could furnish anyone who would be interested with duplicates of our "copy" if any would care to adopt the same plan. Furthermore, if any of your readers wish to go into this matter and adopt the Huntington plan and will correspond with me, I shall be very glad to put them on a mailing list and send them copies of our local papers as our advertisements appear.

I am confident that if all of the smaller cities would adopt this plan, which would not be a very expensive one owing to the small rate for advertising space in cities of this size, we would create a great deal of interest throughout the United States and encourage a great deal more building than would be possible if the attention of the people were not called to it through a sane and careful advertising campaign.

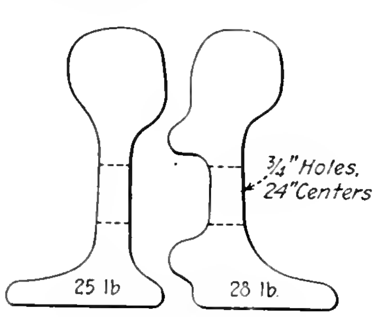
J. M. TRIGGS,
The Majestic Company.

Huntington, Ind.

Finds Peculiar Old Railroad Rails

Sir—I am inclosing a drawing of a section of compound rail found in the vicinity of Camp Sherman, Ohio. In making a topographical survey of the surrounding country I found the rail shown in the right-hand sketch. It was 16 ft. long, not very badly corroded, but had the heaviest fish tails on the outside of the head I ever saw on a rail. No one recognized it as part of a rail, and I did not think of it as such until I found, on another farm, the rail represented by the left-hand sketch. This rail was also 16 ft. long. Both rails have evidence of small fish tails on the inside of the head. The material of which the two rails are made is wrought iron. None of the oldest inhabitants know when this rail was used. The B. & O. Southwestern is in this vicinity and the Marietta & Cincinnati, its predecessor, was one of the first railroads in Ohio. S. P. BAIRD.

Columbus, Ohio.



OLD COMPOUND RAIL SECTIONS

Criticises Details at Support of Pony Span in Cantilever Bridge

Sir—The rôle of critic is not an enviable one, but the urge that impels a man to want to see progress in his profession is one that is hard to resist. The writer believes that criticism pointing out errors in design that may spell failure of a structure is eminently constructive criticism. One of the most vital essentials of safe design is a proper regard for details. I have many times called attention publicly to common errors of steel structural detail designing. Some of the very errors that I have emphasized are exhibited in an article in your issue of Jan. 16, p. 143, on the Willamette River bridge at Salem, Oregon.

One of the errors referred to, or a nest of them, is at the support of the pony span. In the first place, the line of reaction of the rocker shoe is apparently about 9 in. away from the intersection of the members supporting it. This means that a tremendous bending moment must be carried by these members. The next fault is that the upper one of the two members just referred to has a sharp bend where it has its full stress. By no law of mechanics should a structural member be expected to take its full stress around a bend. Bends should only be employed where there is a properly detailed member to take the resultant stress at the bend.

The other error in this detail is in the lack of adequate support under the rocker shoe. There is a load here which I estimate roughly to be 130,000 lb. for dead load only. There are no stiffeners under the seat of the shoe and a very few rivets under it. The center of gravity of the group of rivets connecting the supporting angles is a wide distance from the center line of the rocker shoe, which means heavy eccentric stress on the rivets. Judging from the number of rivets in the other ends of these members no excess of rivets has been put in to take care of this. On the face of it, the supporting of this heavy load on the feather-edge of these two members, so to speak, is not proper design.

The next fault in details is in the sidewalk bracket in the half cross-section of the deck span. The tension of the upper member of this bracket produces twisting on the top chord of the truss, or, in other words, this tension is not provided for. There ought to be a connection to the top flange of the floorbeam. The bottom member of this same bracket is bent (in the connection plate) where it has its full stress. There is no provision to take the "kick."

The sidewalk bracket shown in the half section of the pony span is also faulty in its connection to the truss. This connection, so far as the drawing shows, is by means of a pair of angles giving excessive tension on the rivet heads, and there is no diaphragm or other member to take the top-flange tension into the floorbeam.

This designer is not alone in these errors. They are all too common. It is for this reason that they ought publicly to be emphasized. EDWARD GODFREY.

Pittsburgh, Penn.

International Language for Modern Engineers

Sir—I have read with much interest the letter in your issue of Jan. 16, p. 156, entitled "International Language for Modern Engineers" and advocating Esperanto as a study for engineers. I hope other engineers will follow it with like recommendations, for I believe there are many in this country who are heartily in sympathy with this idea of using an international language. I note, for instance, that Henry W. Fisher, chief engineer of the Standard Underground Cable Co., is an enthusiastic Esperantist, also that William L. Church, one of the founders of Westinghouse Church Kerr & Co., is another.

The signs of the times point to a steady growth of the use of Esperanto. I know of a $50,000 contract obtained in connection with a reinforced-concrete undertaking that came about through Esperanto. The introduction of Esperanto as a regular feature in the school courses is making decided headway in England; while especially valuable is the testimony that it helps in the study of other languages.

This means that if you would learn to speak Spanish—a year's study—you would make more headway by spending the first three months on Esperanto in order to gain a general language sense than by devoting the entire 12 months to Spanish alone. This argument of Esperanto as a basis for language study bids fair to find general acceptance among the very many who, because they are accomplished in one or more foreign languages, would like to sidetrack any effort to supplant foreign-language study by this international medium.

"Free Masonry for a dollar a year" is an argument with strong appeal. Learn the language and buy an Esperanto directory for a dollar; look up the Esperanto consuls who officially represent the language here, there and everywhere, and see if in traveling for business or pleasure, or even in writing for information, you do not find a hospitality that cannot be estimated in dollars and cents. Experience has shown that the Esperantist, thus using his directory, finds he has friends and information bureaus the world over.

As chairman of the propaganda committee of the Esperanto Association of North America, I am too prejudiced to give much advice. Rather let the advice come from people who are disinterested. I have been at it 12 years and have found my interest steadfast.

G. W. LEE,

Boston, Mass. Librarian, Stone & Webster.

Heavy Counterweight Tested According To Assumptions

Sir—In reference to the article "Proportion Concrete to Weigh 173 lb. per Cubic Foot," in *Engineering News-Record*, of Dec. 26, 1918, p. 1187, attention is called to the following test of an extra-heavy concrete counterweight, in which the added weight was gained by the use of punchings.

The proportions and weights per cubic foot of the materials were:

Cement	0.172 cu.ft. at	94 lb. =	16 lb.
Sand	0.515 cu.ft. at	95 lb. =	49 lb.
Aggregate	0.86 cu.ft.		
1. Stone	(0.36 x 0.86) cu.ft. at	98 lb. =	31 lb.
2. Punchings	(0.64 x 0.86) cu.ft. at	266 lb. =	146 lb.
Total			242 lb.

With 9 lb. water these weights make 1 cu.ft. of concrete exactly. In the test the weights of the cube were as follows:

Weight day of test	247 lb.
Weight 3 days after	243.5 lb.
Weight 10 days after	242 lb.

No loss in weight after this time.

C. C. NEHER.

United States Engineer Office, San Juan, P. R.

Alaskan Railroad Train Service Maintained Despite Icy Rails

Difficulties of railroad operation in Alaska are apparent from a note in the official weekly publication of the Alaskan Engineering Commission, which describes conditions between Mile 57 and Mile 68 early in December. Despite these adverse conditions service has not been discontinued. This section of the line is low and flat and is affected by the adjoining glaciers. Warm rains, followed by sudden cold weather, made about an inch of ice on the rails in this section and, there being no machinery to remove it, gangs of laborers at a temperature —12 F., worked continuously in relays Saturday, Saturday night, Sunday and Sunday night, picking the ice off the rails ahead of the trains. According to a later issue of the Alaska Railroad *Record* the operating department was not discouraged by this and other troubles along the line, through service being maintained even when dog teams had to be used to transfer mail and passengers across snow-filled gaps.

Hints for the Contractor

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Awning Reduces Lost Time by Hiding Movements of Derrick

COMPLAINT of an overhead cable tramway was made by the superintendent of a construction job because "the men stopped work to watch the loads go by." On another job a derrick periodically swung its load over the yard where a crew of carpenters was framing forms. A flimsy canvas awning had been stretched over the carpenters' benches. This covering was obviously no protection against falling objects, and no other purpose which it served could be observed. Curiosity prompted inquiry. "Until that awning was put up," replied the contractor, "those carpenters stopped work every time the derrick swung its load and stood ready to dodge if it let go. Now they can't see the load pass and they pay no attention to it. That awning saves 10% lost carpenters' time." Perhaps the saving was overestimated, but the contractor's action was prompted by sound reasoning. Any spectacular construction operation distracts to some extent the attention of every workman within sight of it. If the operation involves an element of danger, its attraction becomes almost irresistible. If in such cases the construction of a screen is practicable at small cost the investment will often be profitable.

Other Articles in This Issue of Interest to Contractors:

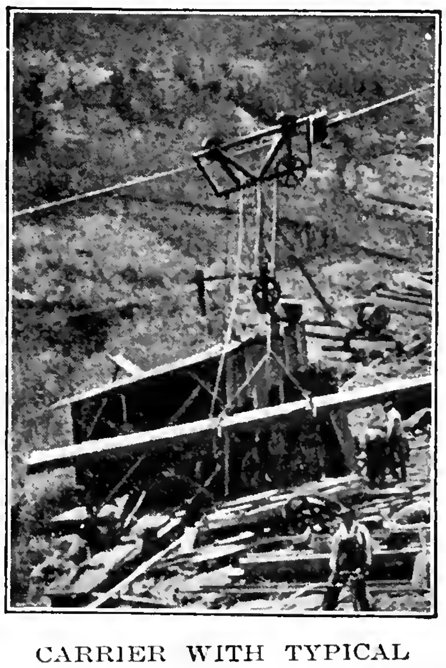
Home-Made Cableway Carrier Operates With Single Hauling Line

MATERIALS and equipment for the Gibraltar dam near Santa Barbara, Cal., had to be conveyed over a 750-ft. cableway from the end of the industrial railroad track to the dam site. A carrier was devised for this cableway by W. A. Kraner, of Bent Brothers and W. A. Kraner, contractors, and it is operated satisfactorily with a single hauling line. This is made possible by the fact that the cableway is on an incline sufficient to return the carrier by gravity, but there is also an ingenious arrangement of hooks which lock the carrier under certain conditions.

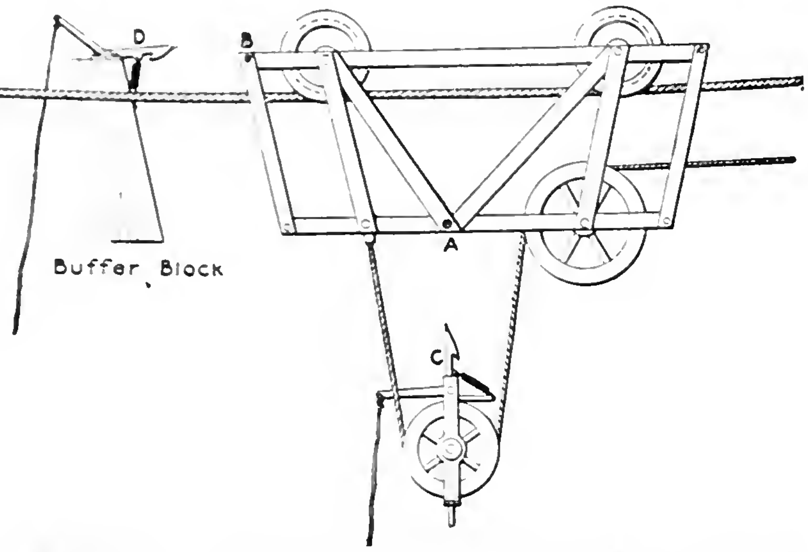
The carrier is made of heavy strap iron, and operates on a 1½-in. cable. Besides the two main cable wheels which support the frame there are only two other wheels on the carrier. One of these is an idler or guide sheave fixed to the carrier frame and around which the hauling line passes. The other is a sheave around which the hauling line also passes but which is attached to the counterweight and moves with the load to and from the carrier. The end of the ⅝-in. hauling line, after passing around the two sheaves, is attached to the carrier frame.

The interesting features of the carrier are the two hooks which lock automatically. One is attached to the sheave which moves up and down with the load; its function is to lock the load to the carrier so that it cannot come down until desired. The hook projects above the sheave in such a way that as the load is drawn up to the carrier the hook engages a bolt in the frame and is held in place by a steel spring. Thus, even though the hauling line is slacked off, the load would remain suspended from the hook. The hook can be disengaged from the bolt by a pull on the releasing rope which hangs down to the ground. This release can be effected only when the hauling line is taut; afterward, as the hauling line slacks away the load comes down from the carrier.

The second hook is attached to the buffer-block at the lower end of the cableway span. Its function is to engage a bolt in the carrier and hold it stationary on the main cable while the hauling line lifts the load and locks it to the carrier. After this has been accomplished the hauling line is slacked away slightly, and the hook in the buffer block is released by the pulling of a rope which hangs down to the ground. The load is then moved up the cableway by winding up the hauling line. A buffer-block hook is needed at the lower end of the cableway only because the incline of the main cable is not steep enough to cause the carrier to slide down from the upper end when the load is being lowered. However, if the cableway were steeper the addition of a hook in the upper buffer block could hold the carrier in the same way as



CARRIER WITH TYPICAL LOAD



HOME-MADE CABLEWAY CARRIER OPERATES WITH SINGLE HAULING LINE

Hooks C and D automatically engage pins A and B until released by trip ropes

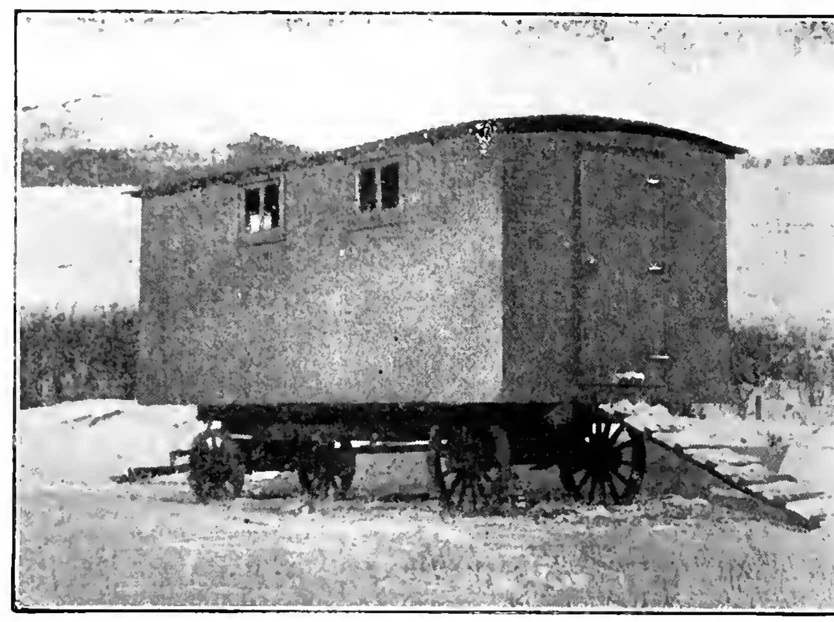
the one at the lower end, and the system would still be automatic. The carrier has given excellent service, it is reported, and has regularly handled 40-sack cars of cement with 6 min. to the round trip. Loads up to six tons have been hauled up with the 25-hp. motor installed for operating the cable.

Car Camps for Road Maintenance Gangs Repay Cost Each Season

CAR camps on wheels with a bunkhouse and mess-hall unit in each outfit repay their cost each season on road maintenance in Gogebic County, Michigan, by reducing lost time of men and wear and tear of camp equipment. An outfit, with a mess-hall unit complete, as illustrated, and an exactly similar bunkhouse unit without furnishings, was built by a local wagon maker for $675.

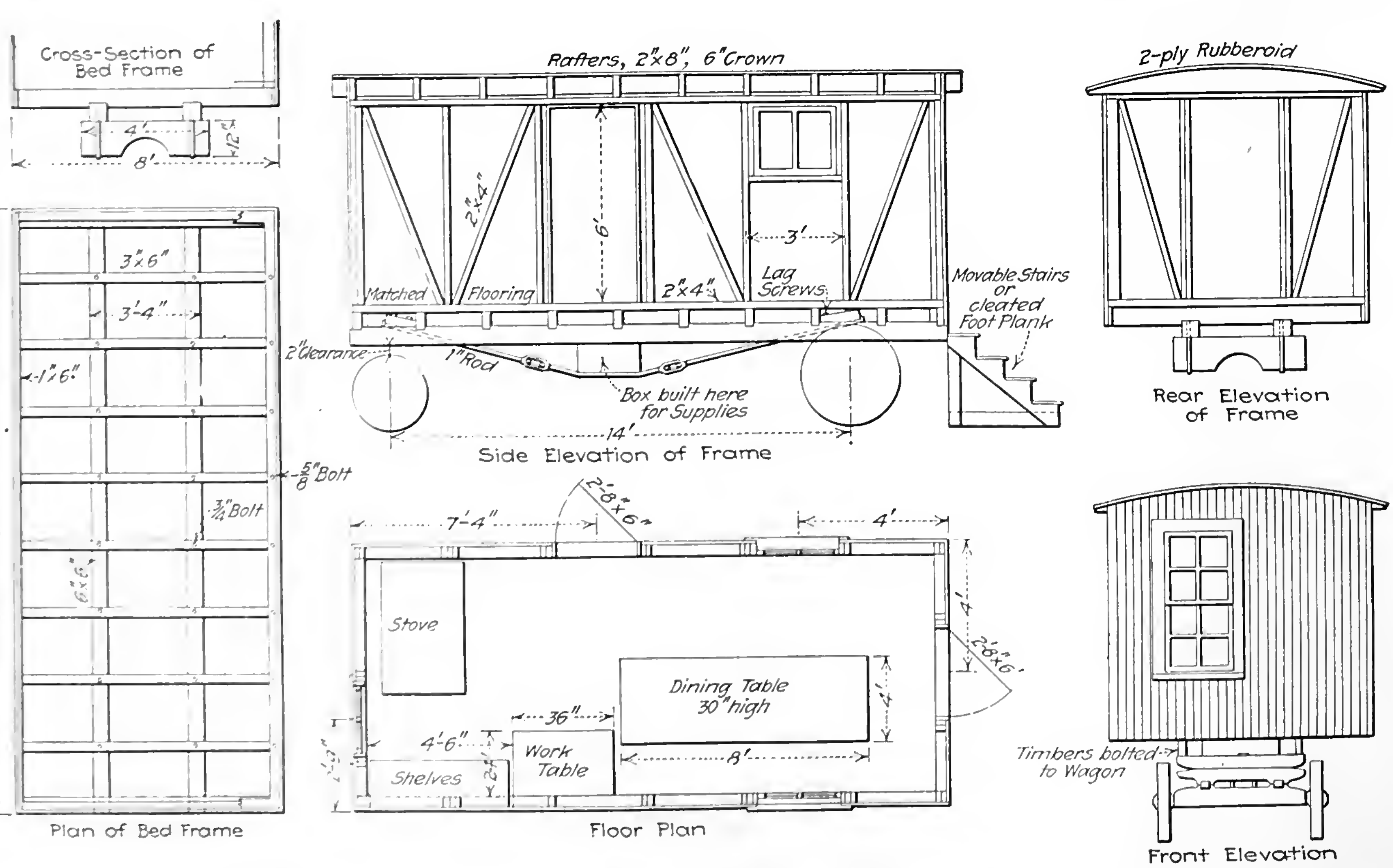
Roads in Gogebic County are long and run through a sparsely settled country. In summer the traffic is heavy. Maintenance, therefore, calls for continuous repairs over long stretches of road. One outfit last season kept a 70-mile road in shape, and the camp was at all times close to the repairs being done. The time lost traveling between camp and work was almost negligible.

The wagons are standard-gear, with $\frac{5}{8}$ x 4-in. tires, $3\frac{3}{4}$ x 12-in. skeins, 28-in. front wheels and 36-in. rear

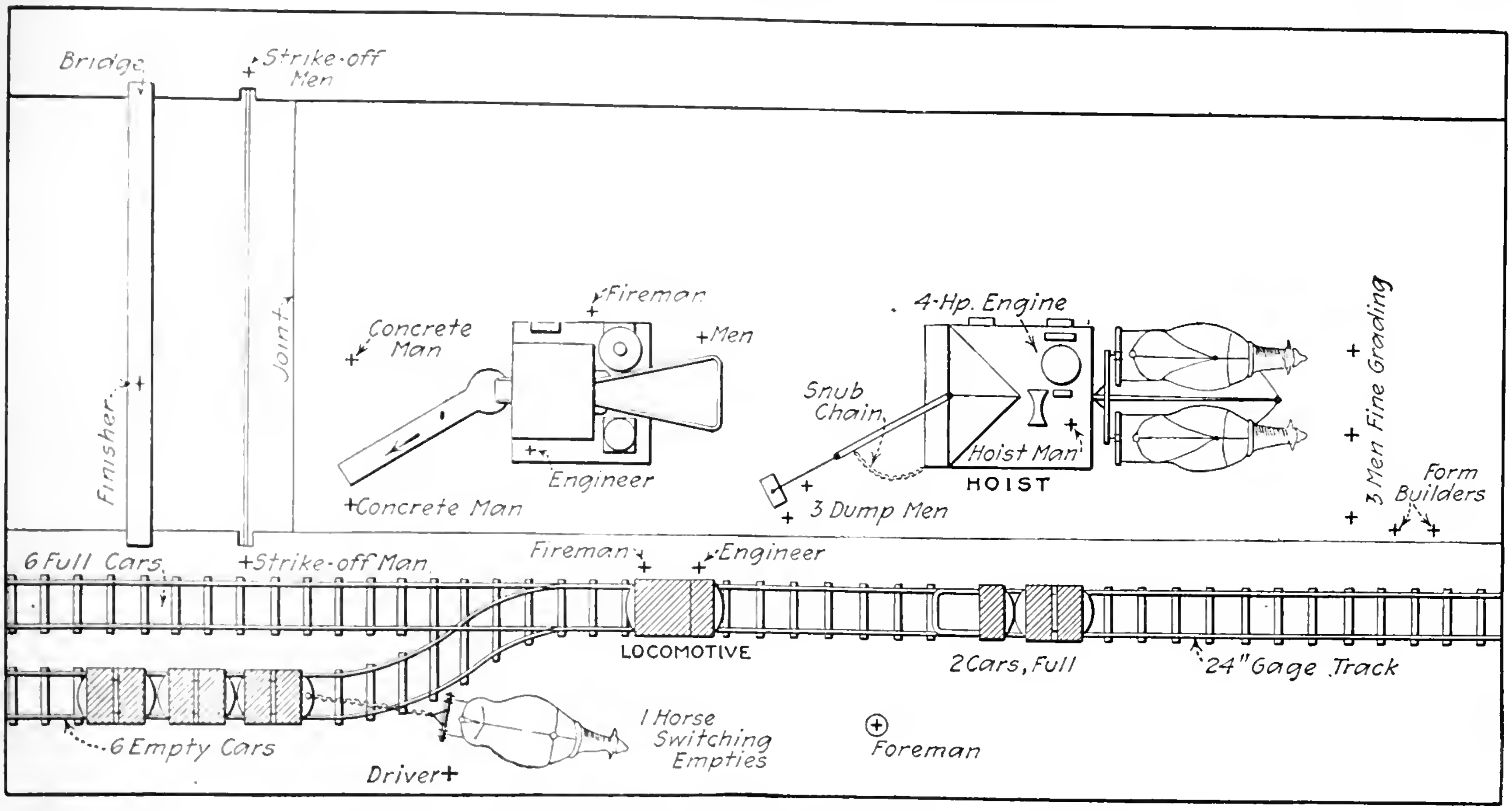


WAGON CAMP UNIT LOCKED AND LAID UP FOR WINTER

wheels. The bolsters are made as wide as possible; in this case they are 40 in., and the front bolster is so arranged that the front wheels can turn under the body as far as the reach. The construction of the wagon house is clearly shown by the drawings of the mess-hall unit. The bunkhouse unit is exactly similar in construction, but is furnished with steel cots. It will accommo-



DETAILS OF WAGON TOP FOR PORTABLE BUNKHOUSE AND MESS HALL ON ROAD REPAIR WORK



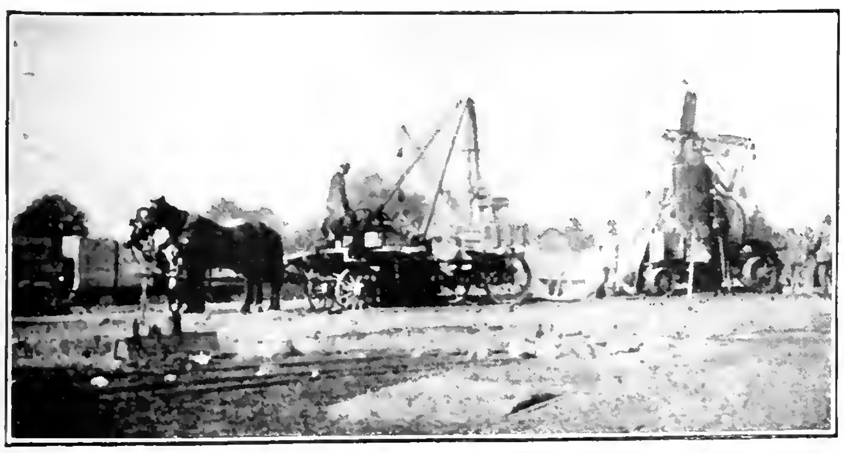
LOCATION OF EQUIPMENT AND WORKING FORCE AT MIXER

date cots for 12 men. A 7000-lb. tractor hauls each unit easily. C. F. Winkler, Bessemer, Mich., is the engineer of the board of road commissioners of Gogebic County.

Horse-Drawn Derrick Loads Concrete Mixer

PROPORTIONED batches hauled in buckets on industrial flat-cars were transferred to the mixer by a horse-drawn derrick, in constructing 5557 ft. of concrete road for the extension of Camp Custer. The concrete slab was 18 ft. wide, 8 in. thick at the center, and 6 in. thick at the edges. At intervals, opposite warehouses, the pavement was widened into aprons each 216 sq.yd. in area. One apron was a day's work for the paving gang; on straightaway pavement the maximum day's work was 330 lin.ft. or 660 square yards.

Aggregate brought in railway cars was unloaded by a clamshell into stock piles or elevated bins located about three-quarters of a mile from the job. Industrial flat-cars, each carrying two 120-cu.ft. bottom-dump boxes,



HORSE-HAULED DERRICK HANDLED BATCH BOXES

ran to the bins and received their charges of sand and gravel, then to the warehouse to take the cement, and finally, in five-car trains, were hauled to the mixer by a 3-ton gasoline locomotive. At the mixer the derrick with a 4-hp. gas engine lifted the boxes one at a time and dumped the batches into the mixer. The operations at the mixer are indicated by the drawing.

The Camp Custer extension was built under the direction of Maj. T. A. Leisen, constructing quartermaster, and Samuel A. Greeley, supervising engineer, by the W. E. Wood Co., Detroit, Mich., contractors. D. E. Marsh was division engineer of highway construction.

Extra Screening of Sand Reduces Concrete Costs

EXTRA screens and a sedimentation basin added to the gravel-washing plant at Lockington dam of the Miami Valley flood-protection works are saving $100 a day in the cost of concrete. The washing plant is the standard construction described in *Engineering News-Record* of Oct. 10, 1918, p. 680. At Lockington the sand, as it came from the regular ⅜-in. revolving screen, contained an overproportion of grains of larger size. To increase the fine-grain content of the sand produced, two stationary inclined screens of ¼- or ⅛-in. mesh have been placed underneath the revolving screen, and the water from the revolving screen, instead of being wasted, is led to a settling tank where the fine sand is dropped and the water escapes over a weir. At intervals the fine sand is shoveled from the tank into the sand bins.

By thus screening out the coarse grains and salvaging the fine grains, a concrete sand is being obtained which in lean concrete has reduced the cement required from six to five bags per batch, of 16⅔ per cent. In rich concrete the saving is proportionally greater.

The construction of the Lockington dam is under the direction of the Miami Conservancy District, Arthur E. Morgan, chief engineer, Charles H. Paul, assistant chief engineer, and C. H. Locher, construction manager. B. M. Jones is division engineer.

NEWS OF THE WEEK

New York, February 27, 1919

New Highway Bill Introduced in Congress

Federal Highway Commission and System To Be Established—Presented as Basis for Future Action

A new highway bill, which would establish a Federal highway commission to take charge of building and maintaining a United States highway system, has been introduced in Congress. In introducing the bill into the Senate (as S.5626) Senator Townsend stated that he did not contemplate asking for its passage at this session, but desired that it might be criticised by interested parties to furnish a basis for intelligent action by Congress at the next session

The bill provides for a commission of five members, to be appointed by the President, with the advice and consent of the Senate. Not more than three of the commissioners may be of the same political party, and they must be selected from various sections of the country. In appointing the first commissioners, the President shall designate each man's term as three, four, five, six or seven years, after which vacancies shall be filled for seven-year terms as they occur. The compensation of each commissioner shall be $10,000 per year, and the commissioners shall give their entire time to the work. They shall select a chairman from their number, and the commission is allowed to appoint a chief engineer and a secretary, and employ engineers, special experts, attorneys, clerks, etc., as they may be necessary. All other employees shall be obtained through the United States Civil Service Commission.

In defining the highway system the bill states: "There is hereby authorized to be established, constructed and maintained a system of highways . . . to comprise not less than two main trunk-line roads in each state and joining the national highway system in the adjacent states and countries." It includes necessary bridges, drainage structures, signs, guard rails, etc.

All Government highway agencies are taken over by the commission, and appropriations are provided for carrying on the work as follows: Fifty million dollars, available July 1, 1919; $75,000,000, July 1, 1920; $100,000,000 for each of the three next succeeding fiscal years, or $425,000,000 in all, which shall be available until expended. It is further provided that the Secretary of War, at his discretion, shall deliver to the commission without charge such vehicles, motor vehicles, road-building machinery, and other equipment as are suitable to construct and maintain highways. The Federal-aid law of 1916 is amended to allow wider scope in the interpretation of the words "post roads," and $25,000,000 each for the years 1919 and 1920 is appropriated for Federal aid.

After the general expenses authorized for the commission are deducted, the appropriations shall be divided as follows: One-third in the proportion of the area of the state to the total area of all the states; one-third in the proportion of the population of the state to the population of all the states, and one-third in the proportion of the mileage of highways in the state to the total mileage in all the states.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western Zone, 63 E. Adams St., Chicago.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Meyers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Federal-Aid Highway Appropriation Goes Through

Federal aid for highways received a large addition when the Post-Office appropriation bill went through the Senate carrying $200,000,000 for this purpose. The bill, which was noted in *Engineering News-Record* of Jan. 30, p. 251, now awaits the signature of the President.

The provisions of the bill greatly enlarge the scope of the term "rural post road" to cover roads that either are used or can be used for transportation of the mails. It also increases the maximum payments which the Federal Government can make per mile from the previous amount, $10,000, to $20,000. This will allow the building, in coöperation with the states, of roads costing $40,000 per mile.

Will Attempt to Bring About Lower Prices

Government Commission to Issue Fair Price Lists After Study of Each Commodity

Voluntary and general price reductions will, it is hoped, result from the operation of a new commission which has just been organized by the Department of Commerce in coöperation with the Council of National Defense. The scheme, which was proposed by Secretary of Commerce Redfield, does not involve any regulatory powers of the Government in price fixing, but is intended to bring about reductions in prices through coöperation of capital, labor and the Government and through wide publicity of what the Government considers fair prices.

The commission, known as the Industrial Board of the Department of Commerce, will meet with the representatives of each manufacturing interest and with the representatives of labor and will endeavor, through an adequate presentation of the underlying costs of the commodity involved, to ascertain what should be a fair price for it. This price it will announce with as much publicity as possible. There will be no obligation on any one either to pay or to accept such a price; it will merely be what the Government experts, after an analysis of the situation, consider to be a fair return for all parties involved. It is possible, however, that this price will become the basis for the Government's own purchases in the commodity.

It is hoped by this means to bring about that general, mutual and simultaneous reduction of reward, to all parties who profit by a sale, which is necessary to a gradual price reduction.

The board at present has for members George N. Peck, chairman; Hugh Frayne and Thomas C. Powell. Mr. Peck was vice-chairman of the War Industries Board. Mr. Frayne is a noted labor leader and its representative on the War Industries Board, and Mr. Powell is director of capital expenditures of the Railroad Administration. Three other members will be appointed.

Engineering Council in Annual Meeting Reviews Year's Work

At its second annual meeting in New York, Feb. 20, the Engineering Council voted to appoint a small committee to advise and confer with the Reconstruction Commission of the State of New York. This action was taken in response to a request from Abram I. Elkus, chairman of that commission, which request probably resulted from the letter sent by the Engineering Council to Governor Smith. The executive committee reported on the effect of the hearing called by the Engineering Council in regard to the sudden dismissal of 339 Public Service Commission engineers, and the fact that reinstatement followed. It was also decided to appoint a special committee to consider the classification and salaries of railway and Government engineer employees.

Among the many committee reports one of the most important was that of the Engineering Societies' Employment Bureau, which up to Feb. 15 had 1400 applications for positions and found positions for 200, and to which the national societies have agreed to give larger appropriations.

The new representatives in the Engineering Council are: A. N. Talbot, past president of the American Society of Civil Engineers; J. R. Worcester, consulting civil engineer, of Boston; M. E. Cooley, president of the American Society of Mechanical Engineers, and Albert Ladd Colby, of South Bethlehem, Penn., representing the American Society for Testing Materials. The other members whose terms expired were reelected. The total number in the council is now 26.

The new officers are: Vice-chairman, E. S. Jacobus, advisory engineer, Babcock & Wilcox Co.; C. S. Churchill, second vice-chairman, vice-president of the Norfolk & Western R.R. The additional members of the executive committee are Comfort A. Adams, president of the American Institute of Electrical Engineers; Philip N. Moore, past president of the American Institute of Mining Engineers; Charles E. Skinner, engineer of the research division, Westinghouse Electric & Mfg. Co. J. Parke Channing and A. D. Flinn were reelected chairman and secretary, respectively.

Freight Increase in Road Materials Not Contemplated

Recent rumors of a horizontal increase of 30% in freight rates, applying to sand, gravel, crushed stone and slag, are without foundation, according to the Division of Public Works and Construction Development, Department of Labor. Considerable highway construction and other contract work have been held up by the uncertainty, and should now go forward. The Division of Public Works investigated the rumor and was assured by the Railroad Administration that no such raise is contemplated. If these rates are increased in the future, it will be as a part of a general rate increase, which is not proposed at the present time, as shown by the following circular of the Railroad Administration, dated Jan. 20:

"There is no foundation for the report that the Railroad Administration has given, or is giving, any consideration to any increase in the present basis of rates."

President Invites Local Officials To Discuss Reconstruction

Governors of the states and mayors of over 100 cities have been invited to attend a conference at the White House Mar. 3-4 to discuss "vital questions affecting business and labor." The President will address the conference. The Department of Labor, which is promoting the meeting, issued the following statement:

"The conference will take up vital questions affecting business and labor. It is the desire of the President to establish before he returns to Europe a definite nation-wide policy to stimulate public and private construction and industry in general. A large number of officials have already signified their willingness to attend such a conference. Plans will be presented to show that the Federal Government is anxious to coöperate with the various states and municipalities in all efforts to assure continued prosperity in the interests of manufacturers, merchants and wage-workers."

Society Gets Mayoralty Candidates' Promise to Aid Engineers

The five contestants for mayor in the primary election in the City of Chicago, Feb. 25, all answered in the affirmative the following questions put to them by the Chicago Chapter of the American Association of Engineers: "Will you, if elected, fairly investigate the claims of the engineers working for the city to more adequate remuneration?" (The rates have not been changed in 21 years). "Will you appoint no 60-day men without engineering experience to engineering positions?"

Water-Works Improvements for Seattle Authorized

The city council of Seattle has authorized a transfer of $750,000 from the Skagit River hydro-electric fund to the water-works fund for three dams at Swan Lake, and for conduit construction. The Board of Public Works is busy with plans and specifications. The lake will be raised from El. 468 to El. 488, creating a total storage of nearly 80,000,000,000 gal., of which almost 50,000,000,000 gal. will be available through an outlet at El. 455. A 2½-mile tunnel will be driven from the lake to Molasses Creek, and a pipe line will be built from the creek to the city. L. B. Youngs is superintendent of water-works.

Transmississippi Readjustment Congress at Omaha

Some 1200 delegates from 204 cities and towns in 22 states held a Transmississippi Readjustment Congress in Omaha Feb. 19-20.

City officials who attended a section meeting agreed that public improvements should be made without waiting for a fall in prices of labor and materials. The keynote of the section meeting of the contractors and builders was that "the way to resume building operations is to resume." Several speakers were of the opinion that there would be no material fall in prices for months to come. John W. Towle, of Omaha, said, "We should go ahead for the next few months and do business on a very slight margin of profits, or no profits at all."

Resolutions were adopted indorsing the principle of a league of nations; the promotion of public and private work by Federal, state and municipal governments during the readjustment period; Federal reclamation of arid and waste lands in the public domain and the enactment of state laws "whereby the returning soldiers may be given employment in the preparation of such lands for settlement and provided with assistance to make permanent homes when the reconstruction period is passed"; the construction of good roads by Federal, state and local coöperation; partnership instead of enmity between capital and labor; the return of the railroads to their owners, with Government regulation to "prevent the abuses of the past and secure to the public the greatest good to be derived from economic, efficient, coöperative management, eliminating restrictive legislation that has hitherto hampered much-needed improvement"; the development of inland waterways, particularly the Mississippi and its tributaries, the extension of foreign trade and the turning over to private ownership of vessels built by the United States Shipping Board; legislation for "the early development of the water power now going to waste on the public domain," and giving to the people of the West the same right to develop their natural resources as "has already been exercised by the people of the Eastern states"; a Federal budget system; and "the extension of the Americanization campaign so as to include all portions of the country in which foreign influence still prevails."

American Institute of Consulting Engineers Elects Officers

The American Institute of Consulting Engineers elected the following officers at its recent annual meeting: President, L. B. Stillwell, reëlected; vice-president, A. M. Hunt; secretary and treasurer, F. A. Molitor. The following members of council were elected to replace those retiring: S. Whinery, Desmond FitzGerald, and J. Parke Channing.

Sacramento Flood Damage Increases

Heavy rains early in February caused a rise in the Sacramento River sufficient to inundate some 10,000 to 15,000 acres of farm land in the Sutter Basin district south of Marysville, Cal. The continued reclamation of areas along this stream has decreased the local storage capacity so that floods which a few years ago would not have caused material damage are now sufficient to submerge farms that have been heretofore above even the higher flood levels.

The extensive damage of the present flood is thought to be in large measure due to the fact that the west levee of the district was built before the east levee was closed, work being continued meanwhile on the Armour project, known as Reclamation District 1500. A large number of farmers have been flooded out, and the value of the crops lost is estimated to be between $500,000 and $1,000,000. Draining the inundated areas may require cutting the levee at the lower end of the district, and this cannot be done until the river subsides from the present flood stage.

The flood control in the Sutter Basin district is closely identified with the Sutter bypass project, and it has been understood in the court procedure attendant upon the work thus far that temporary inconvenience could be expected during the construction period.

Outlines Policies of American Association of Engineers

President W. H. Finley addressed an open meeting of the American Association of Engineers in New York City on the evening of Feb. 10, following a dinner of the New York chapter in his honor.

In referring to the great change of conditions in the engineering profession during the past quarter century, he pointed out that the schools are now turning out engineers in shoals, and that the profession has hardly found itself yet, but that it is clearly necessary for engineers to associate for the protection of their business relations to the community. The American Association, organized as a business association of engineers, he said, has no desire to take up technical matters, but is willing to leave that to the established societies. Its scheme of organization is to leave the development task to the local chapters, which should be free to work out their destiny without feeling the heavy hand of the national organization extended over them.

Following Mr. Finley, R. S. Parsons, chief engineer of the Erie Railroad Co., spoke entertainingly of the specific mental qualities that characterize the engineer, and of the relationship between these qualities and the ability to direct affairs efficiently. He made an earnest plea for greater participation of engineers in politics and administration.

Secretary of Associated General Contractors of America

G. W. Buchholz, who has been selected as acting secretary of the Associated General Contractors of America, as mentioned in these columns last week, p. 398, has been engaged in general contracting since his graduation from Columbia University, in civil engineering, in 1901. His service has been principally with the Snare & Triest Co. and the North-Eastern Construction Co., both of New York. He has acted in a wide variety of positions both in the field and in the office.

During his connection with the Snare & Triest Co. he was in intimate contact with the following works: The Government coaling station at Frenchman's Bay, Maine; terminal improvement, Williamsburg bridge, New York; Lackawanna Railroad Terminal at Hoboken, N. J., and the Delancey Street subway connection to the Williamsburg bridge. Later he served as works manager of the company's pier work in New York harbor and had charge of the construction of city pier 30, South Brooklyn, N. Y.; Pier 3, Erie Basin; Pier 17, North River, and Pier 8, Weehawken, Erie Railroad.

Chosen to Act as Secretary of General Contractors' Association

G. W. BUCHHOLZ

Shortly after the declaration of war against Germany, Mr. Buchholz was placed in charge of the construction of 36 fire-resisting ammunition-storage buildings for the Navy Department at Lake Denmark, N. J., and Iona Island, N. Y., including the necessary railroad construction to serve them. On Mar. 1, 1918, he joined the forces of Fred T. Ley & Co., Inc., of New York and Springfield, and went to Perryville, Md. as assistant works manager on a contract to construct an ammonium nitrate plant for the Bureau of Ordnance, Atlas Power Co. agents. He later became works manager of this $13,000,000 operation.

William A. Davis, selected to act as organization manager, to assist Mr. Buchholz, was recently connected with the War Labor Board and has been connected with the organizing of the National Association of Manufacturers, the National Association of Marble Dealers and the National Association of Steam and Hot Water Fitters. The association has taken offices in the Conway Bldg., 111 W. Washington Street, Chicago, Ill., which will be its headquarters, with a branch office in New York at 225 Fifth Ave., until May 1.

Navy Sells Material By Bids

Such surplus material as the Navy Department has will be sold through the usual sealed bids and not by a sales organization such as has been organized in the War Department. The amount of Navy surplus, however, is very small compared to that of the Army.

England Will Subsidize Home Building

Dispatches from England state that the British Reconstruction Ministry has offered to rebate 75% on the loss on homes built now if the property has decreased in value at the end of five years.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 910 Michigan Ave., Chicago; Mar. 18-20; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

The Detroit Engineering Society held a meeting Feb. 21 which was devoted to a discussion of the measurement of the flow of liquids and gases by means of the Pitot tube. L. D. Royer, power and construction department, Ford Motor Co., delivered the address. The meeting was held jointly with the Michigan Chapter of the American Society of Heating and Ventilating Engineers.

The Michigan Engineering Society will hold a special meeting at Ann Arbor Feb. 28 for the purpose of reorganizing.

The Montreal Branch of the Engineering Institute of Canada will be addressed Mar. 6 by N. M. Campbell, who will speak on "Air Drills," and by Dr. Howard Bronson, who will read a

paper on "The Halifax Explosion from a Chemist's and Physicist's Viewpoint." A motion picture of "Burroughs Adding Machines," by the Burroughs Adding Machine Co., will be shown.

The Rochester Engineering Society will hold a meeting Feb. 28 at which Samuel W. Miller, president of the Rochester Welding Works, will speak on "Heat Treatment of Steel."

The Engineers' Club of Baltimore was addressed by C. J. Blanchard of the United States Reclamation Service at a recent meeting. Mr. Blanchard spoke on the work being done by the Government in reclaiming 2,000,000 acres and the establishment of homes for 3500 families, in the light of the plan of the Department of the Interior for returned soldiers.

The San Francisco Association of Members of the American Society of Civil Engineers held a special meeting Feb. 12, which was addressed by Maj. John D. Galloway, past president of the association, just returned from more than a year's service in France. Major Galloway was on duty at General Headquarters of the Army in the Intelligence Section, and gave an interesting illustrated talk on the information obtained from the enemy about troop movements and location and capacity of transportation facilities. He also showed a series of charts with which he reviewed the progress and important elements of the chief battles of 1918.

The Engineers' Club of Trenton Feb. 24 inspected the works of the Mercer Automobile Co. An opportunity was afforded by the automobile company for the inspection of every detail of the manufacturing process.

The National Fire Protection Association will hold its 23rd annual meeting May 6-8 in Ottawa, Ont.

The Cleveland Engineering Society was addressed Feb. 18 by J. C. Beardsley, Thompson Meter Co., New York, who read a paper on "The History of Water-Supply."

The Albany Society of Civil Engineers held a meeting Feb. 25 at which Col. C. G. Mettler, U. S. A., spoke on "Making Cannon at the Watervliet Arsenal."

The Engineers' Club of Philadelphia will hold a regular meeting Mar. 13. Dr. John A. Brashear will present an illustrated paper entitled "An Evening's Journey Among the Stars." On Mar. 12 the club will hold a special meeting, which will be addressed by Prof. Warren P. Laird, of the department of architecture, University of Pennsylvania, who will present an illustrated paper on "The Placement of the Delaware River Bridge." Professor Laird's paper will deal exclusively with the problem of the location of the bridge as a public utility, without going into matters of construction and finance. At the weekly luncheon Mar. 4 Alfred D. Flynn, secretary of the Engineering Council, will speak on "Joint Activities of Engineers; a Résumé of the Work of the Engineering Council and the Engineering Foundation."

The Nebraska Engineering Society will hold its annual meeting at the University of Nebraska, at Lincoln, Mar. 11. It will consider bills presented by its legislative committee to the present legislature designed to improve the position of the county surveyor by establishing as "official" only surveys made by county surveyors, state surveyors and Government surveyors. It will also consider the engineers' license bill, motor-vehicle license bill, state highway system bill and the one-mill state-aid road fund. In connection with this meeting there will be held the second annual Nebraska Road Institute, at the University, Mar. 10-14. The subjects will include the new road laws, road construction and road surveys. A visit will be paid to the Lancaster County roads now being built. Clark E. Mickey, University of Nebraska, is president of the Nebraska Engineering Society and chairman of the Nebraska Road Institute.

The Seattle Association of Members of the American Society of Civil Engineers elected the following officers at the recent annual meeting: President, L. M. Grant; vice-president, John L. Hall; secretary and treasurer, Philip A. Franklin.

The Duluth Engineers' Club passed a resolution, at its monthly meeting Feb. 20, authorizing the president of the club to appoint a civic relations committee of six members for the purpose of taking an active part in municipal projects. A resolution was passed in favor of the proposed appropriation of $50,000 a year by the State of Minnesota to complete the topographical survey.

The Pittsburgh Chapter of the American Association of Engineers has elected the following officers for the year: President, C. K. Harvey; vice-president, H. C. McCormack; secretary, H. Gellin.

Personal Notes

LIEUT. ARCH. W. NANCE has received his discharge from the Army and has returned to his work with the Farris Engineering Co., constructing engineers, Pittsburgh.

EDWARD R. BOWEN, formerly of the firm of Lippincott & Bowen, consulting engineers, has opened offices in the Central Building, Los Angeles, Cal., to specialize in water-supply and irrigation work.

CAPT. CHARLES A. FRENCH, Construction Division, U. S. A., has received his discharge from the service and has resumed his duties as city engineer and superintendent of public works of Laconia, N. H. He was in charge of utilities at the United States Army General Hospital No. 19, at Oteen, N. C.

COL. W. P. ANDERSON, C. M. G., C. E., chief engineer of the Canadian Department of Marine since 1891, is retiring from that position. He entered the service of the department in 1874. Colonel Anderson is a member of the Light House Board, which has recommended that his connection with that body be continued in view of his knowledge of navigable waters.

E. W. HAMMOND, division engineer, Buffalo, Rochester & Pittsburgh R.R., with headquarters at Du Bois, Penn., has been appointed city engineer of Summit, N. J., and will take office between now and the first of May.

GEORGE W. BORDEN, county engineer of Klickitat County, at Goldendale, Wash., has resigned to become construction engineer for Trout Lake Improvement District No. 3, recently organized to construct a concrete road from Trout Lake to White Salmon and Underwood.

MAJ. A. C. EVERHAM, Construction Division, U. S. A., has received his discharge from the service and has been appointed Western contract manager, Raymond Concrete Pile Co., with headquarters in Chicago.

CHARLES G. EDWARDS, assistant chief engineer of the Maryland Public Service Commission, has been appointed chief engineer, succeeding Charles G. Phelps, whose death was noted in *Engineering News-Record* of Dec. 26, 1918, p. 1203.

B. L. CROZIER has been appointed assistant engineer, Paving Commission of Baltimore.

LIEUT. JULIAN MONTGOMERY, U. S. A., formerly office engineer, Texas State Highway Department, has received his discharge from the service and has returned to the Highway Department as division engineer in charge of southern Texas.

WILLIAM F. STROUSE, Baltimore, has been appointed assistant chief engineer of the Maryland Public Service Commission, succeeding Charles G. Edwards, appointed chief engineer, as noted elsewhere.

CAPT. R. McC. BEANFIELD, topographical officer, Eighth Mounted Engineers, U. S. A., has received his discharge from the service and has entered the service of the Emergency Fleet Corporation as engineer, shipyard plants division, with headquarters in Philadelphia.

LIEUT. EDWARD T. JONES, Engineers, U. S. A., who was engaged in water-supply work on the staff of the chief engineer, Advanced Section, American Expeditionary Forces, has

returned to this country and has received his discharge from the service. He has resumed his duties as chief engineer, Stevens & Thompson Paper Co., Greenwich, N. Y.

LIEUT. JOHN MACMILLAN, Engineers, U. S. A., formerly city engineer of South Pasadena, Cal., who was recently discharged from the service, and C. R. SUMNER, consulting engineer of Los Angeles, have become associated as partners in the practice of civil engineering, with offices in the H. W. Hellman Building, Los Angeles.

LIEUT. COL. L. E. CURFMAN, 314th Engineers, 89th Division, has just returned from overseas and has resumed his former position as city engineer of Pittsburg, Kan.

LIEUT. HOMER G. OLMSTED, Engineers, U. S. A., formerly located at Camp A. A. Humphreys, Virginia, was recently discharged from the service, and has opened offices at Newkirk, Okla., for the practice of engineering, specializing in reports on oil properties.

LIEUT. JOHN T. CHILDS, Sanitary Corps, U. S. A., has been discharged from the service and has returned to his former position with the Rochester Bureau of Municipal Research, to continue his work in connection with the local sanitary services of street cleaning and collection.

CHARLES K. TUCKER, Morgantown, W. Va., has removed to Pittsburgh and has entered the office of the United States Engineer.

ALFRED M. BARRETT, Flushing, N. Y., has been appointed superintendent of highways of Queens County.

MAJ. H. M. MONTGOMERY, previously constructing quartermaster and disbursing officer at Government warehouses and waterworks at Jeffersonville, Ind., and the clothing warehouse at St. Louis, has received his discharge from the service and has become city engineer of Evanston, Ill.

E. N. FLOYD has been appointed supervisor of fire protection of the newly organized Bureau of Fire Prevention, Cleveland, Cincinnati, Chicago and St. Louis Ry., Cincinnati Northern R.R., and Louisville & Jeffersonville Birdge & Railroad.

LIEUT. W. H. FRANKLIN, Construction Division, U. S. A., has received his discharge from the service and has returned to the James Black Masonry & Contracting Co., of Seattle.

HENRY J. BURK, formerly county surveyor of Imperial County, California, has been appointed to the newly created position of city engineer of Holtville, Cal., to undertake surveys and the establishment of street lines and grades.

ALAN T. FRASER, district engineer, Western District, Canadian Northern Ry., previously division engineer at Edmonton, Alta., has been appointed chief engineer, Western Lines, Canadian Nationals Rys., with office at Winnipeg, Man. He was born in 1872 and was graduated from the School of Practical Science of Toronto in 1892, after which he entered railroad service as a rodman, later becoming assistant engineer. He served as resident engineer, Ontario & Rainy River Ry. at Port Arthur, Ont., and was also locating engineer for the Canadian Northern and assistant district engineer of the National Transcontinental before he became division engineer for the Canadian Northern.

JAMES B. HAYS, of F. C. Horn and James B. Hays, engineers and constructors, Boise, Idaho, will continue the business of the firm, following the death of Mr. Hays, noted elsewhere.

Civil Service Examinations

United States.—Superintendents of road construction, Bureau of Public Roads, Department of Agriculture, Mar. 25: Class A (candidates with four years' responsible charge of construction) $150 to $175 per month; Class B (six years' responsible charge) $185 to $225; Class C (eight years' responsible charge) $230 to $250 a month. Apply to United States Civil Service Commission, Washington, D. C., or to local office of commission for form 1312, and file before Mar. 25.

United States.—Assistant examiner, Patent Office, Washington, Mar. 26-28, and May 21-23 and July 23-25. Pay, $1500 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission for form 1312, to be filed in time to arrange for examination at place selected by applicant.

United States.—Chief physicist, qualified in aëronautics, National Advisory Committee for Aëronautics, Langley Field, Hampton, Va., Mar. 25, $3000 per year. Also physicist, $2100 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission for form 1312, to be filed before Mar. 25.

United States.—Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agriculture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3400 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission for form 1312, to be filed before Apr. 1.

OBITUARY

RUFUS CAMERON HUNT, civil engineer and contractor, of Washington Court House, Ohio, died in Bowling Green, Ky., Feb. 18, at the age of 68. Mr. Hunt had been engaged in railroad work in this country and in China and South America since 1874, when he was employed by the Cumberland & Ohio R.R. A few years later he served as assistant engineer and resident engineer on contsruction work for the Cincinnati Southern Ry., and in 1881 became chief engineer of the Ohio Southern R.R., in charge of operating and construction work. From 1881 to 1891 he served as resident engineer and division engineer for the Louisville & Nashville R.R. and the Ohio River R.R. He afterward was employed as engineer for the Bessemer Iron & Steel Co., in charge of the construction of blast furnaces, and later went into the contracting business. After a brief employment with the Washington County R.R., Maine, as division engineer, he served two years in China as assistant engineer to William Barclay Parsons on the survey for 750 miles of railroad. During the following two years he was engaged as engineer and manager for the James P. McDonald Co. in mining and construction work in the Andes Mountains in Ecuador, Bolivia and Peru. Later he was connected with subway construction in New York City and with the construction of the Cumberland Mountain cutoff of the Baltimore & Ohio Railroad.

BRIG. GEN. JAMES F. MCINDOE, formerly colonel, Corps of Engineers, U. S. A., died in Tours, France, Feb. 6. He was born in 1868 and was graduated from West Point in 1891. For five years previous to 1913 he was stationed at Portland, Ore., with the rank of major, as United States engineer of the Portland District. In 1913 he was ordered to Manila, P. I., to assume charge of fortification construction, and was afterward transferred to Kansas City, Mo., where he was engaged in Missouri River work at the outbreak of the war.

F. C. HORN, of F. C. Horn and James B. Hays, engineers and constructors, Boise, Idaho, died Feb. 16, at the age of 57. In 1890 he was engaged in construction work in connection with the Chicago Drainage Canal project. He remained in the Chicago district until 1900, when he became assistant engineer on the construction of the Swan Falls power plant on the Snake River, Idaho. In 1905 he was employed by the United States Reclamation Service in the building of Minidoka dam and the Boise River dam.

RICHARD KEATINGE, for many years in the contracting business on the Pacific Coast, died at Los Altos, Cal., Feb. 13. His first connection with the contracting business was in the service of Ernest L. Ransome during the late '80's, from which time he was actively engaged in construction work in the West, erecting many of the concrete buildings in San Francisco. He had also been engaged in hydraulic work.

Shipping Board Reduces Cost of Tracings

Mechanical Reproductions Hard to Distinguish From Originals—Cost But Fraction of Latter

By means of a recently patented process, the Emergency Fleet Corporation has been producing, at a cost of from 10 to 13c. per square foot, tracings which, if made by hand, would ordinarily cost from $1.50 to $5 per square foot. The resulting tracings from this process are so nearly like the original that they are distinguishable as reproductions only on close inspection.

The accompanying table shows the amount of tracings delivered and the cost for the week of Dec. 5 to 12, 1918. A similar table submitted for the week of Oct. 17 to 24, 1918, shows 1137 sq.ft. at a cost of 12.9c per square foot. Besides the simple operation of reproducing tracings either on cloth or paper, the process has been used in a number of other ways and for a variety of purposes. It has been used for progress work, the reproductions, either on cloth or strong paper, being used instead of blueprints or Vandykes. It has also been used to produce new drawings, a large part of which are similar to those previously made, by blocking out the parts to be changed on either the transfer print or on the plate, with the new details drawn in by hand.

WEEKLY REPORT OF LITHO ROOM, DEC. 5-12, 1918

Number of men in room	2
Original tracings received	417
Process tracings made	1681
Number of plates of jelly poured	36
Number of square feet of tracing cloth used	2566
Number of square feet of tracing cloth delivered	2460
Number of square feet of tracing cloth wasted	106
Approximate Expense of Section for Seven Days	
Cost of tracing cloth	$137.25
Miscellaneous supplies and jelly	29.00
Supervision	60.00
Labor	46.00
Total Expense	$272.25
Approximate Cost per Square Foot	
Labor per square foot	$ .019
Materials and supervision	.093
Total Cost	$ .112

The work is done in the following manner: A matrix blueprint on a special transfer paper is made on any good blueprint apparatus, but it is not developed or washed before its use in the process.

When at the proper temperature a sensitized gelatine is pourned over a zinc plate, usually 42 x 98 in., or 42 x 110 in., which rests on an inclined, adjustable table, proper thickness of gelatine being obtained by the angle of inclination of the table and by the special pouring pot designed for the process. The overflow is caught and used again. As soon as the gelatine is poured, the table is righted and the gelatine allowed to set a few minutes.

From the adjustable table the gelatinized plate is put into a recess of a patented refrigerating table and undergoes the essential treatment on which the success of the process depends.

After a few minutes in the refrigerator the plate is placed, gelatine up, on the refrigerated top of the table, its temperature being maintained at the 60° limit of efficiency. The unwashed matrix print is laid face down on the gelatine for a few seconds, which, on removal, leaves the reversed image on the gelatine, a reaction having taken place between the unexposed lines of the transfer-print and the sensitized gelatine.

The gelatine plate is then inked with a squeegee roller spread with special carbon ink, which clings only to the lines left by the transfer-print reaction, being repelled by the rest of the gelatine.

The paper or cloth on which the tracing is desired is then laid smoothly on the gelatine, pressed flat and immediately taken off, the complete tracing being transferred to the finest line. As many as 10 to 15 impressions may be made on tracing cloth from one gelatine plate, merely by re-inking, and 40 to 60 copies reproduced on paper. The finished tracing is then complete, and can be used within a short time.

The time from the transfer print to the finished tracings was 30 min. or less. Pouring and refrigeration of plates are so controlled that no delay occurs at any stage of the process, and although the stated limit of capacity for a one-table plant is 500 sq.ft. a day, actual results, as shown by the table, have been greater than this.

New Locomotive Crane Developed by Construction Company

In the prosecution of heavy construction work, the Terry & Tench Co., Inc., of New York City, found it impossible during the recent emergency, to purchase in the open market hoisting and other machinery heavy and strong enough to answer the demands of the work they had on hand. They solved the problem by designing and manufacturing their own equipment. A locomotive crane is the latest product of this program.

After the needs and experience of the company were incorporated into the design of the various plants, their use in the field created a demand from other contractors in similar lines. To supply this demand, the Edward F. Terry Manufacturing Co. was organized and is building shipyard and locomotive cranes, steel derricks, erectors' tools, etc. This company, although associated with the Terry & Tench Co., does all of the manufacturing, the Terry & Tench Co. confining itself strictly to construction work. This will correct the impression given in *Engineering News-Record* of Jan. 16, 1919, pp. 136 and 137, in which it was stated that the traveling cranes described are of Terry & Tench manufacture.

The locomotive crane mentioned above carries out the results of experience on the work of the Terry & Tench Co. in a number of ways, among which are that all clutches of large size and of inside-band-brake type, and levers operating the clutches are balanced so that the mechanism is free from eccentricity and unbalanced thrusts, thereby making the work of shifting easy and reducing to a minimum the wear of these important parts. The turntable is prevented from tipping by the use of rollers bearing against the under side of the base ring, rather than by the center pin, as is the usual practice. The boom-hoisting drum is driven by means of a train of spur-and-bevel gears, eliminating the friction of the worm gear ordinarily used, so that the boom may easily be raised with full load on the hook. The boom-hoisting drum is equipped with an automatic holding and lowering brake of the inside-band-type, whereby the boom is positively held in position and is under complete control of the operator at all times, and the brakes for the main drums are so arranged that the speed of operation and safety are increased by means of a device which allows the load to be hoisted while the brake is set.

Business Notes

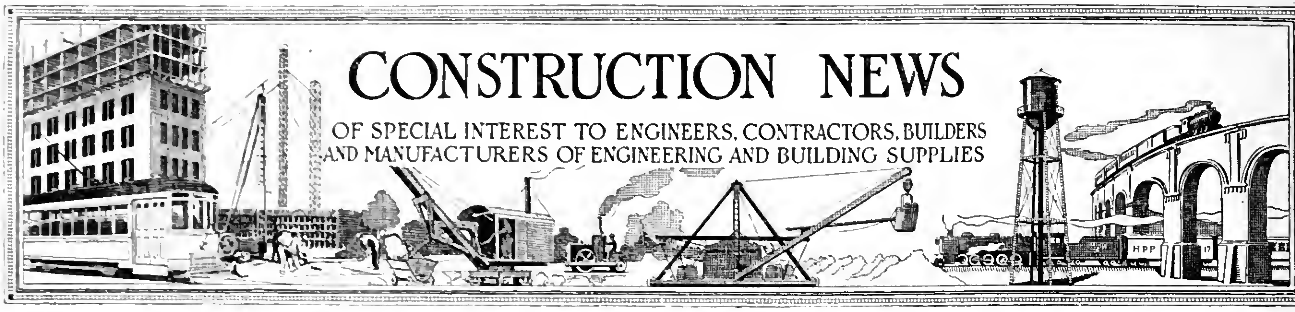
The W. L. Goeltz Co., Inc., engaged in industrial engineering and building, announces that on account of the increasing demand for its "Unit Construction" it is compelled to seek larger quarters. The company is now in its new offices at 150 Nassau St., New York City.

F. A. Putt, formerly with the Clyde Iron Works and the General Electric Co., has become manager of the equipment department of Edward Jobbins, Marquette Bldg., Chicago, handling railway, power and contractors' equipment and supplies.

The Barber Greene Co. of Aurora, Ill., announces the engagement of W. A. Buell, formerly conveyor engineer of the Goodyear Tire and Rubber Co., as sales engineer, and of H. W. Cudding, formerly general auditor of the Lyon Metallic Mfg. Co., as auditor.

The Con-Oil Tank Co. announces the opening of its Pittsburgh office, at 1215 Fulton Bldg., to facilitate the construction of concrete tanks in the Pittsburgh district. The company specializes in the construction of oil and water tanks.

The Wallace & Tiernan Co., Inc., 349 Broadway, New York City, manufacturer of "W. & T." chlorinating apparatus, has appointed David Morey, Jr., as its Southwestern representative with offices at 507 Scollard Building, Dallas, Tex.



PROPOSALS

For Proposals Advertised See Pages 65-69 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 7	Pembroke, Ont.	Feb. 6
Mar. 10	Junction City, Kan.	Feb. 27
Mar. 10	Underwood, N. D.	Feb. 27
Mar. 18	Wyandotte, Mich.	Feb. 20
Mar. 25	Jersey City, N. J.	Feb. 20
	Adv. Feb. 27.	

SEWERS

Mar. 3	Phillipsburg, N. J.	Feb. 27
Mar. 3	South Orange, N. J.	Feb. 27
Mar. 4	Buffalo, N. Y.	Feb. 27
Mar. 5	Detroit, Mich.	Feb. 27
Mar. 10	Durham, N. C.	Feb. 27
Mar. 10	Underwood, N. D.	Feb. 27
Mar. 14	Trenton, N. J.	Feb. 27

BRIDGES

Mar. 3	Bisbee, Ariz.	Feb. 6
Mar. 4	Lewisburg, W. Va.	Feb. 20
	Adv. Feb. 13 to 27.	
Mar. 5	Holdenville, Okla.	Feb. 20
Mar. 10	Walkerton, Ont.	Feb. 27
Mar. 11	Falls, Pa.	Feb. 27
Mar. 15	Charleston, Miss.	Feb. 27
Mar. 15	Montreal, Que.	Feb. 27
Mar. 20	Springfield, Mass.	Feb. 27
	Adv. Feb. 27.	
Mar. 23	Buckhannon, W. Va.	Feb. 13
Apr. 16	Ottawa, Ont.	Feb. 20

STREETS AND ROADS

Mar. 3	Indianapolis, Ind.	Feb. 6
Mar. 3	Marshall, Minn.	Feb. 13
Mar. 3	Portsmouth, Va.	Feb. 20
Mar. 3	Charleston, Miss.	Feb. 20
Mar. 3	Alexandria, La.	Feb. 27
Mar. 3	Sumterville, Fla.	Feb. 27
Mar. 3	Eutaw, Ala.	Feb. 27
Mar. 3	Coffeeville, Miss.	Feb. 27
Mar. 3	Lingwich, Que.	Feb. 27
Mar. 4	New Cumberland, W. Va.	Feb. 27
Mar. 4	Davenport, Ia.	Feb. 27
Mar. 4	Roundup, Mont.	Feb. 27
Mar. 4	Hoboken, N. J.	Feb. 27
Mar. 4	West Orange, N. J.	Feb. 27
Mar. 4	De Kalb, Miss.	Feb. 20
Mar. 4	Augusta, Ga.	Feb. 20
	Adv. Feb. 13 and 20.	
Mar. 4	Ripley, W. Va.	Jan. 23
Mar. 4	Indianapolis, Ind.	Feb. 6
Mar. 5	Alexandria, Minn.	Feb. 6
Mar. 5	San Diego, Cal.	Feb. 20
Mar 5	Brooklyn, N. Y.	Feb. 27
Mar. 5	Rhode Island	Feb. 27
Mar. 5	Mt. Holly, N. J.	Feb. 27
	Adv. Feb. 27.	
Mar. 6	Kenosha, Wis.	Feb. 27
Mar. 6	Fairmont, W. Va.	Feb. 6
	Adv. Jan. 30 to Feb. 20.	
Mar. 7	Eldorado, Ill.	Feb. 20
	Adv. Feb. 13 to 27.	
Mar. 7	Webster Springs, W. Va.	Feb. 27
Mar. 8	Indiana	Feb. 27
Mar. 8	Lincoln, Neb.	Feb. 27
Mar. 10	Lafayetteville, W. Va.	Feb. 27
	Adv. Feb. 27.	
Mar. 10	Mt. Vernon, O.	Feb. 27
	Adv. Feb. 20 and 27.	
Mar. 10	Indiana	Feb. 27

Bids Close		See Eng. News-Record
Mar. 10	Salem, N. J.	Feb. 27
	Adv. Feb. 27.	
Mar. 10	Clifton, Ariz.	Feb. 27
Mar. 10	Selma, Ala.	Feb. 27
Mar. 10	New Iberia, La.	Feb. 20
Mar. 11	Eutaw, Ala.	Feb. 27
Mar. 11	Buffalo, N. Y.	Feb. 27
Mar. 11	Michigan	Feb. 27
Mar. 12	Baltimore, Md.	Feb. 27
	Adv. Feb. 27.	
Mar. 15	Atlanta, Ga.	Feb. 27
Mar. 17	Riverside, Cal.	Feb. 27
Mar. 18	Santa Ana, Cal.	Feb. 27
Mar. 18	St. Louis, Mo.	Feb. 27
Mar. 18	Kansas City, Mo.	Feb. 27
Mar. 18	St. Louis, Mo.	Feb. 20
Mar. 22	Oregon	Feb. 27
Mar. 31	Lockport, N. Y.	Feb. 6
Mar. 31	Ottawa, Ont.	Feb. 27
Apr. 7	Moulton, Ala.	Feb. 20

EXCAVATION AND DREDGING

Mar. 4	Garner, Ia.	Feb. 20
Mar. 4	Vermilion, S. D.	Feb. 27
Mar. 5	Marshall, Minn.	Feb. 27
Mar. 10	Marks, Miss.	Feb. 27
Mar. 10	Waseca, Minn.	Feb. 27
Mar. 11	Harrisburg, Ark.	Feb. 27
Mar. 11	Rochester, N. Y.	Feb. 20
	Adv. Feb. 13 to 27.	
Mar. 13	Tyler, Minn.	Feb. 6
Mar. 19	Carthage, Ill.	Feb. 20
Mar. 19	Quincy, Ill.	Feb. 20
Mar. 20	Osceola, Ark.	Feb. 27
Apr. 8	Hollandale, Miss.	Feb. 13

INDUSTRIAL WORKS

Mar. 4	Thiells, N. Y.	Jan. 16
Mar. 5	Baltimore, Md.	Feb. 20
Mar. 10	Hibbing, Minn.	Feb. 27
Mar. 19	Brooklyn, N. Y.	Feb. 20
Mar. 20	La Crosse, Wis.	Feb. 20
Apr. 1	Sioux City, Ia.	Jan. 16

BUILDINGS

Mar. 3	Center, Colo.	Feb. 27
Mar. 3	Rockport, Ill.	Jan. 23
Mar. 3	Brooklyn, N. Y.	Feb. 20
Mar. 4	Utica, N. Y.	Feb. 13
	Adv. Feb. 20.	
Mar. 4	Wards Island, N. Y.	Feb. 13
Mar. 4	Winnipeg, Man.	Feb. 20
Mar. 10	Chicago, Ill.	Feb. 27
Mar. 14	Humboldt, Ariz.	Feb. 20
Mar. 14	Dallas, Tex.	Feb. 20
Mar. 15	Baton Rouge, La.	Feb. 27
Mar. 15	Culver, Ind.	Dec. 26
Mar. 15	Duluth, Minn.	Feb. 13
Mar. 17	Johnstown, Pa.	Feb. 20
Mar. 18	Esquimalt, B. C.	Feb. 20
Mar. 18	Esquimalt, B. C.	Feb. 27
Mar. 25	Bath, N. Y.	Feb. 27
Mar. 28	West Unity, O.	Feb. 27
Apr. 2	New York, N. Y.	Jan. 23
Apr. 10	Newaygo, Mich.	Feb. 6
Apr. 15	Newark, N. J.	Feb. 6

FEDERAL GOVERNMENT WORK

Mar. 1	Earthwork—New Orleans, La.	Feb. 27
Mar. 3	Barracks—Spec. 3733—San Diego, Cal.	Feb. 13
Mar. 3	Hospital—Baltimore, Md.	Feb. 13
Mar. 3	Post Office—Walden, N. Y.	Feb. 6
Mar. 3	Sidewalks — Washington, D. C.	Feb. 20
Mar. 3	Grandstand and Bleachers —Spec. 3795—Norfolk, Va.	Feb. 27
Mar. 3	Grandstand and Bleachers —Spec. 3795 — Hampton Roads, Va.	Feb. 27

Bids Close		See Eng. News-Record
Mar. 6	Paving — Washington, D. C.	Feb. 27
Mar. 7	Lavatory Annexes — Shiprock, N. M.	Feb. 13
Mar. 7	School and Assembly—Hall —Wahpeton, N. D.	Feb. 13
Mar. 10	Argon Production Plant— —Spec. 3800—North Ft. Worth, Tex.	Feb. 20
Mar. 10	Structural Shop—Spec. 3691 —Mare Island, Cal.	Feb. 20
Mar. 10	Railroad Extension—Spec. 3727—Ft. Mifflin, Pa.	Feb. 13
Mar. 10	School and Assembly Hall— Rapid City, S. D.	Feb. 20
Mar. 10	Condensers—Spec. 3797 — Washington, D. C.	Feb. 27
Mar. 11	Dredging — Philadelphia, Pa.	Feb. 13
	Adv. Feb. 6 to 27.	
Mar. 12	Enlarging Levees — St. Louis, Mo.	Feb. 20
	Adv. Feb. 13 to 27.	
Mar. 12	Boathouse, etc.—Charlotte, N. Y.	Feb. 20
	Adv. Feb. 13 and 20.	
Mar. 14	Hoistway, etc. — Easton, Pa.	Feb. 27
	Adv. Feb. 27.	
Mar. 15	Dredging, etc.—Nome, Alaska	Feb. 27
	Adv. Feb. 27.	
Mar. 17	Wooden Pier and Approach — Spec. 3820 — Yorktown, Va.	Feb. 27
Mar. 17	Building—Spec. 3760—Annapolis, Md.	Feb. 27
Mar. 19	Post Office, etc., Woodward, Okla.	Feb. 20
Mar. 24	Dredging — Wilmington, Del.	Feb. 27
	Adv. Feb. 27.	
Mar. 25	Remodeling Post Office, etc. —Providence, R. I.	Feb. 27
Mar. 31	Coal—Memphis, Tenn.	Feb. 27
	Adv. Feb. 27.	

MISCELLANEOUS

Feb. 28	Tractors — New York, N. Y.	Feb. 27
Mar. 3	Dock—Seattle, Wash.	Feb. 20
Mar. 3	Miscellaneous Supplies — Hamilton, Ont.	Feb. 20
	Adv. Feb. 13 and 20.	
Mar. 3	Riprap—Shakopee, Minn.	Feb. 20
Mar. 4	Road Material — Newark, N. J.	Feb. 20
Mar. 5	Seawall—Detroit, Mich.	Feb. 27
Mar. 5	Road Oil and Tar—Clayton (St. Louis P. O.), Mo.	Feb. 20
Mar. 6	Stone and Screenings—New York, N. Y.	Feb. 27
Mar. 6	Cocks—New York, N. Y.	Feb. 27
Mar. 8	Pipes—York, Ont.	Feb. 27
Mar. 10	Elevated Roadway — Portland, Ore.	Feb. 27
Mar. 11	Miscellaneous Supplies — Newark, N. J.	Feb. 27
Mar. 14	Electric Fixtures—Hudson, N. Y.	Feb. 27
Mar. 14	Radial Chimney — Sarnia, Ont.	Feb. 27

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

N. Y., New Rochelle—City retained Gannett, Seelye & Fleming, engrs., 204 Locust St., Harrisburg, Pa., to make investigations and report on value, needed improvements, etc., of New Rochelle Water Co.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, MARCH 6, 1919 — Number 10

Controlling and Using Colorado River Floods

FOR good or for evil, the possibilities of the Colorado River are great. Uncontrolled, that mighty stream may in any year surpass its ravages of the past and return the now fruitful Imperial Valley to a desert region—hopelessly irreclaimable should channel changes make irrigation impossible. With the river controlled, the future of the Imperial Valley will be insured and its possibilities increased. In addition, other areas may be made to produce bountiful crops, and vast water powers made possible. A storage project for achieving this, but with its more immediate aim to prevent floods and utilize water at and near Yuma, is outlined on p. 456 by one of the hydraulic engineers of the United States Geological Survey. His story compels interest. His closing plea for additional funds for more study of the Colorado problem deserves attention.

Making Supporters Through Committee Work

ONE of the wholesome signs in engineering society activities is the broadening of committee work. With the tendency to become interested in local civic affairs there is the inevitable consequence that committees on various civic activities will be appointed. These give opportunity for those who for a variety of reasons have abstained from service on technical committees. Thus, the interest in the society is broadened by bringing into activity a larger percentage of the society's membership. The same movement is in evidence in the Engineering Council. Its national service and licensing committees are composed of engineers widely scattered geographically. Moreover, they are not members of the council. One of the certain ways of making staunch supporters for an institution is to put inactive men to work.

Sound Practice in Bridge Detailing

BRIDGE engineers and detailers will be well repaid by a careful reading of Mr. Godfrey's letter to the editor in last week's issue, p. 441, and the reply by Mr. Metzger, published on p. 486 of this issue. One of the most important results of recording details of such bridges as that at Salem, Ore., here under discussion, lies in the constructive criticism thus developed. Mr. Godfrey has pointed out details considered to violate principles of sound engineering practice. Mr. Metzger would justify eccentric load application by "architectural requirements," and explain the use of bent members and connection plates virtually by appealing to the "factor of ignorance." Most engineers will agree that the joint detail at the rocker support of the pony span is an example of questionable practice. Whether or not an attempt was made to approximate to actual stress conditions in the several cases to which Mr. Godfrey refers, the lesson in this discussion for bridge detailers is plain: While mathematical analysis based upon fair fundamental assumptions can always be utilized for more or less exact knowledge of stress conditions, the best practice would avoid altogether details that involve eccentric loading or bring large torsional stresses to bear on bridge members.

Federal Government Has No Public-Works Policy

FOUR months after the armistice was signed, the President of the United States admits that the administration has no policy of reconstruction, in so far as that word applies to labor or public works. That is the only interpretation to be put upon Mr. Wilson's remarks to the Governors' and mayors' conference in Washington Mar. 3. "The primary duty of caring for our people in the intimate matters that we want to discuss here," he said, "falls upon the states and municipalities, and the function of the Federal Government is to draw the executive minds of the country together, so that they may profit by each other's suggestions and plans, and so that we may offer our services to coördinate their efforts in any way that they may deem it wise to coördinate." Clearly, this puts it up to the states, the counties and the cities. Public work must be started at once if the initial push to industrial activity is not to be delayed. Everyone seems agreed on this, but no one—or at least hardly anyone responsible—is doing much more than to accept it as a proper policy. When at this rather late day the Federal Government called together a conference of the Governors and mayors there seemed hope that some definite centralized scheme for action would be presented by which the states and cities might be encouraged to go ahead, and to go ahead immediately. Such a hope, apparently, is not to be realized. Instead, there is merely a continuance of the mild encouragement that has marked so much of the recent Department of Labor publicity bulletins, and optimistic expectation of some universal panacea arising from the conference. Whatever else the visiting mayors and Governors get out of the final two days of the meeting, they may be sure, after attending the first day, that they will have to go back home determined each to work out his own salvation.

Another Step Toward Society Coöperation

ANOTHER step and a long one toward uniting the engineering profession by coöperation between national and local engineering societies has been taken. The first advance was made last year, when the Cleveland Engineering Society adopted a plan for intermembership with the national engineering societies. Similar overtures were made soon after by the Engineers' Society of Western Pennsylvania. After a lapse of some months the American Society of Mechanical Engineers does itself and the profession the credit of meeting the local society proposition half way. Very properly, the first union of the mechanical engineers will be with the Cleveland Engineering Society. The elements of the plan are given on p. 495. It is not to be expected that the national societies will make similar arrangements immediately with all the local societies of the country, for in such departures it is best to make haste slowly, and in this particular case it will be necessary to weigh carefully the aims and accomplishments of each local society before according to it joint membership in the national societies.

Highway Builders in A. E. F. Needed Here

AN APPEAL that will get universal support in engineering and construction circles was made in a resolution passed last week at the convention of the American Road Builders' Association. It authorized the appointment of a committee to lay before the officials of the Government the urgent need, in the interest of highway work, to return to this country at once the road builders enlisted with the overseas forces. Highway departments and highway contractors' organizations throughout the country are short of experienced men. Under any war condition this would have been true, but the trouble is aggravated in the road-building field because of the strenuous campaign waged to get volunteers who were *competent to act as foremen and superintendents*, particularly for the Twenty-Third Engineers. It was set forth that pick and shovel workers were not wanted, but rather those who could direct work. Due to this appeal, a magnificent body of men was recruited. They are now sorely needed, particularly in view of the imminence of a heavy highway-construction program. Efficient handling of work depends on having an adequate force of men capable of directing operations. Therefore, highway engineers and contractors, deprived of the needed services of the men in the Army, should support the appeal of the road-builders' association, and urge upon the War Department the very great necessity of an immediate return of the road-building forces.

Nature Promotes Better Highways

SELDOM has there been such a swing of opinion away from earth roads as exists in Iowa today. The Governor has turned around completely, and is now an ardent advocate for hard surfaces. Nature, not to be outdone, has this year been so prodigal with heat units that the dirt roads during the winter have been practically impassable. Light graveled roads have been cut through, and under heavy hauling the best gravel has shown signs of utter destruction. Commenting on the situation, the *Service Bulletin* of the Iowa Highway Commission says: "Scores of the people who were the most enthusiastic advocates of the earth road as sufficient for Iowa's needs have lost patience and have come to the conclusion that it is a waste of energy to continue further on such a policy. Most of the county systems have reached a stage where the dirt surface has every advantage of good grade, good surface and good underdrainage. There has also been the advantage of fairly persistent dragging. If earth roads are ever going to be entirely satisfactory for heavily traveled roads, they have been given every chance in Iowa the last few years. With the grades built and drainage taken care of, the next logical step, if the dirt surface fails, is to put down a strip of hard surfacing." This is sound doctrine.

Railway Bridge Impact Allowances

TAKING proper account of the effect of moving trains on bridges—a crucial problem since the earliest days of the iron bridge—will reach a new stage of progress if the American Railway Engineering Association adopts the impact formula which it has had as a tentative standard for several years. The formula invites confidence, since it is based on tests to determine the stress increase caused by the motion of a train. Unfortunately, bridge men of wide experience raise certain objections to its practical value, and this latter, of course, is the real touchstone.

As compared with the earlier standard, the widely used empirical formula $I = 300/(L + 300)$ of the late C. C. Schneider, the new one will give higher impact values for short spans and very much lower values for long spans. Both effects are of questionable value.

Not only does the new formula demand higher impact allowance for short spans when L, the length, is taken at the same figure, but it adds to this effect in the case of main girders of bridges carrying two or more tracks. The old formula took L as the loaded length which produces maximum stress, and thus automatically reduced the impact tax on a multitrack bridge. The new formula, taking L as the span length, imposes severer requirements, which are only partly relieved by the provision of live-load reduction factors for multi-track bridges. It results herefrom that more metal will have to be used in bridges shorter than 100-ft. span.

But these, in modern practice, are plate-girder spans. Floor systems, which are also affected, are likewise of plate-girder construction. No type of bridge, it is safe to say, has given better account of itself, in many years of experience, than the plate-girder span. If this type is now to be penalized by a higher impact addition, is the procedure to be regarded as logical or in the interests of economy? It is true that floor systems have often shown weakness, but this was due to increased engine weights and not to impact. The fact remains that plate-girders, our most robust steel members, do not need the further increase of metal which the new formula will require.

Applied to long spans, on the other hand, the new

formula gives remarkably low figures, 5 to 15% impact in place of the 25 to 40% which the old formula yielded. At first sight this is an improvement, for no one believes that 30% impact really occurs in the main members of a 700-ft. span; the 6% which the new formula demands is more logical. However, true impact is not the only action that an impact formula must cover.

Whether we wish it or not, we actually provide by the impact formula for all live-load effects, of whatever nature, even though they may not be measurable as axial stress increments. The formula, further, must serve as a blanket allowance to cover the secondary stresses. For a long time to come, secondary stresses will be computed only for extraordinary spans, and even here the reliability of the calculations is doubtful.

Briefly stated, the fact is that under the methods of today the impact formula constitutes the only discrimination between the effects of a moving train on a real bridge and the effects of dead weight on an ideal bridge. Do these effects differ by only 5 or 6%? Unless this allowance does actually cover all live-load effects and their secondary stresses—always more severe than dead-load secondaries—the new formula will have the rather curious result of permitting a higher working-stress for live load than for dead load. In this aspect the operation of the old formula is manifestly fairer.

We have quoted these practical considerations rather fully because the matter of impact increments touches very closely some of the problems at the core of bridge design. The subject is complex; but its practical aspect is more simple, and this, we believe, is controlling.

The objections offered from the standpoint of practice do not question the theoretical excellence of the formula or the merits of the investigations on which it rests. They are concerned solely with the service value of the formula and with its influence on the efficiency of bridge design, and they claim attention accordingly.

Need for a National Technical Highway Association

LAST week the American Road Builders' Association drew to its convention a representative and interested group of highway engineers and builders from the Eastern states. Ohio was represented, as well as the Southern states, but, on the whole, the description of the gathering as an Eastern meeting is correct. The association is now the only one in the highway field which devotes itself to technical matters and professes a desire to be national in scope. There is need for such a national body, but whether the American Road Builders will be that association is doubtful.

In the first place, it is on a false basis so far as technical strength goes; it admits material and machinery manufacturers and salesmen on the same basis as engineers and contractors. Second, the Eastern dominance that has restricted the organization in the past is as strong as ever, and is not likely to be abated. The geographical representation in the directorate is wide, but it is scenic rather than active.

It may be seriously questioned whether an organization with headquarters in New York can become the national association of road builders. The gravitation toward New York, natural in some industries and professions, does not obtain in the case of highways. New York may be more important to the banker, the manufacturer, the importer, the engineer, than any other city in the country but the logical headquarters for a national road-builders' association is near the population center. Doubtless similar reasoning located the Associated General Contractors of America in Chicago.

But even if there is no immediate effort to establish a national association in Chicago we do not expect the American Road Builders' Association to be anything but an Eastern organization—unless there should come a sharp break with its traditions and management.

All of which points to the need for a strong technical highway association of national scope, and does not detract from the fact that last week's convention was a good one and that as an Eastern organization the American Road Builders' Association can be of much value to road builders and the road-building art.

How Much Education For Minor Engineering Positions?

MR. GOODELL'S letter on p. 482 of this issue sounds a new note in the current discussion of engineering compensation. His thought, in brief, is this: Men should not be educated beyond the jobs they are likely to hold. Conversely, every man who goes through a technical school feels he has a guarantee that he will be given a prominent position at free-from-worry compensation. Consequently, if the busy world refuses to make good the guarantee the individual feels that he has been victimized. For remedy, Mr. Goodell proposes that for the minor positions in engineering—such as surveying, inspection and the simpler jobs in designing—there be high-school (or trade-school) courses.

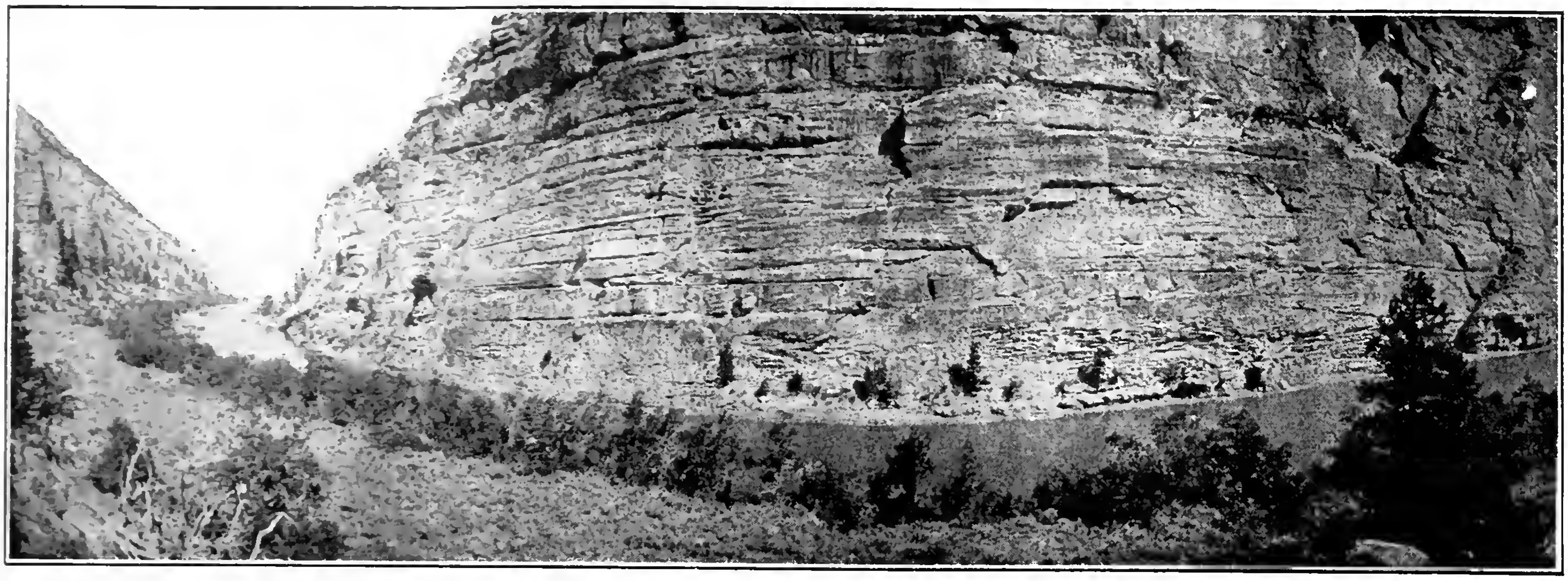
Here surely is much food for thought. The suggestion fits in with the theory of the technician courses given by the Army during the war to prepare airplane mechanics, concrete workers, etc. Moreover, its purpose is similar to that of the plan for two-year courses in engineering in technical schools. Such courses would be elected by those unable, for financial or other reasons, to stay for four years, or whose ability fitted in better with quite narrow specialization than with the broader work for which a four-year course is a preparation.

To Mr. Goodell's plan less objection will probably be made than to the two-year college courses here suggested, for many who see the wood-hewing and water-drawing character of numberless minor positions on engineering work will protest vigorously against any plan that might seem to lower engineering standards. In our judgment, however, engineering standards are lowered more by having within the profession a lot of discontented men than by instituting short, highly specialized courses. Both plans are in the interest of human conservation. Neither controverts the ideas of the Mann report. In fact, by the method of testing Dr. Mann proposes it may eventually be possible to determine which men had better stop at the high school and which might with profit spend two years in college. Mr. Goodell's plan, to be workable, requires that engineers recognize the correctness of his analysis and endeavor to divert from college those who had best stop their work on completing the high-school course.

Colorado River Flood Control by Storage

Reservoirs at Available Sites Would So Cut the Flood at Yuma as to Safeguard the Imperial Valley—Water-Power and Irrigation Opportunities—A Hundred More Gaging Stations Needed

By E. C. La Rue
Hydraulic Engineer, United States Geological Survey, Pasadena, Cal.



HORSESHOE CANYON OF THE GREEN RIVER IN UTAH, SHOWING FLAMING GORGE DAM SITE AT THE LEFT
A dam here with a spillway 255 ft. above low water would form a reservoir extending well up into Wyoming with a capacity of 4,720,000 acre-feet.

STORAGE on the Colorado River would control the floods which threaten the Imperial Valley. Great power and irrigation possibilities might also be developed by dam building and storage. In a broad political sense, the problem is a large and complicated one, because it involves not only seven large states but also the Republic of Mexico. This article will be devoted chiefly to flood control by storage, but some consideration will also be given to the other aspects of this great stream.

The Colorado is formed by the junction of the Green and Grand Rivers in southeastern Utah. It flows in a southwesterly direction across northwestern Arizona, and forms the boundary between Arizona and the States of Nevada and California. The Green, which rises in the Wind River Mountains in Wyoming, drains an area of 44,400 square miles. The Grand rises on the western slope of the continental divide in central Colorado, and drains an area of 25,900 square miles. Including the Green, the entire length of the Colorado River is 1700 miles. The total fall from source to mouth is more than 14,000 ft. The drainage basin of the Colorado (244,000 square miles) comprises the southwestern part of Wyoming, the eastern half of Utah, the western part of Colorado, practically all of Arizona, and small portions of California, Nevada, New Mexico and Old Mexico. Most of this area is arid. The streams receive their main supply from the melting snow from the high mountains of Wyoming, Utah and Colorado.

Irrigation and Water-Power—Some of the largest irrigation, storage and water-power projects in the Western United States are in the Colorado River basin. When these projects are completed, probably more than $100,000,000 will have been expended. Considering the basin as a whole, the area irrigated in 1913 was about 1,600,000 acres. By proper regulation and control of the water-supply the irrigated area in the basin may be increased to about 7,000,000 acres.

The present developed water power in the Colorado River basin is about 76,000 hp. The total undeveloped water power may exceed 3,000,000 horsepower.

Flood Control—That the floods of the lower Colorado should be controlled was shown by the writer in his report, "Colorado River and Its Utilization," published by the United States Geological Survey as Water-Supply Paper 395.

The elevation of the water surface of the Colorado River at Bulls Head Rock (see map) is 500 ft. above sea level. The distance by river between Bulls Head Rock and the Gulf of California is 370 miles; the average fall in this section of the river, therefore, is 1.35 ft. per mile. Between Bulls Head and Yuma, Ariz., about 200,000 acres of irrigable land are subject to overflow during periods of high run-off. From Yuma to the Gulf the river flows through its delta, which is made up of silt brought down and deposited during past centuries. At low stages the river winds through the delta in a channel fairly well defined by banks 10 to 12 ft. in average height; at high stages it overflows its banks at many points. After the river has flowed in one channel for a number of years, its bed and banks are built up by silt deposits, until the stream itself occupies a ridge on the delta. As the slope of the delta is greatest toward the north and west, the river during flood periods is continually seeking a new channel to Salton Sea. Several million dollars have been expended by private interests and the Federal Government in constructing more or less temporary levees and protective works to prevent overflow of the Colorado into Salton Basin. The value of the property in Imperial Valley subject to injury by overflow has been

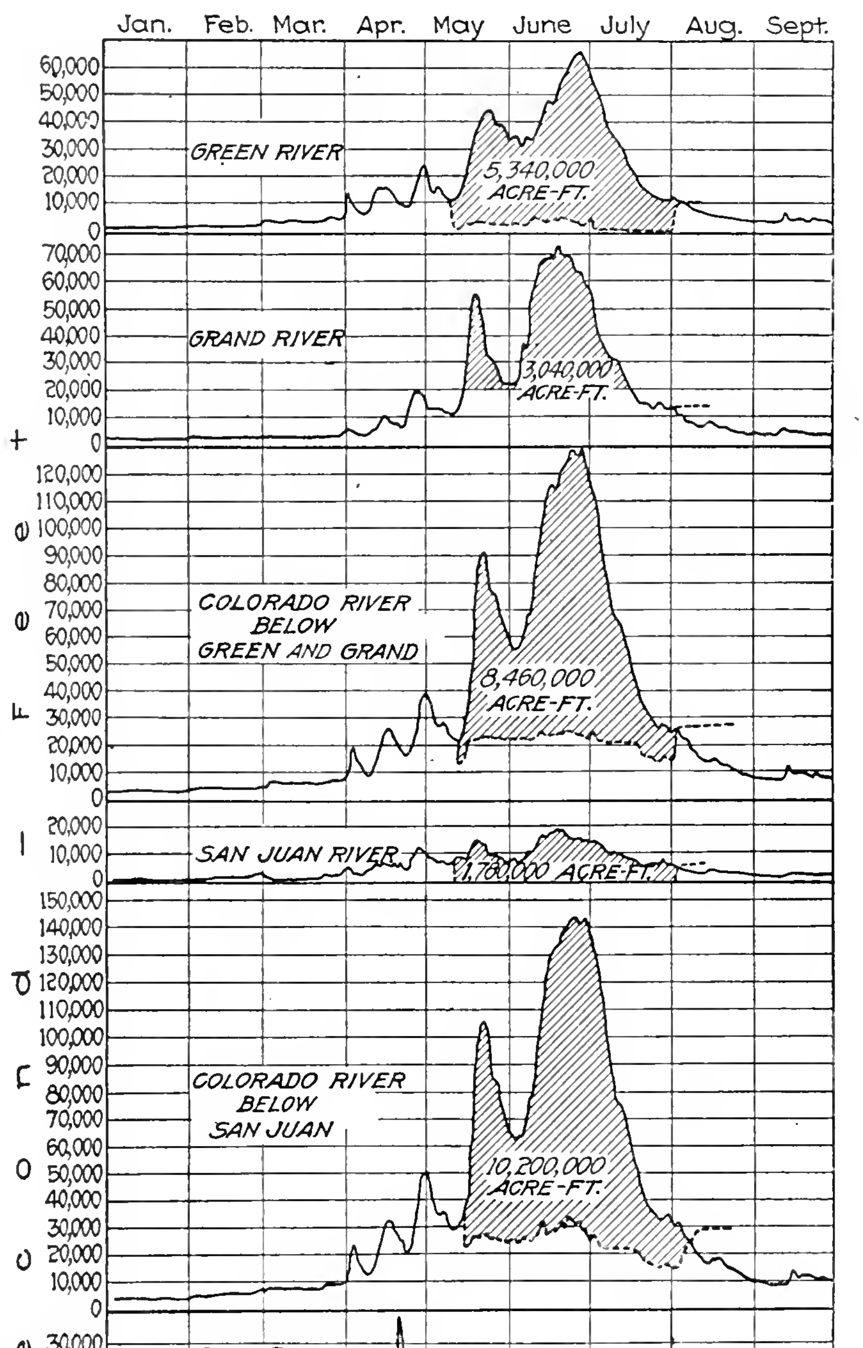
PROPOSED FLOOD-CONTROL RESERVOIR SITES IN THE COLORADO RIVER BASIN

variously estimated at $30,000,000 to $50,000,000. Between Bulls Head Rock and the international boundary are properties valued at $10,000,000 to $15,000,000, which also need protection from the floods of the Colorado.

Obviously, no amount of levee construction and bank revetment will prevent high-water stages on the lower Colorado, and if floods are not prevented thousands of dollars must be expended annually in maintaining protective works on the river below Bulls Head Rock. For the control of the extremely high stages only one method is available—the construction of properly located storage reservoirs of sufficient capacity to hold back the flood-making waters. If by this means all or the greater part of the overflow is prevented, the lands along the lower river can be adequately protected by bank revetment, and the cost of maintaining protective works will have been reduced to a minimum.

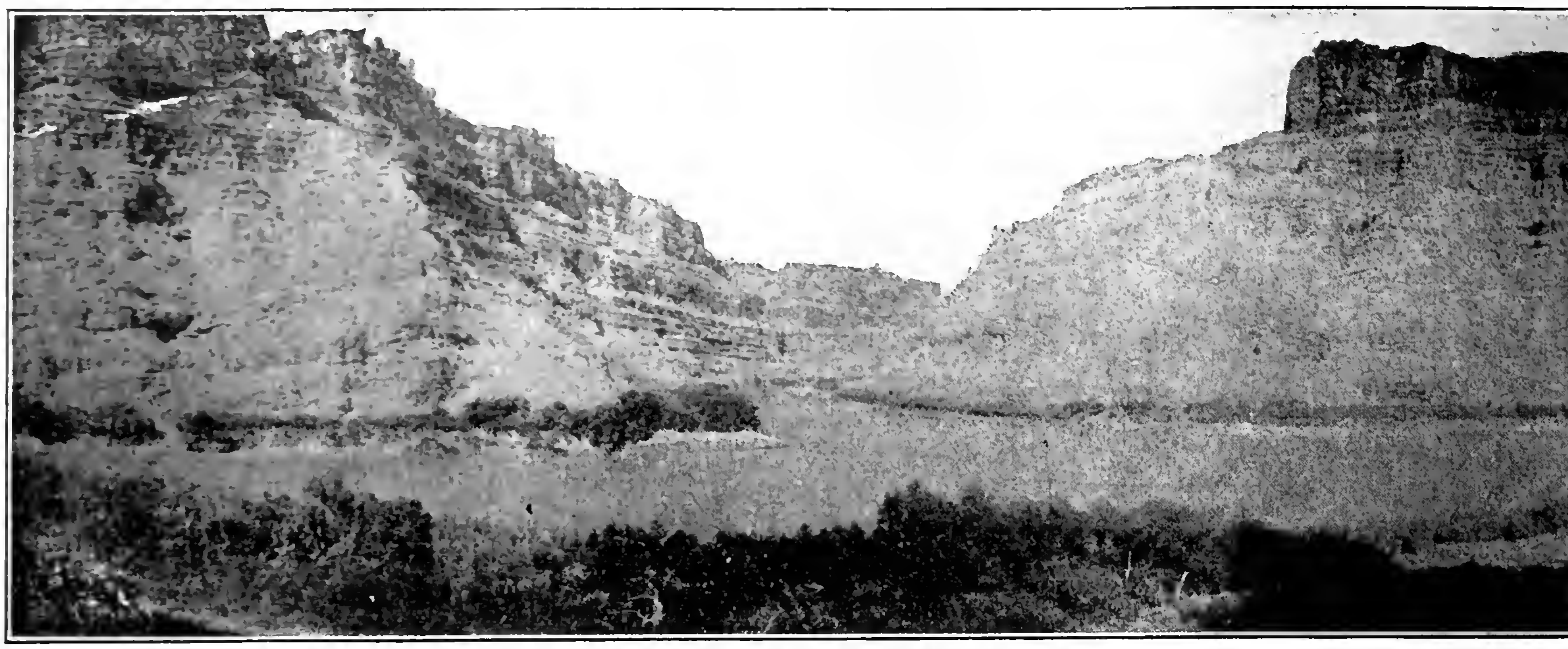
Prominent engineers have expressed the opinion that the influence of reservoirs on flood prevention rapidly diminishes down stream, and the influence of levees correspondingly increases in importance as a method of flood protection, and that for the lower alluvial reaches of long rivers, such as the Mississippi and Colorado, levees afford the only sure means of flood control.

The foregoing statement is not correct when applied to the Colorado River. Although the Colorado, including the Green, is 1700 miles long, and drains an area of 244,000 square miles, the precipitation and run-off from the lower half of the basin is small compared with that from the upper half. At Yuma, Ariz., 92% of the annual run-off is contributed by that part of the drainage basin above the Utah-Arizona line, which is 700 miles above Yuma. The Green and the Grand Rivers, which unite to form the Colorado, drain 70,300 square miles, which is only 28% of the Colorado River basin;



DAILY FLOW OF THE GREEN, GRAND, SAN JUAN, GILA AND COLORADO RIVERS FROM JAN. 1 TO SEPT. 30, 1917

The irregular curve represents the daily flow at each river station. During February the flow at Yuma was less than 10,000 sec.-ft., except during the last two days; during the first four days in July the flow was more than 140,000 sec.-ft. The shaded area on the chart shows the part of the flood that might have been stored in reservoirs. The dotted line below the shaded area indicates the flow resulting from such storage. The chart shows that at Yuma the flood flow could have been reduced from 143,000 to 33,000 second-feet.



JUNCTION OF THE GREEN AND GRAND RIVERS IN UTAH AT OR NEAR PROPOSED DAM SITE

A reservoir with a capacity of 8,600,000 acre-ft., extending for many miles up both rivers, could be formed by a dam with a spillway 270 ft. above low water. Such a reservoir, with a 2,000,000-acre-ft. reservoir on the San Juan River, would have reduced to 25,000 sec.-ft. the flood flow of the Colorado at Yuma in 1917.

yet these rivers contribute 76% of the water that passes Yuma. The junction of the Green and Grand Rivers is 1000 miles above the Gulf of California.

As a result of investigations made by engineers employed by the Federal Government, sufficient data are available to show that there are reservoir sites properly located and with sufficient capacity to hold back the flood-making waters. Some of the more important reservoir sites are shown on the accompanying map. The capacities of these sites, all of which can be utilized, are given in the following table:

Name of Site	Elevation of Spillway Above Low Water, Ft.	Capacity, Acre-Feet
Flaming Gorge	200	2,600,000
Flaming Gorge	255	4,720,000
Juniper Mountain	200	1,600,000
Ouray	170	8,000,000
Ouray	190	10,000,000
Ouray	220	15,000,000
Green-Grand	180	3,330,000
Green-Grand	200	4,250,000
Green-Grand	240	6,460,000
Green-Grand	270	8,600,000
Kremmling	100	574,000
Kremmling	150	1,240,000
Kremmling	200	2,200,000
Bluff	214	1,600,000
Bluff	264	2,600,000

The utilization of the Colorado River presents a complicated problem: The extreme floods must be prevented, water must be stored for irrigation, and at many points it may be desirable to regulate the flow for power development. The value of each site and the capacity to which it should be utilized will be determined by a study of the problem as a whole. Each large undertaking should be but a unit of the great project which, when completed, will result in the utilization of the entire water resources of the Colorado River basin.

The Colorado River Flood of 1917—During the winter of 1916-17 the snowfall in the upper basin of the Colorado River was unusually heavy. The spring of 1917 was cool. On May 10 the upper tributaries began to rise, and the automatic water-stage recorders maintained by the United States Geological Survay gave warning that the flood period was near. Fourteen days later the flow of Green River increased to 42,400 sec.-ft., and reached its maximum discharge of 65,900 sec.-ft. on June 27. The maximum flood flow of the Grand River —73,200 sec.ft.—occurred June 19-21. On June 28 the peak flood of 129,000 sec.-ft. occurred immediately below the junction of the Green and Grand Rivers. The San Juan River contributed 18,700 sec.-ft. on June 17, and with the unrecorded flow of the Frémont and Escalante Rivers, the maximum flow of the Colorado River at the Utah-Arizona boundary reached about 147,000 sec.-ft. June 25. The maximum discharge for the year at Yuma, 143,000 sec.-ft., was recorded July 4. This was one of the greatest summer floods ever recorded on the lower Colorado. The levees were overtopped in the vicinity of Needles and near Volcano Lake, in Mexico.

It will be interesting to analyze the stream-flow records and determine to what extent the flood of 1917 could have been prevented by means of storage. A chart has been prepared on which the daily discharge of the Colorado and its principal tributaries is shown for the period of Jan. 1 to Sept. 30, 1917.

The flow of Green River was obtained by adding the flow of San Rafael River to the recorded flow of Green River at Little Valley, Utah. These stations are about 90 miles above the mouth of the Green. The gaging station on Grand River is near Cisco, Utah, about 90 miles above the junction of the Green and Grand Rivers. No tributaries of appreciable size join the Grand River below the gaging station near Cisco. During the flood stage it requires about 24 hours for the water to flow to the junction of the Green and Grand Rivers from the gaging stations above mentioned. The combined flow of the Green River at Little Valley, the San Rafael near its mouth, and the Grand at Cisco, represents with fair accuracy the flow of the Colorado immediately below the junction of the Green and Grand Rivers. By adding the flow of the San Juan River, the discharge of the Colorado below the mouth of the San Juan is obtained. This latter record, as shown on the chart, is approximately correct, except that the flow of the Frémont and Escalante Rivers has not been added. No record was kept of the flow of these streams, but it is

unlikely that they increased by more than 3000 sec.-ft. the maximum flood of the Colorado. The daily discharge of the Gila River was placed on the chart to show that this tributary was dry while the Colorado was in flood from June 5 to Aug. 1.

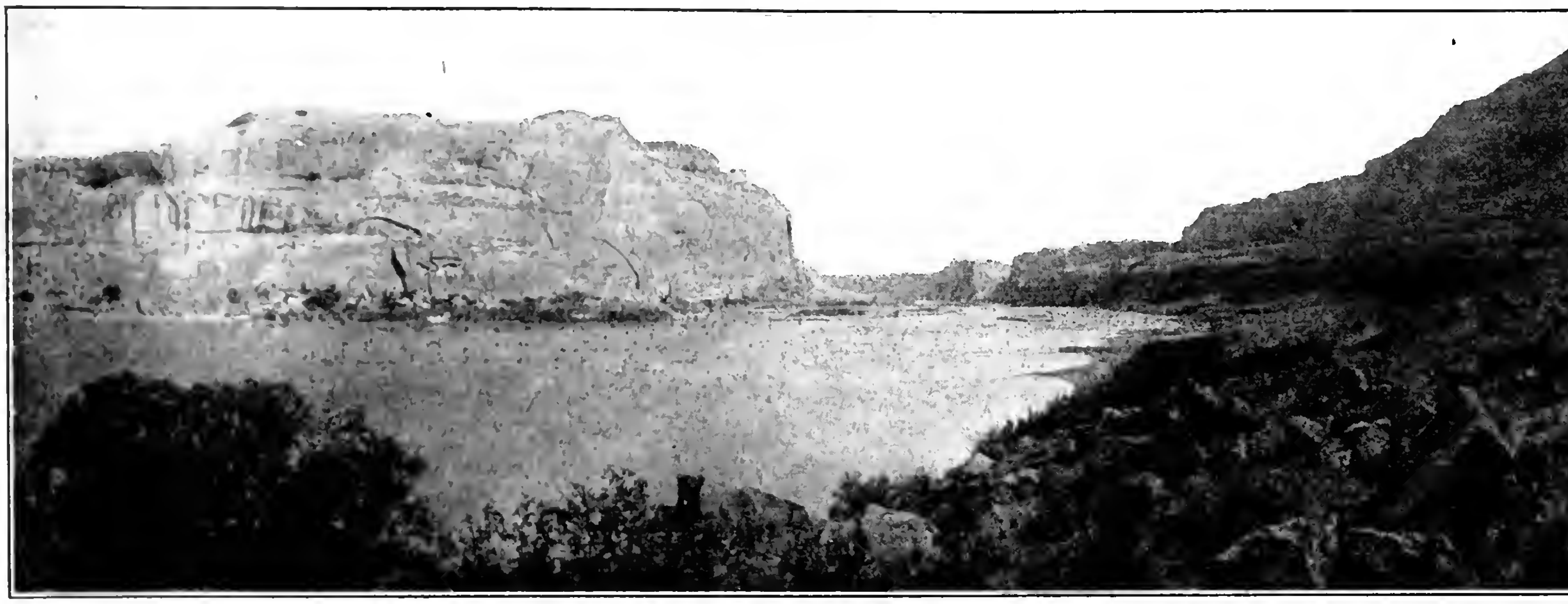
There is a reservoir site on the Green River at Ouray, Utah, where a capacity of 10,000,000 acre-ft. may be obtained by raising the water level 190 ft. The capacity of this site is much greater than that required to control completely the flow of Green River below the mouth of the Duchesne and White Rivers. Had this reservoir been in operation in 1917, the portion of the flow of Green River shown by the shaded part of the chart could have been stored. The peak flood of Green River at its mouth would have been reduced from 65,900 to 5200 second-feet.

Only preliminary data are available relating to the possibilities of storage on the lower Grand River. It is believed that there is a feasible dam site on Grand River a few miles above its mouth, where a capacity of 3,000,000 acre-ft. may be obtained, and there is another storage basin on Grand River near the mouth of the Dolores. The Kremmling site, near the headwaters of the Grand, affords storage capacity of 2,200,000 acre-ft. for a dam 230 ft. in height.

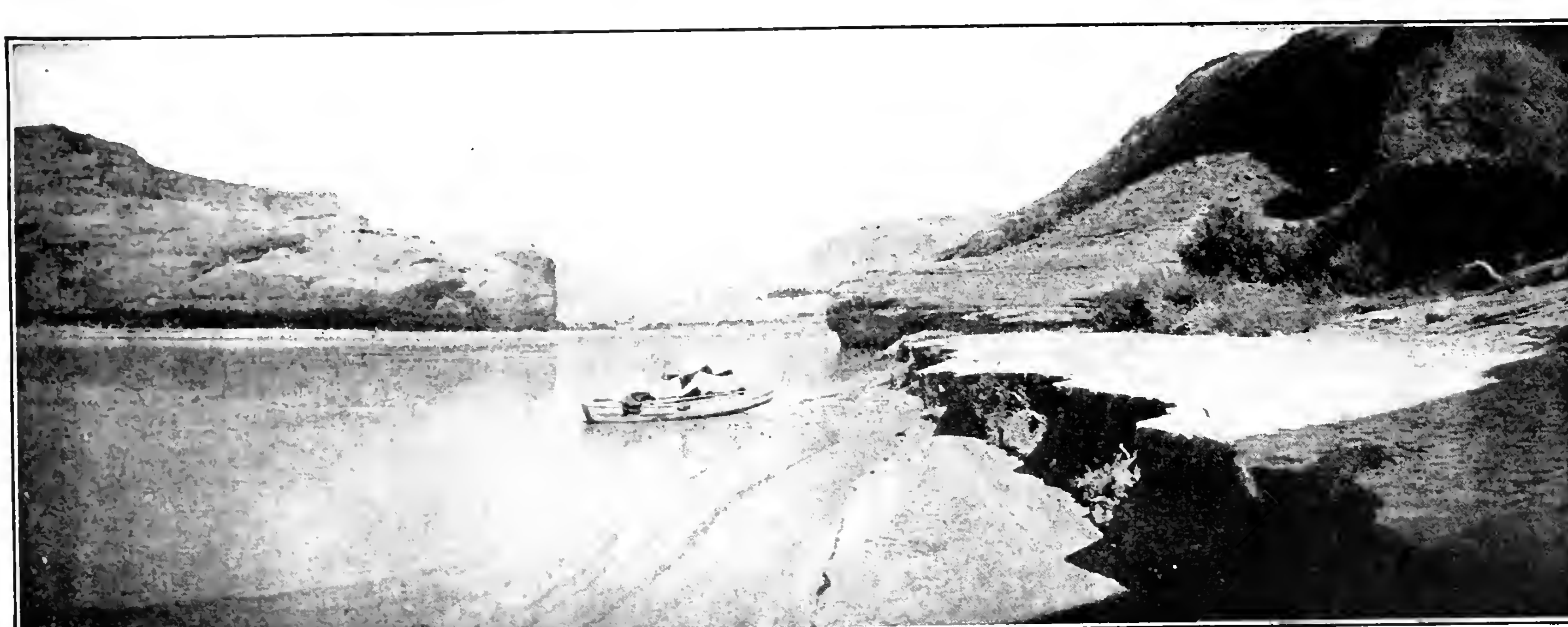
The writer has taken a pessimistic view of the possibilities of storage on the lower Grand, and has assumed that it would be necessary to allow 20,000 sec.-ft. to pass so that the capacity of the reservoirs would not be overtaxed. Under this assumption, the flood flow of the Grand River could have been reduced from 73,200 to 20,000 sec.-ft. by the storage of 3,040,000 acre-feet.

On the San Juan River, near Bluff, Utah, a dam 264 ft. high would give a storage capacity of 2,600,000 acre-ft. As shown by the chart, the entire flow of San Juan River could have been cut off during the flood period, and the amount of water stored would have been 1,780,000 acre-ft., or 920,000 acre-ft. less than the capacity of the reservoir. The San Juan is silt laden, and it may be necessary to build retarding basins on this stream.

Referring again to the chart, the shaded portion shows that part of the flood flow at Yuma which could



BEDROCK REACHES THE SURFACE FROM SHORE TO SHORE AT NO OTHER KNOWN POINT ABOVE THE GRAND CANYON
This point is 21 miles above the Escalante River and 100 miles below the junction of the Green and Grand Rivers



THERE IS A HEAVY SILT DEPOSIT 12 MILES BELOW THE MOUTH OF THE SAN JUAN RIVER
This and the other pictures shown were taken by the author while making a boat trip through the cañons of the Green and Colorado Rivers in 1915.

have been held in storage reservoirs in the upper basin. The unshaded area below the dotted line shows the regulated flow. The maximum flood at Yuma could have been reduced from 143,000 to 33,000 second-feet.

By the building of a dam below the junction of the Green and Grand Rivers that would raise the water level 270 ft., a reservoir having a storage capacity of 8,600,000 acre-ft. could be created. By the utilizing of this site to its full capacity, and the Bluff reservoir site on San Juan River to a capacity of 2,000,000 acre-ft., the flow of the Colorado at Yuma during the flood period of 1917 could have been reduced to less than 25,000 sec.-ft. It is thus seen that by the utilizing of two reservoir sites the floods of the lower Colorado may be prevented. The site at the junction of the Green and Grand Rivers is known as the Green-Grand reservoir site and is described in Water-Supply Paper 395, issued by the United States Geological Survey.

About 100 miles below the junction of the Green and Grand Rivers there is a section where solid rock extends across the channel of the Colorado River. This is the only point on the Colorado above the Grand Cañon where bedrock is known to extend across the channel at the surface. This dam site may prove valuable at some future time in connection with the development of storage and water power. Instrumental surveys have never been made on this section of Colorado River. The amount of silt carried by the Colorado at this point is comparatively small. San Juan River contributes the greater part of silt found in the Colorado above Grand Cañon.

The above data are submitted as proof that by utilizing two reservoir sites, or a combination of three or four sites, the summer flood on the lower Colorado in 1917 could have been prevented.

The sudden floods from the Gila River will always be a menace to the water users below Yuma unless these floods are controlled by storage in the Gila basin.

With the flow of the Colorado placed under control by storage, the cost of maintaining the levees will be reduced to a minimum and an adequate supply of water for irrigation will be available for all time. Some water power may be developed at the storage dams, and new lands may be placed under irrigation in the upper basin. As a result of storage, the water-supply would be sufficient at all times to meet the demand for the irrigation of more than 2,000,000 acres of new lands on the lower river.

Emergency Storage Dam at Bulls Head Rock—During the summer of 1906 the Colorado River changed its course and flowed north into Salton Basin. The break was not closed until February, 1907. The cost incidental to closing the break and the damage to property in the Imperial Valley amounted to several million dollars. With the exception of construction of levees and works protecting the banks, nothing has been done to prevent the recurrence of this catastrophe. A sudden summer flood from the upper Colorado may overtop the levees at any time. With their lands and homes below sea level and the Colorado flowing on a ridge in the delta above them, the people in the Imperial Valley cannot feel secure until every precaution has been taken to prevent overflow and to keep the river in the channel leading to the Gulf of California.

It was the floods from the Gila River that overtopped the levees and caused the break in 1905. These floods are of short duration, rarely lasting more than a few days, yet the break was not closed in time to prevent the summer flood water from the upper Colorado from flowing north into Salton Basin. If it had been possible to shut off the flow of the Colorado for a period of two weeks, the break could doubtless have been closed if a railroad trestle had been constructed across the crevasse and cars loaded with rock had been in readiness. The writer believes that by the utilization of an emergency storage dam at Bulls Head Rock the river below the Imperial Canal heading can be made dry at any time for a period of three weeks when the stage of the river is 10,000 sec.-ft. or less. With such a dam in operation the Colorado might flow north into Salton Basin for a short period but not for two years.

A dam could be constructed at Bulls Head, designed primarily for the diversion of the river at the 20-ft. level for the irrigation of about 56,000 acres, but carried high enough to store water to the 60-ft. level. The storage capacity between the 20-ft. and 60-ft.

COLORADO RIVER CANYON EIGHT MILES ABOVE LEE FERRY, ARIZ., WHERE WALLS ARE ALMOST 1500 FEET HIGH

levels is 243,000 acre-ft. If a break in the levee should occur below the heading of the Imperial Canal during the summer floods, preparation for closing it could be made while the river was still flowing into Salton Sea, and when the discharge had fallen to 10,000 sec.-ft. the spillway and canal head gates at Bulls Head could be closed. The Palo Verde, Imperial and Yuma canals could take care of 5000 sec.-ft., and the remaining 5000 sec.-ft. could be stored for 24 days, during which time the river channel at the break would be dry and the break could no doubt be effectively repaired. The capacity of the reservoir above the 20-ft. level would not be impaired by the deposition of silt, for it would be used as a storage reservoir only in an emergency and for a short period.

A Complicated Problem—The Colorado is not only an interstate but an international stream. The Federal Government, in coöperation with the seven states affected, should formulate plans for the collection of engineering, stream-flow, and water-right data in order that the meager information now available may be increased as rapidly as possible. The interests of each state affected should be taken care of, and there should be a thorough understanding between the United States and the Republic of Mexico regarding the use of the waters of the lower Colorado.

The most neglected part of the investigations of the Colorado River is the collection of stream-flow data. A knowledge of the flow of the main stream and all its tributaries is of primary importance. The amount of water available for the various irrigation, storage and water-power projects must be known before the value of these respective projects can be determined. Especially does this apply to the large storage reservoir sites in the upper basin. The relative value of these sites will depend largely on the volume of the floods and the annual run-off available for storage.

Time is required to collect dependable stream-flow data. The longer the record the more valuable. A hundred or more new gaging stations should be established and a fund of at least $50,000 should be available annually for carrying on this work.

Wider Pavements Needed by Motor Vehicles at Curves

Theoretical Width Determined by Formula—Chart of Necessary and Recommended Widths Plotted for Various Radii

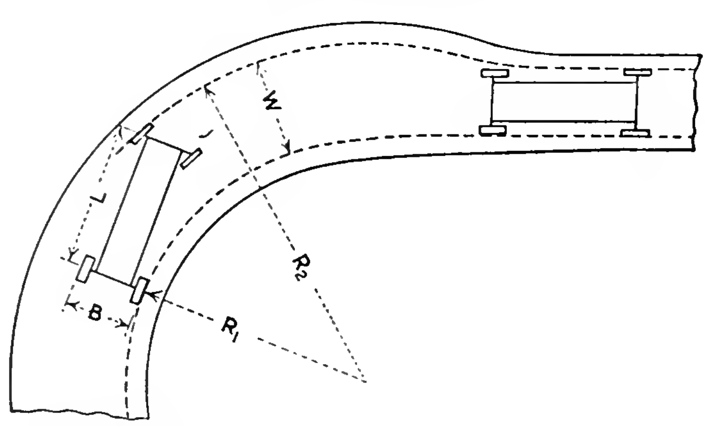
By G. S. Eaton

Assistant Division Engineer, Promotion Bureau, Universal Portland Cement Company

EXTRA width required by modern motor trucks when rounding curves should receive careful consideration when narrow pavements for country roads and driveways around industrial plants are designed. Too narrow a roadway means traffic inefficiency; too wide a pavement requires unnecessary expenditure. The adoption, for general hauling, of large trucks, which have a longer wheel base and greater width than horse-drawn vehicles, and a peculiar action in turning due to the fixed front axle, has changed traffic conditions. Even on the wider city streets, especially at intersections, attention must be given to these developments.

The action of a truck in rounding a sharp curve will be made clear by reference to the illustration which shows a truck turning on a one-lane pavement. Assuming that the machine is turning at constant radius, the width of the pavement theoretically required can be obtained by the formulas $R_2 = \sqrt{(R_1 + B)^2 + L^2}$ and $W = R_2 - R_1$, where W is the width of pavement; R_2, the radius of the outside of the outer front wheel; R_1, the radius of the inside of the inner back wheel; B, the out-to-out of rear wheels; and L, the length of wheel base. For example, a truck 7 ft. wide with 15 ft. wheel base requires a roadway more than 10 ft. wide when turning on a radius of 25 ft., in order that it may keep on the pavement. While there are minor inaccuracies in the above formula, such as difference in width at the front and the rear trucks and variations caused by the knuckle joints on the front truck, the error is unimportant, as a safety factor is desirable in any event.

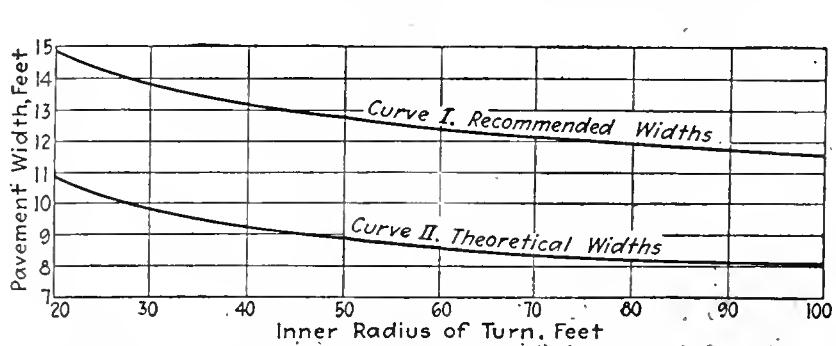
Passenger automobiles also require considerable extra width, as is shown by actual measurements made of the turning radius of an automobile of 137-in. wheel base and 56-in. tread. When the inside rear wheel was turning on a radius of 13.9 ft.—a minimum for this car—the radius of the outer front wheel was found to be 22 ft. Substituting in the formula, $R_2 = 21.8$ ft.,



ACTION OF MOTOR TRUCK IN ROUNDING A CURVE, AND SUGGESTED WIDENING

checking the field measurements almost exactly. The width needed in this case was 8.1 ft., or 72% more than the tread.

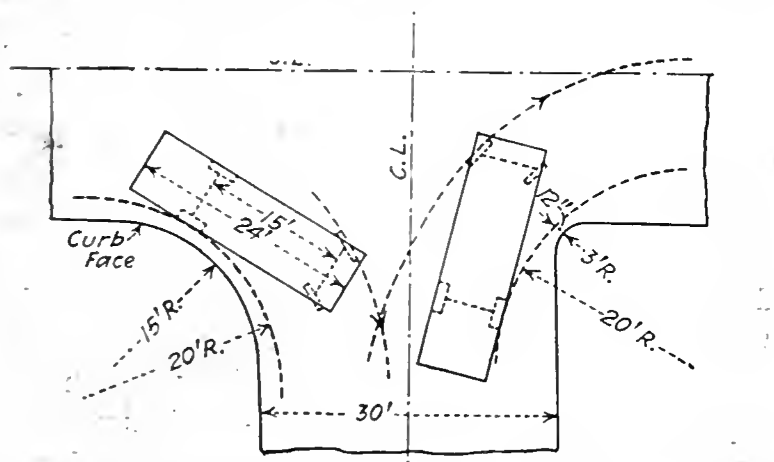
The width theoretically required for a truck with a 15-ft. wheel base and a 7-ft. width, when turning with any inside radius between 20 and 100 ft., can be obtained from curve I. Curve II shows width suggested for actual use, and is based on widening amounts which vary from 4 ft. more than the theoretical require-



THEORETICAL AND RECOMMENDED WIDTHS OF LANE FOR VARIOUS RADII SHOWN GRAPHICALLY

ments for a curve of 20-ft. inside radius, to 3 ft. on a tangent. This gives a pavement 10 ft. wide on straight sections. Where pedestrian traffic uses the road 11 or 12 ft. is preferable, with corresponding increases at turns. The recommended widths are desirable though not absolutely necessary, as they save the time and cost of slowing down for safety. The minimum inside turning radius of the average large truck is slightly less than 20 ft.; with some trucks a larger radius is necessary, and in all cases it is desirable. From curve I it may be seen that the extra width is needed even on curves of considerable radius, 48 ft. requiring about two feet.

Where provision must be made for two trucks to pass on a curve, the total length of the truck attains importance, particularly when there is any overhang



BEHAVIOR OF TRUCKS PASSING AT INTERSECTIONS

beyond the front axle. Although the overhang back of the rear axle is not important when both machines are following arcs of concentric circles, sufficient width should be provided to leave clearance when the arcs are not concentric.

Widths for double-track pavements may be obtained from curves I and II by doubling the values shown for the single track. While this is not exact, the error is small for turning radii of practical importance, and is on the side of safety. The shape of the truck assumes importance where vehicles are expected to pass on the curve, especially the distance from the rear axle to the front of the truck, if the body is of the same breadth throughout. Doubling the values, however, will allow sufficient clearance with the usual truck. That the extra width is needed for some distance past the point of curve is evident from the illustrations. This means that both three-way and four-way intersections on narrow pavements should be widened for some distance beyond the usual points of curvature, where short radii turns are constructed.

Space occupied by motor vehicles in turning is of considerable importance in street construction as well as on the narrower pavements. The more expensive types of pavement are being generally constructed, and the matter of deciding on the most economical width, where the excess adds materially to the cost, is more important than heretofore.

Street pavements wide enough on straight sections may prove too narrow at intersections, unless care is taken to construct curbs of large radii. For example, with the old-style curb, rounded on a radius of 3 or 4 ft., a modern truck of 15-ft. wheel base and 7-ft. width cannot make a right-angle turn from one 30-ft. pavement to another and still remain on its own side of the center line of the street. Should two trucks going in opposite directions, as shown in one of the illustrations, attempt to turn at the same time, with a turning radius of 20 ft. for the inner rear wheel, a collision would be likely to result. But where the curb radius is as great as 15 ft., the two could make the turn safely, with several feet to spare.

With a continuously increasing percentage of motor traffic, driven at much greater speeds than formerly, and with widths of tread up to 7½ ft., the customary 8-ft. lane is too narrow, and a greater margin of safety should be allowed. In all highway improvements of a permanent nature allowance should be made for still further increases in the sizes of motor trucks, as well as for great development in their use.

Licensing Bill Proposed by American Association Committee

THE Committee on Legislation of the American Association of Engineers, L. K. Sherman, chairman, has just prepared a form of licensing bill which is designed to include all classes of engineers, although certificates in each branch are prescribed. In all essential details it is the same as that of the Joint Committee written in 1915 (see *Engineering News-Record* of Feb. 27, 1919, p. 423), but is unique in the fact that it includes land surveyors by name and definition. The following general features are given for comparison with the Joint Committee bill:

A "surveyor" is defined as any person engaged in locating, establishing, or relocating any land boundary lines between two or more land owners, or locating any United States Government, state, county, township, or municipal land survey lines, or the lines of any public streets or roads.

The state board would consist of five members instead of nine—three civil engineers, one mining or electrical engineer, and one mechanical engineer or naval architect, and one professor of engineering in the state university. The regular terms would be four years, instead of six, and the qualifications are the same, except that a three-year residence in the state is required instead of one. Compensation would be paid at the rate of $10 per day, instead of no compensation, as in the Joint Committee's bill. The officers are elected annually instead of biennially and are called chairman, vice-chairman, and secretary, the secretary being a member of the board and being required to furnish a $3000 surety bond. At all meetings a majority shall constitute a quorum; the reports shall be made annually on or before June 30, instead of Feb. 1.

For admission to examination, a $15 fee is required, practice in land surveying is accepted, and as the alternative to six years' practice only two years' practice instead of four is specified in addition to graduation from an engineering school, and the following is added as a part of the graduation requirement of the candidate, "That he is qualified in the knowledge and prac-

tical application of the principles of physics, strength of materials, and mathematics, including trigonometry."

Examinations are held to determine the qualifications *separately in surveying or in any one of the branches of professional engineering.* An additional fee of $10 is required for certificates of registration. *These certificates are issued in the branch or branches of engineering in which the candidate is qualified, or in land surveying,* and authorize the recipient for practice professional engineering or land surveying. A $5 annual renewal fee for certificates is required.

Penalties are provided for violation, which is classed as a misdemeanor; either a fine not to exceed $500 or imprisonment not to exceed three months, or both.

The bill exempts United States Government engineers, etc., and in addition all architects who may be registered under an architects' law. Licensed engineers are exempted from provisions of any act for licensing architects, so far as the term "buildings" in such act may include or be included in the structures enumerated in this proposed act.

Concrete Box Flume Carried Across Gulch on Trestle

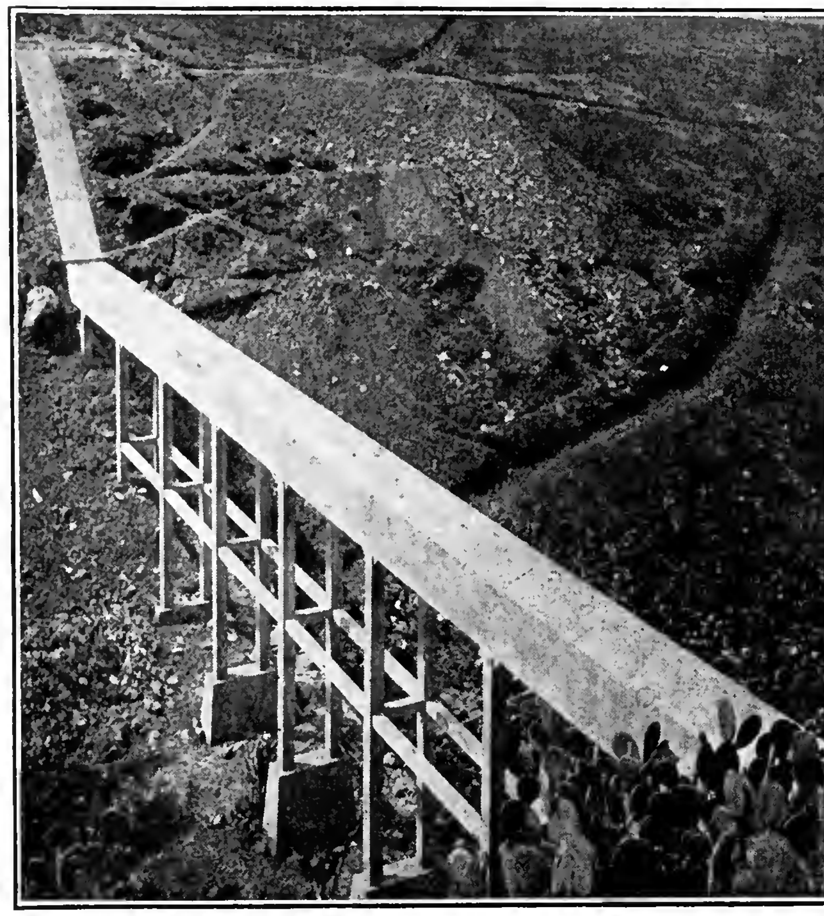
Irrigation System in Hawaii Substitutes Concrete for Steel Which Has Been Customary Material for Such Crossings

By A. W. Collins

Engineer for Maui Agricultural Company, Paia, Maui, T. H.

War embargoes on steel, and particularly on plate steel, in the Hawaiian Islands have forced the sugar plantations to substitute other materials in such structures as have been built of steel. The irrigation flume shown in the accompanying view and drawing is an example of such substitution.

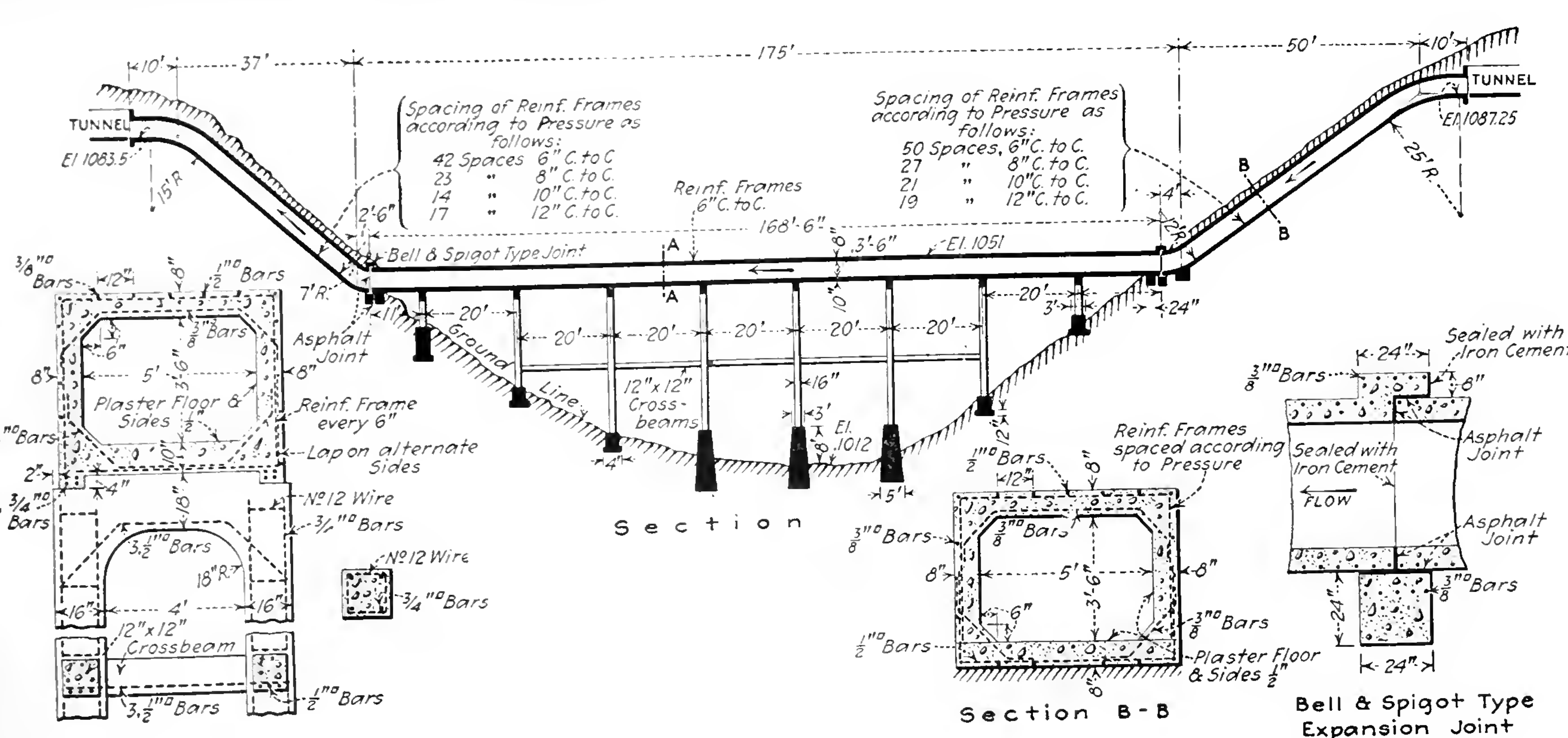
The topography of the Island of Maui is such that there are many box-like gulches running to the sea. These gulches are from 50 to 900 ft. in depth, and require the extensive use of flumes and inverted siphons in the irrigating systems of the sugar plantations. Across one of these gulches, known as Kailua Gulch, an irrigation line was carried across on a reinforced-concrete pressure flume combining the features of an ordinary flume and an inverted siphon. The grade line



SIX-BY-FIVE-FOOT IRRIGATION FLUME IS CARRIED ACROSS HAWAIIAN GORGE ON A CONCRETE TRESTLE

of the intake is 75 ft. above the bottom of the gulch, and the floor of the flume is 36 ft. below the intake, leaving 39 ft. for flume columns and footings. The difference in elevation of the intake and outlet is 4 ft. As shown in the drawing, the flume itself consists of a rectangular box resting on concrete column bents reaching down to prismatic piers in the gulley bottom.

The inclined stacks and flume columns were poured previous to the flume box, a rectangular bell-and-spigot



DETAILS OF HAWAIIAN IRRIGATION FLUME OF REINFORCED CONCRETE

expansion joint being constructed at the back end for connecting the stack to the flume. The flume itself was poured monolithically in 18 hours' continuous work. The steel plates inserted between the stack and flume at the expansion joint were later withdrawn, and the space was filled with an asphaltic cement poured hot. This joint has been under pressure for a number of months, but shows no leakage except some dampness on the outside.

Hydrated lime to the amount of 12% by weight of the cement was used in the concrete. No leakage of the flume or stacks has occurred except by sweating. The labor was entirely performed by Japanese, an American foreman being in charge of the work.

After-War and Motor-Truck Problems Hold Attention of Road Builders

How properly to connect up our national highway system, furnish labor for its construction, and decide upon the quality of the materials to be used for surfacing to support the heavy truck traffic which it must carry, were subjects discussed at the recent meeting of the American Road Builders' Association. These points are emphasized in the following abstracts of papers which created considerable discussion.—EDITOR.

Efficiency of Bituminous Surfaces Under Motor-Truck Traffic

BY PRÉVOST HUBBARD

Chemical Engineer, United States Bureau of Public Roads

FROM experience with pre-war traffic conditions many engineers had classified the various types of pavements with relation to their efficiency under the ordinary variations in traffic encountered on county, state and municipal highways. Their ideas were fairly well fixed on the subject, as was evidenced by more or less consistent practice in their choice of types when reconstruction or new construction became necessary. Just where the dividing line should be drawn between different types of pavements has always been a matter of individual opinion, but in general, with increases in volume and weight of traffic, the increasing efficiency of the bituminous types has been rated as follows: (1) Bituminous surfaces; (2) bituminous macadam; (3) bituminous concrete; (4) sheet asphalt and asphalt block.

Suddenly, and with little opportunity for anticipation, a very large mileage of our important state highways and many of our local county and municipal pavements were subjected to a tremendous increase in heavy truck traffic. This, coupled with an unusually severe winter, and immediately followed by war restrictions and other difficulties, created a serious situation and hundreds of miles of roads of all types failed within a comparatively few weeks or months. These failures were not only sudden but complete, and almost over night an excellent surface might become impassable. Such rapid and complete failures in municipal pavements were of less common occurrence, and as sheet asphalt and asphalt block have always been largely confined to municipal work, failure of these types have not been noted to the same extent as those of the other types mentioned.

In the haste and confusion of war activities, little opportunity has existed for a systematic and comprehensive study of the problem suddenly thrust upon highway engineers. Reports from all parts of the country have, however, established one outstanding fact which has a most important bearing upon any consideration of the efficiency of bituminous surfaces and bituminous pavements. A very large proportion of the failures have been characterized by an almost simultaneous destruction of the entire road structure. When not only the surface but the entire structure fails suddenly, inadequate subgrade or foundation conditions are primarily responsible, and but little basis exists for placing an efficiency valuation upon the wearing course.

Foundation failures in bituminous pavements may be due to one of two causes: Lack of thickness, or inability of the foundation structure to sustain the loads without appreciable internal movement. So far as bituminous pavements are concerned, remedy of the first cause does not affect the general type of construction; but the second cause may have a direct bearing upon possible modifications in design. There is practically no beam action in a broken stone or gravel foundation, and a load applied to the bituminous surface is transmitted quite directly to the subgrade. This load may be so great as to cause an internal movement sufficient to produce disintegration of the pavement.

EXPERIENCE ON CITY STREETS AS GUIDE

In general, experience on heavily traveled city streets has demonstrated the necessity of a slab foundation for any wearing course, and there appears to be no reason why such experience should not serve as a guide for new construction on heavy-traffic state and county highways. With respect to existing gravel and macadam roads, it would seem far safer at the present time to attempt to preserve them under heavy motor-truck traffic by means of surface treatment with bituminous materials, rather than to utilize them as foundations for the construction of new bituminous macadam or bituminous concrete pavements.

Under the same conditions of traffic, bituminous surfaces are most efficient in localities where frost action is either absent or not severe. Such treatments, used in connection with gravel roads adjacent to Army cantonments in the far South, have given reasonable satisfaction even under heavy motor-truck traffic. North of the frost line, and particularly in connection with the treatment of clayey gravel roads which become soft during the spring months, bituminous surfaces are apt to disappear completely. If, however, the gravel road is maintained by dragging and at the end of the thawing-out period is reshaped, thoroughly compacted and again treated with bituminous material, it may be kept in a reasonably satisfactory condition. Under very

heavy motor-truck traffic, however, maintenance costs may be extremely high, so that if a continuation of such traffic is to be expected the construction of a new road may be necessary.

Bituminous surfaces on properly constructed macadam roads subjected to heavy motor-truck traffic may, as a rule, be maintained in localities north of the frost line with less expense and better results than on gravel roads under the same conditions. Such surfaces, under heavy motor-truck traffic, cannot be considered as economical from the ordinary standpoint, but may prove the most efficient temporary method of preserving the existing road until money is available for reconstruction. It is believed, however, that they will not prove efficient unless constantly maintained by a patrol system operating throughout the year. This has been proved on maintenance by the Bureau of Public Roads of experimental bituminous surfaces on the Rockville Pike, Maryland, which is a macadam road having an average traffic of 135 motor drays, 816 motor pleasure vehicles, and 81 horse-drawn vehicles per day during the past year.

With regard to the efficiency of bituminous macadam under heavy motor-truck traffic, there are a number of points to be considered. In general, bituminous macadam has not been thought to be capable of carrying such traffic but, on the other hand, it has almost invariably been placed upon a broken stone or gravel base. Results obtained in the City of Alexandria, Va., by E. C. Dunn, city engineer, indicate that the bituminous macadam, if properly constructed and laid upon a concrete base, may prove quite satisfactory.

The efficiency of bituminous-concrete, sheet-asphalt and asphalt-block pavements under city traffic is so well understood as to require little comment in this paper. If they are laid upon suitable concrete foundations, there is no reason to suppose that the results will not be duplicated on county and state highways subjected to heavy motor-truck traffic. If the foundation is inadequate to support the load, the pavement is bound to fail, but, as previously pointed out, failure cannot then be considered a measure of efficiency of the pavement surface proper.

Materials of Construction and Efficiency

With regard to materials of construction a few comments may not be out of place, as the efficiency of a bituminous surface or bituminous pavement depends not only upon its method of construction but of what materials it is composed. In general, the author's observation and experience has been that the most efficient bituminous carpets are constructed with the heaviest grade of bituminous material which it is possible to apply and make adhere uniformly to the road surface. On old macadam roads it is advisable to keep the thickness of carpet under ½ in.; on certain types of soft gravel it may be of greater thickness, provided there is used a hard and tough coarse-aggregate cover of sufficient size to force into the old gravel surface by rolling. For clay-gravel or sand-clay-gravel roads north of the frost line, it is believed that light superficial treatment with bituminous materials applied cold will prove more efficient than the construction of a bituminous carpet, although neither will be adequate to carry the road through winter.

With regard to bituminous macadam and coarse-aggregate bituminous concrete, there is little to suggest in connection with the grades of bituminous materials ordinarily used. It is believed, however, that even in the northern United States the use of an asphalt cement softer than 120 penetration or a refined tar of less than 120 sec. float test at 50° C. for bituminous macadam is inadvisable if modern heavy motor traffic is to be sustained. It is also believed that more attention should be given to specifying and securing a uniform size, and grading within reasonable limits, of coarse stone, in order to promote uniformity in the penetration of the bituminous material as it is applied, and to produce a surface that will wear as uniformly as possible.

Thickening of Binder Course Desirable

In connection with sheet asphalt and the fine-aggregate bituminous concretes, the tendency to use harder grades of asphalt cement than heretofore used may prove advisable for very heavy traffic conditions. It is quite possible, however, that better results may be secured by a reduction in the compacted thickness of such pavements, with a corresponding increase in thickness of binder course where one is commonly used. For fine-aggregate bituminous concretes which are commonly laid without a binder course, the introduction of such a course not less than 1½ in. thick may prove advisable, with a reduction in thickness of wearing course to not more than 1½ in. Provided the binder course is properly constructed, such practice should tend to produce a pavement less susceptible to displacement under heavy truck traffic. It is believed that even more attention should be paid to aggregate grading than heretofore in order to produce most satisfactory results.

State, City and County Road Systems Should Be a Unit

By Nelson P. Lewis
Chief Engineer, Board of Estimate and Apportionment, New York City

The need of some kind of system in city streets is universally recognized; that is, the need of a primary system of main thoroughfares by which traffic is enabled to reach any part of the city from any other part with economy of distance and time. The need also of suitable connections between this primary street system and the chief highways traversing the immediate surroundings of the city, or reaching nearby places of interest and recreation, while more slowly realized, is quite apparent. The interest of the city, the county or the state is still largely confined to the system of streets or roads under the jurisdiction or control of these several units, and they have not been regarded as one great system of vital interest to all the people.

This lack of coördination is not a fault peculiar either to the city street system or the rural highway system, but is apparent in both. Rural highways connecting more or less important centers of population are generally much older than any part of city street systems,

except those in the oldest parts of the towns. It might have been assumed that the traffic between these centers of population would continue to follow these old routes, and yet how often it is found that they are reached only through streets of minor importance, often shabby and unattractive, not infrequently by means of awkward and obscure offsets, so that the dominant feeling is one of relief in leaving them or of extreme unpleasantness in entering them.

On the other hand, when a county or state road system is being improved, an increase in the width of such road as it approaches the city, the improvement of its alignment and grades, special attention to its cross-section and drainage, the planting of trees, etc., would be of incalculable benefit and involve little additional cost. Of course, this requires vision, a quality all too rare, and it may even involve the diversion of traffic through bypasses about already existing centers There are abundant instances showing what is daily lost through confusion or lack of traffic capacity at certain points along important highways.

The value of a trunk-line highway is generally in proportion to its length, provided it is well improved throughout. There are cases where an important state highway has been improved for long distances on both sides of a town and up to its corporate limits, but the town is not disposed to undertake a similar improvement of the portion of the road within its limits. The state may have the right to, and in equity it should, bear a certain portion of the expense, this portion depending upon the width at which the highway is to be improved through the town as compared with the width of the part outside of the town, but there may be no way of compelling the town to do its part. The result may be a delay of years in the realization of the benefit which would result from the complete improvement of the road.

State Should Have Power to Build Through Towns

It is probable that many of the state highway laws determine the proportions of the expense of improving such a link in its road system, which should be borne by the state and the town, but there may be no means of securing prompt action by the town authorities in providing its share of the funds. Such laws, where they exist, are necessarily uniform and inelastic; but even this is better than would be the practice of enacting special laws to fit each case. This would result in endless log-rolling, unfair compromise and grave abuse. It is difficult, if not impossible, to standardize where conditions are quite different. Prompt improvement of the entire trunk highway is the object to be sought.

The state should be able to secure this result, but without injustice to communities where the imposition of the share of the cost determined by statute would involve serious hardship. It would seem as though the power to carry out such improvement at the time other sections of the road are improved should be vested in the state, and that the town should be obliged to contribute such share as may be designated by law, with the right of appeal to some high judicial body which would have the power either to decrease or increase the proportion fixed by statute, after careful considerations of all the circumstances.

This suggestion may be somewhat crude, but it is put forward in the belief that the conditions which it is designed to meet are a serious obstacle to the prompt realization of a complete scheme of state and national highway improvement, and also in the belief that the value of such a system is dependent in no small degree upon the promptness with which it can be wholly completed.

Sources of Supply of Unskilled Labor for Highway Work

Committee Report by Chairman Paul D. Sargent
Chief Engineer, Maine State Highway Commission

After correspondence with members of your committee, it seemed advisable to approach this question from three directions: First, to learn if possible the condition of the unskilled labor market in the years immediately succeeding the close of the Civil War; second, to make a limited survey of labor conditions as they have affected highway work during the past few years and attempt to estimate probable labor conditions during the coming season; third, to get such information from the United States Department of Labor as has a bearing on this question.

Meager statistics contained in a letter of Charles B. Baldwin, acting commissioner of labor statistics, under date of Jan. 30, 1919, gives all of the information which your committee has been able to obtain concerning labor conditions after the close of the Civil War. This letter shows that while conditions were not good, times could not be called hard, and business remained good until the panic of 1873. Little unemployment was reported.

A questionnaire was sent out to all state highway departments, to the city engineers of all cities having a population in excess of 100,000, and to many of the large road-building contractors throughout the country.

The questionnaire asked for information as to the number of hours for a day's work, the rate of pay per hour for common labor from 1912 to 1918, and what would be the probable rate for common labor for 1919, 1920 and 1921. Inquiry was also made as to the apparent available sources of supply of common labor for the present season; as to additional sources of supply, if there did not appear to be a sufficient supply in sight, and whether state labor exchanges had been used where established, and with what result. It concluded by asking for information as to the number of common laborers required for construction work during the season of 1919.

Replies from Three Sources of Information

From the replies, which have been tabulated, we extract the following information:

Replies from State Highway Departments—Thirty-nine state highway departments made replies to our questionnaire. As some of the departments are only two years old, we have not used their replies in figuring average rates of wages.

In 1912 the average rate per hour as reported by 27 states was $0.188, while in the same year Georgia was paying $0.09 and Nevada was paying $0.40. Only six states were paying $0.25 or more, and 10 states were paying $0.15 or less—most of them less. In 1913

the average, as reported by 28 states, was $0.20. In 1914 the same states reported an average of $0.205, in 1915 of $0.225, in 1916 of $0.2585, in 1917 of $0.303 and in 1918 of $0.39. The highest rate for 1918 is reported by Oregon at $0.58, while the lowest is by South Carolina, at $0.18 per hour.

Twenty-seven states reply to our question as to probable wages in 1919. The average of these replies gives a rate per hour of $0.352; which, compared with the average of $0.39 for 1918, shows a slight decline. Fifteen states think the rate for 1921 will be slightly less than in 1920.

Thirty states think labor supply will be more plentiful in 1919, 1920 and 1921 than during the past three years. Twenty give as their reason the ending of the war with return of soldiers, closing of war industries and munitions plants, stopping of shipbuilding, etc. Seven states report an oversupply of labor now.

Fourteen states have state labor exchanges. Five states have obtained labor through these exchanges, but only three report good results. Twenty-eight states estimate their requirements of common labor for 1919 as 160,900 men.

Replies from Cities—Fifty-four out of 82 cities have replied to our questionnaire. Forty-six furnish information as to wages for all years from 1912 to 1918. Taking the year 1912, Spokane, Wash., reports $0.375 per hour, which was the highest, and Birmingham, Ala., with $0.14, was the lowest, while the average rate for the year was $0.234. In 1913 these 46 cities report an average wage of $0.238 per hour. In 1914 the average was $0.245, in 1915 $0.255, in 1916 $0.276, in 1917 $0.312, in 1918 $0.384. Boston, Mass., reports the highest rate for 1918, at $0.525 per hour. San Antonio, Tex., had the lowest for the year, $0.25, while Atlanta, Ga., and New Haven, Conn., both report a wage of $0.28.

Average Wage and Supply of Labor

The average wage which 48 cities expect to pay in 1919 is $0.384, which is the same as the average for 1918. Forty-two cities expect labor to be more plentiful this year than last, and 28 of the cities give as a reason the termination of war, the closing of war industries and the return of soldiers. Sixteen cities report plenty of labor now and in sight. Only two cities suggest additional sources. One New York city thinks immigration should not be prohibited, and one California city suggests Mexican labor. Three cities have obtained labor from state labor exchanges with good results; seven have had poor results with such labor.

Thirty-nine cities report that they will need 19,160 laborers during the season of 1919. Forty-three report that they will spend $46,570,613 in highway and street work.

Replies from Contractors—Twenty-four contracting firms, well distributed throughout the country, make replies which may be summarized as follows:

The average rate of wages they paid in 1912 was $0.192; in 1913 it was $0.20; in 1914, $0.21; in 1915, $0.23; in 1916, $0.256; in 1917, $0.315; in 1918, $0.397. The average wage which they expect to pay in 1919 is $0.38.

Sixteen contractors expect labor to be more plentiful on account of the cessation of war activities and the return of soldiers. It is interesting to note that just half of these contractors suggest immigration as the source of further labor supply.

Nine contractors have used labor from state labor exchanges. Six report "poor" results; one reports "bad" results, and two state that results were indifferent.

Information from United States Department of Labor

Through its employment offices distributed throughout the country, the Department of Labor has kept close tab on employment conditions, beginning soon after the signing of the armistice, and the number of cities reporting unemployment has been growing weekly. From Otto T. Mallery, executive secretary of the War Labor Policies Board of the United States Department of Labor, it was learned that this board is rather apprehensive of a serious condition of unemployment. The director of the board, Harold G. Moulton, concludes that, during the next 12 months, it is probable 5,000,000 or 6,000,000 workers will seek employment in this country.

As many of the industries which would under peace conditions absorb these laborers were dismantled and refitted for war work, and as many new plants were built in the early months of the war and fitted for war work exclusively, and will now have to be refitted for peace-time production, it is apparent that there may be some hiatus in employment, unless public works of a large volume can be provided to consume this labor during the process of transition.

It is interesting to note, in a recent report of Mr. Mallery, the following list of activities suggested for providing employment for surplus labor: (1) Highways; (2) forestry; (3) water conservation and control; (4) health; (5) public works of cities and towns. Note that highways are placed first. The following explanatory statement is interesting:

"Highway construction is particularly useful in providing employment for unskilled workers, upon whom the greatest burden of suffering falls in bad times. The geographical distribution of highway work is another element of advantage for our purpose, because it will diminish unemployment in many districts at the same time." Mr. Mallery states that the road builders of the country should rest assured that plenty of common labor for all highway construction work will be available during the present season, and from its investigations your committee concludes that the 1918 wage rate will be slightly lowered.

Vitrified Brick Construction for Heavy Motor-Truck Traffic

By Major W. M. Acheson
Division Engineer, New York State Highway Department

Brick pavement construction since 1915 has been subject to far greater changes in design than any other type. These changes, through a more rational use of the same amount of material, have tended to greater strength and durability. Engineers are now giving special attention to the various details of the

pavement, such as a foundation, a bedding course, and a wearing surface, in order to meet the existing conditions due to heavy motor-driven traffic.

In present practice, the foundation course is usually made of cement-concrete, of proportions from 1:2½:5 to 1:3:6, the thickness depending largely upon the character of the subsoil and the amount of traffic. While cement-concrete foundations predominate in brick pavements, many miles have been laid on foundations of compact sand, gravel and broken stone. However, engineers will agree to the absolute necessity and economy of concrete in the foundation for brick and all types of block wearing surface, together with mixed types of bituminous pavement. In fact, the time is here when highway engineers are called upon to design rigid types of construction. Too great care cannot be exercised in the proper design and construction of the foundation.

Sand cushion was originally intended to serve the double purpose of providing a uniform bearing for the wearing surface and a resiliency to absorb the impact of traffic However, it has been found impossible to obtain uniformity, even though this bed was reduced from 2 to 1 in., due to the variation in moisture content and thickness, which causes unequal shrinkage, thus defeating the function of providing a firm, uniform bearing for the wearing surface and causing failure under heavy traffic. Another defect is that the sand cushion works up between the joints of the brick, thus preventing the proper penetration of the filler. It is the opinion of the writer that the day of sand cushion for grouted surfaces has passed.

Brick Pavements of Semimonolithic and Monolithic Construction

To overcome these difficulties, which all precautions in laying the sand cushion have not sufficed to eliminate, the laying of the bricks upon a cement-sand bed, known as semimonolithic, or upon a green concrete foundation, which is known as monolithic, has been resorted to.

In the semimonolithic type, the proportion generally used for the bed is three parts of sand to one of cement. It is the practice to machine mix these materials while dry. In spreading upon the base, care should be taken to get uniformity; but hand rolling is not deemed advisable as it makes too dense a bed and it is hard to obtain a smooth surface by rolling. The thickness advocated is a minimum of ¾ in. and a maximum of 1 in. Immediately preceding the grouting of the brick surface, the bed should be thoroughly saturated with water.

Brick pavements with cement-sand bed were built at Baltimore as early as 1906, and adopted as the city's type of construction in 1915. It was used in Jacksonville and also in the ramps of the Pennsylvania R.R. station in New York in 1910. (See *Engineering News-Record* of Feb. 20, 1919, p. 378.)

With present methods the semimonolithic type is better adapted to wide streets than is monolithic, but where widths are not over 24 ft., so that a templet may be used to shape the entire crown, the monolithic type of construction may be used. Proper consistency of concrete foundation is essential for this class of construction, and care should be taken to spade properly and distribute the concrete to prevent waves in the finished surface due to the difference in density. The foundation is spread usually ½ in. thick and formed by using a tamping templet, which brings the mortar to the surface, thus forming a bed for the brick. A mechanical templet has been developed which consists of a gasoline engine mounted on a cross-frame, with wheels which rest upon the side forms. This power templet performs the double purpose of tamping and smoothing the concrete, giving it greater density. It moves at the rate of 4 ft. per minute and can be adjusted to various widths. For rolling the wearing surface of the monolithic type, the use of a hand roller about 30 in. long, 24 in. in diameter, and weighing from 600 to 900 pounds, is advocated.

The advantage of these monolithic types of construction is that they overcome defects of the sand cushion, insuring rigid construction. The cement-sand bed practically unites the wearing surface with the concrete foundation and assures a proper penetration of the grout, thus giving a perfect bond for the full depth of the brick.

Both of these types largely eliminate the hollow rumbling noise which is common with sand-cushion construction, and give a more economical and scientific design in that a stronger slab is provided with the same amount of material. The use of the monolithic type also permits of the elimination of the edging, thus reducing the cost.

Wearing Course

Monolithic types have tended to develop the use of paving brick of less thickness, which will result in more economy, one of the important features being the saving in transportation charges. There should also be an economy in the first cost, together with a saving in actual manipulation.

The standard paving brick of today is 3½ in. wide by 8½ in. long by 4 in. deep, laying 40 to the square yard. They are provided with spacing lugs of either the repressed or the wire-cut lug type, the latter having rapidly increased in favor with paving engineers and being now extensively specified. The fiber sides of wire-cut lug brick which are produced by the method of manufacture give a greater bond strength, the uniform lugs insuring a thorough and even penetration of filler and the square edges making it easy to obtain flush joints which do not cobble, thus giving a smooth wearing surface.

Two classes of joint filler are used to bind the brick units together, the cement-grout filler and the bituminous filler. The experience and observation of the writer are that the results from the cement-grout filler are superior to those with soft filler, and it is absolutely necessary in the modern semimonolithic and monolithic types of construction. The New York State specifications for cement grout filler allow the use of one part cement to two parts sand when machine mixed, and one part cement to one part sand if hand mixed. Machine mixing is considered far superior to hand mixing, and is more economical.

Health Board Studies Pipe Corrosion in Buildings

Cast-Iron Vents Have Long Life but Increasers Required at Roof Cause Rusting from Stoppages—Wrought Iron Preferable to Steel

EXAMINATIONS of sewer- and vent-pipe systems in buildings of various ages in the Chicago business district, made under the supervision of Thomas J. Claffy, assistant chief inspector of the sanitary bureau of the Chicago Health Department, have disclosed satisfactory service from black and galvanized steel pipe for a period of from five to 15 years. Wrought-iron and cast-iron vents in installations more than 20 years old are 20 and 25%, respectively, destroyed, while steel vents were 90% destroyed in the same periods. Mr. Claffy gave the information in a paper presented before the American Society of Sanitary Engineers, from which the following notes are abstracted.

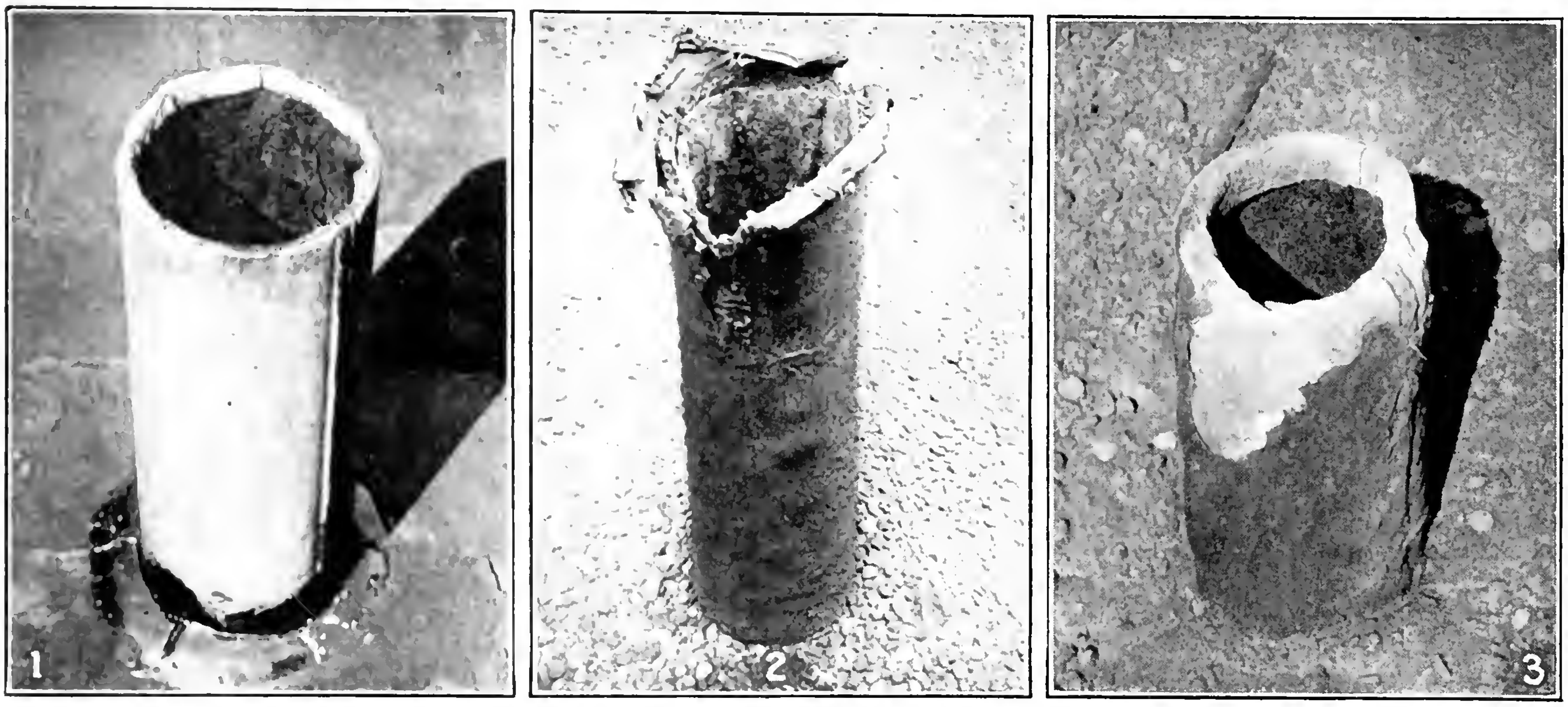
It was the aim to examine buildings of six stories and higher, and more than five years old. In making this investigation the inspector was required to report on the height and age of each building; the number of vents at the roof line; the size of pipe and whether cast-iron or screw-joint; also to obtain samples of pipe and to describe such conditions as were found. Photographs were obtained of sufficient vents on the roofs to show an existing average of their condition. The inspector also was required to state whether the owner, superintendent, engineer or other person was interviewed. To distinguish between wrought-iron and steel pipe, it was necessary to take samples, filings being obtained of the clean metal for chemical tests, and pieces of the pipes for fracture tests.

Of 63 buildings investigated, 11 were less than eight years old, while 52 ranged between 10 and 30 years. Classified according to kinds of pipe used, 15 had cast iron; eight wrought iron; 19 steel; 11 mixed wrought-iron and steel; 10 cast-iron mixed with wrought-iron or steel. In the pipe systems more than 20 years old 33 roof terminals were of steel and were practically all destroyed; of 155 wrought-iron vents 17 were nearly destroyed, and of 218 cast-iron vents 43 were nearly destroyed. The relative estimated per cent. of destruction for steel, wrought iron and cast iron was 90, 20 and 25.

The poorer rating for cast iron in comparison with wrought iron is to some extent due to the probably higher average age of the cast-iron installation. The comparison refers only to destruction or near-destruction by corrosion, and does not take into account several dozen cast-iron vents which had clogged up with rust at the increaser below the roof and had thus become temporarily useless. Neither does it take into account the condition of the joints, which would further improve the rating of wrought iron over cast iron. The steel pipe was so completely destroyed by corrosion after 20 years as to exclude all consideration of joints or clogging which might be figured in its favor.

In buildings from 10 to 19 years old the large number of steel installations indicate how completely steel pipe, on account of its slightly lower first cost, has come into use in Chicago. On 101 galvanized steel vents 25% of the galvanizing was destroyed; of 144 black steel vents all were "scaling badly," and the depreciation was estimated at 75%. Of 28 wrought-iron vents, both black and galvanized were in "good" condition, the black being estimated at 10% "depreciation." All of the 13 cast-iron vents were in "good" condition, but with an estimated 10% "depreciation."

Galvanizing on the steel pipe appeared to be partly or wholly destroyed before the pipe is 15 years old, the pipe as a result lasting from 15 to 25 years before com-



LEAD SHEATH PROTECTION ON VENTS SAVES OUTSIDE FROM COMBUSTION GAS CORROSION

Fig. 1—Galvanized steel vent seven years on City Hall scaling badly. Fig. 2—Black steel vent 16 years on the National Life Building crumbles in the hand. Fig. 3—Black wrought iron 27 years on Tacoma building is pitted as if by heavy sand blast

plete destruction is observed. The relatively good condition of wrought iron, both black and galvanized, should again be noted, the 10% given for both wrought iron and cast iron indicating a slight depreciation but no actual failures.

Severe corrosion of steel pipe becomes evident even before the building has passed its first decade. Notable examples are the Cook County Building, 10 years old, with 34 steel vents, about half of them galvanized; and the City Hall, seven years old, with 42 steel vents, all galvanized but, in spite of this, all scaling severely. This does not support the claims concerning the improvement of steel pipe in recent years, according to Mr. Claffy, for, if anything, these new installations seem to be relatively worse than the older ones.

Although corrosion of drainage piping is severe everywhere, it appears to be about 50% worse in Chicago than in New York and other cities. Mr. Claffy attributes this largely to the fact that sewers are too small and remain full of water well beyond midnight, and the small-sized vents and wastes result in blowing out of trap seals and in siphonage of fixtures. The flat topography of the city, making possible only flat grades, tends to produce a septic condition and also accentuates the concentration of gases arising therefrom. This sewerage condition caused the main house trap to be abandoned long ago, the sewers and house drains being ventilated through the plumbing system.

If the destruction of the different pipes mentioned were confined to the roof line or the space immediately below it, there might be some grounds for believing that sulphuric acid gas from burning coal might be the destructive element. This, however, is not the case. In the Borland Building the soil, waste and vent pipes at the third and fourth levels were entirely rusted away, while the same lines of pipe near the roof were practically as good as when installed. In the Unity Building a wrought-iron waste line from urinals was rusted out entirely from the third floor up.

In the reconstruction of bath rooms in the Great Northern Hotel, about 10 years ago, it was found that the old system of waste and vent pipes was entirely destroyed at the threads and over practically the entire length of the pipe in many places. In other instances, drains hanging from the basement ceiling had rusted through and had to be replaced, and branch soil and waste pipes on intermediate floors were subject to the same deterioration from internal corrosion. For this reason, Mr. Claffy holds, it is clear that the agency causing corrosion is not from the atmosphere above the roof, but is due to the gases developed within the plumbing system itself and from the sewer in the street.

City ordinances in Chicago require the size of vents and soil stacks to be increased from a point directly below the roof to the top of the pipe, so as to prevent hoar frost from closing up the pipe in cold weather. Unfortunately, this causes rust and dirt falling down the pipe to find lodgment at the increaser, clogging up the pipe and defeating the purpose of the ordinance. This tendency to clogging is noticeable everywhere, even in cast- and wrought-iron pipe installations. The type of fitting now used as an increaser has a more gradual taper than that formerly in vogue, but the tendency to clogging can hardly be eliminated. The remedy would seem to be in the adoption of larger sizes of pipes, all the way down through the building, while if increasers are used they should never be over 1-in. taper. It would seem far better to have the hoar frost closing up the pipes for a few days in extremely cold weather than to have the pipes permanently clogged with rust and dirt.

From the standpoint of sanitation, one leaky pipe is as bad as another, regardless of what causes the leak, whether corrosion or failure from expansion and contraction. Many instances of leaky calked joints were observed, and unquestionably many escaped attention, being more or less inaccessible. Many joints also had been recalked, but it is a regrettable fact that leaky

EXPOSURE FOR THIRD OF CENTURY STILL LEAVES MUCH LIFE LEFT IN CAST IRON AND WROUGHT IRON

Fig. 4—Block wrought-iron vent 29 years on Bedford Building, although badly scaled and pitted, had to be cut with chisel for sample. Fig. 5—Heavy cast iron 30 years on McCormick Building only pitted deeply inside. Fig. 6—Medium or standard cast-iron vent on old Oxford Building cracked and pitted nearly through on one side

calked joints are not always readily discovered, and even less frequently repaired with promptness. In the meantime they permit the escape of gases of a noxious, if not dangerous, character. Unquestionably, from this point of view the screw joint is to be preferred, as long as it can be obtained without sacrifice of the necessary rust resistance of the pipe material.

If satisfactory service from black and galvanized steel pipe is obtained only for a relatively brief period of five to 15 years, and the ordinances do not differentiate between such pipe and wrought iron, Mr. Claffy believes that this is not playing fair with the public, which pays the bills. He says that the evidence against steel pipe is so indisputable as to admit of no contention. He is firmly convinced from what has been demonstrated in this investigation that there is a most decided difference between steel and wrought iron for such purposes as are necessary in a sanitary plumbing system. That fact should be recognized, and ordinances, laws or specifications should provide that steel pipe be not used in any buildings except those of a temporary character.

Arch Analysis by a Method Using Variable Elastic Weights

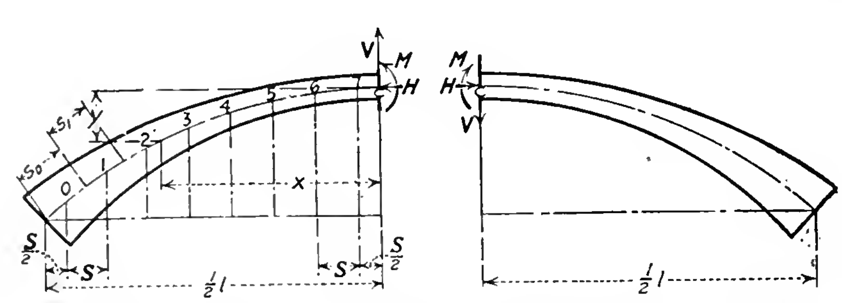
By Simplifying the Computation of the Summations Required, New Tabular Form Permits Rapid Solution of Arch Problem by Influence Lines

By F. J. Dulude
With J. G. White Engineering Corporation, New York

In analyzing arches with fixed ends by the elastic theory, it is customary to divide the arch ring into a number of sections such that the ratio of the length of each section to its moment of inertia is a constant; i.e., the elastic weight, s/I is a constant. This method is open to criticism on the score of inaccuracy and difficulty of application, as it gives excessively long sections near the springing and unnecessarily short sections near the crown. Since the moment of inertia varies very rapidly near the springing and very slowly near the crown, it is evident that, from the standpoint of accuracy, this arrangement of sections is exactly the reverse of what it should be. Again, the points at which the bending moment must be figured are inconveniently spaced for ease of calculation, having no relation whatever to the location of the loads, especially in the case of arches with open spandrels. This makes it difficult to apply influence line analysis for moving loads.

The method presented herewith consists in finding the horizontal thrust, bending moment and shear at the crown for a load unity at any point, from which H, M and V for any system of loads can readily be found. When these unknowns at the crown are determined, the true equilibrium polygon can be drawn and the stresses at any section computed. By dividing the arch ring into sections with equal horizontal projections, as shown, accuracy and simplicity of calculation are obtained, as can best be demonstrated by reference to the concrete example which follows.

Tables I and II give the complete solution of H_u, M_u and V_u at the crown for a load unity at 15 points, including the crown. It should be noted that of the 22 columns in these tables, only 12 involve multiplication or division, and of these 12 only four—namely, 6, 9, 12 and 13—involve the multiplication of one variable by another, necessitating a separate setting of the slide rule for each line. Columns 14, 15, 17, 18, 19, 21 and 22 can each be obtained by one setting of the slide rule, being the product of a constant by a variable. Columns 4, 5, 7, 8, 10 and 11 are obtained by addition. Columns 16 and 20 are obtained by subtraction and columns 1 and 2 are obtained by scaling. Column 3, which is a tabulation of the variable s/I, involves computation which must be made in any event, no matter which method is used.



ARCH TREATED AS CURVED CANTILEVER BEAM

The example has not been solved beyond finding H, M, and V at the crown for live and dead loads, because when these are known the problem becomes statically determinate and further solution presents nothing new.

The notation and working equations, including equations 4 and 5 for temperature change, are as follows:

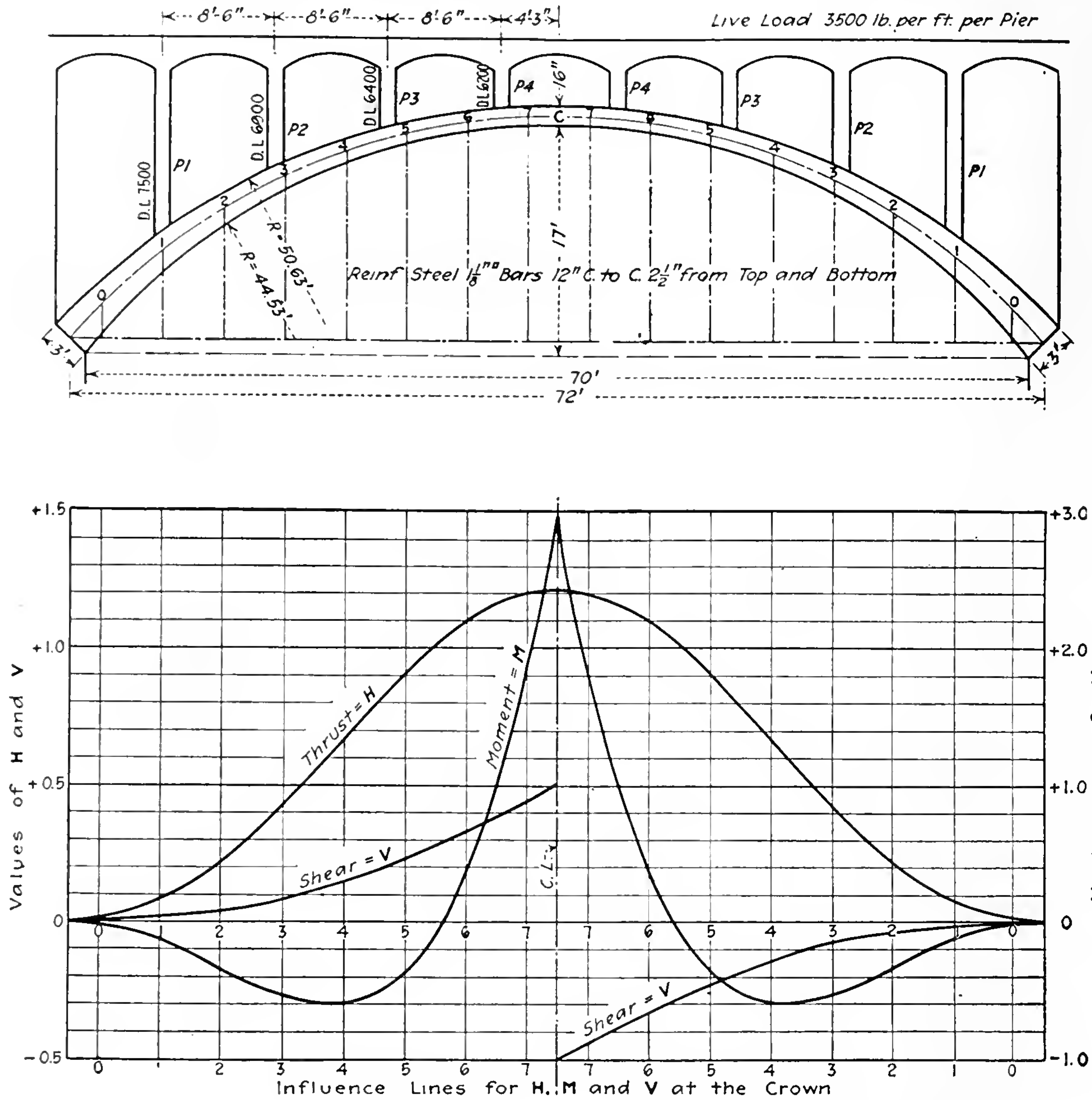
Let H, H_u, H_t be the horizontal thrust at the crown

TABLE I—COMPUTATION OF REQUIRED QUANTITIES

	1	2	3	4	5	6	7	8	9	10	11	12	13
	x	y	Δ	$\Sigma_0^n\Delta$	$[\Delta]$	$y\Delta$	$\Sigma_0^n y\Delta$	$[y\Delta]$	$x\Delta$	$\Sigma_0^n x\Delta$	$[x\Delta]$	$x^2\Delta$	$y^2\Delta$
0	33.75	14.3	2.95	2.95	0	42.2	42.2	0	99.5	99.5	0	3,360	603.0
1	29.25	10.2	4.36	7.31	2.95	44.4	86.6	42.2	127.5	227.0	99.5	3,730	453.0
2	24.75	7.1	5.41	12.72	10.26	38.4	125.0	128.8	134.0	361.0	326.5	3,320	273.0
3	20.25	4.6	7.95	20.67	22.98	37.0	162.0	253.8	161.0	522.0	687.5	3,260	170.0
4	15.75	2.8	10.90	31.57	43.65	30.5	192.5	415.8	171.8	693.8	1,209.5	2,705	85.5
5	11.25	1.4	12.85	44.42	75.22	18.0	210.5	608.3	144.5	838.3	1,903.3	1,625	25.2
6	6.75	0.5	15.91	60.33	119.64	7.9	218.4	818.8	107.2	945.5	2,741.6	725	4.0
7	2.25	0.1	17.85	78.18	179.97	1.8	220.2	1,037.2	40.1	985.6	3,687.1	90	0.2
C	...		....	....	219.06*	...	.	*1,147.3	.....	.....	*4,180.0	.....	.....
Σ	.....		78.18	.....		220.2	..	....	985.6	....	....	18,815	1,614.0

*179.97 + ½ (78.18)   * 1,037.2 + ½ (220.2)   *3,687.1 + ½ (985.6)

due to live and dead loads, unity at any point, and temperature change respectively; M, M_u, M_t the bending moment at the crown due to live and dead loads, unity at any point, and temperature change respectively; V, V_u the shear at the crown due to live and dead loads, and unit load at any point, respectively; m the bending moment due to external loads at any point on either half of the arch considering each half of the arch as a cantilever, m_L for left half and m_R for right half; s the length of a division of the arch measured along the arch axis; I the moment of inertia of any section; $s/I = \Delta$ a variable having the value $\frac{s_0}{I_0}$ of pt. o, $\frac{s_1}{I_1}$ at pt. 1, etc.; x and y the coördinates of any point referred to the crown as origin; C the coefficient of expansion; T the temperature variation in degrees; E the modulus of elasticity of concrete; l the length of span, and S the horizontal division of span. M and V are assumed positive when acting as shown by the arrows in the diagram. Each half of the arch can then be considered as a cantilever subjected to exactly the same forces as exist in the arch itself; that is, the external loads, the reactions and the stresses at the crown represented by H, M and V. By applying the three fundamental equations of the elastic equilibrium to curved beams, it can be shown that:



SPANDREL ARCH OF 70-FOOT SPAN ANALYZED BY INFLUENCE LINES

$$H = \frac{\Sigma my\Delta\Sigma\Delta - \Sigma m\Delta\Sigma y\Delta}{2[\Sigma y^2\Delta\Sigma\Delta - (\Sigma y\Delta)^2]} \qquad (1)$$

$$M = \frac{\Sigma m\Delta - 2H\Sigma y\Delta}{2\Sigma\Delta} \qquad (2)$$

$$V = \frac{\Sigma(m_L - m_R)x\Delta}{2\Sigma x^2\Delta} \qquad (3)$$

$$H_t = \frac{CTlE\Sigma\Delta}{2[\Sigma y^2\Delta\Sigma\Delta - (\Sigma y\Delta)^2]} \qquad (4)$$

$$M_t = \frac{H_t\Sigma y\Delta}{\Sigma\Delta} \qquad (5)$$

The summations $\Sigma m\Delta$ and $\Sigma my\Delta$ are for the entire arch. All other summations are for one-half the arch.

The only really troublesome terms in the above equations are $\Sigma m\Delta$, $\Sigma my\Delta$ and $\Sigma(m_L - m_R)x\Delta$. But it will be shown that, for unit loads, these three terms can be obtained by the simple process of addition. By dividing the horizontal projection of the semi-axis into any number of equal divisions, S, the points, 0, 1, 2, etc., are located by verticals at the center of each division.

Now consider a load of unity at any point, say 7 for example. Then $\Sigma m\Delta = m_0\Delta_0 + m_1\Delta_1 + m_2\Delta_2 + \ldots + m_6\Delta_6$;
but $m_0 = 7S$, $m_1 = 6S$, $m_2 = 5S$ etc.: Therefore:

$$\Sigma m\Delta = S[7\Delta_0 + 6\Delta_1 + 5\Delta_2 + \ldots\ldots + \Delta_6] \quad (6) \ldots$$

similarly

$$\Sigma my\Delta = S[7\Delta_0 y_0 + 6\Delta_1 y_1 + 5\Delta_2 y_2 + \ldots + \Delta_6 y_6] \quad (7)$$

and

TABLE II—COMPUTATION OF H_U, M_U AND V_U

	8	14		15	16	17 H_U	18	19	20	21 M_U	11	22 V_U
	$[y\Delta]$	$[y\Delta]\Sigma\Delta$	$[\Delta]$	$[\Delta]\Sigma y\Delta$	$\frac{Q}{14-15}$	$S\frac{Q}{K}$	$S[\Delta]$	$2H_U\Sigma y\Delta$	$\frac{R}{18-19}$	$\frac{R}{2\Sigma\Delta}$	$[x\Delta]$	$\pm S\frac{[x\Delta]}{2\Sigma x^2\Delta}$
1	42.2	3,300	2.95	650	2,650	0.076	13.3	33	— 19.7	—0.126	99	±0.019
2	128.8	10,100	10.26	2,260	7,840	0.226	46.2	99	— 52.8	—0.338	326	±0.039
3	253.8	19,850	22.98	5,060	14,790	0.427	103.5	188	— 84.5	—0.540	688	±0.082
4	415.8	32,500	43.65	9,600	22,900	0.662	196.0	291	— 95.0	—0.606	1,209	±0.144
5	608.3	47,600	75.22	16,550	31,050	0.896	338.0	394	— 56.0	0.358	1,903	±0.227
6	818.8	64,000	119.64	26,300	37,700	1.091	538.0	480	+ 58.0	+0.371	2,742	±0.328
7	1,037.2	81,100	179.97	39,640	41,460	1.195	810.0	526	+284.0	+1.815	3,687	±0.441
C	1,147.3	89,700	219.06	48,200	41,500	1.200	986.0	528	+458.0	+2.930	4,180	±0.500

$K = 2[(1614 \times 78.2) + 220.2^2] = 155,600$ $\quad S = 36/8 = 4.5$ $\quad 2\Sigma\Delta = 2 \times 78.2$ $\quad 2\Sigma x^2\Delta = 2 \times 18,815$

$$\Sigma m x\Delta = S[7x_0\Delta_0 + 6x_1\Delta_1 + 5x_2\Delta_2 + \ldots + x_6\Delta_6] \quad (8)$$

For simplicity, designate the terms inside the brackets in (6), (7) and (8) by $[\Delta]$, $[y\Delta]$ and $[x\Delta]$. Then, for example, $[\Delta]_7 = [\Delta]_6 + \Sigma_0^6\Delta$, etc., since if $[\Delta]^n = [\Delta]$ for a load of unity at point n; $[y\Delta]^n = [y\Delta]$ for a load unity at point n, and $[x\Delta]^n = [x\Delta]$ for a load unity at point n, it can be shown that, in general:

$$[\Delta]^n = [\Delta]^{n-1} + \Sigma_0^{n-1}\Delta \quad (9)$$

$$[y\Delta]^n = [y\Delta]^{n-1} + \Sigma_0^{n-1} y\Delta \quad (10)$$

$$[x\Delta]^n = [x\Delta]^{n-1} + \Sigma_0^{n}\, x\Delta \quad (11)$$

From equations (9), (10) and (11) it follows that $[\Delta]$, $[y\Delta]$ and $[x\Delta]$ for all points can be obtained by successive additions beginning at point 1, where $[\Delta] = \Delta_0$, $[y\Delta] = y_0\Delta_0$ and $[x\Delta] = x_0\Delta_0$.

For a load of unity at any point, then:

$$H_U = S\frac{[y\Delta]\Sigma\Delta - [\Delta]\Sigma y\Delta}{2[\Sigma y^2\Delta\Sigma\Delta - (\Sigma y\Delta)^2]}$$

$$M_U = \frac{S[\Delta] - 2H_U\Sigma y\Delta}{2\Sigma\Delta}$$

$$V_U = \pm S\frac{[x\Delta]}{2\Sigma x^2\Delta}$$

V_u is positive for the left half of arch and negative for the right half of arch.

The tabular forms of computation have been applied to the 70-ft. arch span shown. The time required, after facility is attained, will be considerably less than that usually necessary by the current method, using the determination of arch divisions to give constant s/I.

The value of dead load H is found in the usual way by multiplication of loads and H_u to be 40,860 lb.; similarly dead load $M = -1480$ ft.-lb. With live load on left half and P_4 right, $H = 12{,}450$ lb., $M = +4200$ ft.-lb. and $V = +1020$ lb.

Practicing Engineers Suggest Lines of Progress in Engineering Education

In response to questions similar to those sent to engineering educators, whose replies were published in our issues of Jan. 2, p. 41 and Jan. 16, p. 138, the following communications from practicing engineers indicate the directions in which engineering colleges should progress in order to satisfy the demands of those who are most directly interested in the ability and capacity of the engineering graduate. Among the suggestions made are: Arrangement of technical training into three classes—trade schools, general engineering schools, and post-graduate schools; postponement of specialization; immediate establishment of an education committee; experienced teacher-specialists, especially for freshmen students; more English in the first two college years; use of moving pictures; decrease in routine examples; more thorough knowledge of materials. There is also included a short abstract from a communication received from the dean of the University of Pittsburgh too late to be included in the educators' symposium; in this two general classes of education for the future are outlined. —EDITOR.

Broad Course Without Specializing Should Precede Graduate Work

BY JOHN D. ISAACS
Consulting Engineer, Southern Pacific Company, New York

THEORETICALLY, a complete education for an engineer is a broad college course, without specializing, followed by a post-graduate course specializing in engineering. This is about the way a well-prepared lawyer is educated, and there is no reason why an engineer should not receive the same education in order to prepare him thoroughly for a profession of equal importance. If so elaborate a course cannot be followed, the student should approximate it as nearly as feasible. For example, if the best that he can possibly do is a four years' course, then two years should be strictly general and the remaining two specialized.

In case of both the engineering and the legal student, there is an important psychological objection to a long course. During the educational period as above outlined, the character of a young man should be developing, and he should be acquiring self-reliance, independence and initiative, together with that general hardening and firmness acquired only by contact and competition with other men. But during this educational period he is usually dependent upon others for his living and subject to others for the direction of his conduct and mental energies. This leaves him in a somewhat helpless condition in beginning professional life and is, in part, an explanation of the slowness with which a graduate in any of the learned professions advances in making a place and reputation.

I should like to emphasize the distinction between a specialized education and a practical one. The former is theoretical, and the teaching applies to special branches of the profession. The practical education attempts to give current, practical details, shop methods and practice; detail drawing, etc. Except in a most restricted sense I do not believe in the second of these. The time of a young man at college is too valuable to be wasted on practical details which constantly change, and if he has any time to spare it should be devoted to broadening his course, and may be well applied to a study of literature or of the classics, for example. This much should be conceded, however, that all illustrative examples should be taken from conditions occurring in practice. As a rule, a young man having a thorough, theoretical education attains in the long run a higher position than one who starts with less theoretical but more practical knowledge, although the latter is the more immediately useful. There are exceptions, of course, but these are largely due to inherent qualities.

The rapid rise of the engineer in importance and the great demand for his services have placed his profes-

sion in the same category as regards influence and financial standing as that of the other learned professions, and will more and more give engineers of the coming generations the same opportunities for complete and thorough preparation, enabling them to achieve the highest success and to acquire the wealth and honors which go therewith. While such preparation seems long and laborious, and the opportunity for achievement slow in coming, the rewards are sure and worth the struggle and waiting.

Suggests Specific Subjects for Undergraduate Course

By A. P. Davis
Director, United States Reclamation Service, Washington, D. C.

UNDERGRADUATE engineering courses should, in my opinion, include the following subjects, mentioned in the order of time to be given them: Physics, including electricity and optics; mathematics and mechanics; chemistry; history of science; geology; rhetoric, including elocution and composition of reports; hydrology; physiology, hygiene and sanitation; organization and administration; business accounting; law of contracts; specialized subjects to be elected.

Instead of differentiation, courses should be largely elective, especially in the latter years, and many specialized courses should be added to the above general list for this purpose and receive proper weight and credit. The study of modern foreign languages should take the place of dead languages in a scientific or engineering course, but no foreign language should be compulsory.

Undergraduate work should be of a general nature, to lay a foundation for growth along special lines and to train the student in original research and self-culture. Such a course should require four years above the ordinary high-school course. The highly specialized subjects should mainly be left for postgraduate work and should be strongly interspersed with practical experience in field and laboratory and in shopwork.

The greatest weakness of American education is, I believe, a lack of thoroughness. There has been much improvement in this respect, and should be more in the future. The chief aim of the entire course should be to cultivate self-reliance, logical thought, skill in weighing evidence and in tracing effects to their cause, and, above all, to arouse interest in scientific facts and scientific research. Activity is an essential condition of growth, and mental growth along right lines is the object of education. The necessary activity should be along the lines of acquiring useful knowledge and practice.

Advocates High Degree of Specialization

By Virgil G. Marani
War Service Committee on Gypsum, Washington, D. C.

UNDERGRADUATE engineering courses should include a more thorough knowledge of materials used in engineering practice and an understanding of the process of manufacture of such materials. There should be included a course of instruction upon fire prevention and fire-resisting construction and materials, and upon the causes of the nation's present excessive fire losses and waste.

Courses should be differentiated. This is an age of specializing, and this thought should be carried out during the training of the engineering mind. Coördination should only be indulged in with reference to subjects that of necessity are common to more than one course, which is not a serious problem if engineering schools are patterned after universities. Each course should constitute a highly specialized unit upon one branch of engineering study alone, and extend over a period of not less than four years' continued application, with a shorter summer recess than is customary, or the summer months should be occupied by attention to carefully planned practical application of certain theoretical studies.

The greatest weakness in modern methods of teaching is the lack of practical application, with too much time and attention given to hair-splitting theories not necessary when the graduate launches into actual practice. In many cases engineering educators have sufficient knowledge to teach, but are woefully lacking in actual, practical experience. There are many cases of educators teaching hydraulics who have never had experience in the actual installation of water-works. The same may be said for sanitation, electrical engineering and similar studies. The best instructor is the one who enters the field of engineering for a period of years, and upon his reputation and success during these years obtains a professorship and teaches the subject for which he obtained his degrees and in which he has gained later his practical experience. Many universities will promote an honor graduate to a position of instructor and finally a professorship, placing upon him the responsibility of teaching engineers, when without practical experience he is totally unfitted for such a task.

Broad General Courses Should Treat Fundamentals Thoroughly

By M. M. O'Shaughnessy
City Engineer, San Francisco, Cal.

PRESUMING the student has creditably followed the high school curriculum before entering college, I believe his first two years could be profitably spent in surveying, drawing, advanced mathematics and mechanics, physics; chemistry, theoretical and practical; geology, mineralogy, and materials of construction. The courses for all branches of the art should be identical for two years, and no specialization should be permitted until the student has opportunity to measure up his inclination and ability.

I am in favor of a broad general course for at least three years and believe better results will be obtained in this way than by following highly specialized, restricted courses. With the normal boy who has passed successfully his high-school course, say at the age of 18, I believe the college should equip him in three years with the general fundamentals. If he desires to specialize and shows great proficiency in some particular branch, he can then develop himself either in outside practice or advanced college studies, at a later date.

The greatest weakness in the engineering colleges lies in the tendency for the principals to delegate too many

of their duties to juniors. There is also seen a tendency to load the boys unduly with routine examples which often keep them busy until midnight and exhaust their vital energies. I believe the heads of departments should not keep in a state of isolation from juniors, but mingle freely with them and give them the advantage of human sympathy and interest. Very often the slow, plodding boy is discriminated against in favor of the showy and more energetic, whereas in the real test of outside experience very often the greatest advances are made by the slowest boy.

I believe the greatest headway can be made in our engineering education by teaching a number of the fundamental subjects thoroughly and not scattering useful energies wildly on too broad a horizon.

Greatest Past Weakness is Lack of Teacher-Engineers

By John S. Crandell
New York City

The average student does not know why he takes any particular course. For several years Prof. J. R. Lapham made it a practice to inquire carefully of freshmen why they had chosen civil engineering. The replies were astonishing. A large percentage replied, "Because the surveying instruments looked so nice." Many wrote, "Because father told me to." A great number, said, "Because it is such fine outdoor work." Not 5% had any well defined idea of the work of a civil engineer.

Freshmen need the most experienced and best teachers, for their minds are like twigs to be bent. Let the seniors handle the neophyte in the teaching profession; he will learn much. The freshman class should be carefully pruned; much dead wood removed, many saplings transplanted where they will do better. In fact, every college of size should have a Kathryn Blackford to sort out the human material and place it in the right files. New York University already has made a start in this direction.

Counsel from Experienced Minds

If the student does not know what he came to college for, and if his instructors make no effort to learn his natural bent, how can he be pumped full of specific knowledge? Under present arrangements we lead, push, entice, lure and haul him along a common highway until such time as he is assisted in making up his mind what he wants to do. That time usually occurs during vacation following the sophomore year. As a junior the student begins to have some aim in life. Here he needs counsel from experienced minds, from men who are as conversant with affairs outside the college walls as within, from professional "live wires"—and our colleges should be full of such men. If the student really likes engineering, let him be switched to the branch that interests him most. He may not stick to it after graduation, but that is of little moment. He will do better work in college at something he likes, and will train his mind to better advantage working over interesting problems than he will at something he dislikes.

Therefore, it is my opinion that all courses should be nearly the same through the first two years. During this time the student's mind is forming and is being formed. If nothing but English were taught during those two years the time would be profitably spent, provided the subject were properly taught. How many men are there who can write a really good business letter? How many men can write readable articles on their professional work? How many engineers can make addresses worth listening to? How many engineers have *you* ever heard give really stirring talks? Here lies the English field for engineering students; not the study of Beowulf and Chaucer, but the study of getting business with words.

Four years is long enough to fit a man to become an engineer. Highly specialized courses are for the post-graduates and the faculty members. The undergraduate has neither the inclination nor the ability to follow such work. His mind is not mature, and his social engagements prevent him giving the undivided attention necessary. Do not forget that youth will have its fling. The value of a college course is not measured by the number of logarithms a man commits to memory, but by the number of useful friends he gathers about him.

Greatest Weakness—Lack of Teachers

The greatest weakness of engineering schools is the lack of teachers. There are plenty of professors, an abundance of instructors, and multitudes of assistants. But there is, and always has been, a dearth of teachers. There are many excellent textbooks on the market, written by capable men, there are many well known names in the teaching profession, but, as Milo S. Ketchum said to me, "Too many faculty members know too little about the subjects they teach, and can't teach the little they know." The crying need is for men who can teach; men who are enthusiastic; men who are interesting as well as learned. How many of your own instructors were good teachers? Of mine I recall but three.

Teachers should be specialists. Specific knowledge should be required of them. Teachers should be selected, first, for their teaching ability, and second, for their intimate knowledge of the subject they are to teach.

But the greatest teacher of all is overlooked by every college in the land. The best and cheapest teacher, the teacher whose possibilities are unlimited, the teacher who interests, instructs, never wearies of work, and never needs a vacation, is all but ignored—the moving picture. Why have our educators failed to make the most of this truly wonderful teacher? Perhaps the extraordinarily successful experience of the Government in teaching soldiers by aid of the animated movies will awaken our college faculties. The era of teaching technical work by the moving picture is at hand. Let us grasp it *now*.

Two Types of Men Needed for Industries and Design Work

By F. L. Bishop
Dean, School of Engineering, University of Pittsburgh, Pittsburgh, Penn.

The war has emphasized the need for two different types of men in the industries and in engineering design:

First, a man who may be called a technician, who is highly trained in science and mathematics, who pos-

sesses the instinct of the research man and who can devote his entire time to highly technical research problems, either in the research laboratories which are now rapidly being developed in the large industries, or by applying the results of his research to engineering science. For the training of this type of man there is needed the best of scientific equipment, the members of the faculty must be intimately interested in research problems, and the student himself must have what is sometimes called a mathematical mind. It is doubtful that this type of man can be developed in a four-year course, under existing conditions. In fact, it is probable that such a man can be developed only in a school which has a thorough graduate department devoting its energies primarily to research, but giving instruction in the fundamentals of science and mathematics.

The second type which seems to be demanded by the industries is the man who has a broad, general knowledge of engineering subjects, and can apply that knowledge in an effective way to present engineering problems. He must have the ability to command men, a knowledge of the applications of economic principles to industries, and a broad training in the so-called humanities, since he is the man in contact with men of other types in other fields of human activities. He should not be a research man, his training in mathematics need not be of necessity so extensive as that of the research technician, but his understanding of engineering problems must be extensive.

Such a man cannot be trained in the ordinary schools, because of the artificial conditions which of necessity exist in academic institutions. He must become familiar with the industries while yet a student, in order that he may understand thoroughly the applications of his theoretical courses in school and their application to industries, and also that he may become familiar, in the formative period of life, with the problems of labor and the human factor in engineering. It is in the development of this type of man, who is to become the manager and operating head of our large manufacturing industries, that, more than in the development of any other are needed the advantages to be derived from the coöperative system, which has been adopted at the University of Pittsburgh.

Proposes Education Committee of Engineers and Educators

By J. A. L. Waddell
Consulting Engineer, Kansas City, Mo.

After many years of deep consideration, I have concluded that the best possible arrangement for future technical training is: Trade schools for the rank and file of the profession, such as draftsmen, surveyors, inspectors and the lower grades of assistants in office and field; general courses in engineering for those of higher standing; and postgraduate courses for men of superior ability, energy and ambition.

In trade schools, during two or three years of 11 months each, the pupils should be taught elementary theory and the practical things which would quickly fit them to earn a fair living in a subordinate capacity at engineering.

In the general engineering schools there should be provided broad courses, fitting the students to become useful citizens and broad-gage men, drilling them thoroughly in mathematics and the general theory of engineering, and injecting into the course only enough of higher practice to illustrate the application of the theory that is being learned. This course should cover four years of 11 months each.

In the postgraduate schools should be given thorough instruction by experts in the combined theory and practice of all the special lines of engineering. This course, for any student, should cover not less than two, and preferably not more than three, years of 12 months each.

If the Herman Schneider, or coöperative, method of teaching engineering be adopted, five years of at least 11 months each should be utilized; and afterwards, if desired, any alumnus could take one or two years of postgraduate work in some of the higher branches of engineering.

Descriptive Instruction Necessary

General descriptive instruction should be imparted concerning the salient features of engineering construction and machines of all kinds, so that the student will know what his course is driving at, and so that he may be able to read understandingly and discourse intelligently concerning professional matters. He should learn in a general way how engineering structures are put together. For instances, in bridgework he should know how the metal is fabricated in the shops, and the different methods of erecting it in the field, also how substructure work is done under various conditions. In mechanical and electrical work he should learn how steam engines function and the operation of electric motors; and he should recognize the fundamental differences between direct current and alternating current and between the motors designed for their use.

All such primary ideas concerning practical engineering should be drilled into the student early in the course —preferably in the freshman year, but certainly not later than the sophomore year. He would be interested in securing all such knowledge; for the reason that it would appeal to him because of its utilitarian nature. Many a young man has dropped his engineering course after studying for a year or two almost exclusively mathematics and other subjects of which he could not perceive the practical application to the work of earning a living.

In schools that specialize in one main branch of engineering, there should be general courses in the other main branches—given, of course, with much less attention to detail. In schools offering full instruction in all the branches, it would be ideal to let the specializing be done entirely in the postgraduate course; but, unfortunately, only a small percentage of the alumni from the geenral course can be relied upon to take up postgraduate studies, hence a certain amount of differentiation is necessary. In my opinion, it would be well to confine this to the senior year, and under no conditions should it ever precede the junior year.

After the differentiation is begun, it would not do to let the students in the different lines attend the same classes for the purely technical work. For example, the

civil-engineering students would have to receive separate, special instruction in all subjects relating to electrical and mechanical engineering, the character of the said instruction being more elementary than that provided for the electrical- and mechanical-engineering students.

Weaknesses in Engineering Education

The greatest weakness in engineering education is the failure of instructors to arouse in the students an enthusiasm for the profession and a real liking for hard mental effort. Next comes the failure to teach the students how to study and to think, how to work efficiently, how to systematize and record, and how to read, write, and speak well the English language. The neglect to instill into the young minds the ethics of engineering is also a serious and almost universal fault in technical education. Business training is provided in very few technical schools. The *elements* of business should certainly be taught in the general engineering course; and the *science* of business should be given due consideration in the postgraduate course. Nor does the subject of engineering law receive sufficient attention in technical curricula, nor the allied subject of contract writing.

Engineering economics should be begun late in the sophomore or early in the junior year and continued until graduation, more and more attention being paid to it as the student advances in essentially technical studies. It is in the postgraduate course, however, that the greatest attention should be devoted to economics; for that should be the prevailing feature in all lines of engineering investigation—and it is of investigations that postgraduate work should largely consist.

To insure the most rapid development in the engineering education of the future, there should be appointed at once, preferably by the Society for the Promotion of Engineering Education, a committee of eight, consisting of four professors of engineering and four practicing engineers, in order to study the question thoroughly and report thereon. All of these men should be adequately paid for their services; and to this end an ample appropriation of funds should be made by Congress, because the immediate improvement in technical education is a matter that is of vital national importance.

These appointees should represent the various lines of engineering; they should be chosen solely for their experience, energy and special fitness. The final report should be made as truly thorough and far-reaching as possible, regardless of expense. Urgency should be one of the prime considerations in its preparation, because the time to effect the desired improvements in technical education is *now*.

The special committee suggested should determine to what extent the Herman Schneider method of imparting engineering knowledge should be followed in the general engineering courses given in universities and special technical schools. That it is capable of splendid accomplishment has been shown beyond all doubt in the University of Cincinnati, but whether it should be adopted as the sole, standard method of teaching engineering in all the schools is a debatable point.

Some Pointers on How to Finish a Concrete Floor

Notes From a Practical Cement Finisher on Use of Screeds and Treatment of Aggregate and Surface

By William McGinnis
Cement Finisher, New York City

CONCRETE floor finishing is a trade and, like all trades, has its tricks. The difference between a good job and a bad one and between a profit to the contractor and a loss often lies in the way in which the practical finisher does his work. Some of the points which must be looked out for have been gathered here.

The setting of strips or screeds is very important. Care should be taken that they are set at a dead level and thoroughly blocked or braced underneath, so as to avoid sagging from the weight of the straight-edge during the process of screeding. In nine cases out of ten they are set in an improper or haphazard manner, through carelessness or perhaps an ulterior motive. Where this happens, sagging is inevitable. The floor as finished is not level and depressions are formed, for the time perhaps not visible to a casual glance but later appearing with attendant costs. For instance, during the first troweling the pressure of the float or trowel brings some water to the surface, which afterwards finds its way and trickles into the depressions, forming pools. By the time that these pools are very noticeable the finishers will have worked several yards away, and it would cause too much trouble or annoyance to remedy the defect, so it is passed over. Now, it takes hours in most cases—sometimes from six to ten hours, depending on the depth of the slab—before the water in those pools or pockets is thoroughly absorbed in the aggregate, and the result is that the finishers are obliged to "wait" before they can properly finish the floor, and, even then, they must work slowly over the depressions to avoid leaving "trowel marks," owing to the uneven surface.

Disadvantage of Using "Dryer"

Of course, the pools can be dried by an application of "dryer"—that is, a dry mixture of cement and sand or gravel, poured or laid in the depressions, to absorb the water. This is very often done, but necessitates walking over the fresh concrete, thereby causing other holes and disfigurements, which only retard the finishing, though the cost will be somewhat less than it would be if the finisher waits for the pools to dry out. In both cases overtime charges are common.

Where strips or screeds are properly set and are rigid, no depressions or pockets are left in the surface, and consequently the water in the aggregate is more evenly distributed, thus causing a uniform set. The finisher's trowel glides easily over the surface, "waiting" and extra work are eliminated, and the result is a great saving of time and money. Strips or screeds spaced about 12 ft. apart give the best results. The straight-edge should be about 15 ft. in length, thus allowing an overlap at each end, and should be of a strong, rigid, light wood of 2-in. thickness, for on heavy screeding or "pulling" it often becomes tilted,

and, if less than 2 in., will sag or bend from the strain of pulling, leaving the surface in a more or less rolling condition, which necessitates a second screeding and a consequent loss of time.

In "raw" finishing—that is, one-course work—the proper setting of screeds is, if anything, more important, as the screeding or leveling is heavy and laborious, depending on the aggregate. For instance, crushed rock 1½ in. or less in diameter, with its attendant mixture of sand, etc., can be screeded faster and more easily than rock or other material of a larger size. In finishing a floor of this nature, it is usual and necessary to scatter or apply a layer of dryer over the whole floor to assure a "working surface," and this is usually done when the finishers are about to proceed with the first troweling. This necessitates walking or laying boards over the fresh concrete in order to apply the dryer, causing depressions or holes in the surface. This is the wrong way; the dryer should be mixed beforehand, and, as the screeding progresses, it should be immediately applied evenly to a depth of about ¼ in. In this way it acts threefold: (1) It begins at once to absorb the water on the surface; (2) it eliminates subsequent walking over the fresh concrete, and (3) it saves time.

How to Treat Slag Aggregate

In "raw" finishing where slag is substituted for crushed rock or otherwise, it will result in a great saving of time if the slag is wet and thoroughly soaked for several hours before being mixed in the aggregate. It is a light material, and some particles are lighter than others, though of the same size. When the slag aggregate concrete is poured and screeded, if the slag is not wet down the lighter particles will persist in coming to the surface, where they will remain in spite of all efforts to submerge them, and the finishing becomes very tedious. When the finisher is floating and troweling, those particles have the same effect as trying to float marbles into a hard floor; they roll with the floating, scratching the surface, and very often have to be picked out by hand and cast aside. Again, the edges of the finishers' trowels are nicked and torn, and have to be filed or ground down, and considerable time is lost in the process. In trying to overcome all this, an extra heavy layer of dryer is required, although its success varies, in some cases requiring a second layer, thus consuming extra material and the time in mixing and laying it on the surface. Where slag is thoroughly wet and soaked before being placed in the aggregate, it absorbs a certain amount of water, thus gaining added weight, and is not so apt to appear on the surface, so it requires less dryer and less time in the process of finishing.

On floors previously left unfinished and which later require a top coat of cement mortar or wearing surface, either an acid or a cement wash is used, to assure the adherence of the mortar. Acid should be applied freely at least one hour in advance of the finish concrete pouring, but afterwards, and slightly in advance of this finish placing, the surface should be swept lightly to prevent an excess of water in the mortar. Cement wash should be applied only barely in advance. In pouring, the mortar should not be dumped or heaped at random about the floor, as usually happens, for in case of any excess of water this sets up a dam and creates "soft spots" which retard the finishing. It should be poured in a continuous mass, of an even consistency, somewhat in the nature of a thick paste, and raked always in the one direction. In this way "soft spots" are avoided and a uniform set is assured throughout.

In floors where squares are required, considerable time is occupied in the jointing operation. The smaller the squares the more joints are required, and the more time is consumed. In marking out or spacing joints the ordinary way is to measure out and make notches around the edge of the floor, after the first troweling. This is wrong, as it necessitates walking over the fresh material, and is a slow process. The economical way is to mark out chalk-marks on the walls or outside of the forms, before the material is poured, thus saving time and extra work.

The high cost of finishing cement or concrete floors can in many cases be attributed to negligence, or to a lack of knowledge on the part of those charged with responsibility. Every defect adds to the cost, and the right way is the economical way. To the causes shown in the foregoing others might be added, but all can be summed up in the words, "Faulty supervision."

Macadam Road Built by Red Cross Refugees in China

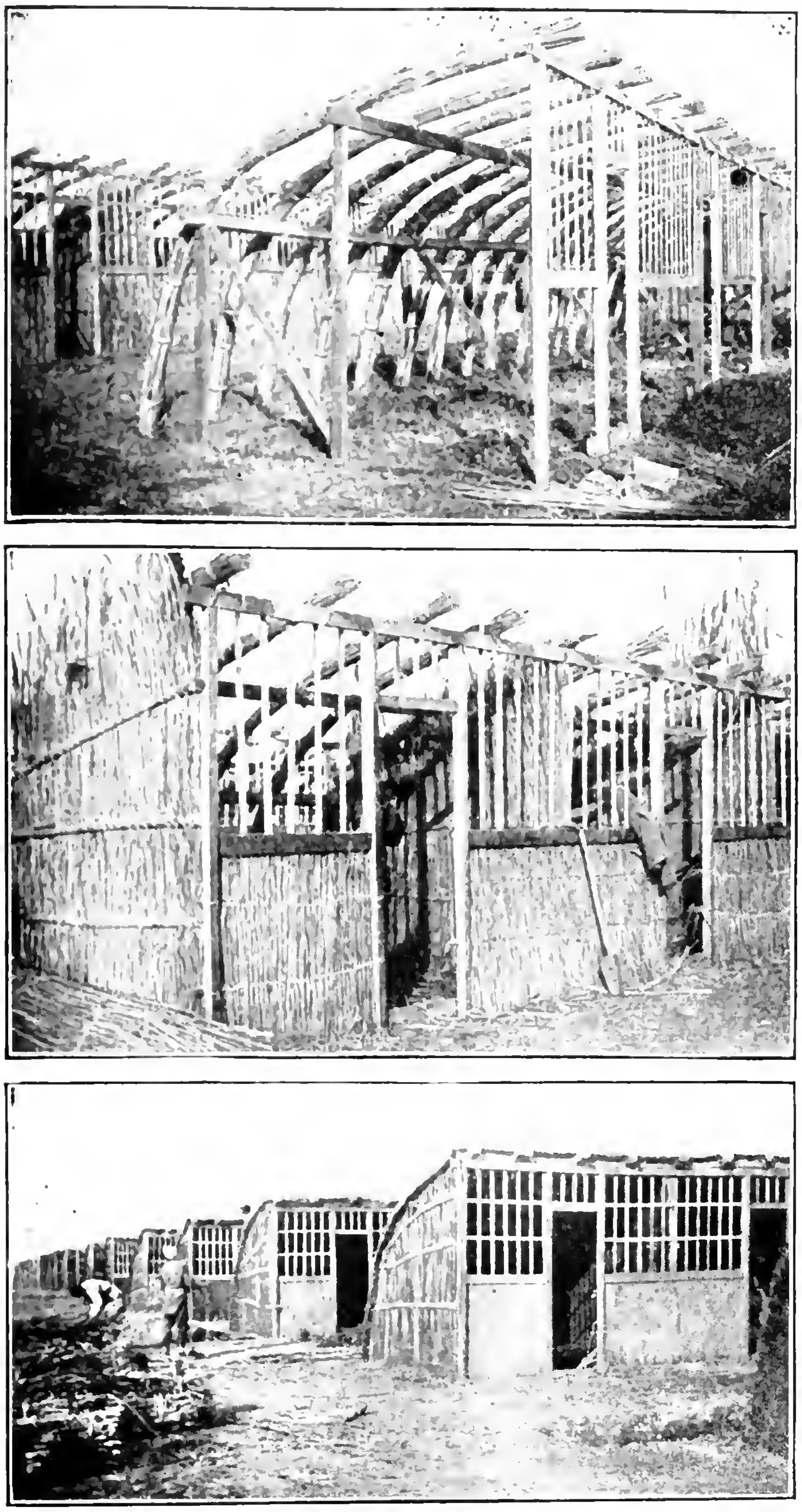
Granite Slabs of Old Road Used for Edging—Type of Camp Built—Macadam Stone Broken by Hand

By R. A. White
Peking, China

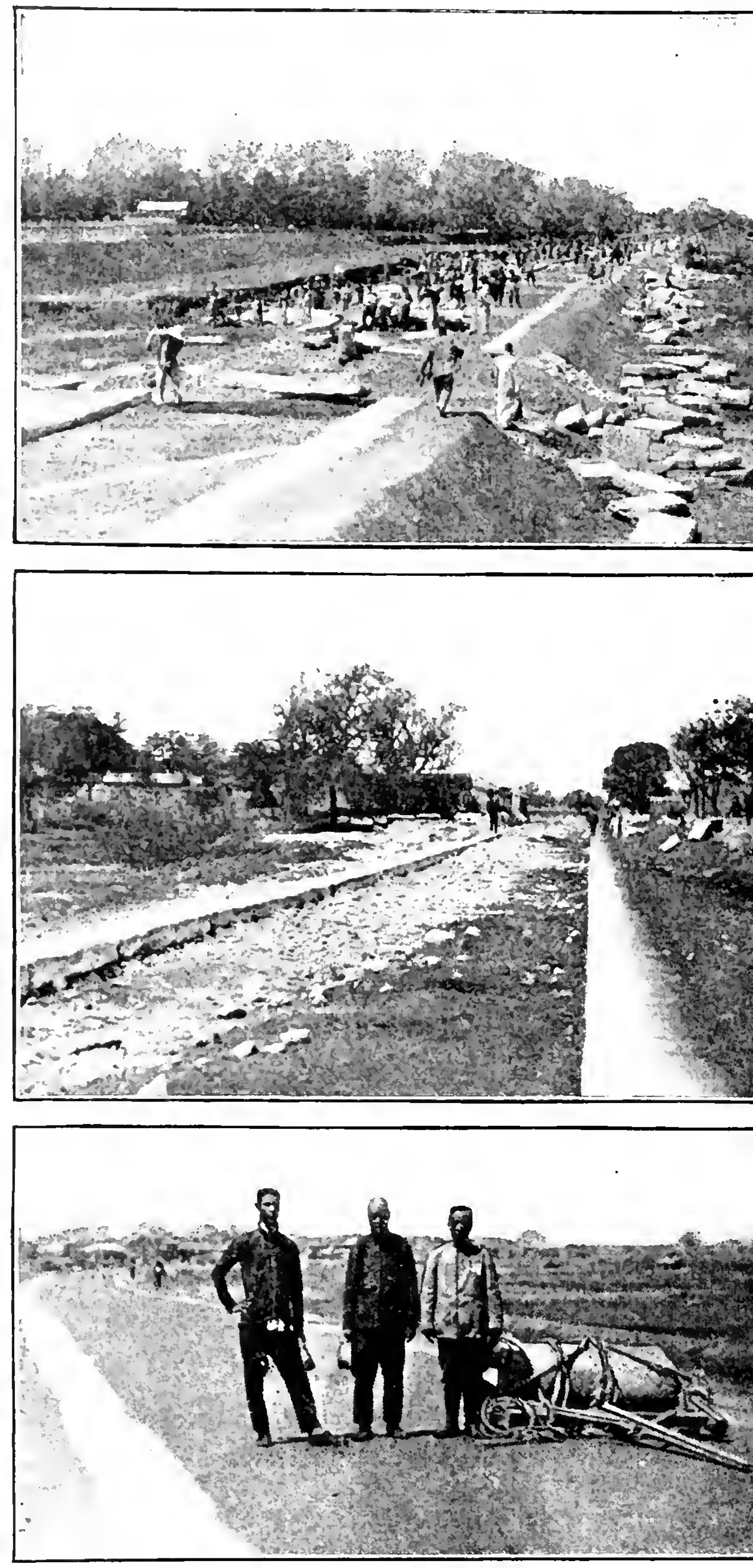
Construction of a modern macadam road to replace a worn granite-slab road has been effected in China by the use of Red Cross refugees. The old roadbed and materials were utilized as far as possible, and edgings 2½ ft. wide were built on each side, by the use of the old slabs which formed the existing surface. Metal for the new surfacing was produced by breaking the remainder of the old surface by hand sledging. Thousands of refugees were housed and fed in specially built camps by the Red Cross.

Late summer and autumn rains in 1917 caused the rivers of Chili Province in northern China to overflow their banks so that many thousands of square miles of rich farming country were flooded, and hundreds of thousands were made homeless. In some cases the water stood several feet deep, entirely destroying the 1917 crops, and when winter came the water had not yet subsided. To save the people, the American Red Cross of Peking, headed by the American minister, appealed to the Red Cross officials in America and received $50,000 in gold, with which a camp was built at Tientsin. This camp, which would house 5000 refugees, was built and filled with occupants in one month. The method of construction of these camps of Oregon pine framing and reeds covered with plaster is shown in the accompanying illustrations. Each one-room house, 9 x 10 ft., accommodated five persons.

Early in November, as the cold weather came on, it was evident that more help must be given. It was



CONSTRUCTION OF REFUGEE CAMPS IN CHINA



RECONSTRUCTION OF OLD SLAB ROAD IN CHINA

not thought advisable to build more camps, but rather to undertake some construction work, which would both benefit the refugees as well as be of some permanent value to the country. Accordingly, the American minister, Dr. Paul Reinsch, sent a second call for help to the American Red Cross, and this, combined with $100,000 paid over by the Chinese Government, made a fund of $200,000 which was set aside for construction work.

Considerable time was lost in deciding which kind of work to take up, but finally the writer, with George A. Kyle, chief engineer of the American railway projects in China, was asked to make a reconnaissance survey and estimate of a highway between Peking and Tientsin. It was found that the entire project, which practically followed the course of the allied march to Peking in 1900, would cost more than $500,000. It was, therefore, decided to construct immediately the section between Peking and Tungchow, a distance of 14 miles, which would afford work for 3500 refugees. These were soon recruited by local missionaries from the flooded areas adjoining Paotingsu. The men were a sorry sight upon arrival in Peking, for they had gone for weeks with little or no food and had very little clothing. It took several weeks to get them in shape for work.

Plans for the project were prepared by Mr. Kyle and the writer. Much thought and attention had to be given the viewpoint and stand taken by the Chinese officials that highways are the natural competitors of the railways. Due to this theory, one finds in China two cities of over 1,000,000 inhabitants, Tientsin and Peking, only 82 miles apart, and with only one single-track railway and an unused canal, long since fallen into decay, connecting them. Inasmuch as a through highway would be a natural competitor of the railway, according to the Chinese view, no highways connect the capital of China and the thriving port of Tientsin.

Tungchow, to which point produce comes by sea, river and canal from the entire country, had been connected with Peking by a granite-slab highway built

originally by the Ming emperors in the fifteenth century for transporting tribute grain overland. The highway was reconstructed during the 26th year of Chien Lung's reign, about the year 1750. Inscriptions on marble slabs placed on tortoise backs along the roadside describe how some 240,000 oz. of gold had been spent to benefit the country people in the neighborhood, in the building of this highway. It was 21 ft. wide with a curbstone set on each side, while the granite slabs were placed across the road and well embedded in a lime-concrete foundation, varying from 12 to 18 in. in thickness. The road was on a fill averaging 4 ft. high. The slabs were about 1 ft. thick, 2½ ft. wide, and varied in length from 4 to 15 ft. Continuous use of the road for centuries had worn ruts to such an extent that the road was practically useless for traffic.

Various stages in the construction of the new road are shown in the accompanying illustrations. The macadam section is 15 ft. wide, with slabs of granite on each side 2½ ft. wide to form an edging. The shoulders are of earth 4 ft. wide with 1 on 1½ slopes. In laying the slab-edging, the stones were set into the old lime foundations about 6 in., so as to avoid filling in with earth under the macadam, which was about 6 in. thick. The roller used to compact the macadam, the method of transporting in baskets supported on a pole carried by two men, and the stone-breaking yards along the highway, may be seen in the illustrations.

Refugees working on the roads were allowed a minimum monthly wage of $6.50 Mexican money, or about $5 in gold. Their food costs about $2.70 per month, and, after deducting this amount from the allowance, the balance is sent to the workman's family. Work was done on a piece-work basis, whereby they were paid an additional amount if the work done exceeded the minimum wage. The following prices, Mexican money, were paid:

Breaking ballast, per cubic foot	$0.04
Earth work, including ramming, per cubic foot	.04
Removing granite slab, per square foot	.02

It is purposed to have carts use the shoulder and granite edging, and as ruts are formed broken stone will be filled in. Metalled highways are not built, according to the official viewpoint, for the Chinese farmer or teamster, but for the nobility, who use rubber-tired vehicles. The carts mentioned have two wheels about 4 ft. in diameter with rims only about 1 in. wide and often carry as many as 20 pigs, the load weighing from 1½ to 2 tons. This type of wheel is ruinous to macadam roads, which will never be a success until the use of wide tires for the carts is made compulsory by regulation.

What the Government Did in Inland Waterway Navigation

Director General of Railroads Reports on Progress Made During 1918 on Waterways Taken Over By His Administration

GOVERNMENT control of inland waterway navigation was undertaken for the first time in 1918 by the United States Railroad Administration. Little actual progress was made by the end of the year, but such foundations for future work as were laid were outlined in the annual report of the retiring Director General of Railroads, W. G. McAdoo. That report, with the exception of the section relating to the New York State canals, which was presented in *Engineering News-Record* of Feb. 20, 1919, p. 370 is abstracted below:

Hundreds of millions of dollars have been expended by the nation, the states, and citizens for the purpose of developing our inland waterways and for the construction of canals. Thousands of miles of rivers, canals, lakes and bays are ready to assist in moving our products. These waterways, with the exception of the Great Lakes, are not being extensively used.

With the assumption of my present task, I appointed a committee to make a prompt investigation and to suggest a definite plan for the additional use of internal waterways, for the economical and expeditious movement of the traffic of the country, so as to relieve or supplement the railways under the conditions caused by the war. This was the beginning of a program which had been constantly pursued, and while the greater urgency for raw materials in war work interfered with the construction of steamers and barges, 160 steel, wood and concrete vessels are now building and 50 steel and wooden craft have been purchased. The total appropriation for old and new floating equipment exceeds $11,750,000.

The increased responsibilities of this country in the family of nations will demand greater commercial activity on our part. Transportation is a major problem, for, on account of the extensive area of our country, we have a longer average haul to seaboard than other industrial commonwealths. It has seemed to me evident that by developing transportation on the waterways and coördinating and articulating them with a unified railway system, we shall bring about a correct solution of the rail-water controversy, which has been in progress for 50 years. This is possible with the railways under Federal control. I doubt if any of our rivers or canals will become active factors in transportation if the railroads are turned back to private control. The old methods of railway competition with the waterways doubtless will be revived, and the waterway experiment may not be able to survive that competition.

Mississippi-Warrior Waterways

On July 11 there were created the Mississippi and Warrior Waterways, and M. J. Sanders was appointed Federal manager to have charge of the construction and acquisition of equipment for use upon the Mississippi River between St. Louis and New Orleans, and for use upon the Warrior River between the Alabama coal fields and Mobile, and in connection therewith for use upon the Mississippi Sound and connecting waters between Mobile and New Orleans, and to operate such equipment upon these waters in the Director General's behalf.

To establish immediately a water service on the lower Mississippi River was a matter of some difficulty, on account of the scarcity of suitable equipment. It was finally determined to purchase the fleet of the Kansas City-Missouri River Navigation Co., consisting of two towboats and nine barges, which, previous to the present season, was operated between Kansas City and St. Louis, Mo. The sum paid for this fleet was $458,500. No other suitable barges were available, with the exception of 20 steel barges in the St. Louis district, United States Engineers, that were used in revetment work and dredging. An arrangement was made whereby these barges were obtained under lease from the Engineer Department until June 1, 1919, together with two steel towboats. A third towboat was chartered from a civilian. There are now in service between St. Louis and New Orleans five towboats and 29 barges, the first sailing occurring from St. Louis Sept. 28. A weekly service is now being performed. Necessarily, there has been con-

siderable delay in the creation of joint tariffs and joint rates with the railroads, so that the operation has been restricted to such traffic as originates on the rivver banks, and also, because of war conditions, considerable decrease in north-bound business has resulted on account of the zoning of sugar. South-bound tonnage is largely composed of wheat and other cereals. The operation to the latter part of November, comprising five round trips, shows a total revenue of $48,500 and a total operating expense of $52,000, exclusive of overhead.

Authority has been issued for the filing of tariffs covering joint through rates between New Orleans and adjacent points taking the same rates, and points in northern Missouri, Illinois, Iowa, Wisconsin and Minnesota in both directions. These tariffs are now being prepared and will shortly be filed. The through rates reflect the differential of 20% between the rail rates and the water rates between New Orleans and St. Louis.

A terminal of considerable capacity is being erected in the City of St. Louis, and the terminal in East St. Louis has been purchased from the Kansas City-Missouri River Navigation Co. Arrangements for the use of ample terminals are being negotiated with the City of New Orleans.

The Director General has just authorized the construction of six large steel towboats and 40 steel barges (capacity 2000 tons each) at an expenditure of $6,170,000 for service on this waterway; estimated annual capacity, 850,000 tons. Operation on the Warrior River previous to this year has been irregular. Since the creation of the Missippi-Warrior Waterways Section the administration has purchased three towboats, 21 wooden barges, and six steel self-propelled barges for service between Cordova (near Birmingham, Ala.) and Mobile, Ala., and New Orleans, La. The cost of this equipment, after reconstruction and necessary repairs are completed, will be about $700,000. These vessels are primarily coal carriers and the annual capacity is estimated to be 300,000 tons. A portion of this fleet is now in operation.

Sufficient coal is produced from mines on the river bank in the Cordova district to employ the fleet constantly. The Director General has just authorized the construction for this service of four steamers to trade between the Birmingham district on the Warrior River and Mobile, Ala., and New Orleans, La., these ships to be designed to carry merchandise as well as coal—the total cost will be about $1,000,000; also, that three steel towboats and 20 wooden barges be constructed for coal service on the Warrior River. The cost of this equipment is estimated at $600,000; estimated annual capacity, 375,000 tons.

Delaware and Raritan Canal

This waterway, extending from Bordentown, N. J., to Raritan Bay, New York Harbor, being of limited draft and inadequate lock structures, had suffered a steady decrease in business up to 1918. It was taken under Federal control as a part of the transportation system of the Pennsylvania Railroad Co., to which it has been leased for many years past. Last year 272,734 tons were moved. It became evident early this season that there would be a very marked loss in tonnage due to the fact that coal was being shipped via other routes. In July the Division of Inland Waterways took charge of the floating power equipment on the canal and of the toll collections, and Dec. 1 the operation and maintenance of the canal was transferred to this division. The increase of tonnage over last year will be about 5%. The gain in the transportation of merchandise and high-class freight has more than offset the shortage of the movement of coal. The Railroad Administration has operated from three to 15 craft between Philadelphia and New York. The season is not completed, but it is apparent the ships, which were in all cases leased, will show a very small deficit, even after charging 10% of the expense of maintaining the New York office of the New York and New Jersey Canal Section to this service.

Chesapeake and Ohio Canal

This canal has been operated at a loss for several years. With the opening of navigation season of 1918 it developed that the Canal Towage Co., which operates the boats of the canal, was not attempting to engage in business. The traffic is almost confined to the transportation of coal, and, as the canal served particularly the needs of Washington and vicinity, the Railroad Administration regarded it important to preserve this utility, and entered into an arrangement to pay the toll charges on the boats of the Canal Towage Co. or any other coal boats. No other boats having appeared, this arrangement was later changed, and a new agreement entered into whereby the Railroad Administration guaranteed the towage company against any operating deficit. There was also authorized the construction of 10 barges to be used on this canal.

The tonnage moved in 1918 will be slightly less than the quantity moved in 1917, but the quantity moved to Washington and vicinity greater. There are two reasons for this: (a) A late opening and scarcity of boatmen, and (b) greater mileage per unit, resulting from the larger percentage of coal delivered to Washington and Indian Head. Although the accounting for the season's operation is not completed, it is apparent the operating deficit will be much less than the toll charges.

Intercoastal Waterway

An investigation was made of transportation conditions on that portion of the inland waterways between Philadelphia and Beaufort. This inquiry shows there is sufficient vessel equipment for normal seasons, and that the various barge companies have been and are building new equipment. There has been a lack of coördination between shipper and vessel owner. A number of vessels ordinarily used in this service has been under charter to the various military and Navy branches of the Government. These are being released to the owners.

The methods of handling freight on this waterway are out of date, and as the supply of labor promises to be somewhat improved, the efficiency of the present fleet, with modern terminal methods, should be increased 30 per cent.

In view of the fact that the projected locks and dams on the Ohio River between Pittsburgh and Cairo are not completed (the improvement has not been finished between Pittsburgh and Cincinnati) it does not seem a proper time to consider any new equipment for this route.

Broad City Planning Program for Pittsburgh

The newly organized Citizens' Committee on City Plan for Pittsburgh, of which C. D. Armstrong is president, has the following as its general program:

Conformity to definite plan of orderly development into which each improvement will fit as it is needed—not the immediate execution of the whole plan.

Saving in cost of public improvements by business methods—not waste through unnecessary or extravagant expenditures.

Encouragement of commerce and facilitation of business—not the obstruction of any trade activity.

The development of an American city worthy of civic pride—not an imitation of London, Vienna or Paris.

Conservation of human energy and preservation of life, particularly child life—not merely restrictive, but also constructive welfare methods.

Correlation of the city's activities—not haphazard changes with no adequate returns.

The proper application of art to municipal improvements—not extravagance, superficial beautification or vague attempts at civic adornment.

The rule of common foresight and prudence—not the rule of chance with ruinous expense and debt.

Preservation of historic buildings with their traditions—not the destruction of the old landmarks and city individuality.

Happiness, convenience, health, for all citizens—not merely expensive boulevards and parks for the few.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

St. Louis Engineers to Engage Actively in Civic Affairs

The Associated Engineering Societies of St. Louis. with a membership of about 775, of whom 575 are in the Engineers' Club proper and the remainder in the local chapters of various national societies, are becoming active in civic affairs. At a meeting of the Engineers' Club Jan. 8 the following resolution was announced and passed:

"Resolved, that the Engineers' Club of St. Louis adopt the principle of taking a more active interest in economic, industrial and civic affairs."

At this meeting, also, the civic committee of the club was instructed to report on the need of a new state constitution for Missouri, on the possibility of issuance of state bonds for highway construction, and on the proposed issue of municipal bonds for public improvements in the City of St. Louis. In furtherance of the investigation and in view of the possibilities of state road construction, the club sent one of its members to the state capitol to attend the public hearing before the legislature.

Business Methods Put Speed into Road Association Work

Such marked success in handling a large amount of work was attained in a conference on rural concrete roads held Feb. 10-11 by the Mississippi Valley Association of State Highway Departments that the procedure is given below. For the discussion of various points the subjects were divided into 12 groups, each assigned to a committee, as follows: Grades and drainage; grades and pavements on culverts; widths of pavement and shoulder treatment for single- and double-track roads and state trunk lines; thickness and crown of pavement; alignment; widening and superelevation of curves; aggregates and proportioning; joints; reinforcement; handling materials from point of production to the work and into the mixer; preparation of subgrade and side forms; water supply; consistency; placing, finishing and curing in warm and cold weather respectively; testing of materials; field and laboratory inspection.

Six delegates were invited from each state, three from the State Highway Departments, and three engineers outside, also district engineers of the United States Bureau of Public Roads. Engineers of the Portland Cement Association attended at the invitation of the chairman, A. R. Hirst. Each delegate was assigned to serve on two committees. The first six committees met separately on the first morning of the conference and formulated their reports. As a basis for these reports there was in the hands of each member of the committee the recommended practice for concrete-road construction by the Committee on Concrete Roads and Pavements of the American Concrete Institute.

In the afternoon these committee reports were presented to the conference and there passed upon. The following day the remaining six committees handled in a similar manner the subjects assigned to them. The result was a large amount of work accomplished in a minimum space of time.

One of the chief objects to be accomplished was to agree as far as practicable upon the general practice for the construction of concrete roads in the Mississippi Valley states and to decide as to what this practice should be on points which were necessarily left open by the committee of the American Concrete Institute. So successful was this method of handling the meeting that it was the general sentiment that the future meetings of the Mississippi Valley Association would probably be arranged in a similar manner.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Educational Training for Minor Engineering Positions

Sir—The recent correspondence in your columns relating to the education and compensation of civil engineers dwells on the subject mainly from the engineer's viewpoint. The viewpoint of the employer is equally important, for he holds the purse strings, determines the compensation and thereby fixes the standard which ought to be the basis for determining the expenditure of time and money it is wise to ask parents to approve as right for technical education. It is manifest folly to overeducate a man for his duties, unless the excess education calls for no parental sacrifice and fits the youth for a broader life.

The employer wishes to pay a fair market price for the engineer's work, but he sees no valid argument for paying more than that. He expects the price to be based on the quality of the technical knowledge required and the time consumed in performing the work. This is the basis of his payments for painting, for instance, for he expects to pay one price for whitewashing his cellar, another price for painting his house, another price for decorating the ceiling and walls of his parlors, and still another price for the preservation in oil and pigments, for the benefit of posterity, of those facial lineaments in which he takes a pride, more or less concealed. He knows what he should pay for such services.

But when, on the very few occasions he needs the help of a civil engineer, and he is without any measure by which to determine the fairness of the bills rendered to him, he notices that the work is actually done by men who are manifestly not paid highly by the engineers employing them. It is inevitable that he should endeavor to pay for such work about on the basis of house painting, for he cannot see that it calls for any greater skill, training or judgment.

In all the discussions of engineering education and compensation the point is overlooked that the requirements for the actual performance of the work to be done form the only basis on which arguments should rest. If the work is promptly, economically and well done, its actual value is not affected by the fact that the man who does it is an authority on municipal government, or able to read the New Testament in the original Greek or, on the other hand, is without training to do anything requiring greater skill and has no education to speak of. The employer is justified by every principle of economics in paying for that work only the minimum price necessary to have it done properly. If he wishes the work done by an expensive specialist who actually delegates it to a low-salaried employee, he has the right to have it done so, just as the great specialist has the right to charge only what the work is actually worth and not what he could earn by turning his attention to more difficult tasks. That men sometimes knowingly pay more than work is worth and charge less than they can earn at the most lucrative classes of work should not becloud the fact that the minimum price at which one class of work can be obtained regularly is the actual measure of value of that work.

Neither the education nor the compensation of civil engineers will be placed on a logical basis until the actual nature of the work done in civil engineering is dissected into its component parts, and the education and training actually required to perform each of these parts are conclusively determined. This means, not the superficial knowledge of history, languages, assorted sciences, literature, economics and the like, "without which no young man is fitted to take a responsible place in his profession," but the knowledge and skill actually needed to do that thing well. When such an analysis is made, it may be found that a very large part of the work done by engineers is really little more than skilled labor. Some of it may be highly skilled labor and deserve corresponding compensation, while part of it may call for no great skill and none of that ability in the direction of men and the reduction of costs which always has been and always will be highly paid because it is executive in nature.

It is debatable, to say the least, whether the present educational training for the engineer is not a questionable thing for the average young man to attempt, provided his circumstances are such that the time and money required for a complete course entail a serious sacrifice by his parents, brothers and sisters. If no such sacrifice is involved, such an education is an admirable thing; if the lad is certain to become a leader, the education is equally desirable; but how many of the thousands of technical-school graduates, educated at the expense of the greatest self-denial of their families, are earning today any more money or living any fuller and happier lives than would be the case had they gone to good trade schools and saved the years of study and hundreds of dollars spent in getting through a technical college?

One of the fundamental difficulties in this closely knit matter of engineering education and compensation lies in the common, wholly erroneous assumption that four years of technical school training superimposed on top of four years in a high school are necessary to train the average youth to perform the average work done in an engineering office. Every engineer in charge of a large office knows it is not true. Yet the young man who has been urged thus to spend these years of preparation has been assured that he must do it in order to carry on this average work, and his investment of time and money deserves a compensation commensurate with such a long educational training rather than the compensation he actually will get, based on the time really needed to acquire the requisite skill and knowledge in other places than a technical college.

Four years in a good trade school, run solely to give the training really needed under men inspired with an enthusiasm for teaching rather than a yearning for research, may be found just as helpful to the great class of young men who are perforce economical of both time and money. These men would go out to their engineering jobs without any of the feeling held by young graduates of technical schools that surveying, drafting, supervision of construction and the like very useful classes of work which do not call for special knowledge or executive ability deserve compensation at rates beyond those paid for similar attainments in other professions or callings.

In closing, attention is called to the very large class of technically trained men who leave engineering for contracting, manufacturing or commercial work. It is open to question if the eight years spent in high school and technical college have been a good investment for them. It is noticeable that they are generally young men with small means upon graduation, whose education has been a strain upon their families. The salary question is particularly serious to them. They have discovered that the greatest opportunities for capitalizing whatever technical knowledge they have acquired are in the competitive strife of energetic man-to-man endeavor rather than in the seclusion of a drafting office or the trackless wastes traversed by a surveying party. It is only this class which shows an inclination to speak disparagingly of present engineering education as the best system for all prospective engineers, but it should be noted that it is only this class which is not complaining about poor pay and lack of public recognition.

Upper Montclair, N. J. JOHN M. GOODELL.

Railway Bridge Impact Experiments Seventy Years Ago

Sir—Mr. Waddell's valuable contribution to the literature of impact on bridges in your issue of Nov. 21, 1918, p. 924, appears to me to give insufficient credit for the work done by the royal commission on iron bridges in 1849, and, as the work of this commission is almost invariably misquoted, I trust I may be pardoned for briefly stating the results.

The first experimental work of the commission was carried out at Portsmouth by James & Galton on cast-iron bars 9 ft. long, which were tested to destruction. Professor Willis enunciated the analytical problem and Sir G. G. Stokes obtained an approximate solution without periodic terms. He showed that his solution was equivalent to calculating the centrifugal force of the load. The impact effect in the Portsmouth experiments was found to be very great, and Willis showed that the experiments did not represent dynamical models of

actual bridges. The Portsmouth experiments did not, however, verify Stokes' analytical results, and the discrepancy was shown by Willis to be due to the fact that Stokes had neglected the periodic terms in his solution; in other words, the passage of a load sets up a vibration, and this vibration had been neglected in the analysis. Stokes then calculated the amplitude of the vibration and his results were then verified by Willis in a series of delicate laboratory experiments at Cambridge, using an ingeniously constructed dynamical model. Professor Willis shows in his summary of the investigation that in actual bridges it is only the periodic terms of the solution (the vibration of the bridge) that are of importance. The whole of this investigation neglected the effect of the periodicity of the load due to unbalanced masses.

The analytical work of Milan in 1893, referred to by Mr. Waddell, was principally the calculation of the centrifugal force of the load; i.e., the nonperiodic part of Stokes' solution. C. W. LLOYD JONES,
Superintendent of Way & Works, His Highness the Nizam's Guaranteed State Railways Co., Limited.
Secunderabad, Deccan, India.

State-Insured Highway Construction Contracts Suggested

Sir—In your issue of Jan. 30, p. 257, there appeared under the title, "State-Insured Highway Construction Contracts Suggested," an article which states that it has been the custom of surety companies to provide contractors on state work with certified checks to submit with their bid. This erroneous statement is based upon the actions of a certain few political insurance brokers, who thought that by providing these checks they would corral all the insurance business, and also place the contractors under heavy obligations to them in other ways. It never was the custom of the surety companies to provide contractors with certified checks for bid purposes.

The article also states that large amounts of money have been paid to surety companies by contractors on state work, and that the companies have lost but little money on the payment of losses. The fact is that the surety companies have paid the state hundreds of thousands of dollars to cover losses. Some underwriters assert that the losses paid exceed the amount of the premiums received.

Many persons, engineers, architects and state officials, do not realize just what the contract bond is. They seem to think that a bond is like a policy of insurance, to cover all kinds of losses, which can be obtained by merely walking into the underwriter's office, laying down the premium and walking out with the bond. Instead, a bond is a three-party contract between the contractor, called the principal, the owner or the state, called the obligee, and the surety; and certain very definite obligations are placed upon each party and certain very definite rights given to each party.

The contract bond is a guarantee on the part of the principal that he will fulfill his part of the contract, and this contract is backed up by the surety company which is organized and operated under the banking and insurance laws. When there is a difference of opinion and a dispute between the principal and the obligee as to facts, the surety or bonding company can make payment on the bond to the obligee only after the dispute is adjusted, and it is determined that the obligee is entitled to recover. The high-grade surety companies have never refused to pay such losses. The surety bond is designated to protect the owner against a loss which he might suffer due to the unexpected and unforeseen contingencies that may (and frequently do) arise to cause even the financially strong contractor to default on his contract.

The hazard in writing surety bonds is so great, and the losses have been so big, that of 10 surety companies which were in businesss 10 years ago only four are now doing business. The others have either been forced to the wall or compelled to merge with stronger companies, by reason of the severe losses sustained on contract bonds. Road building, especially, has proved so hazardous that a contractor today, in order to obtain a bond on a road contract, must prove himself financially stronger and better equipped to perform the work than would be required for almost any other class of work.

There is little likelihood that the legislature would be induced to allow the state to embark on such a hazardous undertaking as the underwriting of contract bonds. HARMON V. SWART.

New York, N. Y.

[Mr. Swart's letter was submitted to the New York Commission of Highways, and Mr. Morris, the secretary, replied as follows:—EDITOR.]

Sir—Your letter of Feb. 20, inclosing a letter from H. V. Swart dated Feb. 18, is at hand

The fact that highway contractors were provided with bidding checks cannot well be denied, in view of the volume and extent of the transactions; the openness with which they were carried on; the number of years the practice existed, and the knowledge generally possessed by all persons connected with the work in regard thereto. No claim has been made, however, that all participated in this practice.

I note that Mr. Swart says that surety companies have paid hundreds of thousands of dollars to the state on losses. I have no knowledge as to what payments have been made with regard to work other than highway improvement; the report of this department referred only to that class of work. As to highway improvement losses, however, it is a fact that from 1898 up to 1917 the records show that total payments by all surety companies for losses on forfeited contracts did not exceed $15,000; the premiums paid during that period for highway improvement work are understood to be something over $500,000.

Mr. Swart states that road building has proven so hazardous that the contractor to obtain a bond on that work must be financially stronger and better equipped than would be the case for almost any other class of work.

The insignificant amount paid during the period above mentioned is of itself an indication as to the lack of hazard. Highway improvement work is free from danger of fire, and, except in very unusual cases,

and even then to a limited extent, is free from any danger of flood. The work lies on the surface and there are none of the dangers of quicksand, cave-in and like hazards which are encountered in many other classes of public works. In short, where road contractors use due diligence in preparing their proposals and obtain contracts for reasonable prices, the danger of loss, under ordinary conditions, is reduced to a minimum.

I. J. MORRIS,
Secretary, New York State Commission of Highways.
Albany, N. Y.

Right-Hand Door Has Clockwise Swing

Sir—In answer to H. L. Conrad's query in your issue of Jan. 23, 1919, p. 201, regarding the swing of doors, I wish to say that one sure way of determining a right- from a left-hand door is as follows: Consider the hinge as the center of a clock; if the swing is in the same direction as the pointers then the door is right-hand, if opposite then it is left-hand.

Milwaukee, Wis. EMIL M. BUEHLER.

The Cost-Plus Contract a Success

Sir—Perhaps no single administrative feature that has ever been introduced into the engineering world has attracted more attention than the now famous cost-plus contract. It has been assailed from some quarters and upheld from others, but nevertheless has forced itself into notoriety and public recognition.

An agency so powerful as to disrupt the peaceful equanimity of commercial practice and line up the brains of America in bitter opposition on the one side, and in unqualified support on the other, surely merits a most thorough investigation and wide discussion, that out of the chaos of conflicting opinions may be builded a sound foundation for future development.

In every cantonment and camp in the United States, the Government maintains an officer in charge of construction, known as the constructing quartermaster. As constructing quartermaster for the building of Camp Frémont, near San Francisco, and now for Fort Sill, Oklahoma, it has been my privilege to supervise construction work amounting to over $3,000,000, under cost-plus contracts covering a period of 18 months.

The cost-plus contract is just as applicable to commercial practice as it is for Army use, the only difference being that under private direction the constructing quartermaster would be known as the supervising engineer. The cost-plus contract as used by the Government has three cardinal virtues: Absolute fairness, flexibility, and centralization of power. The most important of these is the centralization of power in the hands of the constructing quartermaster, or supervising engineer in private work.

Certainly, no fairer scheme was ever devised for both the contractor and owner. The profit is fixed in proportion to the expenditure. Additions to, or subtractions from, the work can be made at will. As unlimited power to direct the work is given to the constructing quartermaster, full and absolute responsibility for its proper execution rests with him. This point cannot be too strongly emphasized. There is no dodging responsibility. If the cost-plus contract has failed anywhere, it is due to the incompetency and mismanagement of the directing head. No orders for materials can be placed by the contractor without his approval in writing; no equipment can be purchased or even rented without it. He has complete authority to order the discharge of any member of the contractor's organization, from the manager down. If the contractor pads the payroll, if materials are ordered that are not needed, if wasteful methods are allowed, the responsibility can be undeniably nailed upon one person—the *directing head.* If the directing head is competent, the proposition will work "like a charm." The success of the enterprise hangs upon the choice of the field management. The trend of modern business methods is toward centralizing authority in one person, and then holding that person responsible.

After operating under its terms in closest detail for almost two years, I am so strongly impressed with its desirability that I believe a monument should be erected to the memory of the genius who invented the cost-plus contract. In spite of all that can be said in opposition, the unassailable fact remains that the Construction Division of the Army has accomplished the greatest building task ever undertaken in the history of the world, and has done it under the cost-plus contract; an accomplishment that will ever shine forth as one of the fairest jewels of the nation's diadem of glory.

J. B. CHAFFEY,
Major Quartermaster Corps, United States Army.
Fort Sill, Oklahoma.

Suggests Practical Method for Testing Truss Bridge Members

Sir—With reference to the matter of formulas for steel columns, dealt with in recent articles and letters appearing in *Engineering News-Record,* the writer wishes to take this opportunity of drawing attention to the fact that existing column formulas are not founded on really proper tests, and that therefore engineers should not rest satisfied until such proper tests have been made, and, from the empirical rules deduced therefrom, a really sound column formula has been evolved.

No column experiments have yet been made which conform to actual conditions existing in modern bridges, as very few columns nowadays have hinged ends, and flat-end tests are likely to be very deceptive, because of corner bearing.

The opinion expressed by Charles E. Fowler in his letter on page 343 of your issue of Feb. 13, 1919, to the effect that a straight-line formula is to be desired on account of its simplicity, is to be commended, as there is every probability that an exact straight-line formula can be derived from proper tests. It is to be noted that some of the formulas given by Mr. Fowler in his letter use the $(l/r)^2$, this being a holdover from the old Euler formula, which was established for greater values of l/r than are used in practice.

With reference to Dr. Waddell's scheme for testing top-chord members by means of experiments conducted on a specially-built full-size bridge, the writer begs to make the following suggestions for a practical method for making such tests: Build a single-track Class 70 through-truss bridge, with the weak member designed for, say, Class 40 loading, so that the destruction of the weak member could be accomplished without injury

to the rest of the structure, thus facilitating repairs for repeated tests. The connection plates for the weak members should be extra strong. After the compression tests are completed a series of corresponding tests on tension members should be made, so as to determine the real efficiencies of both tension and compression members, and their comparative strengths. Unless this kind of a test be carried out, we shall never have any really reliable test data, as the existing data are, to a great extent, misleading. It is advisable that more than one value of l r should be tested for.

It should not be overlooked, in making up a design for a test structure, that there is a necessity for thorough detailing throughout, especially in connection with the weak members, so that failure will be in the form of a square break instead of being due to any insufficient detail, thus removing ambiguity. It would be advisable to build the permanent members of the trusses of the test bridge of nickel steel, so that the permanent and the weak sections would be somewhat alike, if the weak section were of ordinary structural grade of carbon steel.

The most satisfactory method of applying the load would be by means of hydraulic presses or jacks, to be applied at panel points, and all connected so that the load would be uniform. Pressure records should be automatically made. Control of the applied load by this means would be very simple and positive. It would be desirable to make tests for low values of l/r, so as to establish the necessity or otherwise for limiting intensities of stress.

Many of the tests we are relying on at the present time for our formulas were made on badly designed struts, and I venture to say that tests on properly designed struts would show up stronger than the present tendency of the profession in strut design indicates.

F. H. FRANKLAND,
Consulting Engineer.

35 Nassau St., New York City.

Regarding Details at Support of Pony Span in Cantilever Bridge

Sir—Replying to Mr. Godfrey's letter [see *Engineering News-Record* of Feb. 27, 1919, p. 441], the line of reaction of the rocker shoe is shown 5 in. from the intersection of the members supporting it, and this was subsequently changed to about 3 in. The offset was made for architectural effect and was considered justified since there was an excess of strength in the members adopted.

The section composing the tension members of the cantilever where the bend is made at the rocker consists of two 6 x 4 x ¾-in. angles, two 8 x 8 x ¾-in. angles and a 28 x ⅜-in. plate. The maximum stress is less than 7000 lb. per square inch of net section, and the inclination less than 1 in 9, which is not considered such a bad condition. There are two angles 6 x 4 x ¾ in., two angles 8 x 8 x ¾ in., with a ⅝-in. and a ⅜-in. plate on top to form a seat for the rocker, and all the rivets are ⅞-inch.

The writer agrees with Mr. Godfrey, in principle, that top-chord members should not be subjected to torsion, but fails to see any possibility of distorting the frame of the chord where its members are so heavy in proportion to the torque applied.

The bent plate at the connection of the lower member of the sidewalk bracket with the chord is a 15 x ⅜-in. plate, and the stress is about 4000 lb. per square inch.

There is no tension in rivet heads in the connection of the sidewalk brackets at the pony span, as ⅞-in. turned bolts were employed.

L. W. METZGER,
Designing Engineer, Oregon Highway Commission.
Salem. Oregon.

Long-Time Mixing Should Not Reduce Strength of Concrete

Sir—I have read with considerable interest the letter of J. O. Jones in *Engineering News-Record* of Jan. 23, 1919, p. 200. In addition to the account of the very complete tests made by Prof. D. A. Abrams discussed editorially in the issue of Nov. 28, 1918, p. 966, the results of tests made by other investigators have been published from time to time. It is of special importance to note that without exception—at least so far as the writer has knowledge—these investigators have obtained results tending to confirm the finding of Professor Abrams and lacking accord with the results described by Mr. Jones. In this connection, the tests made at Purdue University (see *Engineering and Contracting*, Vol. XLIII, Jan. 27, 1915,) and those made by the Pennsylvania State Highway Commission, are of interest. Fig. 1 shows graphically the results of these tests.

Assuming the use of cement fulfilling the requirements of the A. S. T. M. specification for portland cement, it seems reasonable to assume that little, if any, impairment of the cement matrix of the concrete will result from mixing the ingredient materials 10 to 15 min. However, it is common practice to specify 1 to 1½ min. as the mixing period after all materials are placed in the mixer drum, one-tenth the time assumed above.

In a concrete mix the cement and a portion of the water combine chemically to form the cement matrix, which ultimately binds together the inert particles of the sand and stone aggregates. Since the cement is the only active, strength-producing material entering into the mixture, it follows that, apart from the physical properties of the aggregates, the strength of concrete is dependent entirely upon (1) the proportioning of the materials, including the water, entering into the mix;

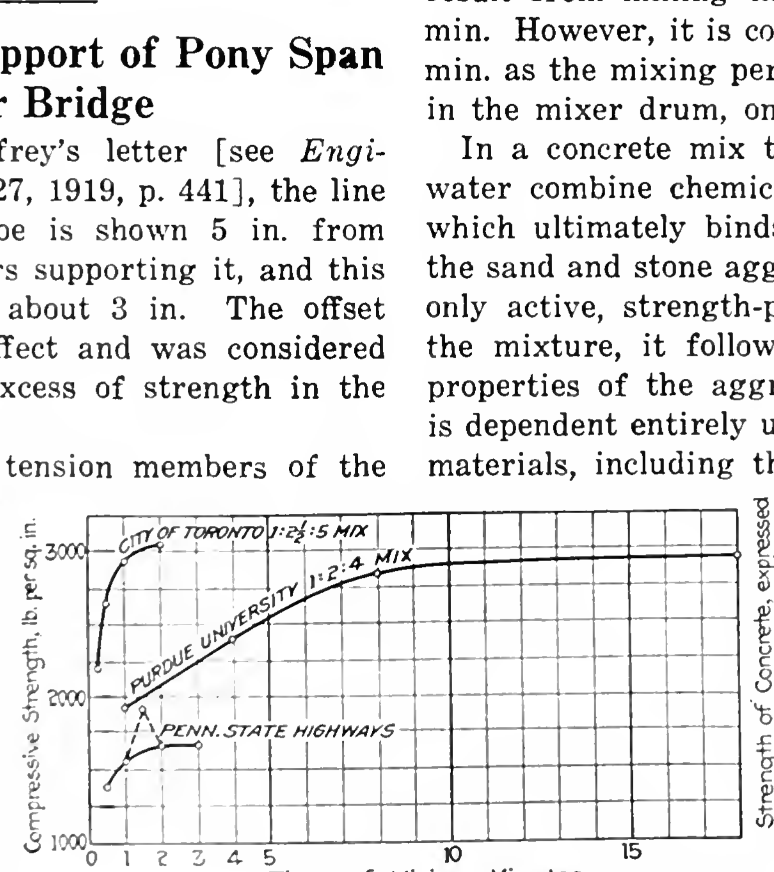


FIG. 1. THREE SETS OF TESTS ON EFFECT OF TIME OF MIXING ON STRENGTH

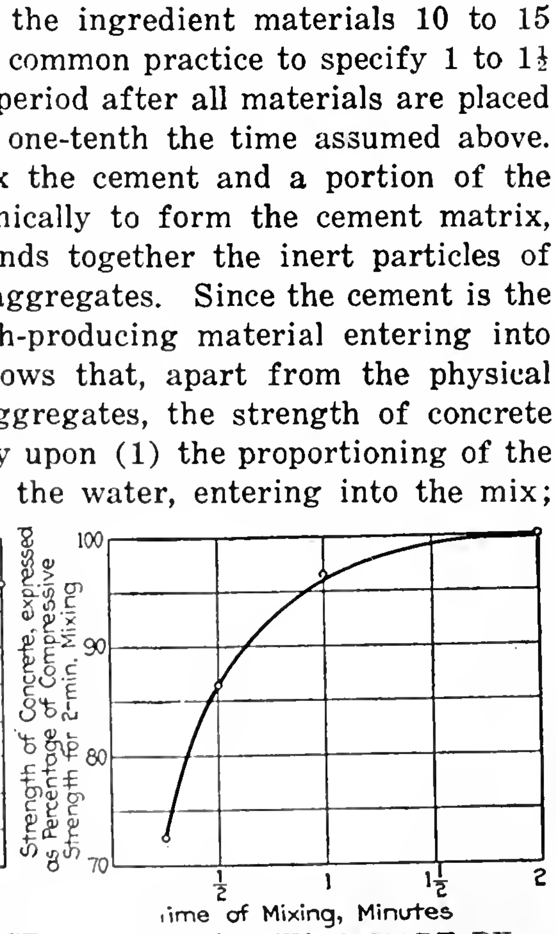


FIG. 2. TESTS MADE BY L. N. EDWARDS

(2) the thoroughness of the distribution of the cement matrix over the surfaces of the particles of sand and stone, and (3) the proper seasoning of the concrete.

The real object and purpose of mixing is the thorough incorporation of the component materials of the mix. The abrading action of the sand and stone particles moving upon each other during mixing is the most important factor tending to produce thoroughness of distribution of the cement matrix. It is commonly recognized by concrete makers that the "workability" of concrete containing sufficient water to produce a saturated, semiplastic mortar, adhering freely to the particles of stone aggregate, is improved by a comparatively long period of mixing. The writer firmly believes that the strength, toughness and durability of the concrete are also improved. Fig. 2, reproduced from his paper, "Effect of Grading of Sands and Consistency of Mix upon the Strength of Plain and Reinforced Concrete" ("Proceedings," American Society for Testing Materials, Vol. XVII) shows the relation of time of mixing to the compressive strength of concrete, as obtained in a very carefully made series of tests. In these tests a steam-operated Foote mixer of ⅓-cu.yd. capacity operated at the rate of 16 rpm. was used. All materials, including the water, were proportioned by weight.

The writer can offer no satisfactory explanation for the rather remarkable results obtained in Mr. Jones' tests. However, he is of the opinion that other factors influencing the strength of the concrete were perhaps not as carefully controlled as they might have been. Too frequently, in concrete-making operations in the field, the valves provided for gaging the water content of the mix are in bad order, and the leakage of additional water into the mixer drum during the mixing period is sufficient to offset the advantages which might be obtained by an increased period of mixing. In this connection it is worthy of mention that Professor Abrams' tests, as well as those of the writer, show that the addition of one pint of water to a one-bag batch of concrete in excess of that required to produce a "workable" mix is equivalent in its effect to the omission of 2 to 3 lb. of cement.

LLEWELLYN N. EDWARDS,
Supervising Engineer of Bridges.

Toronto, Ont.

What Was the Coefficient of Friction in the Calaveras Dam Slide?

Sir—The slide at the Calaveras dam under construction by the Spring Valley Water Co. of San Francisco, occurred Mar. 24, 1918, and was described in *Engineering News-Record* of Apr. 4, 1918, p. 679, by Allen Hazen and Leonard Metcalf. A report on the subject was also made on May 25, 1918, to the United States Reclamation Service by C. H. Swigart and the writer, which was published in the *Reclamation Record* for November, 1918, and in *Engineering and Contracting* for Jan. 8, 1919. In this report the conception of the authors of the relative position of various classes of material in the dam was described and illustrated, certain assumptions were made as to weights, and an approximate calculation was made of the forces tending to produce and resist sliding. Study led up to the following statement in the report:

> The rough conclusion which may be drawn on the basis of assumptions made is that a sliding factor of about one-half for the dry mixed rock and earth-fill used in the dam is safe, and that when this factor reached eight-tenths sliding took place.

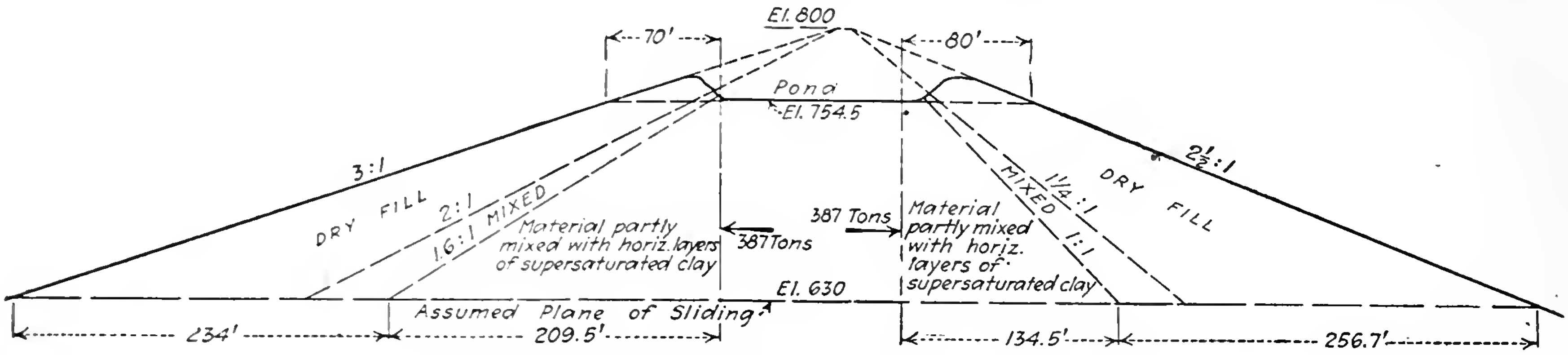
The Spring Valley Water Co. put Mr. Hazen in charge of designs for the completion of the dam. During the summer and autumn of 1918 he made an elaborate study of the materials remaining in the dam, and determined weights, water contents and stability upon which to base his conclusions as to reconstruction. He described the results of these studies in a highly interesting article published in *Engineering News-Record* of Dec. 26, 1918. Incidentally, Mr. Hazen referred in this article to the coefficient of friction of the moving material, saying, "From these figures the coefficient of friction for the whole mass at the start of the slip may be computed as 0.20."

The disparity of the values of the sliding factors 0.50 and 0.83 in the earlier report and the coefficient of friction 0.20 deduced in the later article was so striking as to attract the writer's attention at once. The investigations made after the date of the earlier report gave information which would permit revision and correction of previous assumptions, but this could hardly account for so great a difference.

A careful comparison of the respective conclusions made it promptly apparent that the values mentioned are not comparable. Mr. Hazen determined the *average* coefficient of friction for the entire base, whether consisting of dry material or slippery and partly supersaturated clay. The writers of the Reclamation Service report assumed that the wet-clay portion of the base offered very little resistance to sliding and figured all resistance as being concentrated on the portion of the base free from masses or layers of wet clay, which occupied only about one-third of the sliding base and which by reason of the flat water slope received even a smaller portion of the load. Thus they found a value more than three times greater as regards the reservoir side of the dam, which did slide, than the value found by Mr. Hazen as an average for the entire base.

The subject seemed of sufficient importance in connection with future design of dams with hydraulicked clay core to warrant restudy, and it was also deemed desirable to avoid possible confusion in the minds of readers of both articles, as to the coefficient of friction. The subject was fully discussed by correspondence with Mr. Hazen.

It may be remembered that the effort followed in construction, after it had been decided to use dry fill for the outer masses, was to place these masses as far as practicable in such manner as to have the clay core occupy two-thirds of the volume of the dam upstream from the center line and one-half of the volume downstream. This would make the clay core extend to the sloping lines 2 to 1 upstream and 1¾ to 1 downstream, as shown in the accompanying sketch. This figure represents a section of the dam as originally designed, extending downward as far as the probable level of the plane of sliding, and showing in drawn lines the approximate condition of the finished work just before the slide.



SKETCH OF CONDITIONS IN CALAVERAS DAM SLIDE

In dumping dry material so as to cause it to project over the mud pond, a considerable amount of settling took place, producing a rising pond level at times when no hydraulicking was in progress.

In the writer's previous consideration it was assumed that this process of settling resulted in some mixing of materials along planes of contact, the dry material absorbing the surplus water in the adjoining and intermingling clay and producing practically watertight mixed zones.

The width of these zones was never definitely determined. Such information as was available to the writer in May, 1918, led him to assume that these zones were comparatively narrow and that they were confined between sloping planes, as shown in the sketch.

The elaborate study given to this subject leads Mr. Hazen to conclude that penetration of dry fill into the liquid core was far deeper, and for all practical purpose extended clear down to the base. His conception is that the mixed mass was not homogeneous, but that it contained layers of pure clay supersaturated to an unknown degree, extending far out under the slopes and capable of transmitting hydraulic pressure.

As to weights of materials, the weight of loose fill deposited in 5- to 6-ft. layers, unrolled, was taken by the writer in May, 1918, at 90 lb. and of the liquid core of 83.3 lb. per cubic foot. Mr. Hazen found the weight of the loose fill to be 110 lb. per cubic foot dry and, as near as could be estimated, 120 lb. with its probable contents of moisture. He also found the unit weight of the clay core to be 100 pounds.

If the problem be considered entirely on the basis of Mr. Hazen's finding of weights, and of his conception of mixing and distribution of materials, it is evident that sliding must have taken place along some plane of deeply penetrating pure clay layer, and that one such layer must have existed near the approximate elevation of stable base. The question remains how far out from the remaining liquid core this layer of clay may have extended.

In view of the declared effort to have the core extend to the indicated slope lines of 2 to 1 and 1¼ to 1, it is here assumed that, in spite of the subsequent sinking of outer fill, some pure clay did extend at least to the slope lines 1.6 and 1.25 to 1. If this assumption, which is admitted to be arbitrary, is approximately correct, the upstream 234-ft. width of base developed material friction opposing sliding, while the remaining 209.5 ft. may have been practically frictionless.

The weight borne by the upstream portion cannot differ materially from the weight of the mass vertically above it, which figures 548 tons, as compared with 1920 tons figured by Mr. Hazen to be the weight of the entire prism, and 387 tons figured by him as the horizontal core pressure. Thus, the following values for sliding factor would result:

548 tons on dry-fill base,	387 tons horizontal pressure,	0.71 sliding factor
1372 tons on wet clay base,		0.00 sliding factor
1920 tons on entire base,	387 tons horizontal pressure,	0.20 av. sliding factor

Corresponding figures for the downstream portion of the dam are as follows:

791 tons on dry-fill base,	387 tons horizontal pressure,	0.49 sliding factor
969 tons on wet clay base,		0.00 sliding factor
1760 tons on entire base,	387 tons horizontal pressure,	0.22 av. sliding factor

On the above basis, the factors originally figured for the dry base, at 0.83 and 0.48, towards and away from the reservoir, respectively, should be amended by reason principally of different weights to 0.71 and 0.49, the former resulting in sliding, and representing the coefficient of friction of dry-fill base. The friction coefficient of the entire base was 0.20, as stated by Mr. Hazen.

It will be quite evident that different assumptions as to relative proportion of clay base will produce different results, and, as definite determination has been made impossible by the slide, no certainty as to these values can now be had.

Nevertheless, similar reasoning and approximation of forces in other dams with hydraulicked clay core may permit an intelligent comparison. The writer therefore suggests an amended rough conclusion, drawn on the basis of corrected assumptions, viz.: That a sliding factor of about one-half for the dry mixed rock and earth fill used in the dam was safe, and that when this factor reached 0.71 sliding took place.

Portland, Ore. D. C. HENNY.

How One German Military Tunnel Looks

Sir—The accompanying sketch shows a typical section of what is known as the "Crown Prince Tunnel," constructed on Mort Homme Hill by the Germans for the purpose of affording protected shelter against shell fire and for the conduct of troops to locations on the line. The tunnel was constructed in the side of the bill heading in at grade through a chalk-rock formation, with an average depth from the surface of the ground to the floor of the tunnel of about 35 ft. It could house comfortably 2500 men.

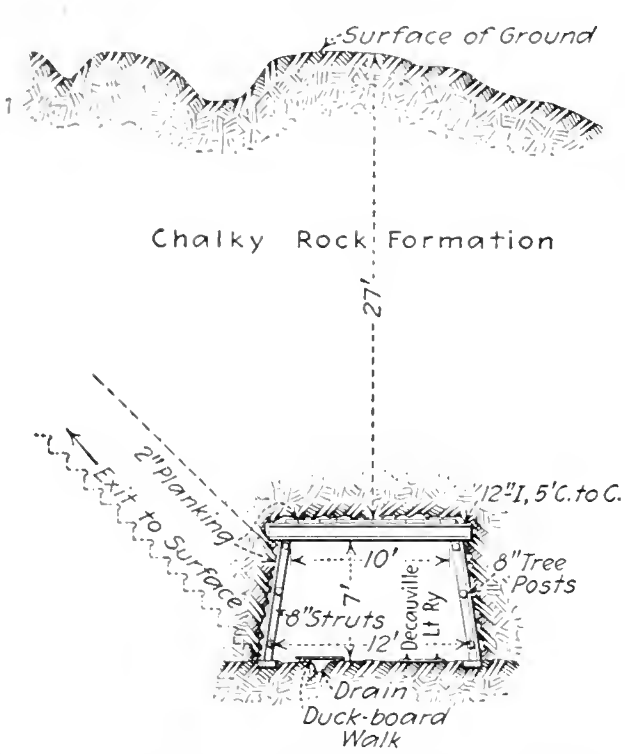
It is situated on the western slope of Mort Homme, about nine miles northwest of Verdun, and runs in a general northeast-southwest direction for a total length of about 750 m. On this hill and the adjoining hills—

No. 304, Montfaucon, Bois de Carbeaux—the greatest fighting of the war was done, and I think it no exaggeration to say that not one square foot of Mort Homme has remained unaffected by shell fire, the hill presenting to the eye one mass of contiguous shell holes and churned earth.

Mort Homme has two German-built tunnels, the Bismarck and the Crown Prince, the Bismarck being the smaller. It is said that the crown prince occasionally visited the tunnel bearing his name and, in fact, had a room therein.

The exits from the tunnel are mostly on the southerly side, marked A in the sketch, a few being on the north side, and there are openings at either end. There are about 10 exits or entrances in all, the entrance to the tunnel being accomplished by means of the northeast end.

There are a number of rooms built into the tunnel, about 10 in all. These rooms are built in the rock without impinging on the tunnel area, which is unobstructed throughout, and they average about 15 ft. square. The rooms comprise three sleeping rooms with bunks, for about 20 men, one kitchen, and a suite of rooms used as an infirmary with about eight cots in it. The infirmary is located at the northeast end, and a number of wounded and the medical staff were killed when a French shell sealed this opening. It may be well to state here that the Decauville railway cars were fitted up with a stretcher arrangement, which was



TYPICAL SECTION OF CROWN PRINCE TUNNEL, BUILT BY GERMANS ON MORT HOMME HILL NEAR VERDUN.

probably used for conveying the wounded to the infirmary from the various openings. The rooms on the northerly side were the dynamo room, with a completely equipped electric-lighting plant, which was housed in a room 12 x 24 ft. long, and another room which contained a ventilating plant of the blower type.

The tunnel is undamaged excepting at the northeast, which was destroyed by shell fire and sealed for about 30 m. At two other points near the southwest end shell fire had caused the rupture of the roof boarding, but the beams were hastily reinforced by 10-in. posts placed vertically under the center of the beams.

When this hill was finally captured by the French, 1200 prisoners were taken from this tunnel.

DANIEL I. CURTIN,
Captain of Engineers, United States Army.
Thirteenth Engineers, Verdun, France.

Construction of Three-Centered Ellipse

Sir—The accompanying diagrams and equations illustrate a simple graphical and algebraic solution for the construction of a three-centered false ellipse. Fig. 1 indicates the solution when the short radius r is known or assumed, and Fig. 2 the solution when the longer

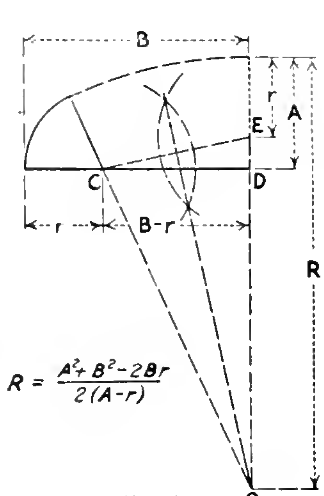


FIG. 1

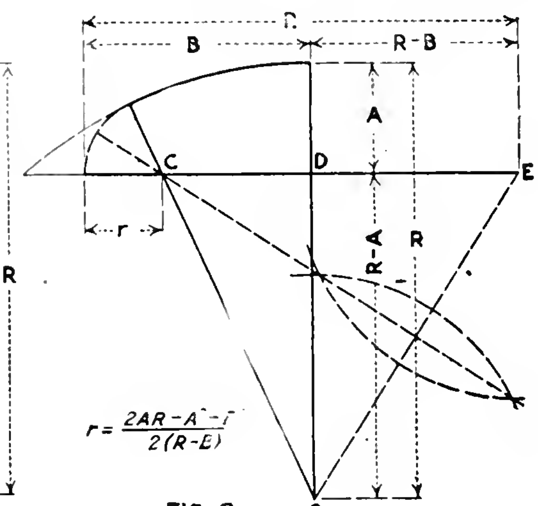


FIG. 2

radius R is known or assumed. In both cases the algebraic solution follows directly from the simple relations existing between the sides of the right triangle OCD.

The graphical construction in Fig. 1 is as follows: Lay off r on the vertical axis, locating E as shown. Connect E with center C, and erect a perpendicular bisector of CE; it will cut the vertical axis at O, the center for radius R.

Similarly, for Fig. 2: Lay off R on horizontal axis to locate E as shown, connect E with the center O, erect the perpendicular bisector of OE; it will cut the horizontal axis at C, the center for radius r.

There are other solutions, but these seem most satisfactory.

BERNHARD SILBERBERG,
Assistant Engineer, Board of Public Works.
San Francisco, Cal.

Asphalt Street Maintenance in Los Angeles

Three methods are used in repairing asphaltic street surfaces in Los Angeles, according to the annual report of the Engineering Department for the years 1917 and 1918. The methods are patch work, cover work and the surface-heating process of resurfacing. Patch work is done by the old method of cutting out and refilling. The cover work consists of cutting a binding edge around the surface to be repaired, and covering the existing asphalt surface with a thin layer of hot asphalt. The surface-heating process of resurfacing consists in heating and removing any desired thickness of the old asphalt surface, and replacing it with new. During the fiscal year covered by the report, the amount of work and the unit cost thereof was as follows: Patch work, 141,181 sq.ft. at 4.73c. per square foot; cover work, 1,012,092 sq.ft. at 3.07c. per square foot; heater work, 1,170,420 sq.ft. at 5.92c. per square foot.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

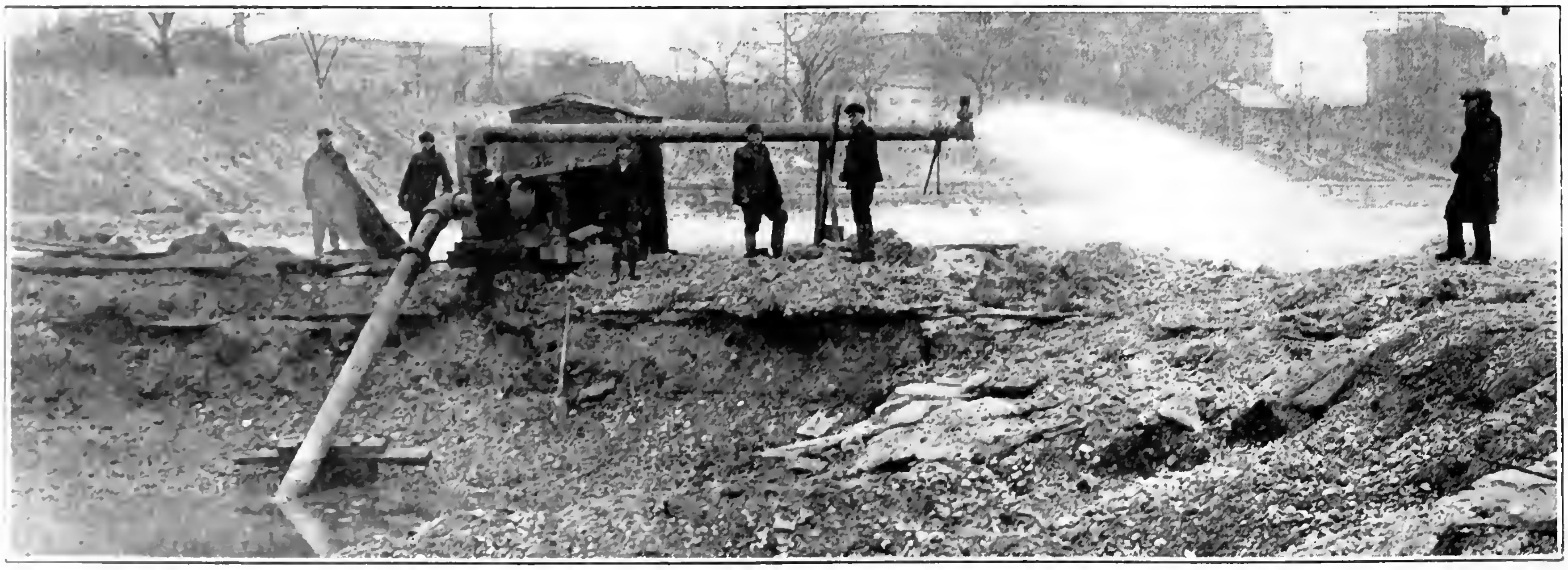
Portable Pumping Outfits Unwater Trenches for Lowering Pipe Lines

PORTABLE pumping outfits are giving excellent service in various unwatering operations in connection with the Miami Valley flood-protection works. They have been employed particularly in the work of lowering pipe lines, which has been made necessary by the deepening of the channel of the Miami River at Dayton, Ohio. Two sizes of outfits have been used for the pipe-line jobs. The smaller outfit consists of a 6-in. belt-driven volute pump operated by a 30-hp. cage-type electric motor, costing $82.50 for the pump and $416 for the motor. The larger size has an 8-in. pump and a 50-hp. motor costing, respectively, $136 and $562. In both outfits the pump and the motor are mounted on the same bed timbers, with a small weatherproof house built over the motor and a narrow roof extending over the belt to protect it from material that might drop from the buckets of excavating machinery. Four hooks in the bed timbers, to which may be attached short pieces of cable, enable the outfit to be readily lifted by crane or derrick for loading and transporting. On land the outfits were moved by motor truck and on water they have been moved on an 8 x 18-ft. general-utility deck scow.

When first sent out, the pumps were equipped with a foot valve only. On the job they were supplied with a gate valve on the discharge pipe. This valve serves two purposes: When entirely closed it retains the water for priming the pump, and when partially closed it can be made to regulate the discharge so as just to take care of the inflow into the excavation. With the pump steadily running, the gate valve can be manipulated so as to keep the water level in the excavation at any desired elevation to meet the requirements of the work.

Priming the foot valves gave rise to much difficulty. Pebbles or other obstructions would collect on the valve seat, despite the use of a strainer, and at times allow the water to flow out almost as fast as it could be poured into the pump. With a gate valve installed on the discharge pipe a more satisfactory method of priming is to pump out the air with a pitcher or diaphragm pump. The general method of procedure on the Dayton work was to excavate with the dragline machines to as near the crossing pipe as possible without damaging it with the bucket, and to build a cofferdam or low levee around the work with the excavated material. The excavating had to be carefully done on account of the weight (about four tons) and unwieldiness of the buckets. It was found that about 2 ft. is the minimum safe distance from the pipe for excavating by machine, when the work is unwatered. As soon as sufficient cofferdam had been placed the pumping outfit was swung into position by the dragline machine, a sump dug out for the suction, and the pit pumped out. As the pit was unwatered the excavation was carried down with the dragline to the desired depth on both sides of the pipe line. The pipe was then uncovered by a shovel gang, the joints were melted out with an acetylene torch, and the

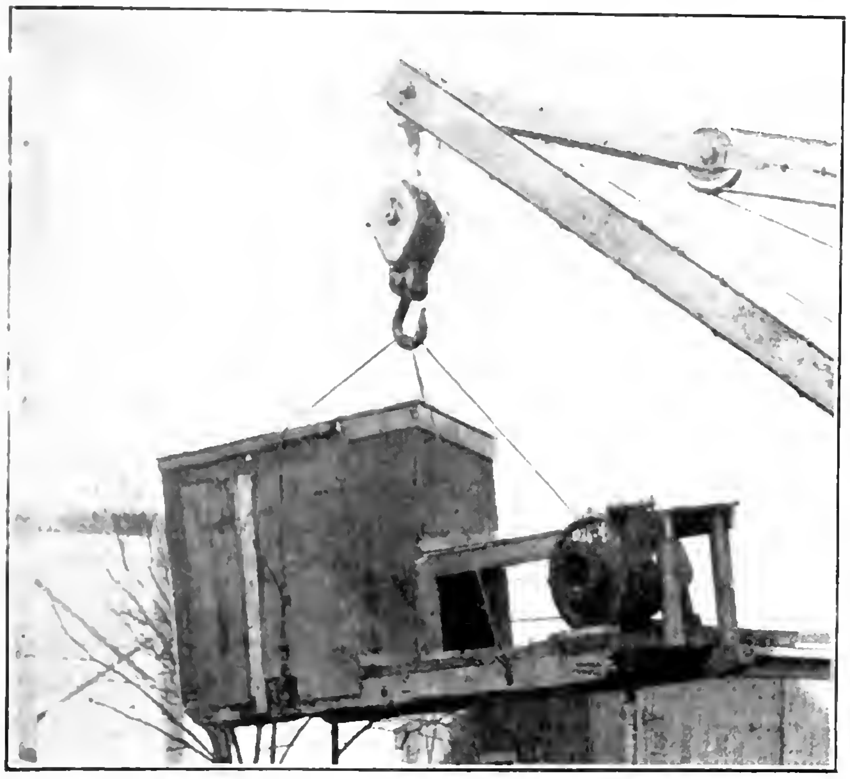
Other Articles in This Issue of Interest to Contractors:



PORTABLE PUMPING OUTFIT UNWATERING EXCAVATION FOR PIPE LINE

sections of pipe were lifted aside by the dragline machine. A new trench was excavated with the machine, and the pipe was relaid in its new bed.

On one of the pipe-line jobs a pit 200 ft. long and about 30 ft. wide at water level was unwatered to a depth of 5½ ft. in 20 min. by the 8-in. pump. The pit was kept pumped out continuously by this pump to a depth of 6 ft. below the surrounding water surface. In another instance a pit 300 ft. long and about 50 ft. wide at the water line was excavated, exposing 250 ft. of pipe line. An extra wide pit was dug in this case to provide ample working space so that the pipe line could be lowered in place without unjointing it. The material



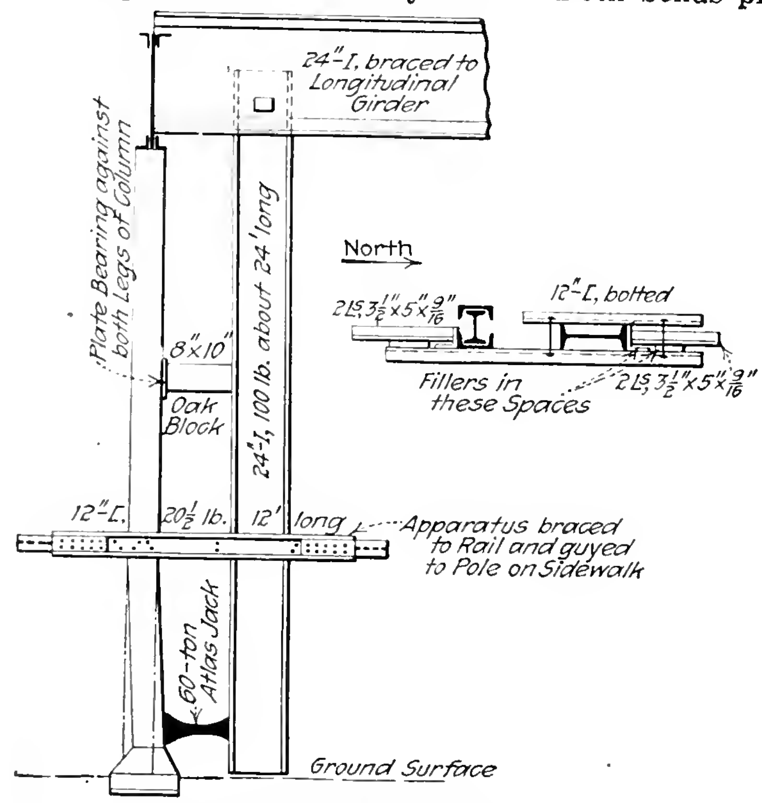
LOCOMOTIVE CRANE LOADS PORTABLE PUMPING OUTFIT ONTO MOTOR TRUCK

in this cofferdam contained considerable silt. One 8-in. pump easily kept the pit unwatered to a depth of 9 ft. below the surrounding water surface of the river.

Arthur E. Morgan is chief engineer, Charles H. Paul is assistant chief engineer and C. H. Locher is construction manager of the Miami Conservancy District.

Jack Straightens Bent Steel Column

TWO bent columns were successfully straightened in one afternoon with a device improvised from materials on the job. A railway traverses the street under the elevated line on Gravesend Ave., Brooklyn, N. Y. Shortly after the erection of the elevated structure, a girder on a passing material train broke loose from its fastenings, and, striking three columns, bent two of them and twisted the third. The twisted column had to be replaced. The more badly distorted of the two bent columns was, at the point where the girder struck it, bent out of plumb ⅞ in. on the east face and ⅜ in. on the north face. Both columns were straightened in the same manner. A 24-in. I-beam was set up and fastened to the elevated structure above and braced to the ground below. Then it was tied to the column at the bent point, as shown by the drawing. A jack was set between the column and the I-beam near the ground, and higher up a timber block was inserted. The ratio of the distance between jack and tie and tie and block was 3 to 2. Each ton pressure on the jack stressed the tie 2½ tons. Pressure was applied until the column returned to plumb and ½ in. beyond it. Both bends prac-



SCREW-JACK ARRANGEMENT FOR STRAIGHTENING BENT COLUMNS

tically disappeared in the operation. The procedure was equally successful with the second column.

The work was performed by Post & McCord, Inc., New York City, contractors for the section of the elevated road on which the accident occurred. This description is taken from an article in the *Public Service Record* by William E. Rudolph, section engineer.

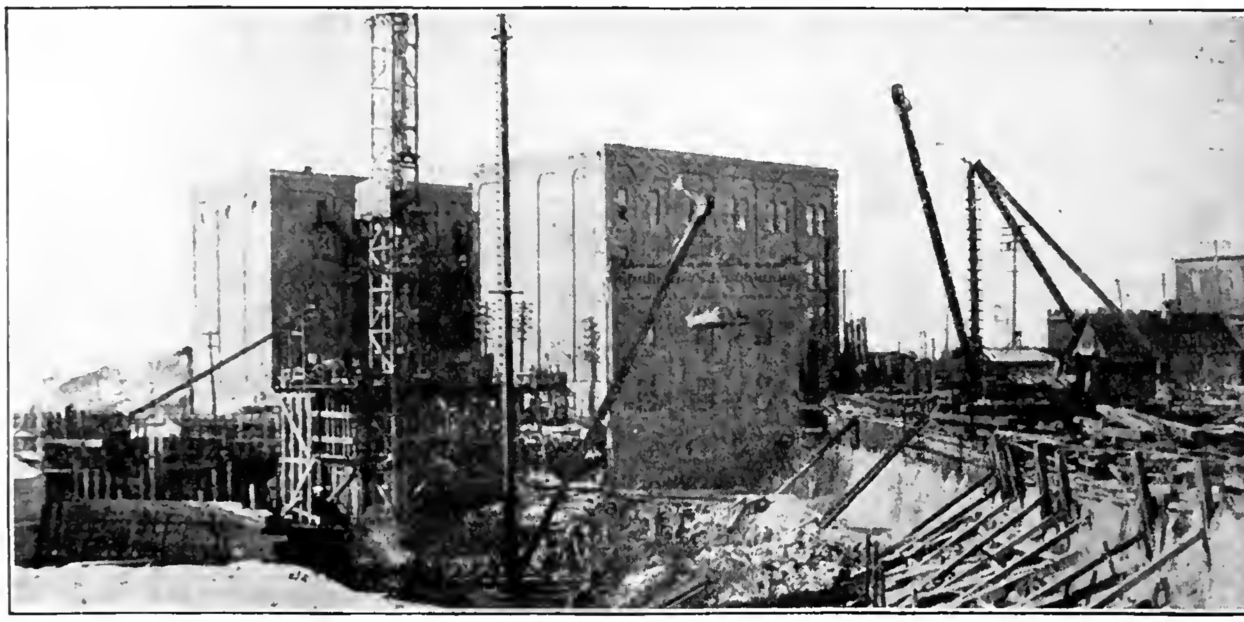
Two Derricks Operated by One Engine and Crew

IN MAKING plant arrangement for the replacing of a dam across the Mississippi River at Little Falls, Minn., the contractors, Siems, Helmers & Schaffner, of St. Paul, Minn., provided a traveling stiffleg derrick moving along the crest of the old dam, the proposed location of the new structure being such that it could be commanded in its entire length from this position. This derrick was equipped with a three-drum engine, fitted with an extra clutch winch for nigger-head work, regular swinging of the derrick being handled by a separate swinging engine.

After the beginning of cofferdam construction, it was decided by the owners to change the location of the new structure, moving it downstream to obtain better foundation conditions. This necessitated the installation of an additional derrick that would command the site, but also relieved the upper derrick of a considerable amount of the work which it was originally figured to do. The contractors therefore provided a guy derrick with an 80-ft. mast and a 70-ft. boom, set on a skid to facilitate its being moved from time to time to command the various portions of the operation.

The boom fall line was taken off the original stiffleg derrick and replaced with a fixed boom fall. With the aid of extra blocks, this left the stiffleg derrick in its original position with a fixed boom reach, one engine-

operated load line and the swinging arranged to be done by nigger-head lines. This permitted the continued use of this derrick for landing form sections, steel and other material from the contractor's yard above the dam. The remaining two engine lines were used respectively for boom fall and load line in the guy derrick, with the swinging engine rigged to do the swinging. The original location of the stiffleg derrick gave the operator an unobstructed view of both rigs.



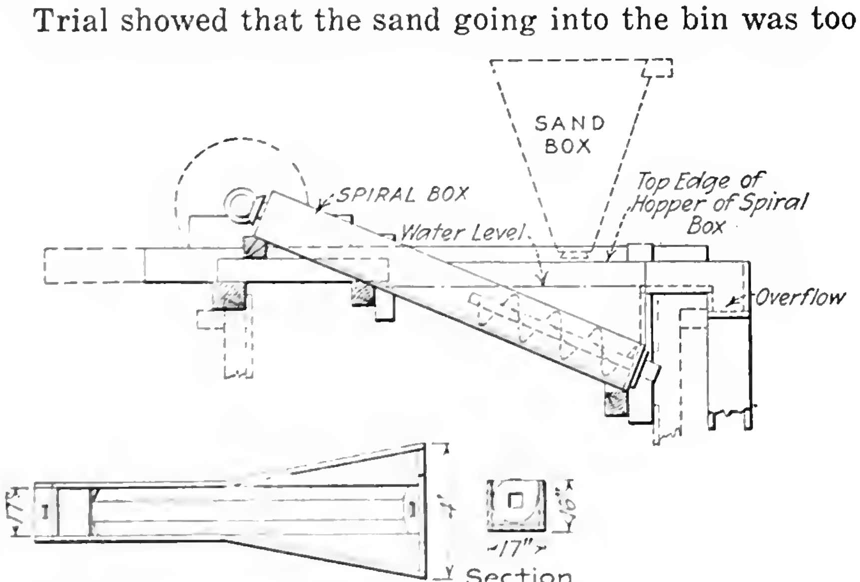
TRAVELING STIFFLEG DERRICK MOVES ALONG CREST OF OLD DAM

After the completion of the work in the river bottom, the guy derrick will be removed and the stiffleg derrick rereeved as originally installed and used for tearing off the crest of the old dam. R. D. Thomas, of Minneapolis, was consulting engineer.

Screw Conveyor Rids Washed Sand of Surplus Water

ATTACHMENT of a simple screw conveyor device to the gravel and sand-washing and screening plant at the Lockington dam of the Miami Valley flood-protection works has successfully eliminated the surplus water carried into the washed-sand bins. The washing and screening plant is of the standard construction employed on the protection works, as described in *Engineering News-Record* of Oct. 10, 1918, p. 680. The sand, wet from washing, flows down the sand screen into an inverted cone hopper which it nearly fills. Most of the contained water rises and overflows through a notch in the top edge of the cone. As the cone becomes full, a counterweighted bottom valve opens and lets the contents fall into the sand bin.

Trial showed that the sand going into the bin was too wet, and to remove this excess water the device illustrated was attached. Now the sand discharged from the cone falls into the screw conveyor hopper, whence it is carried by the screw conveyor up the inclined conveyor box, and from the top falls into the bin. As the sand is carried upward the water drains back into the hopper and, overflowing a notch in the hopper top, is carried away. The device has been found to work effectively.



EXCESS WATER DRAINS FROM WASHED SAND ASCENDING INCLINED CONVEYOR

The Miami flood-protection work, of which the Lockington dam is a part, is being carried out under the direction of Arthur E. Morgan, chief engineer, Charles H. Paul assistant chief engineer, and C. H. Locher, construction manager.

Guard Rope Against Freezing and Prevent Possible Accidents

MANILA or other fiber rope is made brittle by freezing, and should be thawed before being used. Accidents happen because of the neglect of this precaution.

Few contractors try to care properly for fiber rope; neglect of handy rope and of rope used for tackle is particularly flagrant. Fall rope and that used in standing rigging do not absorb much moisture, soon dry out in the wind, and are comparatively free from dirt. They need no special care to prevent freezing. With general utility rope the case is different. A manila rope contains only a small amount of natural moisture, but it will absorb as much as 30 to 40% in a damp atmosphere.

The moisture does no injury, but the freezing of the contained water makes the fibers brittle and the rope weak; therefore the frost should be thawed out before the rope is used subsequently for heavy lifts or pulls.

Dirt is objectionable chiefly because it reduces the working life of rope. When working, the rope fibers move and play on each other and the grit in the dirt cuts and frays them rapidly. On a construction job a visitor recently had to pick his way over the tangle of handy rope and tackle left lying where last used, and frost was in every inch of this rope.

When finished with a rope put it where it will not freeze or be ground into the mud; if this is impracticable coil down the rope and set this coil on a pile of boards or on any other handy object, so that it will have some chance to dry. C. S. H.

NEWS OF THE WEEK

New York, March 6, 1919

Reconstruction in France To Be Delayed for Year

A correspondent with good sources of information writes to *Engineering News-Record* as follows, with reference to reconstruction in France:

"Reconstruction will be a matter of at least a year hence. The work has not even been organized, and with the French habit of talking a thing to death before actually doing any work, the prospects for a speedy beginning are anything but bright."

Civil Engineers' Branches Studying Development Work

Both the Philadelphia and the Pittsburgh Associations of Members of the American Society of Civil Engineers have appointed committees paralleling the subcommittees of the Development Committee of the society. These committees have drafted reports which will be the basis of discussion regarding recommendations to be made by these local associations to the Development Committee. The Pittsburgh Association's committees reported last month, and the Philadelphia Association's committees reported Mar. 3. The number of topics being so large that they could not all be discussed at the last meeting, the Philadelphia Association will finish the discussion on Apr. 7, the committees' report meanwhile being put in type for the information of the members.

Congress Passed Few Bills That Interest Engineers

Only two bills of the many concerned with engineering matters were enacted in the deadlock that marked the final days of the 65th Congress. These are the rivers and harbors bill carrying an appropriation of $37,000,000 for construction and maintenance and also the provision for an investigation of the St. Lawrence River navigation route, noted on this page, and the bill appropriating $10,000,000 for the purchase of the Cape Cod Canal. Among the many bills and parts of bills that died were the water-power and the coal and oil lands leasing bills, the appropriation of $750,000,000 for the railroads, Secretary Lane's proposed appropriation of $100,000,000 for the reclamation of land for the use of soldiers, Senator Kenyon's emergency public-works commission, the Caldwell amendment providing that excess Government machine tools be turned over to the colleges, and the entire Army, Navy, sundry civil, public buildings and general deficiency appropriation bills. The bill validating the informal war contracts was passed and the machinery for its operation is now being put into motion. The daylight-saving law remains in force, as the amendment to the agricultural appropriation bill repealing the law failed with the bill.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western Zone, 63 E. Adams St., Chicago.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Myers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Appoint Reconstruction Advisory Committee

In response to a request from Chairman Abram I. Elkus, of the Reconstruction Commission of the State of New York (office in the Hall of Records, New York City), the Engineering Council has appointed an Advisory Committee of five well known engineers: George W. Fuller, chairman; H. de B. Parsons, George F. Kunz, Paul G. Brown and L. B. Stillwell, who represent the several branches of the profession and the member societies of the Engineering Council. This committee is to confer with the commission upon public works and other engineering matters, particularly the following: (1) The proposed vehicular tunnel under the Hudson River between Manhattan Island and Jersey City; (2) water-power development; (3) sewerage and sewage disposal; (4) garbage disposal and utilization, and (5) port development.

Governors and Mayors Discuss Reconstruction Three Days

At the invitation of the President 19 Governors, the representatives of many other state heads, and 137 mayors, met this week at the White House to discuss "the proper method of restoring all labor conditions to a normal basis as soon as possible and to effect any such alterations of labor and endeavor as the circumstances may make necessary," to quote the President.

The first two days were given over to addresses by the President and his cabinet officers and reports by Governors and mayors as to conditions in their respective states and cities. The last day, the deliberations of which were too late to be noted in this issue, was devoted mainly to a consideration of the resolutions which represent the action of the conference. The Governors, for the most part, reported hopeful conditions as to labor and industry, but the mayors generally told a different story. Constructive measures were absent in the first two days, though toward the end there was a notable trend toward recommendations looking to the investigation of prices, and insistence on railroad purchasing of material.

Bill Authorizes Investigation of St. Lawrence Navigation Route

A final paragraph to the Rivers and Harbors Bill which has been signed by the President authorizes the International Joint Commission, which regulates boundary waters between the United States and Canada, to investigate what further improvement of the St. Lawrence River between Montreal and Lake Ontario is necessary to make the river navigable for oceangoing vessels. The commission is ordered further to report to the Government of the Dominion of Canda and to the Congress of the United States its recommendations for coöperation by the United States with Canada in the improvement.

Seven Bids for Devil's Lake Dam

Bids for the Devil's Lake Dam, an element in the flood-control project of Los Angeles County, California, outlined in *Engineering News-Record* of Feb. 13, 1919, p. 351, ranged from $169,908 to $239,315. Bent Bros., Los Angeles, were the lowest of the seven bidders. The contract had not been awarded at latest reports, owing to the high prices asked for cement, which was to be supplied by the county. J. W. Reagan, Los Angeles, is chief engineer for the work.

Interest at Meeting of American Road Builders Centered in Post-War Problems

Topics Included National Highways, Motor Truck Regulation, Use of Materials for Heavy Traffic, Reconstructing Roads and Bridges

New conditions due to the war, and greatly increased motor-truck traffic, received consideration in many of the papers and committee reports of the American Road Builders' Association, held last week at the Hotel McAlpin, New York City. The attendance was estimated at 1350. A national highway commission and system, regulation of the various dimensions, speed and weight of motor trucks, proper materials and their proper use for heavy traffic, and the reconstruction of pavements and bridges to carry this traffic, were dealt with in various papers, discussions and reports.

Joint Sessions of the Convention

While the convention was primarily one of the American Road Builders' Association, one day was given over to a joint meeting with the American Automobile Association, the Highway Industries Association, the National Highways Association and the National Highway Traffic Association. Practically all the papers at these two sessions dealt with national aspects of good roads and the steps that must be taken to obtain a unified national system. Most of the proceedings consisted of committee reports on the above subjects, there being only two papers read, one by George H. Pride, formerly member of the Highways Transport Committee, on the "Inter-relationship of Highways, Railways and Waterways," and an address on "National Highways," by T. Coleman du Pont of the National Highway Association. Mr. Pride predicted that hauls up to 100 miles by motor truck would be found to be profitable and would not interfere in any way with railroad or waterway transportation.

The report of the Committee on National Highways was read by E. J. Mehren, editor of *Engineering News-Record*. Mr. Mehren spoke at length in advocacy of a Federal highway commission to build, maintain and control a Federal highway system. The Federal-aid law, under which the Bureau of Public Roads now operates, was designed to promote state highway systems. The Federal money is contributed to the states and the roads are built by state road officials. There was doubt in Mr. Mehren's mind whether these officials could use this money to build a system adequate for the Federal Government, when such system would not be to the best interests of their respective states, without violating their oaths of office. State officials must build the roads in locations to serve state interests best, rather than with an eye to direct national routes.

Reports on the reconstruction and strengthening of highway bridges and roadways of trunk highways to accommodate motor-truck traffic were presented for the committees of which they were chairmen by Willis Whited, bridge engineer, Pennsylvania State Highway Department, and H. E. Breed, first deputy commissioner of highways, New York. Mr. Whited stated that the committee deemed it necessary to make inspections of all highway bridges and determine at once what should be done to strengthen or reconstruct them. All new bridges should be designed for a maximum load of 20 tons. The report made by Mr. Breed recommended that in reconstructing narrow roads for trunk highways the minimum width should be 20 ft., with an allowance of 9 ft. for each additional lane of traffic.

George H. Pride read the report of the committee on regulations covering speed, weight and dimensions of motor trucks. The committee recommended the following: Maximum weight on four wheels, 28,000 lb.; maximum speed, 15 miles per hour; maximum weight per inch width of tire, 800 lb.; maximum width of truck, 96 in.; gross length of truck, 28 ft.; maximum height, 12 ft. 2 in. Resolutions recommending the features advocated by Mr. Mehren and Mr. Pride were passed at the last session of the convention.

Road Builders' Association

Besides the abstracts on p. 464 other papers and reports may be noted.

"Recent Developments in the Construction, Maintenance and Reconstruction of Cement Concrete Pavements," was the subject of an address by A. D. Williams, former chairman of the State Road Commission of West Virginia. Among the practices which have become established recently, as outlined by Mr. Williams, are: The submerged or invisible joint to take care of expansion, and the resurfacing of old concrete roads with from 2 to 3½ in. of new concrete. The latter practice has been successful on the Western Pike in West Virginia.

Cost keeping is often carried to such a fine point by highway contractors that it loses its usefulness, according to H. P. Gillette, editor-in-chief of *Engineering and Contracting*. To be of value, costs should be found daily and weekly for each item having a contract price.

One of the liveliest discussions of the convention was precipitated by the report of the committee on the economic status of guarantees for pavements on roads and streets, read by F. P. Smith, consulting paving engineer, New York City. The committee recommended that guarantees be required for the life expectancy of the pavement without repairs. The whole theory of guarantees was opposed by many of the contractors and engineers present. It was contended that guarantees always greatly raise the cost to the city and generally involve a law suit.

Among the resolutions adopted that have not already been mentioned were: One addressed to the Secretary of War, requesting the return of all road-building regiments from overseas at the earliest possible moment; one asking for the readjustment of freight rates to favor road materials, and several advocating earliest possible resumption of all road building.

Iowa Engineers Work for Technical Publicity

State-wide organized engineering publicity, directed by a central committee, has been initiated by the Iowa Engineering Society. Activities of the publicity committee, headed by R. W. Crum, and discussed at the annual meeting Feb. 19-20 in Muscatine, include a plan of action already in operation that has transformed the society from an organization active two days a year to one in continuous operation. License legislation—indorsed by all engineering organizations of the state—society organization, hard-road possibilities and drainage problems, were other topics presented.

The publicity scheme consists mainly in energizing a local engineer in each community to the point of coming into close contact with the local editor, to prepare local material and have printed the material of state-wide interest furnished by the central committee.

"Push public work now" was an idea for which the committee asked every engineer to act as publicity agent. Resolutions to that effect were passed, put into the Muscatine paper in full, and sent by the latter's syndicate service, over the state. Further admonitions were given to talk the slogan to members of councils, boards of supervisors, chambers of commerce and influential citizens. Charles H. Young expanded the idea in his presidential address, exhorting the engineers to promote "carry-on" conventions in each community before going to a proposed state convention at Des Moines.

During the meeting a group of members of the American Society of Civil Engineers authorized a committee to take steps toward the formation of an Iowa Association of Members of the American Society of Civil Engineers. Two new sections of the state society were authorized, mechanical and electrical. A special committee on professional practice was charged with running down rumors of unprofessional conduct, bringing the alleged offenders to justice or stopping the stories; also to handle the problem of engineers' compensation. A minimum wage scale was recommended of \$200 for engineers in charge, \$175 for instrument men and \$150 for draftsmen.

The officers elected for the year are as follows: C. H. Currie, president; H. H. Dean, vice-president; C. H. Streeter and A. F. Fischer, directors; J. H. Dunlap, Iowa City, secretary-treasurer.

Wisconsin Engineers Meet

Encourage construction, prepare plans and let contracts early, and preach optimism—these were the duties with which Wisconsin engineers were charged by the speakers at the annual meeting of the Engineering Society of Wisconsin, held Feb. 21-22 at Madison. A committee on licensing was created.

War, said T. Chalkley Hatton in his presidential address, had taken hundreds of young engineers and put them in positions of responsibility which they would not have reached in many years of civil practice. The country, therefore, has a large body of engineers, men trained to new ideas of coöperation, coördination and speed of production. The only way by which the engineer can meet the higher wage and price scales is by better planning, by improving and coördinating construction methods.

A. R. Hirst, engineer of the State Highway Commission, said there are not in Wisconsin, nor in neighboring states, enough engineers, contractors and inspectors trained in road construction to build the mileage of road for which money was available and which highway officials stood ready to place under construction. This calls for the best of planning and the highest development of mechanical aids to increase output and speed.

Last Meeting of the Season Held

The third and last, and perhaps the best, meeting of the winter season of the New York Section of the American Water-Works Association was held in New York City Feb. 19. Charles R. Bettes of Far Rockaway was elected a member of the board of governors.

The development of the water-treatment motor trucks used by the American Expeditionary Forces in France was outlined, and the trucks were described, by William J. Orchard, manager of the Wallace & Tiernan Co., New York City. These trucks (*Engineering News-Record*, Sept. 5, 1918, p. 458) included a combination of mechanical filter, a chlorinating apparatus and pump and storage tanks; also pumping and chlorinating apparatus alone. Some 50 units had been delivered in France, and others had been contracted for, when the armistice was signed. In order to make it possible to operate the laboratory on the truck it was found necessary to mount the pump on springs.

Application of the chloramine process of water treatment to Esopus Creek, before it enters the Ashokan reservoir, was detailed by Dr. Frank E. Hale, director of the Mount Prospect Laboratory, New York City. Studies of compound meters prior to their possible adoption by New York City were outlined by Fred B. Nelson, assistant engineer of the Department of Water Supply.

Cuyahoga River Conservancy Commission Proposed

The county commissioners of Cuyahoga County are considering the formation of a conservancy district under the Ohio conservancy law, for the purpose of straightening the Cuyahoga River, as a preliminary to the construction of a large bridge across that stream.

Waterways and Drainage Commission Proposed for Missouri

A bill abolishing the present State Land Reclamation Department of Missouri and creating a State Waterways Drainage Commission, to consist of a lawyer, a business man and an engineer, has been introduced in the Missouri legislature. The proposed commission would have charge of all drainage districts and reclamation projects.

First National Society to Adopt Cleveland Plan

A plan for joint membership in the American Society of Mechanical Engineers and the Cleveland Engineering Society, following the general scheme adopted by the latter some months ago, is announced in *Mechanical Engineering*, formerly the *Journal* of the Am. Soc. M. E. for February, as having been adopted in principle by both societies. The tentative plan provides for a division of dues between the two societies, with a reduction of $5 in the total yearly dues previously paid. Members of the national society may join the local society without paying an entrance fee. Members of the Cleveland society, on qualification and election to the Mechanical Engineers, would pay the difference between the entrance fees of the two societies. For members new to both societies the joint entrance fee would be $25—$18 to the national and $7 to the local society.

To Sell Aircraft Materials

Completion of plans and organization to sell surplus materials, including a considerable amount of lumber and shop equipment, has been announced through the Bureau of Aircraft Production, Washington, D. C., which has charge of their disposal.

Civil Service Examinations

United States.—Superintendents of road construction, Bureau of Public Roads, Department of Agriculture, Mar. 25: Class A (candidates with four years' responsible charge of construction) $150 to $175 per month; Class B (six years' responsible charge) $185 to $225; Class C (eight years' responsible charge) $230 to $250 a month. Apply to United States Civil Service Commission, Washington, D. C., or to local office of commission for form 1312, and file before Mar. 25.

United States.—Assistant examiner, Patent Office, Washington, Mar. 26-28, and May 21-23 and July 23-25. Pay, $1500 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission for form 1312, to be filed in time to arrange for examination at place selected by applicant.

United States.—Chief physicist, qualified in aëronautics, National Advisory Committee for Aëronautics, Langley Field, Hampton, Va., Mar. 25, $3000 per year. Also physicist, $2100 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission for form 1312, to be filed before Mar. 25.

United States.—Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agriculture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3400 per year. Apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission for form 1312, to be filed before Apr. 1.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 910 Michigan Ave., Chicago; Mar. 18-20; Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The Montreal Branch of the Engineering Institute of Canada will be addressed by C. V. Holslag, on "Electrical Welding," and by Hanbury A. Budden on "Patents and Engineering," at the meeting Mar. 13. A special meeting was held Mar. 4 at which H. H. Vaughan repeated his presidential address delivered at Ottawa, in which he reviewed the munitions industry in Canada.

The San Francisco Association of Members of the American Society of Civil Engineers held its regular bimonthly meeting Feb. 18. In the annual address of the incoming president, E. J. Schneider, he presented a "budget of suggestions" looking toward an increased membership, closer acquaintanceship among the members, and more

association activities during the coming year. To carry out these ideas, committees were appointed on membership, entertainment and public relations. The topic of the evening was "Concrete Ships," and brief talks were presented on various phases of the subject, by three speakers. Leslie W. Comyn, as president of the corporation which financed the building of the "Faith," told of the obstacles that had to be overcome in starting in the industry. Victor H. Poss, who designed the hull of the "Faith," described, with the use of slides, the details of design and construction. H. J. Brunnier, principal assistant engineer, Concrete Ship Division, Emergency Fleet Corporation, showed a large number of slides, illustrating the various types of concrete ships designed and built, and construction methods in several yards.

The New England Water-Works Association will hold its monthly meeting Mar. 12 at the Hotel Brunswick, Boston. William E. Foss, chief engineer of the Metropolitan Water Works, Clinton, Mass., will read a paper entitled, "A Brief Description of a Break in a 1200-Horsepower Turbine." M. N. Baker, associate editor of *Engineering News-Record*, will speak on "Meeting Water-Main Costs by Assessments for Benefits," followed by a discussion by Caleb M. Saville, chief engineer of the Board of Water Commissioners, Hartford, Conn.

The Engineers' Club of Philadelphia will hold an excursion Mar. 22 to the Philadelphia Quartermaster Terminal, at the invitation of Lieut. Col. E. B. Morden, Quartermaster Corps, U. S. A. C. W. Brown, of the H. K. Mulford Co., will speak on "Health Conservation," at the weekly luncheon Mar. 11.

The Utah Society of Engineers held a meeting Feb. 19 which was devoted to a discussion of the production of potash in the United States. W. D. Bonner spoke on the project of producing potash from the Nebraska potash "brine." O. C. Hart described the recovery of potash at the Brigham City cement plant.

The American Association of Engineers' railroad conference program, Mar. 17, includes addresses as follows: By H. P. Gillette on "Shall Engineers Be Paid Overtime?"; by J. L. Jacobs on "Principles and Procedure in Classification and Salaries of Railroad Engineers," and by W. W. K. Sparrow on "How Shall Proper Recognition Be Obtained?" A discussion on schedules of pay will follow the preliminary report on the subject. A member of the United States Railroad Administration has been asked to speak on the application of Order 27 and Supplements 7 and 8 to the railroad engineer. All professional engineers in railroad service, whether members of any society or not, are asked to participate.

The Northwest Master Builders' Association held its second annual convention in Seattle Feb. 20-21. Resolutions were adopted providing for a campaign for the establishment of trade schools throughout the Northwest. The following officers were elected for the year: President, J. B. Warrack, Seattle; vice-president, S. G. Morin, Spokane, and secretary-treasurer, S. C. Ericksen, Tacoma.

The Seattle Engineers' Club was addressed Feb. 20 by W. J. Santmyer, Puget Sound Traction, Light & Power Co., on "Powdered Coal As a Fuel."

Personal Notes

LIEUT. COL. WILLIAM C. HOAD, Sanitary Corps, U. S. A., who has been stationed in the office of the Surgeon General as advisory engineer on water-supply, sewage disposal, and general camp sanitation, has received his discharge from the service and has returned to the professorship of sanitary engineering, University of Michigan.

J. E. PENNYBACKER, chief of management, Federal Bureau of Public Roads, has resigned to become director of roads, American Automobile Association.

MAJ. W. D. A. ANDERSON, Corps of Engineers, U. S. A., has been appointed United States Engineer at Montgomery, Ala. Major Anderson was previously in command of the 218th Engineers at Camp Travis, with the rank of colonel, for the emergency. He was assistant to the chief engineer of the Army in Cuba in 1907 and 1908, after which he served as an instructor at the United States Military Academy.

GEORGE A. ELLIOTT, engineer, Spring Valley Water Co., San Francisco, has been appointed chief engineer of the company. Mr. Elliott has been in the service of the Spring Valley company for several years, and since the retirement of Hermann Schussler has been in charge of all construction work.

DR. F. W. MCNAIR, president of the Michigan College of Mines, has been appointed consulting engineer of the Bureau of Standards, Department of Commerce, Washington, D. C.

WILLIAM S. WILSON, supervisor of the Pittsburgh division of the Pennsylvania R.R., has been appointed division engineer, with headquarters at Oil City, Penn. He was born in 1880 and received his early education at the Central Manual Training School of Philadelphia. He entered railroad service in the construction department of the Pennsylvania Lines, and a year later was transferred to the office of the engineer maintenance of way, at Philadelphia. Two years later he was appointed assistant supervisor of the Trenton division.

HERBERT THOMAS ROUTLY, who was engaged in the carrying out of highway contracts for the New York State Highway Commission and contracts for county highway work in the vicinity of Dundas, Ont., has been appointed construction engineer of provincial highways of Ontario. He was born in Ontario in 1878, and is a graduate of the Collegiate Institute at Lindsay, Ont.

CAPT. ROBERT O. WHITEAKER, U. S. A., who recently returned from service with the field artillery in France, has received his discharge and will resume private practice in the firm of Whiteaker & Washington, civil engineers, Moore Bldg., San Antonio, Tex.

ROBERT M. KNOX, 70th Engineers, U. S. A., has received his discharge from the service and returned to his former work as general superintendent, A. Guthrie & Co., Inc., contractors and engineers, Blue Island, Ill., on their canal work for the Chicago Sanitary District.

WILLIAM C. PERKINS has resigned as chief engineer of the Dunn Wire-Cut Lug Brick Co. to become chief engineer and secretary of the Eastern Paving-Brick Manufacturers' Association.

CAPT. A. V. RUGGLES, 17th Engineers, U. S. A., has returned to this country and has received his discharge from the service. He has become engineer of construction and surveys in the Cleveland Water Department.

C. E. EDWARDS has resigned as maintenance engineer of the Yakima-Sunnyside project, United States Reclamation Service, to become district manager of the Columbia irrigation district, with headquarters at Kennewick, Wash.

L. W. DUFFEE, acting chief engineer of the Gulf, Mobile & Northern R.R., at Laurel, Miss., has been appointed chief engineer, maintenance of way department, with offices at the same point.

J. R. MCDERMOTT, 832nd Aëro Squadron, was recently discharged from the service after his return to this country, and has become assistant highway engineer of Harrison County, Ohio. He was previously field engineer for the Portland Cement Association.

D. O'HARA and A. L. SHAW announce the establishment of the firm of O'Hara & Shaw, consulting engineers, with offices in the Phelan Bldg., San Francisco. Mr. O'Hara, who was formerly consulting engineer for Jacobs & Co., New York City, recently re-

ceived his discharge from the Canadian Army, which he joined at the outbreak of the war in 1914. He was engaged in the supervision of a considerable amount of construction and engineering work for the Canadian forces on the western front, particularly in the vicinity of Ypres.

T. W. WHITE, assistant engineer, office of the bridge engineer, Canadian Northern Ry., Winnipeg, Man., has been appointed district engineer, Western District, with headquarters at Edmonton, Alta.

EDWARD C. HAYER, JR., formerly of the 29th Engineers, on duty at Washington, D. C., has received his discharge from the service and has returned to the engineering department of the Chesapeake and Ohio Ry. as assistant office engineer at Richmond, Va.

FREDERICK C. FREEMAN, first assistant chief engineer, United Gas Improvement Co., Philadelphia, has been appointed engineer of the Providence Gas Co., Providence, R. I.

ROLLIN J. WINDROW has resigned as city engineer of Waco, Tex., to engage in general contracting in that city. At the time of his appointment as city engineer he was a member of the State Board of Water Engineers, and was the first county engineer of McLennan County.

WILLIAM L. ROCKWELL, senior irrigation engineer, Bureau of Public Roads, Department of Agriculture, has been sent to Haiti to advise in irrigation development work, in accordance with a recent request of the Haitian Government.

W. H. FAIRCHILD, city engineer of Galt, Ont., has become manager of the Galt Public Utilities Commission, and will have charge of both the hydroelectric and water-works departments.

A. V. REDMOND, division engineer, Transcontinental division, Canadian Government Rys., has been appointed district engineer, central district, with office at Winnipeg, Man.

LIEUT. THORALF E. OLSON, 5th Engineers, Camp A. A. Humphreys, Virginia, previously of Trenton, N. J., having been discharged from the service, has resumed his work in the New Jersey State Highway Department as resident engineer for the state highway, with headquarters at Asbury Park.

E. N. FLOYD, who has been appointed supervisor of fire protection of the newly organized Bureau of Fire Prevention, Cleveland, Cincinnati, Chicago & St. Louis Ry. and associated lines, as mentioned in *Engineering News-Record* of Feb. 27, 1919, p. 450, was previously in charge of railway location work for the Miami Conservancy District, which he joined in 1914. Since that time he has been connected with various features of the work and was recently in charge of the railway location in the Huffman and Taylorsville basins.

H. L. VERCOE, special engineer, Canadian Northern Ry. at Winnipeg, Man., has been appointed district engineer, Prairie district, with headquarters at Saskatoon, Sask.

SAUL SHAW, maintenance engineer, Naval Aircraft Factory, Philadelphia, has resigned to become structural designer, Atlantic Refining Co., at Philadelphia.

CAPT. FRANK W. HARRIS, Engineers, U. S. A., has returned to this country and, having received his discharge from the service, is now located at Renton, Wash.

THOMAS TURNBULL, assistant chief engineer, Canadian Northern Ry., has been appointed engineer maintenance of way, western lines, with headquarters at Winnipeg, Man.

OBITUARY

MAJ. JOHN C. OSTRUP, a member of General Pershing's staff, died in New York City Feb. 28. Early in 1917 he sailed for France with the first detachment of the American Expeditionary Forces, as a member of General Pershing's staff, to which he had been assigned to advise in engineering work. He was the author of "Ostrup's Specifications." He was born in Denmark in 1864 and was graduated from the Danish Military Academy in 1885, later going into harbor work for the Danish Government. He came to this country in 1891, and since that time had been engaged in railroad and bridge work. In 1898 he was appointed engineer of maintenance, South Side Elevated R.R., Chicago, later entering the service of the Boston Elevated. He was afterward called to become professor of structural engineering at Stevens Institute of Technology, and maintained offices as a consulting engineer in New York City.

MAJ. JAMES N. HAZLEHURST, Corps of Engineers, U. S. A., previously of Chattanooga, Tenn., died in France Feb. 9, as reported in current casualty lists. He was born in 1864 and received his early education at Kirkwood Military Academy, afterward entering the service of the Memphis & Charleston Ry. as a rodman. He remained in railroad work until 1884, when he resigned as superintendent of construction, New Orleans & Mississippi Valley Ry. to enter the School of Design at Cincinnati as a student. A year later he became general manager of the Lookout Iron Works, and was also associated with the Montgomery, Ala., water-works, becoming principal assistant engineer in 1887. He afterward entered private practice and was in charge of the design and construction of many water-supply systems in the South, including those for Clarksville, Tenn., Algiers, La., St. Augustine, Fla., and Hazlehurst, Miss. For a number of years he was in partnership with Charles L. B. Anderson under the firm name of Hazlehurst & Anderson, with headquarters at Atlanta, Ga., and Wilmington, N. C. The firm was dissolved in 1911, after which Mr. Hazlehurst continued in private practice in Atlanta and Chattanooga. He entered the Army and went to France in 1917 and was engaged in water-supply work for the American Expeditionary Forces.

ROBERT E. MILLIGAN, general manager, New York Continental Jewel Filtration Co., Nutley, N. J., died in Newark, N. J., Feb. 25. He was 52 years old and had been engaged in water-supply and filtration work for the past 30 years. From 1889 to 1896 he was chemical engineer for the Continental Filter Co. of New York City, and was engaged in assisting in the design and operation of water-filtration plants in various cities. Mr. Milligan was in charge of the Continental Filter Co.'s work in St. Louis, and also represented the company in experiments at Pittsburgh. He was afterward engaged in reconstructing and improving the operation of municipal filtration plants at Quincy, Cairo, Danville and Moline, Ill., and installed a new filtration process for Vicksburg, Miss. In 1900 he became associated with the New York Continental Jewel Filtration Co., first as chief engineer, and two years later becoming assistant general manager. In 1907 Mr. Milligan was appointed general manager. During his service with the New York Continental Jewel Filtration Co. he had been in charge of and assisted in the preparation of plans for, and construction and operation of municipal filtration work in various cities, including Atlanta, Ga., Montreal, Portsmouth, Ohio, Charleston, S. C., and Scranton, Penn.

CARL STRADLEY, chief engineer of the Oregon Short Line since 1911, died at Salt Lake City Feb. 11. He was 53 years old. He entered railroad service in 1886 on surveys for the Union Pacific, and for several years was engaged in location work. For a few years he went into mining work, but in 1901 was engaged on location for the Oregon Short Line, remaining continuously in the service up to his appointment as chief engineer eight years ago. Under Government control Mr. Stradley was appointed assistant chief engineer of the Union Pacific System, under Federal Manager E. E. Calvin.

Construction and Prices: 1913 and Now

In Spite of High Costs, Contracts Let Last Month Were Only Twenty-Five Per Cent. Behind February, 1913

Nobody is in a position to state definitely just how far present construction activities are behind those of the latter pre-war years. An approximation, however, is possible by comparing the activities of, say, February, 1919, with those of the corresponding month of a typical year prior to the war. The following is a quick, brief study of February, 1919, vs. February, 1913, as gleaned from the "Construction News" pages of this magazine:

Week Ending	Water-Works	Sewers	Bridges	Streets and Roads	Industrial Works	Excavating and Dredging	Buildings	Federal Govern-ment	Miscel-laneous	Total for Week
Feb. 6, 1919										
Number of bids requested	8	4	3	26	5	7	20	34	10	117
Number of contracts awarded	2	3	3	6	10	1	14	8	4	51
Total value of contracts awarded	$58,000	$214,000	$72,000	$515,000	$5,493,000	$13,000	$1,654,000	$391,000	$166,000	$8,576,500
Feb. 13, 1919										
Number of bids requested	10	7	4	34	5	6	28	27	9	130
Number of contracts awarded	1	2	8	12	8	2	2	6	1	42
Total value of contracts awarded	$6,500	$224,000	$206,000	$1,060,000	$410,000	$109,000	$179,000	$345,000	$92,000	$2,631,500
Feb. 20, 1919										
Number of bids requested	6	4	11	33	8	9	28	27	12	138
Number of contracts awarded	2	1	3	25	21	3	11	7	5	78
Total value of contracts awarded	$287,000	$543,000	$425,000	$1,368,000	$1,311,000	$325,000	$3,534,000	$250,000	$1,398,000	$9,441,000
Feb. 27, 1919										
Number of bids requested	2	7	5	34	1	6	6	12	9	82
Number of contracts awarded	....	....	....	22	16	8	12	12	15	85
Total value of contracts awarded	....	....	....	$1,396,000	$6,377,000	$2,265,000	$2,118,000	$500,000	$541,000	$13,197,000
February, 1919										
Bids requested	26	22	23	127	19	28	82	100	40	467
Contracts awarded	5	6	14	65	55	14	39	33	25	256
Value of contracts awarded	$351,500	$981,000	$703,000	$4,339,000	$13,591,000	$2,712,000	$7,485,000	$1,486,000	$2,197,000	$34,485,500

TABLE II. SHOWING CONSTRUCTION ACTIVITIES IN FEBRUARY, 1919

existence. Let them therefore be regarded as reasonably accurate. Then in February, 1913, there were 84 more contracts let than in February, 1919, the difference in value being $18,213,000.

The money value of contracts is of secondary importance to the number of contracts let; that is, one thousand $20,000 contracts mean far greater prosperity to contractors, engineers and manufacturers than twenty $1,000,000 jobs. Therefore, it should be noted that although last month the money value of contracts let was 70% of that of February, 1913, the number of contracts let was only 25% behind.

As a matter of fact, the money difference between the two periods may be more than accounted for in the $24,000,000 worth of railway work let in February, 1913. Very little grading and track work is under way at the present time, nor has there been much in the past four years.

After glancing at Table I, the most pessimistic will concede that road work is not merely picking up but is actually moving toward a boom. Last month bids were requested on 127 new projects and 65 contracts were let, aggregating more than $4,000,000, whereas in February, 1913, the contracts awarded amounted to only $2,254,000. As for industrial work, it would be reasonable to suppose that this class of construction had already been overdone; yet, last month $13,591,000 worth was let against only $1,672,000 six years ago.

The first figures to compare are the grand totals. In February, 1913, contracts let numbered 340 and aggregated $53,058,000 against the 1919 figures of 256 contracts valued at $34,845,000 (exclusive of two $50,000,000 contracts which it would be unfair to include). Of course, these figures are not absolute. The system whereby they are collected has been vastly improved since 1913. However, the figures used for both years are, so far as the writer is aware, the most reliable of the kind in

The two tables show the jobs let in each class of construction and the money involved in the particular periods under consideration. Work in four of the classes may be regarded as being normal, in four as subnormal and in two—streets and roads and industrial works—as far above normal.

Everybody in the business of supplying or using construction materials knows that the country is far underbuilt, nor is this knowledge restricted to contractors, engineers and manufacturers of construction materials. The many who have sought dwellings and apartments have learned how stringent is the housing situation. In February,

TABLE II. SHOWING CONSTRUCTION ACTIVITIES IN FEBRUARY, 1913

Week Ending	Water-Works	Sewers	Bridges	Streets and Roads	Industrial Works	Excavating and Dredging	Buildings	Federal Govern-ment	Railways	Miscel-laneous	Total for Week (All Classes)
Feb. 6, 1913											
Contracts awarded	7	5	5	13	9	3	11	9	2	4	68
Value	$170,000	$181,000	$205,000	$421,000	$305,000	$239,000	$1,632,000	$673,000	$1,800,000	$578,000	$6,204,000
Feb. 13, 1913											
Contracts awarded	10	7	5	8	10	5	14	1	8	3	71
Value	$252,000	$1,634,000	$457,000	$153,000	$654,000	$247,000	$5,515,000	$80,000	$6,350,000	$145,000	$15,487,000
Feb. 20, 1913											
Contracts awarded	9	15	7	21	10	1	28	3	3	5	102
Value	$403,000	$304,000	$130,000	$1,075,000	$242,000	$32,000	$3,409,000	$119,000	$2,090,000	$1,802,000	$9,606,000
Feb. 27, 1913											
Contracts awarded	7	11	2	25	7	10	23	9	5	6	105
Value	$234,000	$504,000	$305,000	$605,000	$471,000	$1,764,000	$3,477,000	$294,000	$14,000,000	$107,000	$21,761,000
February, 1913											
Contracts awarded	33	38	19	67	26	19	76	22	18	18	340
February, 1919											
Contracts awarded	5	6	14	65	55	14	39	33	....	25	256
February, 1913											
Value of contracts	$1,059,000	$2,623,000	$1,097,000	$2,254,000	$1,672,000	$2,282,000	$14,033,000	$1,166,000	$24,240,000	$2,632,000	$53,058,000
February, 1919											
Value of contracts	351,500	981,000	703,000	4,339,000	13,591,000	2,712,000	7,485,000	1,486,000	....	2,197,000	34,845,500

1913, contracts were let for 76 large non-industrial buildings, valued at $14,-000,000. Last month only 39 such building projects were contracted for, worth $7,485,000. Last month, however, bids were requested on 82 new projects.

That building is on the increase is indicated by the following:

From Nov. 7 to 14, 1918, bids were requested on 3 new building projects; Dec. 5 to 12, on 1; Jan. 9 to 16, 1919, on 8; Feb. 6 to 13, on 28; Feb. 13 to 20, on 28. These figures are only promising. They are not satisfactory in themselves. Much more building is needed to relieve the stringent housing conditions in this country.

As for public work, there is much to be done. Sewer work is practically at a standstill. One manufacturer of sewer-pipe told the writer that were he not also a manufacturer of hollow tile he would have to borrow lunch money. This was in New York. Water-works construction is away behind, contracts let being only 5 against 33 in February, 1913. The case of bridges is more encouraging. Fourteen contracts valued at $700,000 were let last month against 19 aggregating $1,000,000 in February, 1913. The same is true of dredging work, except that the value of the 14 contracts let last month was $400,000 in excess of the value of the 19 awarded six years ago. Federal Government work still exceeds pre-war conditions.

PRICES CONSIDERED

No discussion such as this is at all complete without a consideration of prices. There is no denying that the high price schedule prevailing today is an important factor in the seriousness of the construction situation. In February, 1913, cement sold for 90c. per barrel in bulk at the mill, whereas today it is $1.90. Crushed stone at dock in New York City was 85c. to 95c. per cu.yd. for 1½ in.; 90c. to $1 for ¾ in., against the present minimum of $1.65 and $1.75 respectively. Sand was 50c. per cu.yd. It is now $1.25. Gravel was 85c. to 90c.; it is now $2 a cu.yd. Steel plates in Pittsburgh sold for $1.45 per hundred and in New York at $1.61 (future deliveries in both cases), against today's quotation of $3 in Pittsburgh, $4.27 in New York. Cast-iron pipe in New York was $24 to $25 per ton for 6-in., against $62.70 today. As for pig iron, the February, 1913, Pittsburgh prices were $18.15 for bessemer, $17.15 for basic, against present prices of $32.20 and $30. Building materials are high, but that has ceased to be the "burning question"—which is, Are they going to be lower this season? The indication is that they are not going to fall very much.

It is complacent to say that if capital holds off long enough prices will tumble. It should be borne in mind that a rapidly declining market never indicates prosperity. It is almost safe to prophesy that prices will come down, but it is extremely doubtful whether the decline will be of such importance as to warrant postponing construction work. A price collapse is quite unlikely. Furthermore, it is the last thing that anyone desires. What is fervently desired and of primary importance if prosperity is to persist is a gradual lowering of prices to more attractive levels and a quickening in the placing of contracts. There must be confidence among the several parties—the party who wants work done, the party who wants to do it and the party who wants to supply the necessary materials. When this is established there will be good business for all. A. W. W.

Auto Truck Trailer Manufacturers Effect Reorganization

On Feb. 20 there was effected in Cincinnati a reorganization of the Trailer Manufacturers' Association of America. The following firms were represented: Miami Trailer Co., Troy, Ohio; Warner Mfg. Co., Beloit, Wis.; King Trailer Co., Ann Arbor, Mich.; Martin Rocking Fifth Wheel Co., Springfield, Mass.; Freuhauf Trailer Co., Detroit, Mich.; The Ohio Trailer Co., Cleveland, Ohio; Detroit Trailer Co., Detroit, Mich.; Arcadia Trailer Corporation, Newark, N. Y.; Rogers Bros. Co., Albion, Penn.; Northway Trailer Car Co., East Rochester, N. Y.; Troy Wagon Works Co., Troy, Ohio; Trailmobile Co., Cincinnati, Ohio.

The following officers were elected: W. E. Ferris, of the Ohio Trailer Co., president; W. A. Murfey, of The King Trailer Co., first vice-president; R. C. Sykes, of The Troy Wagon Works Co., second vice-president; J. C. Endebrock, of The Trailmobile Co., secretary-treasurer. The four officers, with W. R. Bond, W. F. Jolley and C. H. Martin, who were elected, constitute the executive committee.

In regard to legislation, it was pointed out that the manufacturers have been following legislation instead of leading. The difficulty of undoing legislation when once enacted was strongly emphasized, and measures were discussed to enable the association to take the lead in constructive legislative work that will not only benefit them but be a benefit to the public as well. The best legal talent will be engaged, and a digest made of all state and municipal laws available, upon which the legal efforts will be based.

Engineering and Business Interests Unite for Export Trade

A merger of large engineering interests with equally large exporting companies in New York, which will be known as the Factory Products Export Corporation, with offices at No. 2 Rector St., has been announced. The exporting organization concerned is a consolidation of the Factory Products Export Corporation and the Manufacturers' Agents Co., Inc., which have been building up a general export and import business in the Latin-American countries and the Far East since 1914 and 1916, respectively. The engineering interests are represented by the J. G. White Engineering Corporation of New York, and the activities of the company will be engaged in a general exporting and importing of hardware, machinery, engineering supplies, and building materials. The corporation expects to be of service both to the American manufacturer and the foreign buyer.

The Factory Products Corporation has business relations already established in Argentina, Chile, Ecuador, Venezuela, Mexico, the British West Indies, China, India, French Indo-China, Siam, Burma, Ceylon, Egypt and the Hawaiian Islands. These relations will be developed more comprehensively before there is expansion into new quarters of the world.

Walker W. Vick, former receiver general of Santo Domingan customs, is president of the corporation. Its directors are Louis E. Stoddard, of Bonbright & Co., Inc., and the Marlin-Rockwell Co.; George H. Walbridge, of Bonbright & Co., Inc.; Arthur H. Lockett, of Bonbright & Co., Inc.; E. J. Kulas, of The Cuyahoga Stamping & Machine Co.; E. N. Chilson of the J. G. White Engineering Corporation; D. M. Barclay and Mr. Vick.

Bridge Builders Report 12 Per Cent. of Capacity Taken

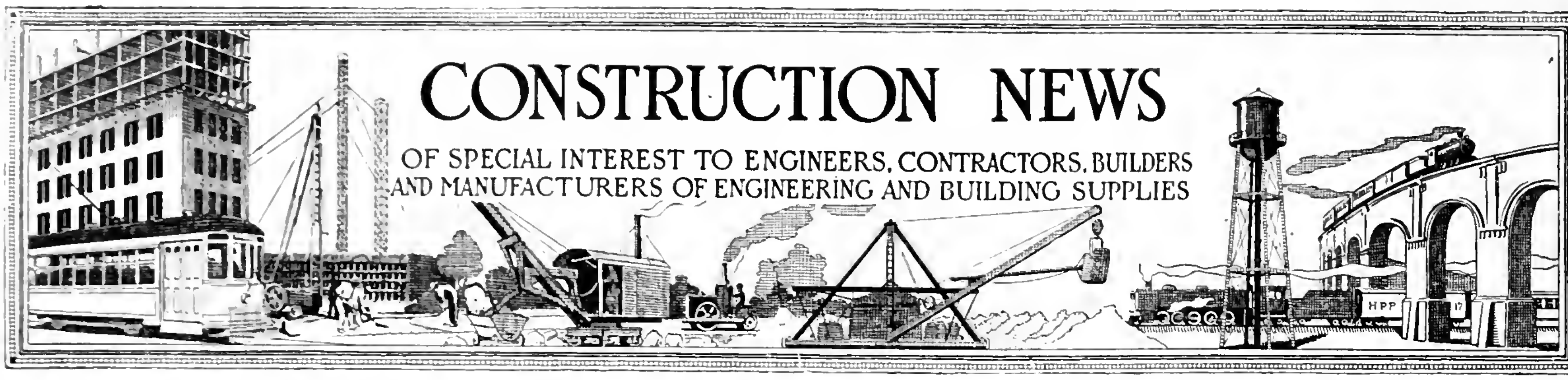
The records of the Bridge Builders' and Structural Society, as collected by its secretary, show that during January, 1919, 12% of the entire capacity of the bridge and structural shops of the country was contracted for.

OBITUARY

HOWARD P. EELLS, of Cleveland, Ohio, who until his death recently was the chairman of the Board of Direction of the Bucyrus Co., held a place of much prominence in the engineering manufacturing field.

Born in 1855, he was graduated from Harvard University in 1878, and began his business career in a Cleveland bank. In 1880 he entered the business of the Bucyrus Co., then located at Bucyrus, Ohio. In moving to South Milwaukee, Wis., to enlarge its works the company suffered from financial difficulties in the panic of 1893. Mr. Eells was appointed one of the receivers of the company, and managed its affairs so successfully that in 1898, when it was discharged from the receivership he was made its active head of the company.

When, in 1911, the company was greatly enlarged and recapitalized, Mr. Eells retired from the presidency and became the chairman of the board of directors. He remained closely interested in its affairs until his recent death.



Price advances are indicated by **heavy type**; declines by *italics*.

PIG IRON—

	Current	One Month Ago
CINCINNATI		
No. 2 Southern	$35.85	$37.60
Northern Basic	31.80	34.80
Southern Ohio No. 2	32.80	35.80
NEW YORK, Tidewater delivery		
Penna. 2X	36.15	39.55
Southern No. 2 (Silicon 2.25 to 2.75)	39.95	.....
BIRMINGHAM		
No. 2 Foundry	31.00	34.00
PHILADELPHIA		
Eastern Pa. 2X	36.15*	39.15*
Virginia No. 2	38.10†	40.50†
Basic	33.90*	36.90*
Grey Forge	33.90*	36.90*
Bessemer	.....	39.10*
CHICAGO		
No. 2 Foundry Local	31.00	34.50
No. 2 Foundry Southern	37.20	39.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley	31.00	35.40
Basic	30.00	34.40
Bessemer	32.20	36.60

* F.o.b. furnace. † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh		Chicago	
	Current	One Year Ago	Current	One Year Ago
Standard bessemer rails	$55.00	$55.00	$65.00	$60–65
Standard openhearth rails	57.00	57.00	67.00	63–65
Light rails, 8 to 10 lb.	3.13½*	3.13½*	3.13½*	3.13½*
Light rails, 12 to 14 lb.	3.09*	3.09*	3.09*	3.09*
Light rails, 25 to 45 lb.	3.00*	3.00*	3.00*	3.00*

* Per 100 lb.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots together with the warehouse prices at the places named:

	Pittsburgh				
	Current	One Year Ago	Chicago	St. Louis	San Francisco
Standard spikes, 9/16-in. and larger	$3.70	$3.90	$4.50	$5.04	$6.15
Track bolts	4.90	4.90	5.50	Premium	7.50
Standard section angle bars		3.25	4.45	Premium	5.15

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

		7 In. x 9 In. by 8 Ft. 6 In.	6 In. x 8 In. by 8 Ft.
Chicago	Plain	$1.48	$1.33
San Francisco	Douglas Fir—Green	1.35	.96
San Francisco	Douglas Fir—Creosoted	2.70	*1.62*

Prices per tie at Missouri mills; St. Louis prices about 25c. higher:

Untreated A Grade White Oak 6x8x8		Untreated A Grade Red Oak 6x8x8	
No. 1	$0.70	No. 1	$0.55
No. 2	80	No. 2	.65
No. 3	90	No. 3	.75
No. 4	.98		
7x9x8 white oak			1.05
7x9x8 red oak (No. 4) $0.80		No. 5	.87

Note:—Add 36c. each for treatment.

PIPE

STEEL—From warhouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
¾ to 3 in. butt welded	4[illegible]%	44.9%	[illegible]%
2½ to 6 in. lap welded	[illegible]8%	40.9%	38%
	Galvanized		
	New York	Chicago	St. Louis
¾ to 3 in. butt welded	27%	29.9%	[illegible]7%
2½ to 6 in. lap welded	2[illegible]%	26.9%	[illegible]4%

Malleable fittings, Class B and C, from New York stock sell at +15% list price. Cast iron, standard sizes, 10% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York						
	Current	One Month Ago	One Year Ago	Chicago	St. Louis	San Francisco	Dallas
4 in.	$65.70	$65.70	$58.35	$64.80	$58.00	**$82.55**	*$70.00*
6 in. and over	62.70	62.70	55.35	61.80	55.00	**79.55**	*67.00*

Gas pipe and 16-ft. lengths are $1 per ton extra

CLAY DRAIN TILE—The following prices are per 1000 lin. ft.:

	New York				
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco
3	$35.00	$35.00	$22.50	$30.00	.....
4	51.00	51.00	27.00	40.00	$45.00
5	65.00	65.00	45.00	50.00	65.00
6	90.00	90.00	55.00	60.00	90.00
8	130.00	130.00	100.00	80.80	150.00

SEWER PIPE—The following prices are in cents per foot for carload lots:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$0.117	$0.096	.....	$0.125	$0.09	*$0.132*
4	.117	.096	.....	.125	.15	*.132*
5	.1755	.144	.....	.175	.1875	.207
6	.1755	.144	$0.16	.175	.225	.207
8	.273	.224	.22	.25	.3475	.2875
10	.4095	.336	.30	.375	.45	.4025
12	.5265	.432	.43	.475	.60	.5175
15	.702	.576	.65	.63	.9375	*.7475*
18	.975	.80	.96	1.00	1.275	*.9775*
20	1.17	.96	1.14	1.20	1.71	*1.15*
22	1.56	1.28	1.46	1.60	.....	*1.495*
24	1.755	1.44	1.64	1.80	2.125	*1.725*
27	2.73	2.145	2.00	2.75	.....	*2.5875*
30	3.024	2.376	2.70	3.45	.....	*3.1625*
33	3.96	3.15	3.25	4.00	.....	*4.025*
36	4.51	3.5875	3.55	4.35	.....	*4.60*

	3	5	8	12	24	36
Boston	$0.12	$0.18	$0.28	$0.54	$1.80	$5.535
St. Paul	.12	.18	.25	.45	2.00	4.75
Denver	.09½*	.....	.....	.....	.....	.....
Seattle	.15	.....	.33¾	.64	2.00	.....
Kansas City	.12	.18	.25	.50	1.80	4.60
Los Angeles	.08¼	.13¾	.24¾	.44	1.50	.....
New Orleans	.10¾	.13½	.27	.459	1.75½	.....
Cincinnati	.108	.162	.252	.486	*1.62*	3.9975
Atlanta	.135	.2025	.315	.6075	2.025	4.6125

*4 in.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8000 gal. minimum f.o.b. place named:

	Current	One Month Ago
New York, 45–65% asphalt	*$0.06½*	$0.07½
New York, liquid asphalt	*.07½*	.08
New York, binder	*.07½*	.08
New York, flux	*.06½*	.07½
St. Louis, 35% asphalt	.09	.09
Chicago, 15–20% asphalt	.10	.10
Chicago, 100% dust layer	.11	.11
Dallas, 40-50% asphalt	.09	.09
Dallas, 60-70% asphalt	.10	.10
Dallas, 75-90% asphalt	.11	.11
San Francisco, 75-95% asphalt, per bbl.	2.10	2.10

ASPHALTUM—Price per ton in packages and bulk in carload lots:

	Brand	Package	Bulk
New York	Texaco	*$25.00*	*$22.00*
Chicago	Mexican	35.50	33.50
San Francisco	California	17.00	13.75
Dallas	Texaco and Mexican	32.00	30.00
Seattle	D grade	23.10	.....
Denver	Trinidad	*45.00*	.....
Denver	California	*38.00*	.....
St. Louis	Stanolind	**30.90**	22.90

PAVING STONE—

New York	Manhattan	$2.80 sq.yd.
	Other boroughs	2.80 sq.yd.
New York	5-in. granite	2.80 sq.yd.
Chicago	About 4x8x4 dressed	2.70 sq.yd.
	About 4x8x4 common	2.35 sq.yd.
San Francisco	Basalt block 4x7x8	57.75 per M
Kansas City	Limestone	2.90 sq.yd.
Boston	5-in. granite	98.00 per M
St. Paul	Sandstone	1.75 sq.yd.
Atlanta	Sta. No. (Lithonia, Ga., rock)	1.75 sq.yd.

FLAGGING—

New York	Bronx	$0.20 sq.ft.
	Manhattan	.21 sq.ft.
	Queens, 5 ft. square	.20 sq.ft.
	5x20-in. cross-walk	.70 lin.ft.
Chicago	18 in. wide	.80 lin.ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York	3½	16	**$3.25**
New York	4	16	3.50
Chicago	4	16	3.10
Chicago	3½	16	2.95
Chicago	City specifications		3.10
St. Louis	3½	16	2.45
St. Louis	4	16	2.60
St. Louis, Minneapolis spec.	3½	..	2.40
St. Louis, Minneapolis spec.	4	..	2.55
Seattle	4	16	2.55
Boston	3½	16	3.25
Boston	4	20	3.50
Kansas City	4	16	3.00
St. Paul	3½	16	2.50
Dallas	3½	18	3.17
Dallas	4	18	3.56

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 — NEW YORK, THURSDAY, MARCH 13, 1919 — Number 11

Under the Shadow of the Railroad Problem

NEXT week the American Railway Engineering Association will hold its annual meeting. It meets at a most extraordinary time for the industry to which its labors are devoted. Last year, it is true, the railroads were under Government control. But they had only recently been taken over, policies were necessarily unformed, and the war was in progress. Now we have had over a year of Government operation. Moreover, the war being ended, the disposal of the properties has become one of the big problems of the day. The multitude of financial, legislative and regulatory questions raised by the situation will not come before the association in a formal way, but the confusion and the serious condition in which the railroads find themselves will inevitably overshadow the meeting and give it a tone more serious than would come merely from the discussion of technical questions. Moreover, the obligation which these straight-thinking men have in the rehabilitation of the railroads, which they and their predecessors have helped to create, cannot but impress itself upon them individually and collectively. Theirs is the type of thinking—the impartial analysis of all factors, even the social ones—which must prevail if the railroads are to be brought to better days. Had the thinking on top in railroad management been as solid and sane as the admirable committee work of the association, we should not have come to the present pass in railroad matters. Certainly, the work of the association looms greater now than ever, for the roads in the time of rehabilitation will have need for all the economies which engineering skill can possibly devise. That thought surely will soberly overshadow the meeting next week.

Public Work More Than Ever the Duty of the Cities

IF THE Governors' and mayors' conference at Washington accomplished little else, it certainly impressed the delegates with the necessity of getting busy each in his own city and state. No better time could have been selected for revealing the breakdown of the national Government in the reconstruction crisis. The 65th Congress was talking itself to death in a whirlwind of masterly inactivity, while the delegates were listening to depressed Federal officials explaining what they would have done had Congress acted. The President, his mind still in Paris, referred to this country's problems only to shift them onto the shoulders of the states and the cities. With few exceptions, the Governors did not show that they were alive to the situation, or that any help might be expected from them, but the mayors—being closer to the people—gave promise of action. After all, they are, in this matter, the more important of the two classes of official. Now that all hope of Federal public works for buffer employment is gone—for many months, at least—it is the cities which must step into the breach and start the street paving, the bridges, the sewers, and the water supplies, which will not only furnish work to the unemployed but give the initial impetus to business activity. No one knows this now better than the mayors of our cities. Let us hope that they will have the coöperation of every contractor and material man, particularly in giving them the best possible prices future conditions will allow. It is the duty of everyone to go as far as he can to stimulate the revival.

Enriching the Literature of Engineering

WHEN the tree is mature and its fruits are mellow, then should the fruits be picked and not be allowed to waste. Engineers and constructors there are, however, who come to maturity, who produce bounteous and splendid fruits of an intellectual and constructional kind, but never share them with others. The fruit-tree analogy is not exact, for these intellectual and constructional fruits are not wasted. They find embodiment in worthy structures. But hundreds—aye, thousands—might know of these works and profit by them, instead of the dozen who now have the knowledge. The difficulty is that these men do not take the time to record and publish their researches and experiences. This train of thought is prompted by the article by R. Fleming in this week's issue of *Engineering News-Record*. For some years Mr. Fleming has been pursuing a policy of setting down the experiences of a lifetime for the benefit of his professional brethren. The tree is mature. The fruit is mellow and of splendid quality; it is here set out that all may take and profit. Other instances might be cited, such, for example, as that wonderful article on slow-burning mill construction in *Engineering News-Record* of Dec. 27, 1917, in which F. W. Dean compressed a lifetime's experience into a few pages. But where one such instance can be cited there are, unfortunately, a dozen where experience that future generations might use will go down into the grave. Is there here not a duty as well as an opportunity? We are all heritors of the ages. Shall not the treasury of engineering knowledge be made richer because we have lived?

Grade-Crossing Problems Demand Coöperation

COÖPERATION rather than controversy should mark the solution of grade-crossing elimination, according to the Detroit report abstracted on another page. This is a principle which other cities and all

railways might well take to heart. In all such work the city gains safety and convenience for its citizens and commerce and usually an improved appearance along the railway lines. The railway gains by saving continual expense for watchmen, gates and damages, and also in freedom of operating its traffic. Certainly, as the report says, the city should pay a fair share of the expense on the ground that systematic elimination of grade crossings is a general public improvement. Discussion of principles and general policy rather than of details is a characteristic of this report which adds to its weight and value. Much of the matter applies to the problem in general as well as to the local condition of Detroit, and it would be well for other cities which have this problem before them to investigate it in the same broad and comprehensive manner.

Compensation Laws and Accident Prevention

THE economic urgency of greater safety in construction is made clear by the steady progress of the movement to compensate industrial workers for accidents, without suits to prove negligence of employers. According to a bulletin recently published by the United States Bureau of Labor Statistics six new states adopted compensation legislation during 1917 and 1918. Only 10 states are now without such legislation. Naturally, compensation laws vary greatly in character, and some of them are partial and crude, compared with others. All, however, place the burden of cost for accident squarely on the employer. To reduce the frequency and severity of accidents and thereby reduce the charge against his business for accident compensation, is the employer's problem. Contractors need particularly to visualize this fact. Construction has been the laggard among industries in practicing accident prevention. This is not because contractors are callous to humanitarian appeal. Nor is it because they are not aware of the responsibilities which workmen's compensation laws place upon them. It is chiefly because they have not been convinced that systematic safety engineering costs less than accidents. Partly, also, it is because few contractors know just what procedure to follow to educate their organizations and their workmen in "safety-first" practices. In both these problems, contractors can obtain material help from the Construction Section of the National Safety Council, whose headquarters are in Chicago.

The Railroad Plans Before Congress

IN EVERY quarter the railroad problem is recognized as one of the biggest and most pressing of the day, for it involves not merely the rights and property of thousands of citizens but the welfare of the entire community as well. Consequently, it was to be expected that when Congress, through one of its committees, announced that it was ready to hear all parties at interest, many plans and much opinion would be offered. To most of us the multiplicity of plans is confusing. Fortunately, one who has followed the testimony closely, who has studied and compared the various plans and whose standing and long railroad experience give to his words unusual weight, has prepared a discussion of the merits of the outstanding features of the various plans. It appears on p. 504 of this issue.

A presentation of each of the principal plans in detail would, naturally, run into much space. Mr. Fritch has chosen, accordingly, the logical procedure of taking up those points which are common to a number of suggestions, arguing that the greater merit is likely to rest with the plans emanating from the majority of thinking proponents. As a result of his discussion, Mr. Fritch leaves us in possession of a composite plan, covering all of the chief phases of the problem.

That plan, as he sets forth, is calculated to safeguard the rights of the two parties to the controversy—the owners of railroad securities, on the one hand, and the public, on the other. It provides for private ownership (a feature, happily, that was strongly endorsed at the recent White House conference of Governors and mayors) but for close Government control. The latter is designed to protect the public's interests, while those of the stock and bondholders would be taken care of in the valuation and in the guarantee of a reasonable return.

The problem, obviously, is not one easy of solution, nor is there likely to be much good result from a multitude of suggestions until these have been boiled down, compared and digested. As a contribution toward a better understanding of the problem as it now stands before the Congressional committee, Mr. Fritch's analysis and discussion are a most helpful addition.

Engineers' Salaries vs. Mechanics Wages

ILLUSTRATING the relation between salaries being offered engineers and the wages thought necessary to attract miscellaneous clerical and mechanical workers, a subscriber sends us some "Help Wanted" advertisements from the New Orleans *Times-Picayune*. The first item reads: "Man with knowledge of civil engineering: must own or control surveyor's instruments; to make plans and lay off surface drainage ditches and levels; prefer one familiar with concrete work; employment in city; salary $30 weekly." The second calls for a druggist and stenographer at the same salary, $30 per week; the third, for a shoemaker to do machine work at the same rate, and the fourth for shipfitters, coppersmiths and patternmakers for the Panama Canal at from $1 to $1.11 per hour.

Our first inclination was to remark that comment upon such a situation would be superfluous. However, following the lines of Mr. Goodell's letter in last week's issue, is it not worth while to distinguish in the engineer advertisement between those qualifications which require a high grade of training and those which do not? Had the advertiser omitted the words "to make plans," is it not possible that the offering of only $30 a week might secure the services of some younger man who might serve very well in the capacity and at the same time be not seriously underpaid? We think that $30 a week is far too little for a competent surveyor, but surely this compensation would appear more equitable to a man with surveying experience only than to one who had put in four years at college and had piled up experience in addition. The moment, of course, that the advertiser injected the statement that the incumbent must be able to make plans for drainage ditches he raised the requirements so materially that the salary he offers is absurd. Even so, we have heard some who would question whether the simpler jobs in civil engineering design might not be handled by men who after leaving high school had apprenticed themselves in an engineering office.

The point is that instead of condemning those who offer low compensation for minor engineering work, it is our duty to examine into the nature of the work, to analyze and distinguish as Mr. Goodell counseled, and frankly recognize which classes of work may be done with comparatively little school training and experience, and which, on the other hand, require a high degree of technical education and long experience. When we have done that and have secured a recognition among ourselves of the different elements of civil engineering work, we will be in a position to influence more intelligently the compensation that should be paid those who engage in engineering work.

Letting Road Contracts in Long Stretches

FOR some years the thought has been crystallizing that the best interests of the public would be served by letting some of our road contracts in long stretches. The past practice of short-length contracts has been due to the fact that methods were primitive, permitting the completion in a single season of only a relatively short piece of road. Quite naturally, then, the contracts tended to be limited in extent by the length of road normally laid in a season's work. This limitation, in turn, made it possible for men with small capital to take contracts, while the relative simplicity of the operations was an invitation to men of little experience to engage in road contracting.

Now conditions have changed, yet the contracting system remains relatively unaltered. In an era of expensive road types, with plant available to build rapidly, we still persist in letting contracts in lengths determined by the days of little machinery and less expensive types. The result is that there are scores of small contracts, each carried by a separate organization, while strong firms able to "plant" a job adequately and to handle a large mileage under one contract are kept out of highway work. In consequense, the public loses the savings that invariably come when a well-coordinated, big organization replaces a lot of independent, small ones.

Nor does the disadvantage lie solely in the losses due to higher costs. There is a real menace in the situation. We are embarking on a very extended highway program. This year, already promising to be of good volume, is but an introduction to a succession of years of extreme activity. The people will make the funds available to the limit of the highway engineers' ability to use them. If we persist in the methods of a bygone decade, the limitation to road-building may be serious to the whole country.

It is well known that many strong contracting organizations which have not heretofore done highway work have been studying carefully the highway-contracting situation. They are not merely ready, but anxious, to engage in this new line of work, but always they meet with the same discouragement—short-length contracts, making it impossible to cover a big mileage in one operation, and to make an investment in expensive plant. These organizations are able to take thirty- and forty-mile stretches and to put on the work one or more outfits—each costing from $30,000 to $50,000—and capable of completing a mile of road a week. With the great extension of highway improvement which is imminent, such handling is going to be inevitable, but why wait two or three years and bear the loss and setback certain with the old system?

In some places laws must be changed to permit the letting of such long contracts, but surely the people who vote large road-bond issues are willing to approve whatever is necessary for the efficient expenditure of the funds.

It must not be thought that adoption of the policy here advocated requires the elimination of all short-length highway work. In all state and county systems there are many short, unimproved sections which must necessarily be let under short-length contracts. This is particularly true of county work. In fact, it is certain that with the renewed highway activity the number of these short, unimproved sections is great enough to keep the efficient small contracting organizations hitherto engaged in highway work. These contracts, too, afford an avenue through which capable construction men can build up to the point where they, too, can take the thirty- and forty-mile stretches here advocated. Futhermore, there will always remain as inviting work for the smaller organizations the construction of the less expensive types, in which a much larger mileage can be made in a construction season than with the improved types now being used on trunk lines. We have no fear, therefore, that the adoption of a policy of long-length contracts will tend to close the door of opportunity to those now engaged in a small way in highway work or who contemplate entering this field.

It is worth while noting, too, that large contracting organizations hitherto engaged in other classes of work—such, for example, as buildings—will have much to learn if they are to execute the jobs with maximum efficiency. The type of mentality needed for success in highway construction is somewhat different from that used on building operations. On the latter work the operations are confined within a small area and can be closely supervised with relatively small overhead organization. Moreover, the compactness of the work enables one or two men to watch the sequence carefully, in order that there may be no delays between the successive phases of the operation. On highway construction the work is scattered over many miles, receiving points for materials often being located pretty far away from the actual work of laying the pavement. The type of mentality required in railway construction is more likely to fit in with highway work than is that which has hitherto attained success in such concentrated operations as the erection of buildings or industrial plants. Obviously, the wise course of procedure for big organizations new to highway construction will be to introduce into their organizations experienced roadbuilders and to support and back them with all of the resources of the large organization. Without a doubt, these big companies have much that can be added to highway work, with an assured increase in efficiency, but they have also much to learn regarding the detailed handling of pavement-construction operations.

The crux of the whole matter, however, lies in the traditional methods of letting highway construction in short lengths. Highway engineers generally, our inquiries indicate, believe in the necessity of the long-length contract, but are bound down either by legislation or by the prejudices of those in their organizations who appreciate less keenly the radical change which has come about in highway work. Under the urge of the large programs now maturing, even the conservatives may be brought to a realization of the inadequacy of past methods and adopt a policy that accords better with the new situation.

A Solution of the Railway Problem Based On Plans Presented to Congress

Discussion of the Salient and Common Features of the Various Proposals, in the Light of Experience and of the Equities Involved

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THERE have been upward of fifty plans submitted to the Congressional committee which has been investigating the railway problem, and there will probably be many more before the investigation is closed. With all the data in hand Congress should be able to devise a plan which will embody features that will deal equitably with the various interests concerned and give effect promptly to such legislation as is necessary to place the transportation industry on a sound basis.

The natural assumption of the advocates of plans is that their particular plans are the best, but on careful analysis of the different proposals it becomes apparent that the particular interests suggesting a plan give prominence to those elements which best safeguard their interests. There are many points on which various plans agree, but not a single plan thus far proposed offers a complete and satisfactory solution of the whole problem. A composite embodying the best features of the various plans must ultimately be adopted, and in the drafting of such a plan all selfish interests must be submerged.

It is the purpose of this review to bring out the salient and common points of the various plans, to discuss them in the light of experience and of the rights and equities involved, and as a result to evolve a composite that will be fair to all.

Ownership, Control, Management, Operation

Ownership—The ownership of the railways is vested in the stockholders, representing millions of individual holders, many of them small owners, including women and children who depend upon the dividends for their support. The property rights of these people must be safeguarded, for these interests were honestly acquired.

The ownership should be left with the people—in private hands. Government ownership is recommended in only one plan, that of organized labor, and for the sole purpose of enhancing their interests without regard to the other interests concerned. Government ownership would mean a demoralization of the railway systems and make it a political spoils system with all its attendant evils. If Government ownership were made the issue before the people, it would meet with overwhelming defeat; so one is justified in concluding from the tenor of the plans presented. That which does not meet with public approval can be safely eliminated from the plan.

Corporate Organization—The ownership having been determined, the next step is the proper form of organization of the railway systems.

The predominating view is that railways should be incorporated under a Federal act. Some plans advocate that this should be compulsory, others voluntary.

One of the main difficulties confronting the railways now is the multiplicity of governing bodies controlling their operations. With the Federal Government and the 48 states making laws governing railway operation, it is plain that much confusion and expense must result. It is reasonable to expect that a single authority governing the operation of an industry which is similar all over the country would produce better and more efficient results than 49 authorities. The difficulty can only be overcome by incorporating interstate railways under a Federal act, not depriving the states of such rights as will not conflict with the Federal authority. While it is held by some legal authorities that Federal incorporation would be unconstitutional, others hold the contrary view. Certainly, if prohibition can be made constitutional by an amendment, Federal incorporation of railways, which is infinitely more vital to the welfare of the country, can be made possible.

Federal incorporation *must* be adopted to place the industry on a sound basis.

Government Control—The majority of the plans recommend some form of Government control. This principle is so well established, and has been demonstrated to be so essential, that it can be safely included in the ultimate plan. The open question is as to the form and extent of this control. The Interstate Commerce Commission is now the main Federal controlling body, but its functions are limited by law. The blame often attached to the commission for the present condition of the railways may not be laid upon the commission, but upon the law prescribing its functions. The fact remains that the commission as now constituted is not empowered to perform the functions which should belong to an adequate Federal controlling body, and it will be necessary to enlarge the powers and functions of the commission or create a new board of Federal control to meet the situation.

Various plans recommend the creation of a Department of Transportation, the head of which should be a member of the President's cabinet. It would assume the powers of the Interstate Commerce Commission. Some recommend the enlargement of the commission by creating regional commissions; others recommend no change in the present commission's organization. Strong objections are made to the appointment of a Secretary of Transportation, on the ground that it would result in political control over the transportation industry, a situation which should be avoided.

The predominating view calls for the creation of a Federal Railway Control Board with ample power to exercise public control over railways, such a board to be either an enlargement of the powers and composition of the present Interstate Commerce Commission or an entirely new body. The state commissions need not necessarily be abolished, but should act in coöperation with the Federal Board of Control, exercising such powers as are not in conflict with the Federal authority.

The public will demand and has a right to require close Government supervision over the railways.

Management—The management of the corporations should be vested in a board of directors. The composition of the board is the subject of wide differences of opinion in the various plans submitted. Several plans suggest the selection of the board solely by the stockholders, others by the stockholders and the Federal Government jointly. Again, others would require membership, on the board, of employees, representing the labor organizations.

The predominant view is that the board of directors should be selected by the stockholders and the Government jointly, and this plan will probably meet the public need of close Government supervision. If the Government representatives are chosen from among able business men throughout the country, and not by political preferment, it will result in strong business administration of the railways. The Government members should also be represented on the executive and finance committees of the boards of directors, and compulsory attendance at meetings of the board and the committees should be provided. The selection of such a board would safeguard the interests of the owners and the public and should meet with public approval.

Operation—Private operation is recommended by nearly all the plans as conducive to the best and most efficient service and economical results. The public has had a demonstration of Government operation during the present Federal control of the railways, and doubtless the conclusions reached are the results of this experience. Due consideration must, however, be given to the conditions surrounding Government operation during Federal control. The public was quite willing to endure the inconvenience and increased cost, with less efficient service, during war times, as a contribution toward the winning of the war, the paramount consideration, but it is not prepared to yield to permanent Government operation. Private operation produces results through individual initiative and incentive, which, it has been demonstrated, are lacking in Government operations.

Consolidations and Interest Guarantees

Consolidations—The consolidation or merger of the present railway systems is subject to a wide diversity of opinion in the various plans, and range all the way from a single unified system to regional systems composed of a varying number of lines. The present laws do not permit the consolidation or merger of parallel and competing lines. Therefore, it will be necessary to pass enabling legislation to perfect a comprehensive railway plan. Competition must be maintained between all important traffic centers to give the public the best service, and consolidation should not be carried to the extent of destroying this necessary competition.

The prevailing view is that the country should be divided into regions, and that within the respective regions there should be consolidation of systems, but not to such an extent as will fail to maintain competition between all important traffic centers. The plan which seems to meet the situation in the most practical manner divides the country into eight regions. In these regions, the present systems are to be consolidated into regional systems, with not less than two principal competing systems, reaching all important points, in any one region, thus preserving competitive service. This plan contemplates 17 regional systems, the nuclei of which would be the strongest lines now existing in these regions. The average mileage of the regional systems would be about 15,000, which is not excessive for efficient operation as one unit.

A careful analysis of this plan shows that such a consolidation could be accomplished with minimum disturbance to the existing systems. The 17 nuclear systems would embrace the majority of the so-called strong systems, leaving only the remainder, which form a comparatively small mileage, to be allocated to the nuclear lines. These remaining lines generally have, under the intense competition prevailing for years, operated under most adverse conditions and with uncertain results. The plan proposed would adequately provide for the future of these lines, with better service to the public and more certain financial return to the owners. It will take care of the so-called "weaker lines" and will place them beyond the financial failure and reorganization which have been their experience.

Result Will Be Financially Strong System

The strong lines are always able to provide for their needs, and if the weaker lines are protected the result will be a financially strong transportation system which will be able to serve the public with equal efficiency in all parts of the country. The community located on a "weaker line" is entitled to good service as much as that now served by the stronger roads, and under this plan the weaker lines would be a part of the stronger lines.

The plan as outlined has been developed along practicable and constructive lines and with definiteness, and seems to meet the situation more completely than any other plan respecting this particular feature.

Guarantees—A guarantee of an adequate return to meet the requirements of the railways is recommended in nearly all the plans. Some provide for a guarantee of rates adequate to protect existing investments and attract new capital; others recommend a guarantee of a fixed return upon the capital investment, but leave in doubt the method of determining the investment; others, a minimum fixed return and a division above the minimum between the owners and the Government; one plan provides for a bonus to the employees, by participating in the return.

Whether the country is prepared to guarantee a fixed return upon the capitalization of railways or to establish a level of rates for transportation which will provide a return to meet their financial requirements, the fact remains that unless one or the other means is adopted the transportation industry of the country will languish. Capital will not seek investment in railway securities unless there is some reasonable assurance of an adequate return.

The experience of the past has demonstrated the futility of depending upon a schedule of rates sufficient to meet the needs of the railways, but there is no reason why it would not be entirely practicable so to establish the rates as to meet the situation with equal justice to the public and the security owners.

There are serious objections raised to the Government's guaranteeing a return upon the capitalization of a corporation. If done for the railways, some say, why not for other industries? Others predict that such a policy would lead ultimately to Government ownership. Some have proposed that the Government

guarantee the interest upon the bonded indebtedness of the railway corporations, at the same time fixing a level of rates which will afford an adequate return upon the stock. This plan would at least protect the underlying securities and prevent embarrassment through default and receivership.

The determination of the amount of the capitalization of the railways can only be reached by a valuation of the respective properties. It will not be possible to await the results of the Federal valuation now being made, as it will be some years before that is completed. The situation demands immediate attention. It is not impossible for a fairly constituted commission of reasonable and competent men to fix this valuation in a comparatively short time.

Whichever plan of guarantee is adopted, it must form the most vital element in the problem, and unless the confidence of the public is restored in the investment in railway securities, capital will seek other channels and our transportation facilities will deteriorate.

The most acceptable plan seems to be one that will safeguard first the funded indebtedness and, second, a minimum return upon the remaining securities based upon a fair valuation to be determined in each case, giving due consideration to any expectancy values which may be found to exist. The Government will not necessarily assume any permanent financial obligation in such a plan, as it will have the power to adjust the rates of transportation so as to provide the necessary revenues.

Financial Structure and Rate Regulation

Financial Structure—The various schemes proposed to provide a new financial structure for the railways are interesting, and are mainly as follows: The new financial structure to be adjusted to such plan of rate regulation or Government guarantee as may be adopted; the consolidation of existing railway systems into a number of Federal regional corporations, which shall issue securities in exchange for existing securities, the new securities to be guaranteed from 4% to 4½% on the bonds and from a minimum of 2½% to 6% maximum on the stock, participating with the Government in excess of 6%; the valuation of railways to be ascertained by a joint commission of the Government, owners and shippers, and exchanging the present securities for new securities on an interest-yielding basis and to be guaranteed, first, interest on bonds, second, 4% on par of preferred stock, the balance of equity to accrue to common stock; the exchange of existing stocks at market value for Government bonds, which, in effect, would be Government ownership as proposed by the labor organizations.

If the owners of railway securities expect to receive a Government guarantee of a fixed return, or a guarantee by a level of rates that will produce the necessary revenue to secure that return, they must and should be willing to place their securities on a basis to which they would be entitled by sound financial rules.

This means, of course, a new financial structure for railway securities, and can be accomplished speedily and equitably, if dealt with fairly and honestly.

Three classes of securities would have to be dealt with: First, bonds or funded debt; it has been proposed that these be exchanged for new securities guaranteed by the Government at 4½% par value. The valuation of the outstanding funded debt can be readily determined and be exchanged strictly upon the basis of their actual worth. This will take care of 55% of the total railway capitalization. The owner of railway bonds could not afford to refuse a fixed income bond, even at somewhat lower interest return, for an existing security subject to the vicissitudes of present railway securities.

Second, preferred shares, which, it has been suggested, be exchanged for new 4 to 4½% securities. The preferred shares of some corporations will be found to have a value equal to or greater than the bonds. Where such values are found to exist, they can be readily dealt with on the same basis as the bonds. Preferred shares falling below the value of bonds can be treated with the common shares. The preferred shares represent 7% of the total railway capitalization.

Third, common shares; it has been suggested that these shares be entitled to the equity remaining in the property after the bonds and preferred shares have been protected. This means a valuation of the property, its earning power over a period of years, and other elements of value which may be ascertained. It would not be a difficult task to arrive at a fair and equitable basis for the exchange of these securities on a rate of return which would safeguard the investment. The common shares represent 38% of the total capitalization.

Necessary provision must also be made for existing equipment trusts, unfunded debts, etc.

It has been proposed that a corporation to be called the Interstate Commerce Corporation be organized under Federal charter to act as a clearing house for the exchange of existing securities of the railways into the new securities of the Federal regional railway systems to be organized, of which the total number for the country would be 17. These regional railway systems would arrange to acquire the securities of the various lines allocated to the nuclear roads now embraced in the larger systems, subject to the approval of the Interstate Commerce Corporation. Any railway corporation not electing to join the regional system would, of course, not be subject to the guarantee.

Would Place Securities on Sound Basis

This plan offers no greater difficulties than are usually encountered in the reorganization of any single railway system and would place railway securities upon a sound financial basis.

Rate Regulation—The courts have recognized the principle that "rates should be reasonable and sufficient to provide an adequate return on the capital invested." The Interstate Commerce Commission and the representatives of the shippers also testified before the Senate committee hearings to this effect. The difficulty lies in determining what is a reasonable rate. The burden of proof has been upon the carriers, and in most cases in the past the commission, under its rules, has suspended advances in rates indefinitely, largely because of the impossibility of proving that the rate was reasonable.

The proper solution of the question of rates is the crux of this whole matter; if the public is not prepared to establish a level of rates that will provide the neces-

sary revenue to enable the railways to exist and expand, the whole structure will fall. The people of this country are enjoying the lowest freight rate of any nation on earth—one-third that of England—and the difference between the rates necessary to enable the railways to prosper and those that are inadequate is so slight as to be almost imperceptible to the average person. It has been proposed that regional rate commissions, with proper representation of shippers, the Government and the railways, be created to deal with this question, their duty being to determine definitely the adjustment of rates necessary in any region to produce the required revenues. The final authority in rate matters would be the Federal Railway Board or the Interstate Commerce Commission as reconstituted. The question of intrastate rates now regulated by state commissions would be subject to such restrictions as to prevent discrimination against interstate rates.

The public is willing to pay rates that will provide good service, and the regional rate commissions, with all the facts before them, could readily determine what these rates should be.

Pooling—The pooling of traffic among railways under existing laws is prohibited. During operation under Federal control this restriction has been disregarded, and traffic has been routed with respect to the shortest and most available lines. This has resulted in economy of operation and has been one of the beneficial effects of Federal control. This advantage should be retained by the railways when they are returned to private operation. With a guarantee as to income, it will be immaterial to the railways whether traffic is handled by the shortest or longest route, but the public is interested in having all traffic handled as economically as possible, in order to reduce the rates to a minimum. Legislation should be provided to enable the railways to continue the benefits from pooling of traffic. On the other hand, if the plan of a limited number of regional railways is adopted, the pooling of traffic will be largely effected through the consolidation of the various lines.

Equal in importance to pooling traffic is the common use of facilities, such as terminals, trackage and equipment, which has also been one of the beneficial features of Federal control. If continued under private operation, it will result in economy and prevent the waste of capital in duplicate facilities which obtained under private operation. This can be accomplished only by a Federal control board or agency vested with jurisdiction over such matters. It cannot be and never has been done voluntarily under private control, and the public is entitled, in better service and reduced rates, to the benefits accruing from such a practice.

Labor—The labor organizations have proposed that the Government shall own the railways and operate them in one unified system, labor to reap the benefit of such operation. The defects in this plan are that it ignores the interests of the owners and the public, two vitally interested parties.

Labor is indispensable in any industry, and is entitled to its full reward; so also is the capital which is invested in the railways. Much of the capital now invested was earned by the labor of those who have been provident and put their hard-earned savings into railway securities. These investors are equally entitled to consideration. The public also, which finally pays the bills, earns its money largely by labor and deserves consideration.

Labor on railways is enjoying a higher return today than in any other industry; it should be protected in its wages and working conditions, both of which should be fair and reasonable, just as the rates should be.

The methods of dealing with railway labor organizations in effect under previous private control should be changed and regional labor commissions appointed to deal with all questions of rates of pay and rules and regulations of employment. Their findings and recommendations should be subject to the same authority as finally passes upon the rates which fix the revenue of the carriers.

Conclusions—The eleven points considered above comprise the essential and fundamental elements of the railway problem that is now demanding a solution by Congress.

Congress can solve this problem wisely and constructively and with equal justice to all, provided the various interests coöperate with Congress and approach the subject in a spirit of compromise.

Acceleration of Concrete Hardening

AS THE result of some experiments made by the Bureau of Standards to develop a method to accelerate the rate at which concrete increases in strength with age, it was found that the addition of small quantities of calcium chloride to the mixing water gave the most effective results. A comprehensive series of tests was inaugurated to determine further the amount of acceleration in the strength of concrete obtained in this manner, and to study the effect of such additions on the durability of concrete and the effect of the addition of this salt on the liability to corrosion of iron or steel embedded in mortar or concrete.

The results to date indicate that in concrete at the age of two or three days the addition of calcium chloride up to 10% by weight of water to the mixing water results in an increase in strength, over similar concrete gaged with plain water, of from 30 to 100 per cent., the best results being obtained when the gaging water contains from 4 to 6 per cent. of calcium chloride.

Compressive strength tests of concretes gaged with water containing up to 10% calcium chloride, at the age of one year, give no indication that the addition of this salt has had deleterious effect on the durability of the concrete.

Corrosion tests that have been completed indicate that the presence of calcium chloride, although the amount used is relatively small, in mortar slabs exposed to the weather, causes appreciable corrosion of the metal within a year. This appears to indicate that calcium chloride should not be used in stuccos, and warns against the unrestricted use of this salt in reinforced concrete exposed to weather or water.

The abstract of the results of the tests appear in the recently issued annual report of the Bureau of Standards.

Operation of New York Central's Cleveland Freight Terminal

Mechanical Handling Developed to High Degree of Efficiency—Use of Tractors, Trailers, Lift-Truck Platforms and Hoists

BY W. E. PHELPS

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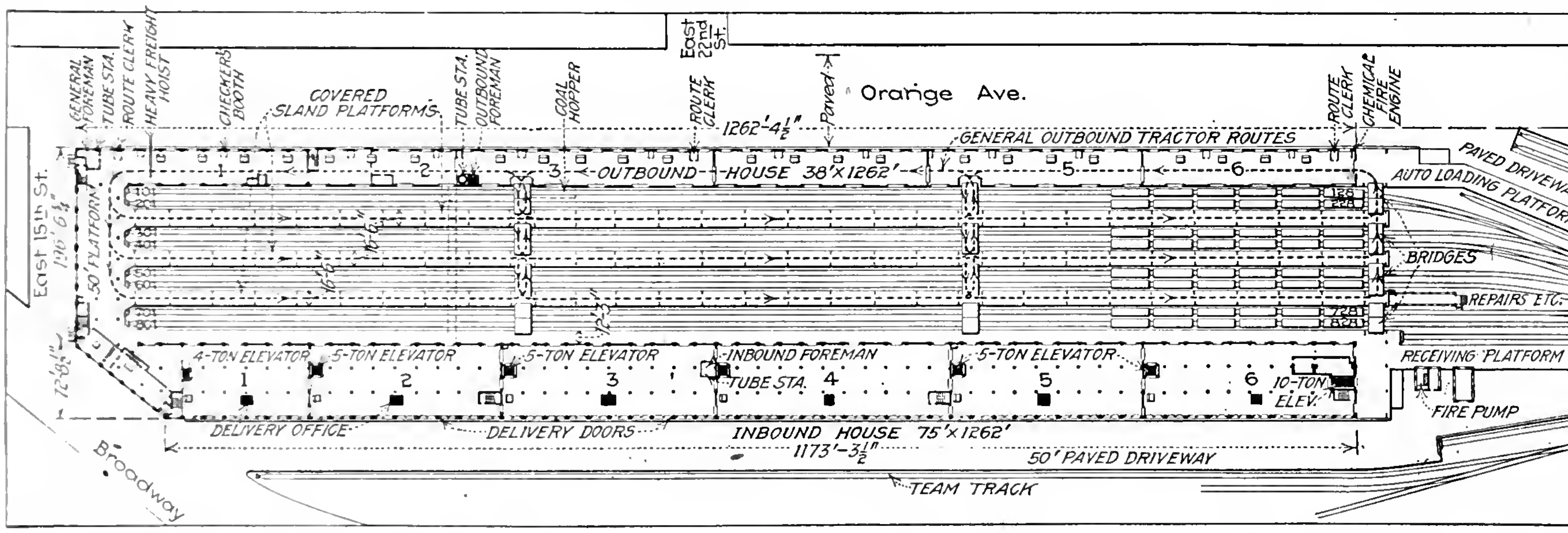
SINCE the opening early in 1918 of the New York Central Railroad's big new Orange Ave. freight terminal at Cleveland (described in *Engineering News-Record* of Mar. 14, 1918, p. 495), the railroad has met the constantly increasing shortage of labor, both unskilled truckers and experienced gang foremen, by the use of an unusual amount of mechanical equipment, and by the constant development, through experience, of highly efficient methods of freight handling. The freight is moved on four-wheel trailers and special equipment drawn in trains by electric storage-battery tractors, and a large part of the inbound freight is held, awaiting delivery, on portable platforms picked up and transported by lift trucks. Special telephone equipment facilitates intercommunication, and pneumatic tubes transmit bills and papers quickly, while the administrative systems that are employed minimize lost motion for both the patron and the railroad.

There are two separate freight houses, each 1262 ft. long, as described in the previous article, with island platforms and trucking bridges as illustrated in the plan reproduced herewith. The double-leaf hand-operated bascule wooden trucking bridges divide each track into three operating sections of nine, ten and nine cars capacity, respectively. The tracks are at street level, with the floors of houses and platforms at the height of the car and the auto truck floors. The basement and upper stories possess no feature that is special, from an operating point of view, and only the operations on the main floor will be described.

Car "spots" are numbered systematically. The first figure of the number denotes the track, and the last two figures the position on the track—as, for instance, 601 to 628 for the 28 cars on track 6. Signboards bearing the numbers are permanently posted opposite the respective positions, and cars are known in the house operations by their "spot" number. Perfectly "green" truckers digest this system of car number layout in a few minutes.

The platforms are well lighted artificially, and plug boxes for extension cords are placed at each car for use when needed; on each platform at each bridge is displayed a prominent yellow marker light to indicate to employees the location of the nearest bridge; blue lights throughout indicate fire-protection equipment; certain circuits control every fifth light on the platforms to provide switching crews and watchmen with some light for night work; the bascule bridges are automatically signalled with red and green lights.



PLAN SHOWING CONNECTIONS BETWEEN INBOUND AND OUTBOUND FREIGHT HOUSES, CLEVELAND TERMINAL

Freight handling here naturally divides itself into the two classifications of (1) outbound freight received for shipment; and (2) inbound freight shipped in for local delivery, each of which will be treated separately, as they differ materially. There is also a small amount of transfer freight handled from inbound cars to outbound cars for forwarding.

The house operating force comprises a general foreman reporting to the agent, and a foreman for each house, each with assistant foremen and clerks, with route clerks, checkers, loaders, trainmen, freight handlers, stowers, etc., handling outbound freight, and deliverymen, tallymen, pilers, callers, freight handlers, etc., handling inbound freight.

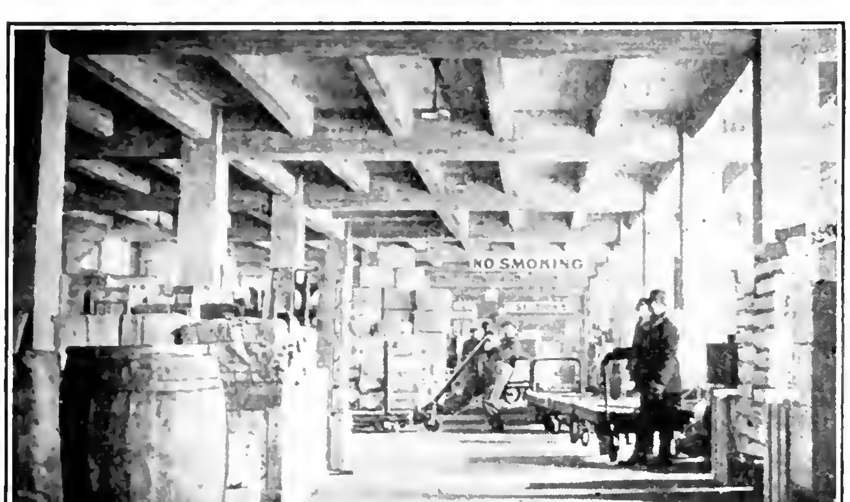
A driver with outbound freight goes first with his shipping bills to any one of three route clerks, located in special booths at the ends and center of the houses. These clerks are experts, and are supplied with all necessary routing information; they mark the shipping bills with the spot numbers of the cars into which the freight is to go, and these numbers govern the checkers in their handling of the freight; this obviates the necessity for each checker or receiving clerk routing the freight he receives (the practice at many houses), and eliminates many errors common with that system.

The spot numbers on the bills also indicate roughly to the teamster the door to which the freight should be taken, as the 56 driveway doors are numbered in groups from 1 to 28, to correspond with the car numbers. The checkers also advise teamsters where to take certain shipments, and compliance with such requests, though not strictly enforced, is fairly general and gradually improving, and results advantageously in shorter trucking hauls and greater consolidation of trailer loads for given cars.

The checker and gang receiving freight loads it generally direct from the wagon onto four-wheeled trailers (loaded for only one car—no "peddling" of freight is permitted), chalks on it the spot number already pencilled on the bills by a route clerk, weighs it on an automatic dial scale adjacent to the doorway, and shoves it out toward the main aisle, where the "despatcher" or "hooker" (one for each of the six sections) shifts the trailers around by hand into trains of six to ten or more, made up if possible with the loads at hand, for one section of one platform, and so grouped that as the tractor-drawn train proceeds the rear trailers are cut off progressively at the proper cars, and when all loaded trailers have been cut off the tractor picks up empties to take back into the house.

The train movement is westwardly in the house and eastwardly on the platforms; this single direction of movement is advantageous in many ways.

In the tractor-train operation it has proved economical to provide, in addition to the motorman, a "brakeman" to couple and uncouple, watch the train to prevent freight falling, etc., thus measurably speeding up the entire operation. Formerly, a gang of three stowers was assigned to each eight cars on the platform to handle the loading of cars, but this method has been superseded by the system, which works much better, of putting all the stowers on one platform in one gang, under the supervision of a head stower, who can intelligently direct the efforts of all the men to prevent

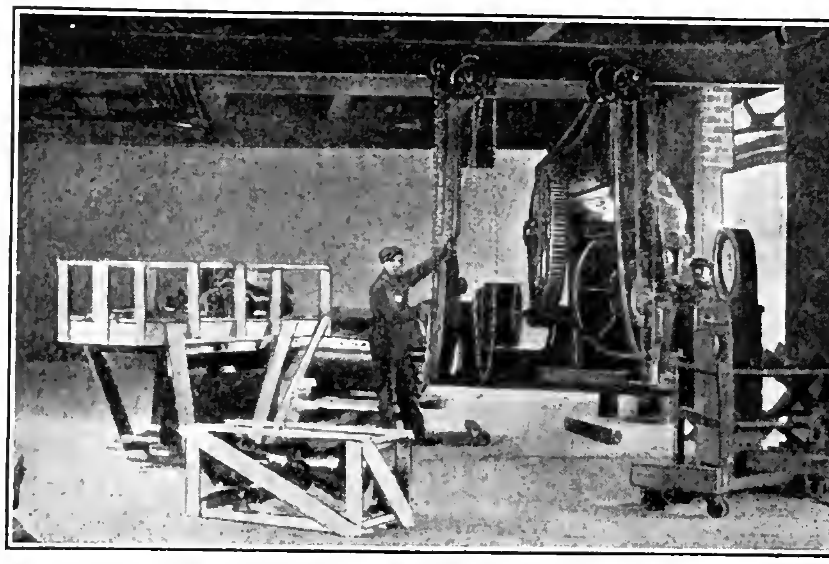


LOADED LIFT TRUCK PLATFORM AND EMPTY TRAILERS

congestion on the platforms, and is responsible for the proper loading of the cars.

The telephone installation by which the head stowers can promptly notify the foreman's office of "full cars," and the foreman's office in turn notifies all route clerks and checkers of the condition, with consequent diversions to other available cars, saves considerable backhauling of freight which would otherwise be marked for cars which would be found full when the freight reached them. This condition naturally occurs just at the peak-load time in the late afternoon, and is a fruitful source of confusion and wrong loading.

A pneumatic tube system for the handling of bills between the "checkers" and the billing department results in a uniform flow of bills into the billing office all day long, permits very prompt billing and reduces the delay in getting out bills for cars after the house is closed; this permits prompter dispatch of outbound trains.



HOIST FOR HANDLING MACHINE TOOLS, SHAFTING AND OTHER HEAVY FREIGHT

Checkers do not "shoot" their bills until the tractor has taken the freight off the floor.

The "sailing date" plan is in effect in Cleveland, and to meet this condition, with its prescribed daily change of "regular" cars which would seriously affect a "permanent set-up," a modified set-up is used, in which certain grouped spot numbers are assigned permanently to each group, consisting of cars to be set out at one certain main station or yard, with the groups arranged to meet the road operating requirements, but the arrangement within each group entirely flexible and at the option of the house forces, who may arrange it at will to meet the varying exigencies of the business.

Trains, under this arrangement, are made ready for road movement by pulling whole tracks at a time and simply kicking out the "set-backs" and switching any outbound team track cars into the groups. The westbound train, given the preference, leaves about 45 min. after the cars are sealed, the eastbound train leaving soon after. In resetting the house with empties after the outbound freight leaves, set-backs are switched back only into their proper groups, and not onto a designated "spot."

Due to the exceptionally heavy class of freight handled, consisting largely of manufactured metal goods, paints, oils, etc., the trailer loads are believed to average heavier than at any other house in the country. A week's check recently showed an average load of 1329 lb. per trailer per trip, each trailer in service averaging about six trips per day, while figures obtained from other stations have indicated an average trailer loading of 1000 lb. to 1100 lb. per trip.

The trailers used are of reinforced wooden construction, with 36 x 72-in. platforms 20 in. above the floor, with inverted U-shape removable "gates" of 1-in. pipe fitting into numerous stake pockets at sides and ends, and interchangeable on the different makes of trailers used. The main wheels are roller-bearing, of 18-in.

diameter and with 4-in. face, and the ball-bearing casters have 9-in. plain bearing wheels. These wheel sizes were selected after the undoubted merits of lower wheels as effecting easier loading conditions had been carefully considered, because of the greater difficulty of moving low-wheel trailers by hand to switch them into trains, move them into cars, etc., and the choice seems to be justified by results, as even the 18-in. wheel trailers are difficult to push around when unusually heavily loaded.

But there is some freight, notably oil and paint in barrels, which is hard to handle on and off trailers with 20-in. platforms, and for handling this class of goods

TRACTOR AND TRAILERS ON TRANSVERSE TRUCKING BRIDGE

an all-steel underslung trailer with the same wheel sizes, but with platform only 8¾ in. above the floor, is provided. A number of old two-wheel hand trucks have been converted into very serviceable trailers for barrel freight by substituting heavy double 5½-in. casters for the original rests or "feet," and equipping them with necessary chains and eye-bolts for couplers. Otherwise, the use of two-wheel trucks in handling outbound freight has been practically eliminated. The couplers on the standard trailers consist of a hook on the caster end, fitting into an eye on the main-wheel end of the trailer ahead.

Many types of dollies and similar special equipment, some of which are illustrated, are in use to handle the large number of heavy machines, etc., received; experiments are being made toward further development of equipment, for handling these heavy loads, which, among other things, will give better load distribution on the floors.

Short sections of gravity-roll carriers, mounted in frames with casters to bring one end to trailer-floor height, while the other end is placed on a discharging wagon or truck, to assist in a quick and easy transfer from wagon to trailers, are under order and are expected to help with certain classes of freight.

A hoist has been provided to handle economically heavy freight like machine tools, etc., from auto or wagon to trailers or dollies. This consists of a suspended I-beam runway extending out about 8 ft. over the driveway, and back 16 ft. into the house, with two three-ton geared trolley hoists operating independently of each other, giving a combined capacity of six tons, which can be concentrated or applied at different points on a load, as necessary; this has a clearance of 10 ft. from the floor to the hook in highest position.

Three-wheel tractors, with 30 cells of Edison A-6 battery, developing approximately 450-lb. drawbar pull, and, with a load of three or four tons, capable of a speed of five or six miles per hour, are used. Loads higher than 11 tons, including weight of trailer, are sometimes pulled, but with material reduction in speed. One load of 25 tons gross, with 21 trailers, was recently pulled 600 ft. and around two 90° turns; however, "freak" loads like this are frowned upon. This three-wheel type has a very small turning radius, and is surprisingly facile in operation. Batteries are charged at night through a motor-generator charging set, and are boosted at noon to stimulate them for the afternoon.

Inbound freight requires quite different handling, and the peculiarities of the plant have made possible more or less radical departures from usual practices. The 1262-ft. house is divided by firewalls into six sections, each in charge of a delivery foreman, under whom are two pilers and a clerk. Sections 1 to 4 are allotted to freight for firms whose business is regularly large enough to justify assignment of regular space in the house; such spaces are permanently marked by appropriate signboards. The "alphabet" sections, 5 and 6, handle freight for smaller and miscellaneous consignees. Freight for any given shipper thus goes to one designated spot in the house.

Inbound freight arrives in cars containing many and various shipments, consequently it is impracticable to place them in the house for unloading in any predetermined order to facilitate their unloading; and, as a result, the hauls on individual shipments to designated locations in the house are often long, sometimes the full length of the plant; under these conditions hand trucking proved expensive, and tractors and trailers have been substituted with markedly good results.

Trailers are loaded to capacity at the cars, with freight for one consignee if possible, otherwise with freight for one section. They are put in trains and pulled into the house by tractors and dropped off in the main aisle nearest the proper pile for unloading. All main and cross aisles in the house are plainly marked with painted 4-in. white lines, frequently renewed.

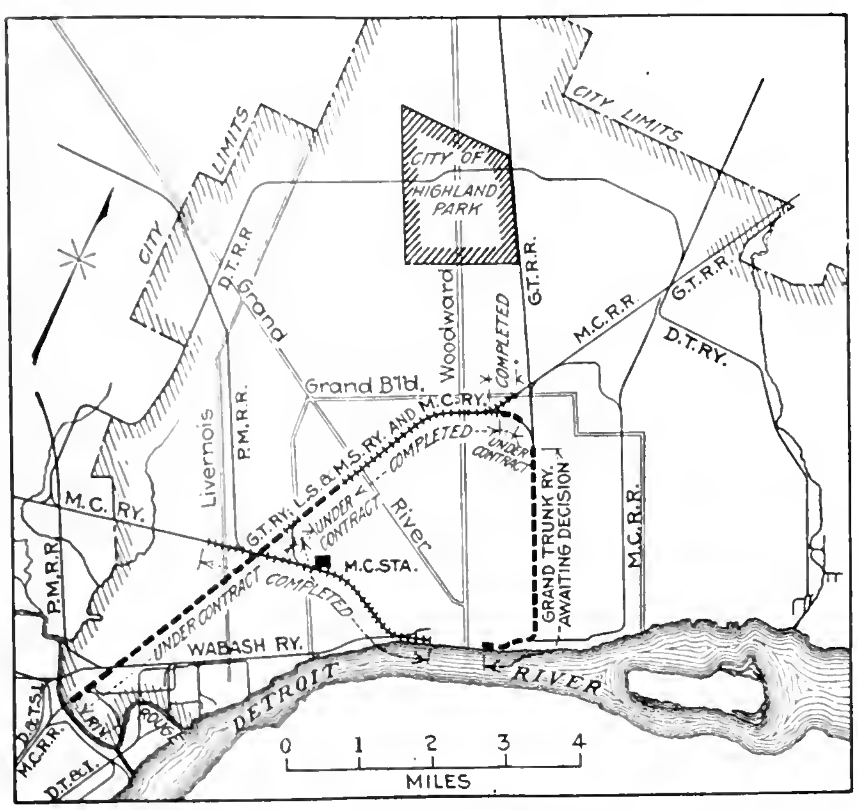
When the size of a shipment, or those of several shipments for one consignee, justify it, the freight is unloaded from the trailers directly onto a 42 x 60-in. lift-truck platform (of which there are about 60 in each section); otherwise, it is unloaded directly on the floor. These platforms are sturdily built, with stake pockets for use when needed, and a large proportion of the inbound freight is handled on them. They permit quick delivery of large loads of freight without second handling, saving labor and damage, and are enthusiastically indorsed by the operating forces. They also add to the general neatness of the house, and prevent freight from getting lost. One lift truck with 9-in. wheels, 2½-in. lift and 48-in. frame is used in each section. These trucks and platforms are used practically only for delivery of freight as above and for occasional transfer of freight to storage, etc.

Transfer of freight by trap-car from this plant to city stations of other roads for forwarding has been abandoned, and this transferring is now done by truck. Fire drills are carried out regularly by the house forces, organized into regular fire companies under the direction of a fire warden. Car-repair facilities permit light repairs and testing and cleaning of brake valves as the cars stand at the platforms, also the charging of train lines before the house is closed, thus saving time after the train is switched up ready for the road.

Detroit Plans Comprehensive Scheme For Grade Crossing Removal

City Engineers Study Problem as a Whole and Recommend Program for Next Fifteen Years — Prepare Standards of Design and Study City Planning, Freight Yards and Industry Tracks

GRADE crossing elimination at Detroit, Mich., is viewed as a single problem by a city engineering commission which has just reported. The needs of the city for the next 15 years have been carefully studied, and a progressive program has been laid out for the completion of all the necessary work in that time. Other important factors of the problem discussed are the relative advantages of full and partial elevation, the clearance and design of subways, the relation to industry facilities, the relation to streets in outlying districts of the present and future, the city-planning aspect and the apportionment of cost.



PLANS FOR GRADE CROSSING ELIMINATION AT DETROIT INCLUDE ENTIRE CITY

The report was made by the city's Division of Grade Separation and Bridges, under the direction of the Department of Public Works. This division was established in January, 1917, with John W. Reid as engineer in charge and Prof. Henry E. Riggs, of the University of Michigan, as consulting engineer. Its report was submitted in September to Clarence W. Hubbell, city engineer, and passed with his approval to H. H. Esselstyn, commissioner of public works, who in turn transmitted it to the city council. It was referred to the council committee on grade separation and it is expected that early action will be taken by the new council.

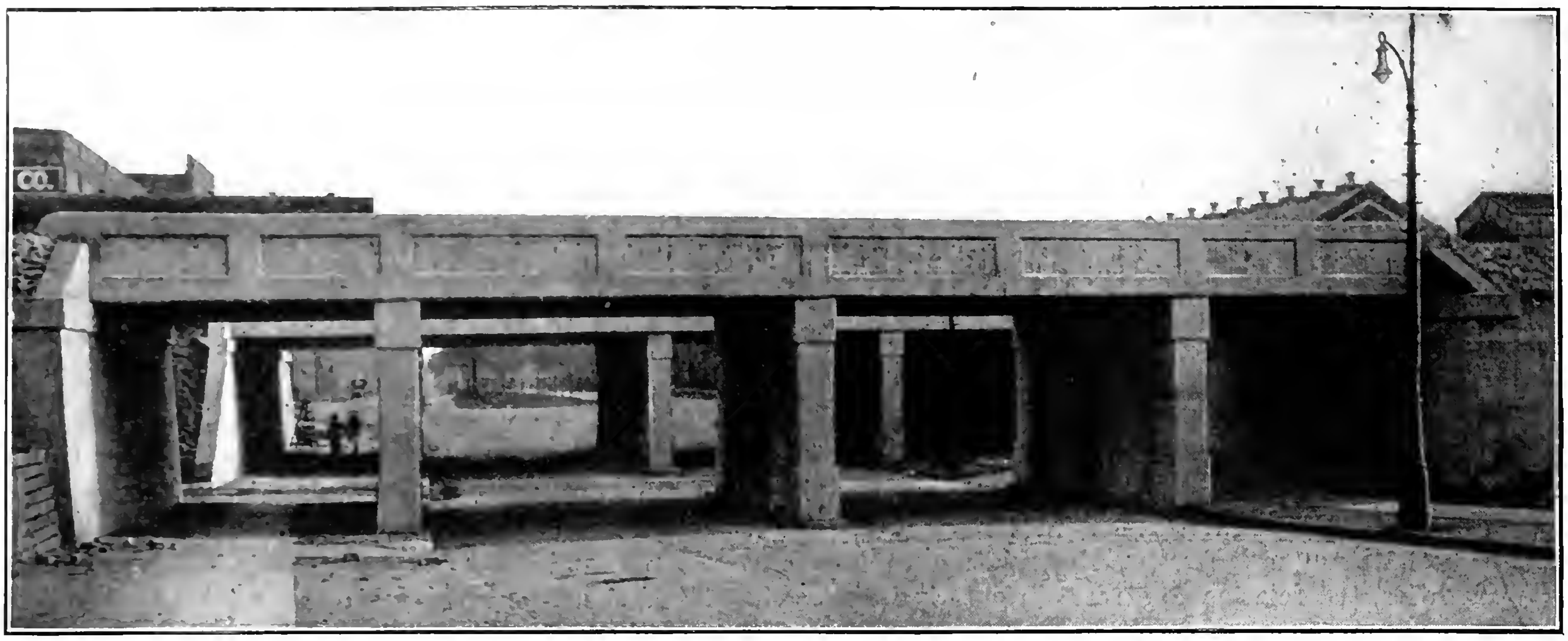
Modern grade-crossing elimination in Detroit dates from 1900, and in 1903 an agreement was made by which the annual expenditure was to be not over $200,000. This was amended slightly in 1906, and additional agreements were made up to 1917. Work which was to have been commenced by the New York Central Railroad and the Wabash Railroad in 1917 was deferred owing to war conditions, by permission of the city council. Since 1900 there have been 43 grade crossings eliminated.

Present conditions are as follows: On 64½ miles of line, considering parallel railways as one line, there are 289 street crossings, at 58 of which the grades are separated, 43 having the tracks carried over and 15 having them under the streets, while 20 more crossings are covered by existing contracts. There remain 211 grade crossings on main lines and 34 on industrial spurs, while 37 of the former carry street-car tracks. Counts made at 147 crossings in 1917 showed an average traffic of 1011 street vehicles and 41 train movements per crossing per day. Street-car movements over crossings were about 250,000 for the year, or probably more than 1,000,000 movements over tracks. Grade separation demands attention urgently as a part of the city's traffic problem. It appears that with the growth of the city the increase in number of grade crossings has been greater than the decrease by grade separation.

Early completion of plans for a comprehensive scheme of eliminating grade crossings, together with a definite program of construction, is recommended by the report. No such program has been prepared, as yet, but the railway system of the city has been divided into sections which may be handled successively. Determination of the grades of streets and railways will permit the making of provision for these ultimate grades in the design and construction of new buildings and industries. With a complete scheme for the entire city the streets of heaviest traffic may be handled first and work carried on at different points and on different properties at the same time, so that no railway will be unduly burdened in any one year.

A program of work must take into account the fact that as it progresses the city will increase in population and area, and that there will be an increase in miles of railway and number of streets. Such a program, it is explained, would cover all railways within the city limits, all existing crossings and all additional crossings which may be necessary to furnish traffic connections with new industrial or residential sections of the city.

The cost of work to be provided for by a comprehensive plan is estimated at from $30,000,000 to $50,000,000. For the completion of such work by 1935 or 1940 the annual expenditure must be very much larger than the limit of $200,000 provided in existing contracts with the railways. To carry out the program it is recommended that the contracts should fix an annual amount, increasing with each year, so as to place the heavier share of the burden on the later years of the period. It is suggested that $2,000,000 for the first year is the minimum to be considered in view of the work urgently needed, and that this should increase about $200,000 per year until it reaches $4,000,000 in 11 or 12 years.



CONCRETE SUBWAY ON DETROIT TRACK ELEVATION: SECOND AVENUE AT NEW YORK CENTRAL LINES AND GRAND TRUNK RAILWAY

Street 80 feet wide has two 21-foot roadways, 13-foot headway and 3—18 per cent. grades

Elevation of tracks as the main principle, in combination with depression of streets as a secondary consideration, is the method advocated in the report. All the work done so far at Detroit has been based on the compromise system of elevating tracks from 6 to 10 ft. and lowering streets from 6 to 14 ft., the comparatively slight elevation being due largely to the fear of owners of industries that a greater elevation would harm them seriously. Another reason, probably, was the belief that greater elevation would lead to excessive cost, but the report states that the total cost is no more for 15 to 17 ft. than for 6 to 8 ft. elevation. Adjustment of tracks in industrial plants may be more expensive, but can usually be made without difficulty, and in close quarters the loading and unloading may be handled at platforms on the second-floor level.

Public interest must dominate in fixing grades of the main traffic streets, since this interest is so overwhelmingly large. For these reasons the following recommendations are made in the report: On all main arteries the maximum street depression should not exceed 2 to 3 ft., with approach grades not exceeding 2½%; on other important streets the maximum street depression should be 5 ft. and grades 3%; in purely industrial districts, especially where the streets carry little through traffic, considerably greater depression may be permitted, but in no case should the grades exceed 3½ to 4 per cent.

Track elevation is shown to be the logical method of eliminating grade crossings at Detroit, since the flat topography, as at Chicago, would prohibit depression on some lines, while complications from sewers and water mains would either prevent it or make it expensive on most lines. For clearance at subways 14 ft. has been adopted in the past at Detroit, but 15 ft. is provided for on some work, and this figure is recommended for streets that have or are likely to have street-railway line. For streets without car lines a clearance of 13 or 14 ft. is considered ample.

Track depression is recommended, however, for that part of the Grand Trunk Railroad on De Quindre St. from Jefferson Ave. to Hale St., 1.3 miles, beyond which there would be track elevation to Clay Ave., two miles. It is explained that this case is exceptional. While the tracks are now on the street level they already pass under three important streets, no large industries are served and there are no complications due to sewers or other underground utilities, as the road was built some 60 years ago. The railway has proposed elevation of its tracks for the entire distance and has submitted two projects, but the report considers one of these open to strong objections, and both of them inferior to track depression on the first section of the line, so far as public interest is concerned. This matter is now awaiting the decision of the Michigan State Railway Commission.

Taking up the design of subways, the report advocates concrete structures, properly waterproofed and having ballasted floors, and the flat-slab type is preferred to arch designs. It is pointed out that extra expense for appearance should be avoided in view of the great total cost and the large number of structures, although some expenditure for this purpose may be warranted at structures crossing boulevards and main thoroughfares. It is recommended that no intermediate supports be permitted in streets of widths up to 50 ft. Where the width is greater or the crossing is at an angle, supports at the curb lines may be necessary to avoid excessive height of elevation, but a support in the middle of the street should not be considered when the width between curbs is less than 60 ft. Shorter spans may be permissible for driveways and streets serving industries only.

An adequate city plan of streets and roads should be made in advance of agreements for grade-separation work, and the report suggests that the city plan commission should coöperate in this respect. Proposed changes in streets should be considered in their relation to grade-crossing elimination, and it is recommended that in general long through streets should be maintained at full width. Opening of new streets and widening of existing streets should be considered as part of the grade-separation project when traffic can be improved in such ways. Closing of streets, it is suggested,

should be considered only in order to improve a subway approach or where the streets are very short or very near the river, where traffic will always be limited. In industrial districts, however, the closing or changing of streets may be of benefit to the railways, the city and the industries.

Location of large railway yards in the outlying districts is a special condition noted, as in some of these cases opened streets are several thousand feet apart, and subsequent plotting of lands adjacent to the right-of-way has been made without reference to the possible opening of streets across the railway. The report urges a careful study of railway right-of-way within the city limits, and the location of a sufficient number of cross streets connecting with main thoroughfares. These should be of ample width, 66 ft. country roads being opened at least across the right-of-way for future avenues of 80 to 100 ft. width. Plans for grade separation on these outlying thoroughfares, it is pointed out, should not be made without full consideration of their future effect upon the city.

The effect of grade separation on industries is discussed as an important consideration. At 880 industries there are 1600 private sidings with a capacity of 15,635 cars, while 159 industries which are located on the railways use team tracks instead of private sidings.

Some industries—large and small—will not be affected seriously, while others will be subjected to considerable trouble and expense. In general, however, track elevation to approximately full height is the cheapest method for the railroad and also brings the tracks near to second-story factory levels, so as to involve less change and reconstruction and to give better spur track grades than an elevation of only 6 to 8 ft. Furthermore, many industries such as coal yards and warehouses can handle a larger volume of business with tracks at the higher level.

Relative Cost and Its Apportionment

Cost of track elevation, says the report, is largely in grading and masonry, and in carrying traffic during construction. For a railway fill made by trains, the cost of steam-shovel loading, train haul and unloading will average less than half the cost per cubic yard of removing the clay soil in Detroit streets, hauling it by wagon to scows and then dumping. Masonry walls for such a fill are of uniform height and standard section, while street retaining walls having approximately 10% more material are irregular in height and section and consequently of greater cost per cubic yard. The cost of permanent bridges and that of carrying railway traffic during construction are substantially the same in either case, while the cost of carrying street traffic during construction is said to be less with railway elevation than with street depression. The cost of track construction and readjustment of industry tracks for elevation is considered to be more than offset in track depression by the cost of rebuilding sewers, water mains, paving, sidewalks and street-railway tracks, in addition to the property damages.

Full elevation of the railway, without change of street grades, is the cheaper solution of the problem, according to the study made at Detroit. The report states that this holds fairly true for all railway right-of-way of 60 to 100 ft. width, with eight or nine streets per mile. It will not hold true, however, where there are only a few streets per mile and where the railways have large yards, nor where the elevation of the railroad involves that of a large mileage of industrial spur tracks or extensive rearrangement of numerous factory buildings.

The apportionment of the cost of grade separation at Detroit has been usually on the basis that the railways

STEEL SUBWAY ON DETROIT TRACK ELEVATION; WABASH AVENUE AT NEW YORK CENTRAL LINES AND GRAND TRUNK RAILWAY

Street 65 feet wide has 26-foot roadway, 13-foot headway and three per cent. grades

have paid the entire cost of construction on their land and on the streets, while the city has paid all property damages, and the street railway has paid for all temporary work needed to maintain its traffic and for all new track and overhead equipment. No adequate or uniform records of cost have been kept, but it is generally understood that the city's share has been 20 to 25% of the total cost. The report considers it probable that with greater elevation of tracks the cost of property damages will be reduced, thus decreasing the city's share of the total. It is considered reasonable, however, that the city should pay from 20 to 25% of the cost of a well designed public improvement and should assume the entire maintenance of the streets. On the other hand, the report points out, the new city charter appears to contemplate payment of nothing more than property damages, so that any plan imposing upon the city a definite percentage of cost probably would have to be passed upon by the courts. As to street railways, the report considers that the company should build its own tracks and pay more than its past share of 2 to 3% of the total cost. Municipal utilities should pay for changing their underground properties to conform to the street changes.

Road Funds Available in Wisconsin

For construction and maintenance on the Wisconsin trunk-highway system and the county systems of prospective state highways, about $11,000,000 will be available for 1919, according to the estimate of A. R. Hirst, state highway engineer. This includes $3,800,000 for state-aid construction, $3,200,000 for Federal-aid construction, $1,500,000 for county construction and $2,500,000 for state and county maintenance work. In addition, the towns will spend about $3,000,000 on township roads.

Governors' and Mayors' Reconstruction Conference Fails to Get Action

Officials at Meeting in Washington Do More Listening Than Talking and Adopt Prepared Resolutions, but Recommend No Comprehensive Program

(Editorial Correspondence)

TWENTY GOVERNORS, 135 mayors, and the representatives of many more executives, met at the White House last week at the invitation of the President to discuss the problems of unemployment and business resumption. They listened to many set addresses by Federal officials, told one another generally of the conditions in their home communities, received a vague program of action from the representative of the Department of Labor, passed reluctantly a wordy and innocuous document prepared for them by a committee on resolutions, and broke up in disorder with an evident feeling of the futility of the conference. Possibly some of the delegates got a thought or two from the discussions which they may put to use when they get home, but no definite, beneficial suggestions materialized on the floor.

The conference was called by the President at the request of the Department of Labor, and was apparently planned and directed entirely by that department. In the light of the proceedings of the three days, it is now very apparent that there was too much direction. A full program was laid out, made up of addresses by men of such national distinction as to make it impossible for the floor to do other than to hear them. These gentlemen all delivered inspiring and stirring addresses, but it soon was evident that the Governors possibly, and the mayors certainly, had come to Washington not to listen but to talk, and the program did not permit such talk. As an ending to the conference, the mayors got together in a more or less informal organization for future meetings, in the hope of establishing something similar to the present House of Governors.

What the Meeting Was For

According to the President's own announcement, the meeting was "to discuss the proper method of restoring all the labor conditions of the country to a normal basis as soon as possible and to effect any such fresh allocations of labor and endeavor as the circumstances may make necessary." This was the extent of the President's reference to the conference itself. His mind, as evidenced in all of his addresses in this country during his brief stay, was on the matters of international relations, which he soon reached in his speech to the conference. He was followed by Secretary of Labor Wilson, who in a remarkable address clearly indicated the serious possibilities in the labor situation in this country and the decided necessity for immediate resumption of business. Then, after brief addresses by the Secretaries of War and the Navy, the Governors of the various states were called on alphabetically. Here the conference met a surprise, because, with only two exceptions, every Governor arose and stated that there were no labor or industrial troubles in his state. Arizona admitted some difficulties in the copper-mining districts and West Virginia in the coal-mining.

The best part of two sessions was taken up by the Governors' speeches, some of which were direct and to the point. Confidence in conditions, however, was soon shattered when the mayors were given the floor. Unfortunately, the program was so full that only a few of the mayors could be heard. Those who did speak, however, definitely stated that the Governors did not know what they were talking about, that labor and industrial conditions were bad, and that there was no immediate indication of relief.

Through all of the reports there was no sign of any great revival of public work. Here and there an executive announced that his state or city was going ahead with a certain amount of work, in general very much less than normal, but many of them repeated the same statement; that is, that so long as material prices kept up not even a public body could be expected to engage in work. Several of them, Governor Cox of Ohio in particular, definitely demanded that the water be squeezed out of present material prices.

The Plan of the Labor Department

Meantime, a representative of the Department of Labor announced what he called not the plan, but the suggestion, of the department as to a program of reconstruction. He laid down seven items in this program: First, begin all public work, especially public buildings and schoolhouses; second, get behind the Build-a-Home movement; third, get the state to build its full quota of Federal roads on the fifty-fifty basis and appropriate large sums for state roads; fourth, see that traction properties of the state and city receive fair treatment; fifth, urge labor to give a greater service for its wage; sixth, get the state councils of defense to advertise as much now to get people to buy as they advertised during the war to get people to economize; and seventh, help the cabinet officers in their efforts to extend opportunities and provide not only employment but a strong United States Employment Service.

Following more addresses, one on building by a representative of the construction industries and one on roads by a representative of the highway industries, and one by Secretary Lane on his various reconstruction policies, the Resolutions Committee, composed of Governor Cox of Ohio, as chairman, and Governors Sproul of Pennsylvania, Bilbo of Mississippi, and G. F. Peabody, representing Governor Smith of New York, together with Mayor Peters of Boston and Mayor Baker of Portland, Ore., brought in the report of the committee on resolutions. Contrary to the expectations of most of those in attendance who had hoped for a series of definite resolutions which could be voted upon one by one, this document was a well prepared essay of the type common to party platforms, and was so tied together as to make it impossible of paragraph acceptance. It was read with considerable oratorical effect by Governor Cox, and was accepted, after a great deal of opposition, by a two to one vote of those present. Only one clause

was added, recommending to the states that they consider means of releasing natural resources from controllers who, for the purpose of speculation, are holding them. There was also a squabble over the public utilities clause noted below, but that was finally adopted by another two to one vote.

Abstract of the Resolutions

The committee's report, which was supposed to embody the findings of the conference, starts with well-rounded phrases, such as, "We are living in the most thrilling time in all history," "We must progress from the fundamental base of American ideals," "The principles of government must change through the evolutions and processes of calm human intelligence," etc., etc. It has clauses condemning any doctrine which inveighs against both God and government. While admitting that it was not the purpose of the conference to discuss the underlying principles of the question of government ownership, it recommends that the national Government in its present conduct of the railways should continue in the purchase of rolling stock, making added betterments, etc., so as to guarantee at least that much of the purchasing of material which should be started at once. It recommends that the Government make a careful analysis of all economic elements underlying costs, and that it establish a fair price for materials, which price is to be followed by the Government itself, with the idea that if the Government in fairness to all interests concerned approves price schedules on materials, public opinion will accomplish the rest in the needed reduction of prices. Indeed, the one definite part in the resolution is, "Prices must change. There may be an economic justifition for some schedules but not many, and if the Government through the operation of a committee or commission such as we have suggested will invite industry to go forward in the work before us, revealing facts and figures upon which earnest calculation can be made, it can, then, in any given line announce to the public what prices it finds to be fair and equitable."

The resolution then definitely recommends that freight rates on all road material, possibly on all building material, be radically reduced. It recommends that there be no present anticipation of an adjustment in the wage scale. It recommends "that the Federal Government continue its helpful offices, with the view to averting serious consequences in the financial affairs of public utilities." It urges that the informal contract act be put in effect as soon as possible and that announcement be made equally soon as to the disposal of Government surplus materials. It regards the discontinuance of Federal aid and maintenance of public employment agencies as both untimely and harmful, and, finally, urges a change in the method of military demobilization by which the soldiers are turned loose in the vast districts from which they came.

Some definite conclusions can be drawn from this conference. First, there is as yet no general unemployment distress, although there is certainly unemployment, growing, as the mayors recognize, but not yet to such a stage as to have come to the attention of the Governors. There is a wide appreciation of the soundness of the build-now policy of public work, but there is an equally wide distribution of the reluctance to start, on account of high prices. There is no indication of a general going ahead in public or private building in spite of the high prices existing. There is a general demand that the railroads, which it was stated many times purchased 30% of all materials bought in the United States, start buying immediately, though, as Director General Hines told the conference, the failure to provide funds by the late Congress complicates the financial situation of the Railroad Administration to a point where it can promise nothing. There is a demand that freight rates on building materials be lowered, and lowered immediately. To this Director Hines promised his immediate attention. There is an appreciation of what is generally called the Bolshevik menace, but a confidence in the American people and its ability to meet it. There is a pronounced expectation of lowering in prices and no hope of a lowering in wages.

These are the impressions derived from the conference of representative men from all parts of the United States. That men holding pretty generally the same views could not get together and coördinate those views and specify remedies or expected remedies is undoubtedly due to the failure of the Department of Labor to provide the proper mechanism for the conference. These men came from all over the country with very little idea of what they were expected to do. They were made to put in three days listening to a number of things which they already knew, and were at the end hurried to a conclusion by lack of time. The resolutions prepared by some of the shrewdest politicians in the United States, and presented on the floor by a master of debate and oratory, were carefully calculated to avoid any controversial subject or to set down in good, round terms any definite program of action. Because the resolutions were adopted there should not be the impression abroad that they represent the feelings of the floor. Those who had hoped that the gathering together of so many men intimate with local conditions would develop a national policy of reconstruction must be disappointed.

F. C. W.

Guatemala Rebuilds After Earthquakes

That reinforced-concrete is the only safe type of construction for earthquake countries has been proved by the earthquakes of Guatemala and Salvador, in the opinion of Lee F. Whitbeck, chief engineer of the International Rys. of Central America. He points out that unfortunately this type of construction is expensive in these countries, as all materials have to be imported.

Reconstruction of the buildings of Guatemala City, the capital of Guatemala, after the earthquakes of December and January, 1917-18, is making slow progress, according to Mr. Whitbeck. This condition is due to scarcity of labor and materials, and apparently to a great lack of confidence on the part of property owners, as a result of the continuance of slight quakes. This fear is evidenced by a reluctance to start rebuilding and by the false economies that are being attempted in the work. The tendency is to adopt the cheapest possible method, and if there is any chance of patching a shattered wall, this is done usually, in preference to tearing down and rebuilding.

Reinforced-mud or "bajareque" is a common type of construction, which consists of a wood frame covered with lath, the wall space being then filled with mud and plastered. The effects that an artistic plasterer can obtain are said to be both surprising and deceiving.

Pennsylvania Has Emergency Public Works Commission

Body Provided For Two Years Ago To Tide Over Expected Periods of Depression Is Now Stimulating Construction

PENNSYLVANIA was particularly forehanded in providing against a possible industrial depression which might follow the war. By an act of the legislature, July 25, 1917, it established the Emergency Public Works Commission, "to provide for the expansion of the public works of the commonwealth during periods of extraordinary unemployment caused by temporary industrial depression." While the commission has not as yet done anything other than to stimulate various kinds of public work by the cities and counties of the state, it has a well considered program which, it is hoped, will help to ward off any actual depression in the next few months.

The act provides an emergency public-works fund, starting at $50,000 in the first appropriation, and constitutes a commission composed of the Governor, the auditor general, the state treasurer, and the commissioner of labor and industry of the state. The Department of Labor and Industry has the duty of ascertaining the existence of periods of extraordinary unemployment within the state and of notifying the commission. Then it is the duty of the commission to proceed to ascertain and obtain, from various departments, bureaus, boards and commissions, tentative plans for such expansion of the public works of the state as shall be best adapted to supply increased opportunities for advantageous public labor during periods of temporary unemployment. The industrial branch of the Department of Labor and Industry is also ordered, under the same act, to conduct an employment bureau for the use of the state departments which are engaged in such public work as the emergency calls for. When an industrial depression period does not exist the emergency public works fund is to be distributed among the various departments of the state, for such expansion of public works as are best adapted to advance public interests by providing the maximum of employment for the relief of existing conditions of extraordinary unemployment.

In November, 1918, a few days after the armistice was signed, the commission began to stimulate the public works of the cities and counties of the state through correspondence. Soon after, the commission requested the various departments of the state Government to report what useful necessary public work they could do during the demobilization period, provided the necessary appropriation and organization were forthcoming. Upon receiving this information, the commission made a report to the present legislature on the method of expanding public works in the state in the existing emergency. This report is now before the legislature for action.

The report takes up in order highways, forestry, factories, and public works in cities and counties. Under highways it recommends that the legislature should assign a percentage of the usual highway appropriation directly to the emergency public works fund, for emergency expenditure only during periods of unemployment, and that a percentage of all state bonds issued for highway construction should be held out of the market and sold only when a period of unemployment occurs, in order that the work may be done at that time. Emphasis is laid on the fact that the demobilization and transition period—from April to October, 1919—should be regarded as a possible period of temporary unemployment, and highway work concentrated then if necessary.

Under forestry, the report notes that the department of forestry of the state is contemplating certain forest work that could well be carried on at the present time, with the employment of 5000 unskilled laborers for three months. It is also noted that the water supply commission is prepared to undertake public works and stream conservation and flood control if a million-dollar appropriation is made. The investigations of this department are quite necessary for the continuance of a number of other public works.

The department of health has possibilities as an employer of labor at the present time, both in the construction of certain necessary sanitariums and in the work in destroying the mosquito. Notice is also made of the fact that for some years past the department of health has ordered certain boroughs to put in sewage-disposal plants, in order to relieve a menace to the public health. Some of these boroughs have not complied with the order, the reason given being that they have reached their debt limit. The report says that the question arises whether a part of the emergency public works fund could not be let to such boroughs in order that they may comply with the health department orders and also provide necessary public work at this time.

Certain taxes, notably the inheritance tax, could well be diverted toward the public works fund, according to the report. At any rate, the whole question of taxation in relation to this kind of work needs to be investigated. Finally, the report to the legislature emphasizes the publicity work that the commission can do in urging the minor political subdivisions of the state to enter into construction work at the present critical time.

The office of the commission is at the capitol at Harrisburg, and Otto T. Mallery is acting as executive secretary.

Standardizing Concrete Pipe

That design of concrete pipe should be standardized to the extent of adopting a certain range of diameters and five classes of varying strength, was the suggestion made in a paper read at the annual meeting of the American Concrete Pipe Association by C. F. Buente, of the Concrete Products Co., Pittsburgh, Penn. Length of pipe and type of joint are matters that, he thought, should be left to the judgment of the manufacturer. To obtain pipe of high quality and strength, he advocated the use of concrete made with a low proportion of water, but he did not know whether such concrete had been used for reinforced-concrete pipe. The meeting was held at Chicago Feb. 14-15. Officers of the association were elected as follows; President, W. E. Goodman, Saginaw, Mich.; secretary, G. E. Warren, Universal Portland Cement Co., Chicago.

Old-Fashioned Methods Reduce Cost of Dam Repairs

Contractor Met Local Conditions and Avoided Expensive Operations Without Interrupting City's Water Supply

By Charles F. Dingman
Assoc. M. Am. Soc. C. E., Engineer, Flynt Building & Construction Co., Palmer, Mass., and New York City

TEN thousand dollars was appropriated by the City of Willimantic, Conn., to preserve the dam in the Natchaug River on which the water-supply and fire protection of the city depended. The contract was awarded for $7000 and the contractor, by the application of old-fashioned but economical methods that conformed to local conditions did the work for less than $4000, although estimates ran up to $39,000.

The dam is about three miles from the city and is of heavy stone-masonry construction, built in 1884. It provides a head of 21 feet, which is utilized to drive two Hunt-Smith hydraulic turbines, operating in turn two Worthington plunger-type pumps. These work at a normal speed of 80 strokes per minute and pump the water through a 12-in. cast-iron main to the reservoir near the city. A steam pumping plant has been provided for auxiliary purposes, but the expense of getting coal to the pumping station makes it necessary to use the auxiliary pumps only for emergency.

VIEW OF DOWNSTREAM SIDE OF DAM, TAKEN FROM SOUTH BANK

For some time past it had been noticed that the front, or downstream, face of the dam showed an appreciable bulge, extending for somewhat over 100 ft. of its total length of 280 ft. During the past summer this bulge reached such proportions as to cause fears for the safety of the entire structure, and an appropriation of $10,000 was obtained to defray the cost of repairs.

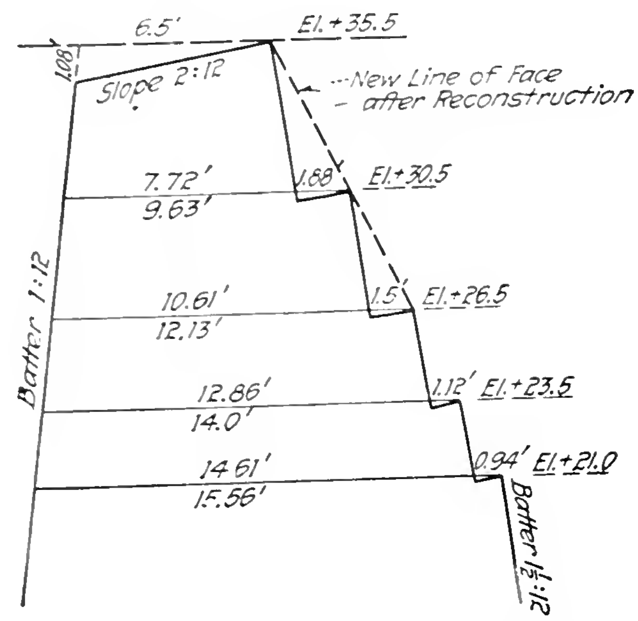
Water overtops the dam during a great part of the season, and, owing to the fact that the waste gates had not been opened for over a quarter of a century, some doubt was entertained as to the possibility of opening them at all so that the water could be drawn down to a point which would permit repairs without the use of expensive cofferdams and other temporary work. Doubts were increased when a diver found the stems of the two iron gates badly corroded and likely to twist off at the first attempt to turn them. The iron gates are 3 x 3 ft., and similar in design to modern sluice gates. In addition two wooden waste gates were provided. The stems of these, however, do not come up to the top of the dam.

The work of lowering the water apparently presented the greatest problem in the entire operation, and until this was done no inspection or plans could be made. The superintendent placed in charge of the work avoided the use of a diver in opening the gates by slinging a chain around the stem of one of the wooden gates, drawing it up and opening it. One of the iron gates was opened by making a new socket wrench sufficiently large to engage the end of the stem, and operating it in the usual manner. There was then some doubt of closing them again, but it was done without difficulty.

As soon as the water was drawn down below the top course of stone the coping was removed, and a large crevice was found. This crevice extended down for 10 or 15 ft. into the body of the dam, and was entirely filled with disintegrated mortar, decayed vegetation, etc. The crevice was undoubtedly caused by the action of water which found its way into the joints of the stone work, the successive freezing each winter causing it to become larger and larger. Although the masonry in the dam is composed entirely of large and heavy stones, there was no bonding between the face and the body of the dam, thus accounting for the facility of the frost action. This made it possible, however, to leave the rear or upstream portion of the dam in place while the front of the dam was removed. The profile of the dam, shown on the sketch (see next page), made it entirely feasible to do this, there being sufficient bulk remaining to make the use of a cofferdam unnecessary.

After the coping and front stone were removed and the disintegrated mortar, decayed vegetation and other

CONDITION OF DAM EXPOSED ON REMOVING COPING, AND SHOWING CRACK



CROSS-SECTION OF THE DAM

foreign matter were thoroughly cleaned out, the joints, wherever possible, were filled with grout, and the face was rebuilt to the new profile, shown in dotted lines on the diagram. The coping was then reset in cement mortar.

The stone was handled bv a hand derrick, as shown in the photograph; this was the interesting feature of the work. Many who saw the work thought this method old-fashioned and inefficient, but it was adopted after much thought had been given to the relative cost of a steam and a hand derrick. The cost of moving a boiler and engine to the work, setting it in place, removing it, and returning it to the equipment yard would have greatly offset the probable cost of all the labor of operating the derrick by hand, and it would not have been possible to raise the stones in sufficiently rapid succession to pay for the higher cost of having an engineer constantly on duty. It is particularly difficult to get coal in this locality.

The various estimates for the cost of rebuilding the dam ranged as high as $39,000, this, of course, including the cost of building a cofferdam and other temporary structures. The Flynt Building and Construction Co., which obtained the contract, estimated the work at approximately $7000, with the stipulation that it be allowed to use its own judgment as to methods. The entire work was handled for a sum considerably less than $4000, and at no time was the water-supply interfered with in any way, nor was it necessary to use the emergency steam pumping system to maintain a sufficient pressure for the water-supply.

The City of Willimantic was represented in the operation by Charles A. Gates, mayor, Henderson S. Moulton, superintendent of water-works, R. E. Mitchell, city engineer, and William A. King, corporation counsel. The Flynt Building organization, which did the work, was represented by L. H. Bogue, general superintendent, and Nelson M. Baldwin, division superintendent.

Concrete Sewer-Pipe Specifications Adopted by Los Angeles

Draft of 1919 Provides for One-to-Three Mix—Dimension Variations Fixed — Imperfections That Will Cause Rejections

Los Angeles in the spring of 1918 adopted pipe specifications for sanitary sewers whereby concrete pipe (called "cement pipe" in the specifications) might be used in place of clay pipe. The use of cement pipe caused a material lowering in the price of clay pipe. At the present time there is very little difference between the costs of the two. The latest specifications for the construction of sanitary sewers in Los Angeles were adopted by the council on Jan. 3, 1919. The main features of these specifications, as regards cement pipe, are as follows:

The cement pipe must be socket pipe of first quality, dense, tough, free from cracks. It must have a smooth interior finish and when struck with a hammer must give a metallic ring. The mixture used must not be less than one part of cement by measure to three parts of aggregate. No materials other than water, cement, sand and stone are permitted in the manufacture of the pipe. This prevents the use of waterproofing compounds. The cement and aggregate are subject to rigid inspection and test before use. The gravel or broken stone must not exceed one-half the thickness of the pipe for which it is used.

It is required that the pipe be made under cover, and the material used is machine mixed, molded and tamped. The city engineer has the right to inspect all materials, method of manufacture and finished pipe at all times. The pipe after manufacture must be kept thoroughly wet for a period of seven days, and not laid until it has cured at least 30 days. The date of making, the name of the manufacturer and the location of the plant must be stenciled on the outside of each length.

TABLE I. DIMENSIONS FOR CEMENT SEWER PIPE, LOS ANGELES, CAL.

	Thickness of Shell, In.		Depth of Socket, In.		Minimum Annular Space, In.	
Size	Standard	Deep and Wide Socket	Standard	Deep and Wide Standard	Standard	Deep and Wide Socket
6	¾	¾	2	2½	⅜	⅝
8	⅞	⅞	2¼	2¾	⅜	⅝
10	1	1	2½	2¾	⅜	⅝
12	1⅛	1⅛	2½	3	½	⅝
15	1⅜	1⅜	2¾	3	½	⅝
18	1½	1½	3	3¼	½	⅝
21	1¾	1¾	3¼	3¾	½	¾
24	2⅛	2⅛	3½	4	½	¾

Limits of Permissible Variation in Inches

Per Ft. (—)	Depth of Socket (—)	Thickness of Shell (—)	Inside Diameter of Bore, In. (+ —)
½	¼	1/16	3/16
½	¼	1/16	¼
½	¼	1/16	¼
½	¼	1/16	¼
½	¼	⅛	¼
½	¼	⅛	⅜
⅝	¼	⅛	7/16
⅝	¼	⅛	½

Note. The minus sign (—) alone indicates that the plus variation is not limited; the plus and minus sign (+ —) indicates variation in both excess and deficiency in dimension.

Pipe 30 days old must appear, when broken, homogeneous, free from voids and generally uniform; and if containing stone must show pieces of fractured stone firmly embedded in the mortar.

All pipe over 6 in. is made in 2½-ft. lengths exclusive of sockets and 6-in. pipe may be either 2 or 2½ ft. in length. The thickness of the shell, the depth of socket and the annular space are given in Table I.

The following imperfections are considered injurious and cause for rejection:

1. When the bore or socket of the pipe varies from a true circle more than 3% of its nominal diameter.
2. A pipe or special designed to be straight, exhibiting a deviation from a straight line of more than ⅜ inch.
3. A single crack in the body of the pipe extending through the entire thickness, regardless of the length of such crack.
4. A single crack which extends through one-half of the thickness and over 3 in. in length.
5. Two or more cracks in the body of the pipe of a less length than 3 in., and extending through one-half the thickness.
6. Any crack which is more than $\frac{1}{16}$ in. wide at its widest point.
7. A piece broken from the spigot end deeper than the socket or longer than one-third of the diameter of the pipe; or a piece broken from the bell if the fracture extends into the body of the pipe or is longer than one-third of the diameter of the pipe.
8. Two or more breaks in the socket or spigot, unless they can be placed in the upper half of the sewer.

The tests for cured cement pipe are the same as for clay pipe and include: (1) Sand bearing crushing test; (2) hydrostatic pressure; (3) absorption test.

Table II gives the minimum strength that samples of cement pipe must develop in order to pass the crushing and hydrostatic tests.

Sanitary sewers are constructed within specified districts, by assessment. In order that sewer contractors may know in advance what their pipe will cost them, the city engineer's office calls for bids from manufacturers of cement and clay pipe for the amount of pipe required in the district before the ordinance of intention is passed by the council. The manufacturers are required to furnish bonds and guarantee the price for one year from the date when bids are received. Residents of the district may specify whether they desire cement or clay pipe used, by obtaining the signatures of more than 50% of the property owners. **A. C. Hansen** is city engineer of Los Angeles.

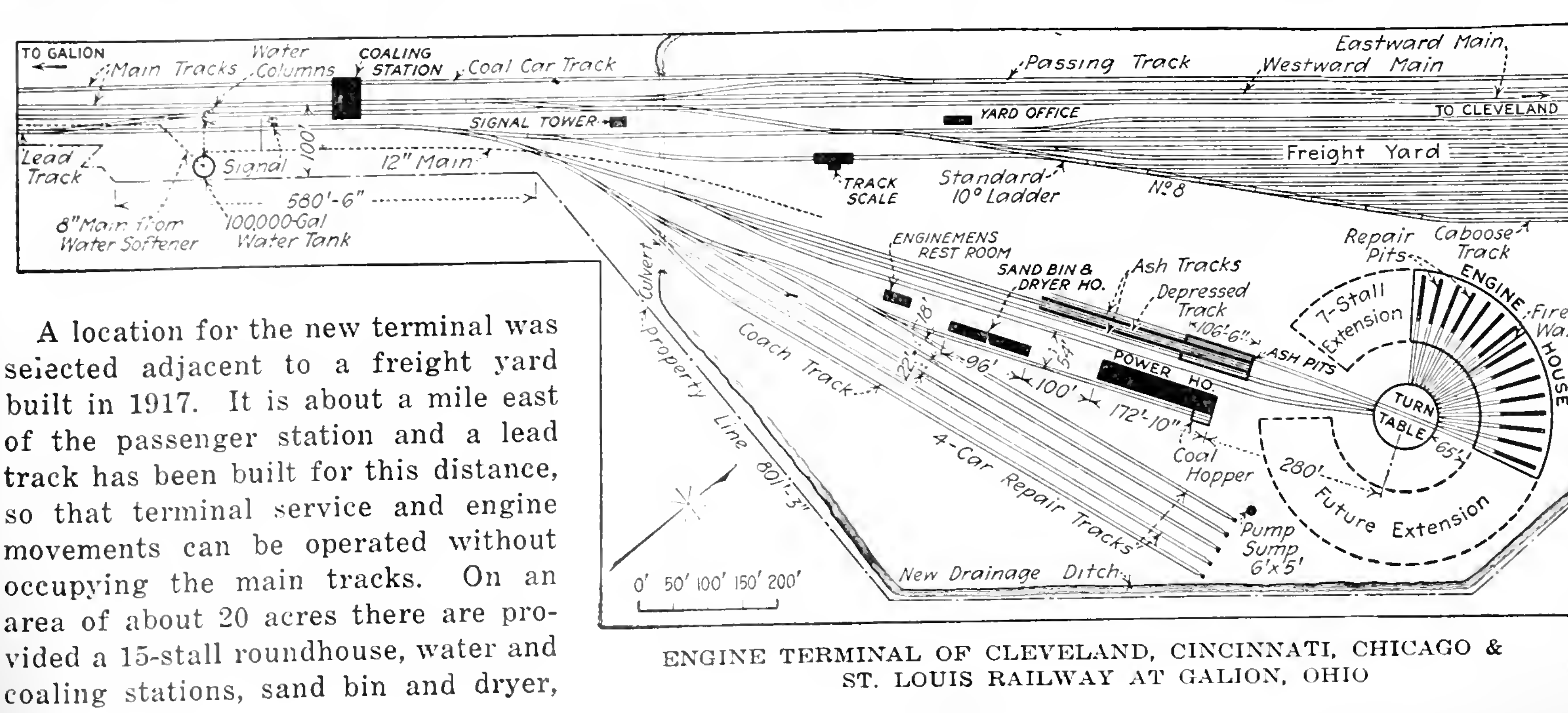
TABLE II

Size, In.	Minimum Crushing Strength (Lb. per Lin.Ft.)	Fracture at Not Less Than (Lb. per Sq.In.)
6	1430	40
8	1430	35
10	1570	30
12	1710	30
15	1960	30
18	2200	30
21	2590	30
24	3070	25

New Engine Terminal Outside City Avoids Congestion

Crowded Site Replaced by Facilities in Open Country—Water Stored and Treated—Standard Designs Employed—Engines Coaled on Three Tracks

REMOVAL of its engine terminals at Galion, Ohio, to a site in open country, beyond the city limits, has enabled the Cleveland, Cincinnati, Chicago & St. Louis Railway to design a new plant layout unhampered by existing facilities. Growth of the city around the old terminal, built in 1878, has made it impossible to extend this so as to provide the accommodation demanded by present traffic conditions, while damage by fire in 1917 necessitated hastening the construction of the new plant during 1918. About 20 engines daily have to be handled, cleaned and made ready for service, besides the train engines which take coal and water while standing on the main tracks.

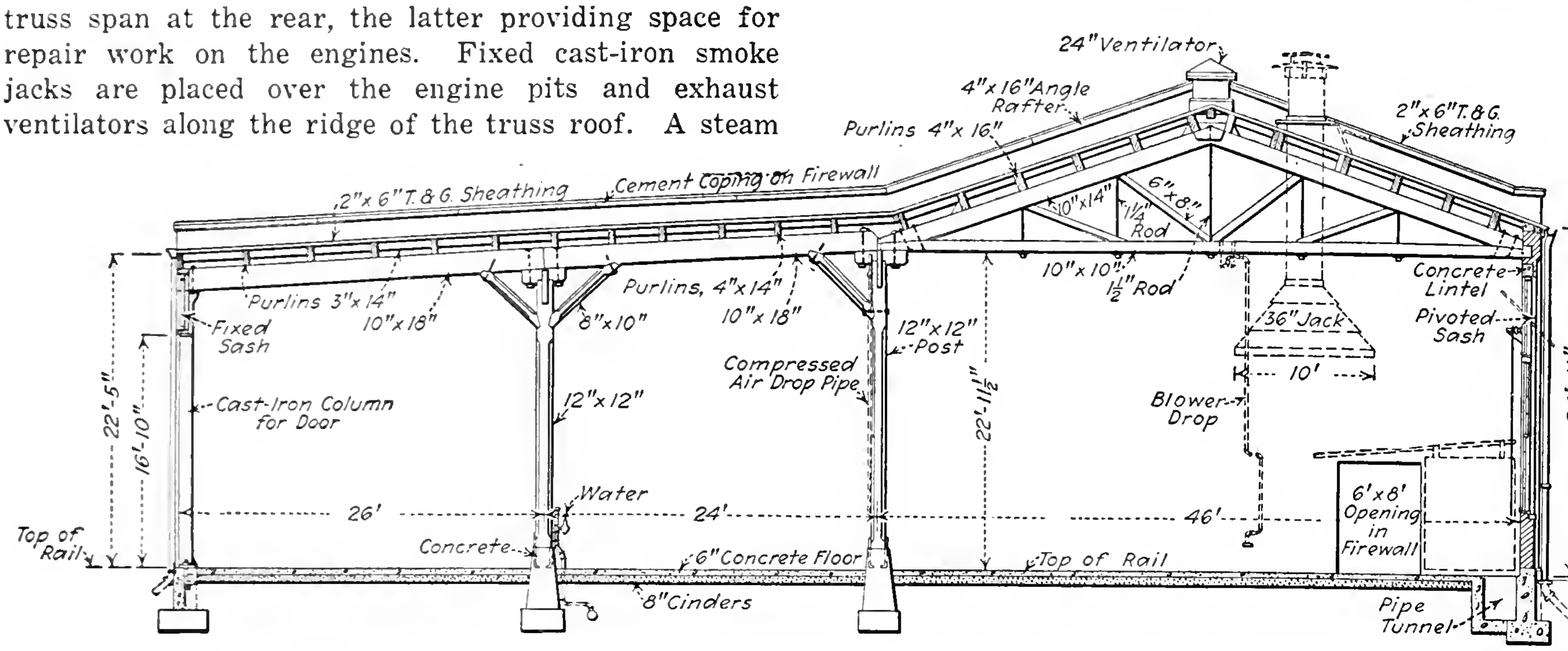


ENGINE TERMINAL OF CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RAILWAY AT GALION, OHIO

A location for the new terminal was selected adjacent to a freight yard built in 1917. It is about a mile east of the passenger station and a lead track has been built for this distance, so that terminal service and engine movements can be operated without occupying the main tracks. On an area of about 20 acres there are provided a 15-stall roundhouse, water and coaling stations, sand bin and dryer, two cinder pits, four car repair tracks for 53 cars, a coach storage track for 10 cars, a power house with shop and storeroom, and a rest house for the enginemen. Electrically operated machine tools for light repair work are installed in an annex of the power house.

The engine-house construction follows a general building design which was adopted as standard on this road a few years ago, and which provides for brick walls and timber roof, with cast-iron columns in the front wall for the attachment of swinging doors. Lintels over the wide window spaces in the rear wall were to have been of steel, but, owing to shortage of supply, they

were made of reinforced concrete. Their span is reduced by two intermediate posts of 6-in. channels, resting on the concrete footings. A firewall divides the building into two sections. Two rows of wood posts on concrete pedestals support the roof framing, which consists of two beam spans at the front and a 46-ft. truss span at the rear, the latter providing space for repair work on the engines. Fixed cast-iron smoke jacks are placed over the engine pits and exhaust ventilators along the ridge of the truss roof. A steam pipe resting on the truss chords has vertical branches or drop pipes for use as blowers in engines which are having the fires started.



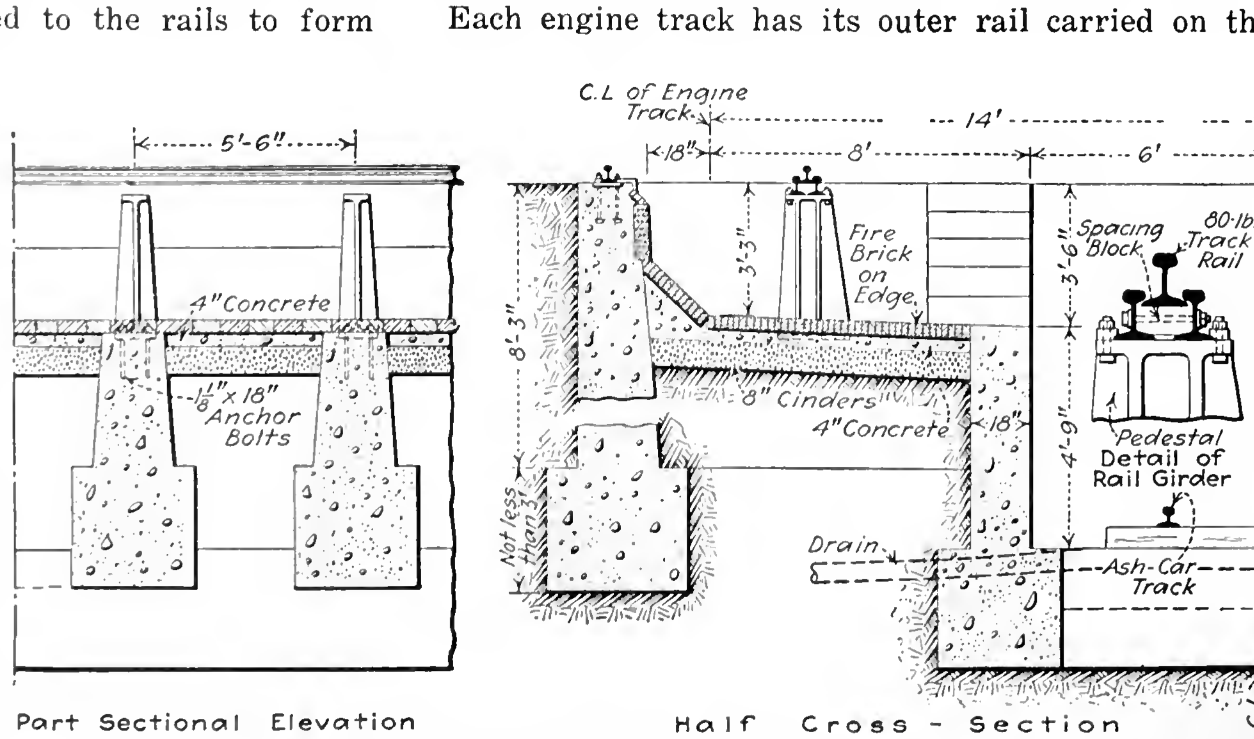
TIMBER FRAMING FOR ROUNDHOUSE ROOF, GALION, OHIO, ENGINE TERMINAL

At present the engine house is built for 15 stalls, but there is provision for a seven-stall extension. The angle between the radial tracks is 7½ degrees. Concrete pits 65 ft. long provide for inspection and repair, and have convex bottoms so that the floor will be dry for the men working under the engines. The side walls have corbeled projections on the inside to protect the water and steam pipes carried along the sides of the pit, while heavy projections on the outside provide supports for engine jacks. Track rails rest on steel plates and are fastened by clips and nuts on anchor bolts embedded in the walls of the pits. No drop pit is provided for taking out wheels and axles, the engines being raised by a jacking hoist with power-driven screw jacks to permit of such removal. The floor is of concrete, steel guards being bolted to the rails to form the flangeways. Pipes and electric cables are laid in a 3-ft. tunnel against the rear wall. In the 90-ft. center-bearing plate-girder turntable the pivot is a 20-in. flat disk with a device for securing a central bearing, this being a standard design on this road. The circular rail is laid on ¾-in. plates on a bench of the concrete wall and is secured by anchor bolts. At main entrance points, where there is impact as the entering load tilts the table, this rail is carried by a segmental 12-in. I-beam resting on short pieces of rail, all embedded in the concrete. Coupled to one corner of the table is a tractor with a 30-hp. motor driving a wheel which rides on the circular rail.

Steel bents with H-beam posts are embedded in the wall of the pit to support the ends of the tracks and thus prevent their depression due to the impact of engines passing off the turntable. There are three approach tracks, two of these being the ashpit tracks and the third a running track which permits of direct movements to and from the turntable. A 65-ft. open space extends between the roundhouse and the turntable.

Mechanical equipment is not provided for removal of ashes from the pits where the engines have their fires cleaned or dropped, the reason given being that such equipment has been found unsatisfactory in operation and expensive in maintenance. The ashpits are of the depressed-track type, 100 ft. long, with two engine tracks spaced 28 ft. on centers and having between them an ash-car track at a lower level but rising to the surface on a grade of 4 per cent. Side-dump cars are used, having A-shaped floors and being of such height that the ashes can be shoveled into them readily from the floors of the ashpits.

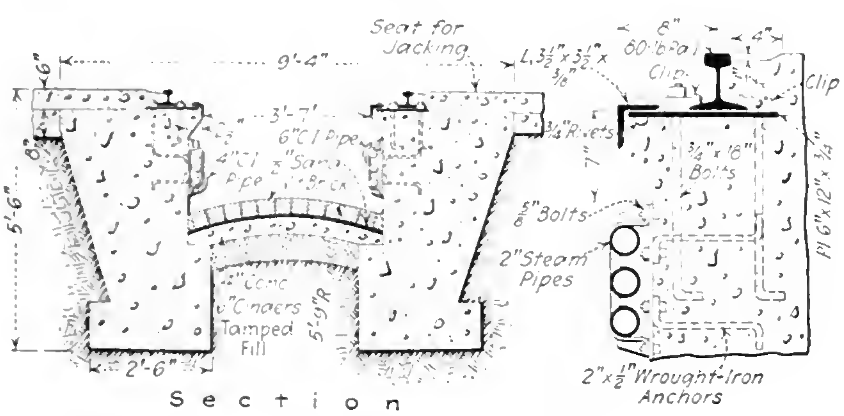
Each engine track has its outer rail carried on the



ENGINE ASHPITS HAVE DEPRESED TRACK FOR ASH CARS

side wall of the pit and its inner rail on a girder supported by cast-iron pedestals, as shown in one of the drawings. This girder consists of a pair of 80-lb. rails bolted together through spacing blocks upon which the track rail rests. Thus the heads of the former fit over the base of the latter and grip it firmly when the bolts are tightened. Spacing blocks 22 in. apart and 6 in. long are used; except that 18-in. blocks with four bolts are used under the rail joints. The track rail on the wall has the inner side of its base gripped by a continuous angle which protects the corner of the wall and is secured by anchor bolts. On the outer side the base is held by clips on similar bolts.

Water-supply for the locomotives and for the service of the terminal is taken from a small creek; a dam forms a pump pit. An electric pump delivers the water to a 17,000,000-gal. reservoir formed by an embankment across low ground alongside the creek and providing storage for low-water periods. From this the water is pumped to a water-softening plant, whence it flows to a 100,000-gal. wood tank placed at such an elevation as to give a gravity flow to a similar tank at the entrance to the engine terminal. The latter distributes a gravity supply to the buildings and to two water columns at the coaling station and two at the cinder pits. An 8-in. main connects the two tanks and a 12-in. main leads from the yard tank to the 10-in. water columns and to the buildings.

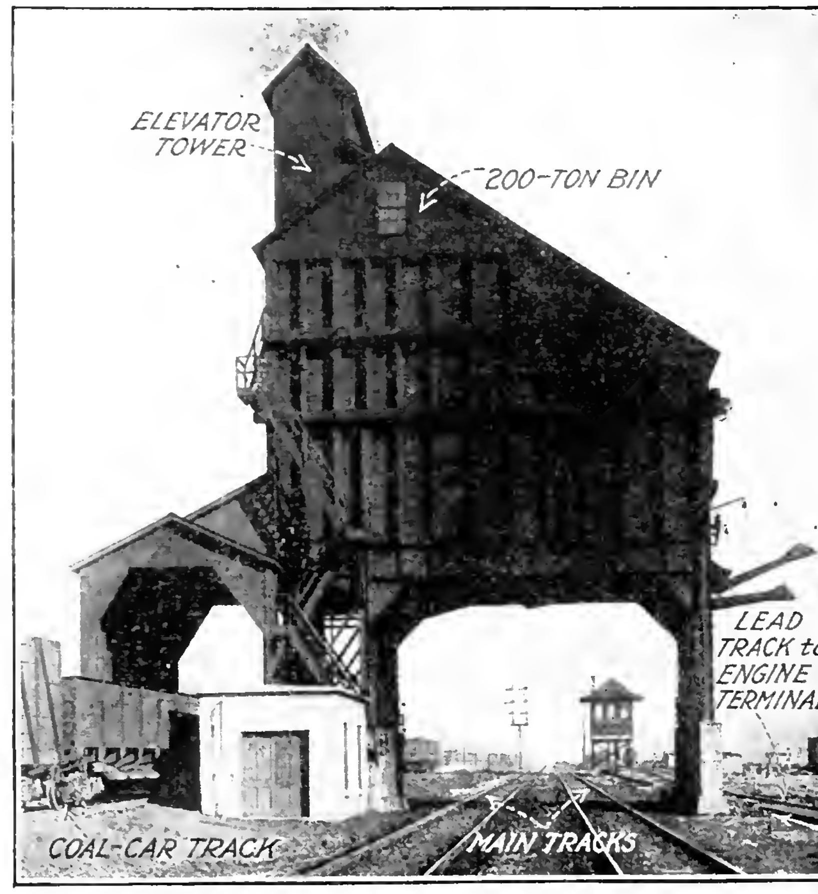


DETAILS OF ENGINE PITS

Engines on three tracks are served by the coaling station, which has a 400-ton bin spanning the two main tracks, with chutes on one side for delivery to engines on the lead track. On the other side is the coal-car track, with a receiving hopper from which the coal flows to a single 1½-ton bucket working automatically in an elevator tower. The bin is of timber and is supported by steel girders which span the tracks and are carried by steel bents, the lower portions of these being inclosed in concrete walls as a protection against blows from derailed engines and cars. Sand is screened and dried in a separate building and is delivered to the engines through pipes by compressed air.

In the power house are two 200-hp. marine boilers and a compressor. This plant furnishes steam for heating and for the engine-house blowers, compressed air for operating tools and testing brakes, and hot water for washing out the engine boilers.

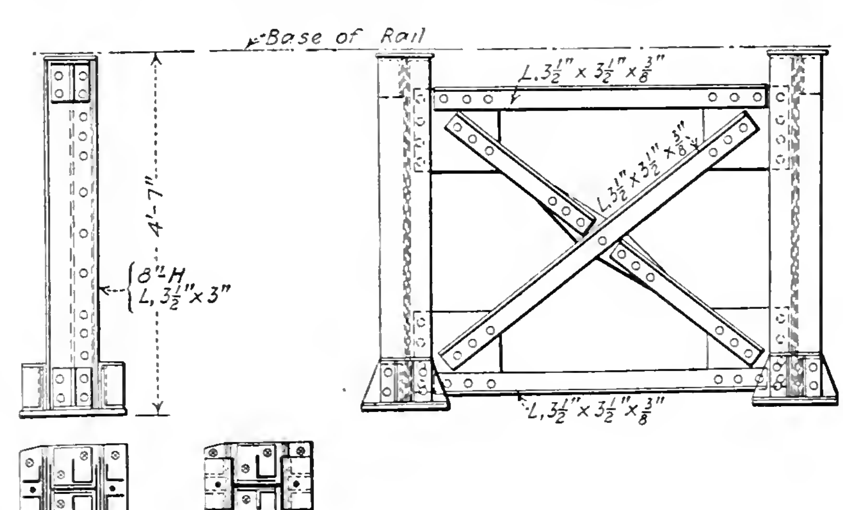
Some grading was required to prepare the site, and a drainage ditch crossing it was replaced by a ditch excavated along the boundary line and carried under the tracks in a 36-in. sectional cast-iron culvert. Drainage and sewage from the buildings, yard, turntable pit



COALING STATION SERVES MAIN TRACKS AND LEAD TRACK TO TERMINAL

and other points are carried by a system of clay pipe and concrete pipe drains to a manhole or sump, where a float-controlled electric pump raises the water about 8 ft. to an outfall pipe discharging into the ditch. The soil is a yellow clay, changing to a stiff blue clay which makes a good foundation. Piles are used only under the footing for the turntable center. Woven-wire fencing which incloses the site is carried by concrete posts designed and made by the railway.

Plans for this engine terminal plant were made under the direction of C. A. Paquette, chief engineer of the railway, and the work was in charge of W. C. Kegler, district engineer at Galion (and W. S. Burnett



STEEL BENTS IN WALL OF TURNTABLE PIT SUPPORT ENDS OF TRACKS

during the illness of Mr. Kegler), with J. Humphries as assistant engineer. The Walsh Construction Co., Davenport, Iowa, has the contract for the buildings, turntable pit and cinder pit. The coaling station was built by the Ogle Construction Co., Chicago, and the turntable by the American Bridge Co. Laying the 8-in. and 12-in. water mains from the water-softening plant to the terminal tank and water columns was done by the railway forces.

Hydraulic Efficiency of a Drainage Ditch for Five Different Channel Conditions

Photographic Views and Tabular Data for Varying Channels Show Effect of Straight and Curved and Clear and Obstructed Courses

By C. E. Ramser
Senior Drainage Engineer, United States Bureau of Public Roads

Experiments to determine the values of n in Kutter's formula

$$C = \frac{\frac{1.811}{n} + 41.66 + \frac{0.00281}{s}}{1 + \frac{n}{\sqrt{r}}\left(41.66 + \frac{0.00281}{s}\right)}$$

were made on five courses of the South Forked Deer River between Jackson and Roberts, Tenn. The channel along these courses varied from a newly dredged channel, in excellent condition, to a very crooked course of the old river channel, in very bad condition. Views of these courses of channel are shown in Figs. 1 to 5. In Tables I to V are given the values of n obtained for each of the courses for stages ranging from low to high, and a full description of the conditions existing along each of the courses.

As may be seen from the tables, the lowest values of n were obtained for the course of channel near Roberts (Fig. 1). Values of n were determined for this course from four to six months after the dredging of the channel had been completed. The low values of n obtained for this course as compared with the values for the other courses may be attributed to the comparatively smooth and regular side slopes and bottom, the uniformity of cross-section, and the freedom from growth or obstructions in the channel.

The effect of roughness and irregularities in the lower portion of the channel is revealed in the results obtained for the course near Jackson (Fig. 2 and Table II.) Although the channel was practically free from vegetation or obstructions of any sort, yet the values of n are considerably higher than those obtained for the course near Roberts. The irregularities in the lower portion of this channel were left at the time of construction, the bottom and sides of the channel never having been smoothed properly. The values of n for this course were determined from nine to 12 months after the construction of the channel.

FIVE COURSES OF THE SOUTH FORKED DEER RIVER, TENNESSEE, SHOWING DIFFERENT CHANNEL CONDITIONS

Fig. 1—Straight and uniform. Fig. 2—Straight and rather poor. Fig. 3—Straight and irregular. Fig. 4—Fairly straight but irregular. Fig. 5—Irregular and obstructed

The numbering of the views corresponds with that of the tables. Fig. 1 is a view taken near Roberts; Fig. 2, near Jackson; Figs. 3 to 5 near Campbell's levee road.

TABLES I TO V. HYDRAULIC ELEMENTS OF THE SOUTH FORKED DEER RIVER IN FIVE STRETCHES BETWEEN JACKSON AND ROBERTS, TENN.

TABLE I. NEAR ROBERTS

Average surface width, 60 ft.; average depth at center, 13 ft.; gage height at bankful stage, 10.5. Course, straight, 1412 ft long; Cross-section, very uniform; Side slopes, regular and smooth; Bottom, even and fairly smooth; Soil, lower part, hard clay; upper part, clay loam; Condition, no vegetation or obstructions of any sort in channel; Constructed: October, 1915.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq.Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
5.82	2/26/16	614.3	328.4	1.87	5.76	0.000094	80.5	0.0255
7.02	2/10/16	798.2	390.0	2.04	6.50	0.000094	82.6	0.0254
7.62	3/29/16	919.4	421.8	2.18	6.84	0.000096	85.2	0.0252
8.40	4/4/16	1252.1	465.0	2.70	7.28	0.000124	90.0	0.0240
8.90	3/4/16	1502.6	494.0	3.04	7.55	0.000166	86.0	0.0248

TABLE II. NEAR JACKSON

Average surface width, 55 ft., average depth at center, 10 ft.; gage height at bankful stage, 12 ft. Course, straight, 952 ft long; Cross-section, fairly uniform; Side slopes, fairly regular near top but very irregular and uneven at bottom; Bottom, very uneven and full of holes; Soil, heavy clay loam; Condition, no vegetation or obstructions in channel; Constructed, March, 1916; General remarks, high values of n are due to very rough and irregular condition of channel as originally dredged; the upper portion of channel is fairly regular.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq.Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
6.30	12/13/16	191.6	115.9	1.66	2.89	0.000530	42.4	0.0420
6.95	12/20/16	282.2	143.0	1.97	3.33	0.000555	45.8	0.0402
7.00	12/22/16	290.4	147.0	1.98	3.40	0.000562	45.3	0.0401
7.09	3/31/17	375.0	150.0	2.50	3.46	0.000694	51.2	0.0362
7.48	2/21/17	433.0	166.0	2.61	3.69	0.000630	54.2	0.0348
7.77	1/17/17	477.0	178.0	2.68	3.87	0.000642	53.8	0.0349
11.30	12/28/16	1078.0	344.0	3.13	5.69	0.000477	60.2	0.0341
11.78	1/31/17	1296.0	366.0	3.55	5.83	0.000534	63.6	0.0322
12.38	1/6/17	1362.0	399.4	3.41	6.10	0.000436	66.1	0.0310

TABLE III. IRREGULAR DREDGED CHANNEL

Average surface width: 61 ft.; average depth at center, 14 ft.; gage height at bankful stage, 9.0 ft. Course, straight, 534 ft. long; Cross-section, considerable variation; Side slopes, very irregular; Bottom, very rough and uneven; Soil, sandy clay loam; Condition, very little vegetaion, few obstructions; Constructed, August, 1914.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq.Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
2.5	3/20/16	395.2	176.1	2.24	3.61	0.000571	49.4	0.0380
3.52	2/25/16	545.9	249.0	2.19	4.65	0.000552	43.2	0.0455
4.30	3/29/16	735.7	305.0	2.41	5.33	0.000452	49.2	0.0410
4.45	3/4/16	715.1	315.6	2.27	5.45	0.000300	56.2	0.0367

TABLE IV. OLD STRAIGHT RIVER CHANNEL

Average surface width, 48 ft.; average depth at center, 13.5 ft. Course, fairly straight, 497 ft. long; Cross-section, considerable variation; Side slopes, irregular; Bottom, irregular with deep holes; Soil, sandy clay loam; Condition, sides of channel covered with trees, roots and vines, and subject to caving; logs, branches and other drift in bottom of channel.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq.Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
2.5	3/20/16	395.2	196.2	2.01	4.44	0.000584	39.5	0.0500
3.52	2/25/16	545.9	240.2	2.27	5.09	0.000734	37.2	0.0550
4.30	3/29/16	735.7	275.0	2.68	5.56	0.001088	34.4	0.0620
4.45	3/4/16	715.1	281.9	2.54	5.66	0.000952	34.6	0.0619
7.00	2/3/16	1066.6	403.2	2.64	7.19	0.000501	44.1	0.0505

TABLE V. OLD CROOKED RIVER CHANNEL

Average surface width, 63 ft., average depth at center, 14.0 ft; Course, very crooked, made up of four distinct curves, 705 ft. long, at low water, 740 ft. at high water; cross-section, large variations; Side slopes, very irregular; Bottom, very irregular and full of holes; Soil, sandy clay loam; Conditions, many roots, trees and bushes on side slopes and many logs, large trees and other drift on bottom; trees are continually falling into channel, due to caving banks.

Gage Height, Ft.	Date of Observation	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq.Ft.	Mean Velocity, Ft. per Sec.	Mean Hydraulic Radius, Ft.	Slope	c	n
2.5	3/20/16	395.2	241.2	1.64	4.15	0.003773	13.1	0.1520
3.52	2/25/16	545.9	311.5	1.75	4.99	0.003812	12.7	0.1620
4.30	3/29/16	735.7	366.0	2.01	5.56	0.003450	14.6	0.1500
4.45	3/4/16	715.1	376.7	1.90	5.68	0.002709	15.3	0.1460
7.00	2/3/16	1066.6	575.8	1.85	7.60	0.001486	17.4	0.1400

TABLE VI. RELATIVE CAPACITIES FOR THREE COURSES OF CHANNEL

Cross section area = 315.6 sq.ft.
Hydraulic radius = 5.45 ft.
Slope = 0.0003

Courses of Channel	n	c	Mean Velocity Ft. Sec.	Discharge Sec.-Ft.	Relative Capacities of Courses Per Cent.
Dredged	0.0367	56.2	2.27	715.1	100.0
Old straight	0.0619	34.8	1.40	443.5	62.1
Old crooked	0.1460	15.1	0.61	192.7	27.0

Figs. 3, 4 and 5 represent three consecutive courses of channel located near the Campbell's levee road below Jackson. The different courses of channel are a straight course of the old river channel, a very irregular and crooked course of the old river channel, and a straight course of a newly dredged channel with irregular cross-section. Gagings of the flow were made at the upper end of the course of the dredged channel, and were used in the computations of values of n for all three courses. The advantage of this practice lies in the fact that an error in discharge would not materially affect the relative values of n, so a ready comparison can be made of the hydraulic efficiency for the three courses of channel. The values of n obtained and a careful description of the three courses are given in Tables III, IV and V. The conditions found in the two courses of old river channel are typical of old channel conditions in this section of the country. The dredged course of channel is considerably more irregular in cross-section than the courses near Jackson and Roberts, shown in Figs. 1 and 2, which accounts for the higher values of n obtained.

Referring to Tables III, IV and V, it is seen that the values of n for the discharge of 715.1 sec.-ft. are 0.0367, 0.0619 and 0.146 for the dredged, old straight, and old crooked channels, respectively, and that the slope of the water surface required for this discharge was over three times as much for the old straight as for the dredged channel. In order to show the relative capacities for these three course of channel for the values of n given above, Table VI was prepared, in which the slope, the hydraulic radius, and the cross-section area of the last set of measurements in Table III were used.

The difference in the relative capacities of the old straight and the old crooked channels is not due entirely to the curves in the latter, since the accumulation of trees, logs and other drift was greater in the crooked channel. However, the difference in the condition of the two channels may be directly attributed to the presence of the curves, since there is a greater tendency for drift and obstructions to accumulate in a curved than in a straight course of channel.

Wood-Block Pavement Has Spread Two Inches

The wood-block pavement on Market St., Chattanooga, Tenn., was 70 ft. wide and has increased in width 2 in. during the three years which this pavement has been in place, according to Robert Hooke, city engineer. This expansion has been taken up, by a reduction of the expansion joint on either side of the pavement, to one-half of its original size. Mr. Hooke attributes the spreading of the pavement to the working of solid particles of grit into the spaces between the blocks at times when the pavement was fully contracted.

Day Labor Does Municipal Work at Flint, Michigan

Engineer Favors Direct Employment for Cities of Moderate Size and Contract System for Small and Large Cities

CONSTRUCTION of sewers, paving and sidewalks, and cleaning of streets, are done at Flint, Mich., by day labor under the direction of the city engineering department. Consequently, the department must have men who are capable of directing work and handling labor, but this is a difficult problem, because men thus qualified are much in demand by contractors and others. In a paper read at the annual meeting of the Michigan Engineering Society Ezra C. Shoecraft, city engineer, said that during and since 1915 all sewer and paving work have been done in this way, except a small amount of asphalt-block paving laid in 1917. Sidewalks have been built by day labor since 1912. In the past four years the work has amounted to about 83 miles of sewers, 27½ miles of paving and 54 miles of sidewalk.

Costs and results have been satisfactory, compared with those in other cities, according to Mr. Shoecraft, who also states that the work is as good as, and generally better than, that done by contract, that it is done more expeditiously, that more consideration is given to the property owners affected by the improvements, and that urgent work receives first attention.

Good equipment is largely responsible for the success of the system. The equipment is put on each separate job on a per diem basis and is entirely self supporting, including allowance for depreciation. The original cost of the plant, including small tools, was $15,000. All machines are of a class that is generally applicable; thus those which can be used only on special jobs are avoided.

The pavement plant includes two revolving steam shovels; two concrete mixers for curbs; two mixers of 14-ft. capacity for foundation work; a 10-ton roller; an eight-ton gasoline tandem roller for asphalt; an asphalt plant capable of producing material for 1500 sq.yd. of 2-in. surface in 10 hours; five asphalt wagons of 2½ yd. each; four 5-ton dump trucks; six dump wagons; a two-ton truck; a wagon loader; an auto crane, and a dragline excavator at the gravel pit. For sewer construction there are two trench excavators for 5 x 20 and 3 x 15-ft. trenches; a backfiller; a trestle and bucket machine for large sewers, and two 600-gal. trench pumps. For sidewalk work there are eight wheeled scrapers and two concrete mixers.

Street cleaning was turned over to the engineering department about July, 1917. The equipment includes two power-operated flushers with 1200- and 1800-gal. tanks. The annual cost of street cleaning and snow removal approximates 4c. per square yard. Mr. Shoecraft believes that still greater efficiency may be secured and that the ideal street-cleaning machine has not been invented.

The day-labor system is not recommended for small cities, Mr. Shoecraft says, as it would be too expensive for them to maintain a trained force for their relatively small needs. Flint has about 90,000 inhabitants.

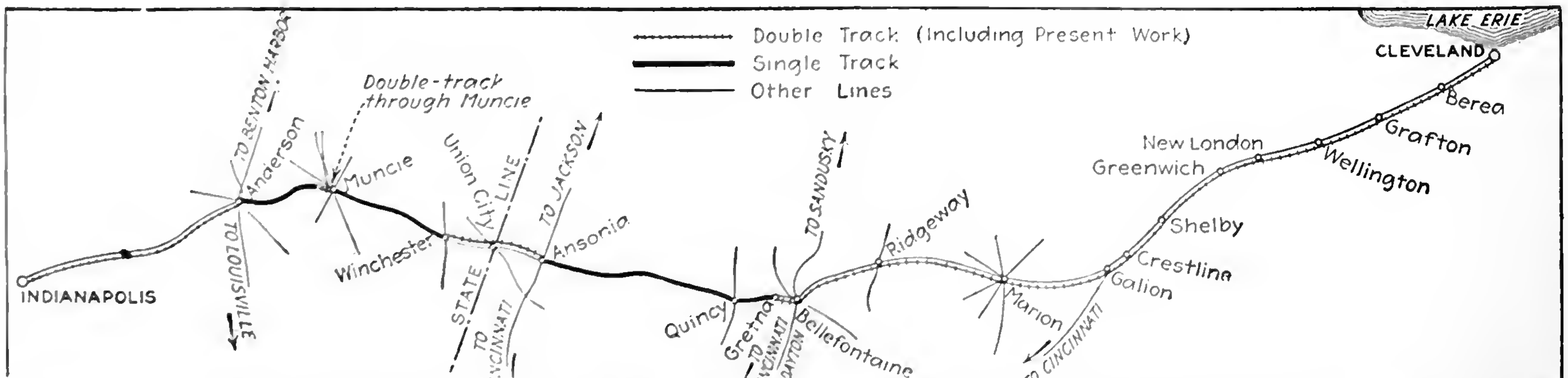
Double-Track Improvement on Big Four Railroad

Study of Operating Conditions for Heavy Traffic Leads to Extending Second Track and Reducing Grades

INCREASE in traffic capacity, more rapid forwarding of freight, and eventually—on some parts of the territory—an increase of train loads from 2200 to 4000 tons, are operating advantages which will be effected by the double-tracking and grade-reduction work and other improvements on the Cleveland and Indianapolis division of the Cleveland, Cincinnati, Chicago & St. Louis Ry. This 283-mile line is the busiest division of the "Big Four" system. It has about six passenger trains and seven scheduled freight trains each way daily, but the traffic density is much greater than would be indicated by the number of scheduled trains. The actual total number of trains during the war period, with the heavy traffic in munitions and supplies, has been as high as 40 to 50 daily.

In this distance there are 150 miles of double track, which the work in progress will increase to 200 miles. This includes the 20-mile stretch between Galion and Marion, Ohio, where the parallel and adjacent single-track lines of the "Big Four" and the Erie railways are operated jointly as a double-track line. Other improvements include an extension of the west-bound yard at Bellefontaine and new engine terminals at Galion and Ansonia, Ohio. At present the maximum grades are 0.8 per cent., in short stretches, but with the completion of the improvements this will be reduced to 0.3 per cent., with some temporary exceptions, as noted below.

The economic and operating phases of the work are



DOUBLE-TRACKING ON 283-MILE HEAVY-TRAFFIC LINE OF CLEVELAND, CHICAGO, CINCINNATI & ST. LOUIS RAILWAY

of primary importance, the construction phase involving no great difficulty. The improvement thus far authorized is not expected to permit of hauling heavier train loads, but it will permit the handling of trains with a great saving in time, due to the elimination of delays from side-track detentions and congested conditions at various points.

Two engine districts compose this division: One is 135 miles, from Indianapolis to Bellefontaine, and the other is 140 miles, from Bellefontaine to Cleveland. Hitherto the maximum train loads permissible over the ruling grades have not been handled through these districts, because of the great distance and the fact that the delays and congestion attending the dense traffic would make it impracticable to handle such trains within the time limits for working hours of train crews, as imposed by law. Changes in the engine districts were considered, but the other methods of meeting the difficulty were considered preferable. In this connection, reference may be made to the rearrangement of a 309-mile division on the Great Northern Ry. into three engine districts instead of two, in order to keep within these time limits, as described in *Engineering News-Record* of Sept. 5, 1918, p. 439. In this case, however, the traffic was very much lighter than that on the Indianapolis and Cleveland line.

Ruling Grades Not All Eliminated

While grade reduction is included in the present improvement, it does not eliminate all the ruling grades in either of the two train districts, but at certain points these ruling grades will still remain on single-track sections outside of the double-track construction now authorized. The new double track, as built for some distance both east and west from Bellefontaine, and, therefore, including both the train districts, is also laid at the old grades, of 0.8 per cent., which are ruling grades, except that east-bound from Bellefontaine the ruling grade is 0.5 per cent. If the two districts were so improved as to reduce the grades at all other points, it would be possible to increase the train loads correspondingly, using pusher engines on the Bellefontaine grades. On the remaining portions of the districts, therefore, the maximum grades on the new double-track work are 0.3 per cent. These portions are being thus treated with a view to their becoming parts of a low-grade line between Indianapolis and Cleveland, such as will be attained eventually either by the reduction of present grades, by the construction of low-grade detours around the heavy-grade sections, or by the application of helper service.

In the case of this division, the need of immediate relief—at least to the extent attainable by double tracking both ways from Bellefontaine and at certain other places, as now in progress—was so pressing as to leave no alternative. Previous experience of this railway as to benefits from double tracking elsewhere under approximately similar conditions left no doubt as to the economy of this particular improvement, which was undertaken, therefore, without making such close study and estimates as would have been necessary to demonstrate the full measure of the benefits which will be derived.

Work now in progress includes the widening of present fills and also the construction of new and higher fills on the present location, in order to substitute long unbroken grade lines for the original irregular profile. It includes three sections, as shown on the accompanying map. From Marion, Ohio, west to Harper, 33 miles, the work is mainly in widening the old fills, and requires relatively light grading. From Ansonia, Ohio, to Union City, eight miles, the subgrade elevation is raised considerably, in order to reduce grades by taking out existing sags. From Union City to Winchester, Ind., 10 miles, there are both widening and raising of fills. The estimated cost is $1,180,000 for the work from Marion to Harper, and $820,000 for that from Ansonia to Winchester. As this line traverses mainly an elevated plateau there are few cuts of importance and few structures other than culverts.

Double Tracking and Passing Tracks

In double tracking, the new second track is in some places on the north and in other places on the south of the old track, which arrangement permits of some improvement in curvature and also permits of taking advantage of the best location for grading and other local conditions. Present passing tracks, which are about six miles apart, are linked into the double track, being ballasted to standard section and relaid with new rails. Passing tracks are required also on the double-track sections, where they are spaced about 10 miles apart, their location being determined more by the occurrence of yards, towns and road crossings than by any specific interval or spacing. These new passing tracks are made long enough to take 100-car trains.

Train movements will be facilitated greatly by the installation of automatic block signals, which it is expected to install later. With this system the block sections will be about one mile in length, as compared with six to seven miles under the present manual-block system, which has towers at the passing track connections.

Rails for the new tracks are of the A. S. C. E. 90-lb. section with four-bolt joints, laid on ties of red oak and similar woods which are creosoted at the railway's plant. Main tracks are spaced 13 ft. on centers and the spacing of main and passing tracks is 16 ft. on centers. Concrete posts of the railway's design and manufacture carry the woven-wire fencing, special braced posts being used at corners and end panels. Mile posts and rests for spare rails are also of concrete.

These improvements are under the direction of C. A. Paquette, chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry. W. C. Kegler is district engineer for all the present work, with F. N. Johnson as resident engineer on the section from Marion to Bellefontaine and T. E. Earle as resident engineer from Ansonia to Winchester.

Railways Should Report Road Crossings

Legislation requiring railways to obtain the approval of the Wisconsin Railway Commission for all new road crossings and abandonment or change of existing crossings is suggested by the commission. Discovery of new crossings established without any report of the fact by the railway to the commission is the reason for this suggestion.

Smooth, Dustless Roads Maintained by Gang System

Bituminous Carpet Placed on Macadam Highways in Michigan Fruit District —Slag Has Proved Satisfactory for the Metal on These Roads

BITUMINOUS carpets maintained by the gang system, as distinguished from the patrol system, are used to cover the slag and stone macadam roads in the Berrien County, Michigan, fruit district. Thus smooth and dustless highways for the hauling of perishable fruit to market are produced. While stone has been used generally for these roads, slag is coming into favor and is said to be giving excellent results. Reports indicate that stone is preferred when bituminous treatment is not contemplated, while many favor slag when such treatment is to be applied.

BITUMINOUS CARPET PROTECTS EIGHTEEN-YEAR-OLD MACADAM ROAD IN BERRIEN COUNTY, MICHIGAN

As stated above, an important factor in deciding road questions in this county is the fruit industry. Peaches, grapes and berries in large motor-truck loads will not reach the shipping point in good condition if bumped over rough roads and covered with dust. Therefore, farmers in this district insist on having the roads maintained in first-class shape. Furthermore, the elimination of dust is of great value to fruit growers whose farms border the highways. One of the accompanying views shows the West Michigan Pike—an 18-year-old water-bound macadam which has received a bituminous treatment.

While slag has been used extensively in Michigan for several years as the base course for stone and gravel surfaces, only in recent years has it been employed for the top course. It is a little more troublesome to compact slag than stone in thin courses, and, according to Frank F. Rogers, state highway commissioner, stone is preferable for the wearing course in water-bound macadam, as the lower cementing property of slag causes it to ravel more quickly under automobile traffic. Where a bituminous carpet is to be applied, however, slag is said to make a very satisfactory surface on which to place the coating. In fact, it is said to be superior to gravel and stone, since it not only is sharp and irregular, but has minute cells which receive the bituminous material, thus causing the carpet to adhere.

Slag has proved satisfactory for two miles of macadam in Berrien County, it is stated, and is now being used quite extensively. An example of this is found in Benton Township, which is now building 22 miles of slag-macadam road under a bond issue of $100,000. As this sum was not sufficient to construct the roads under conditions of increased material and labor cost, the township board adopted a policy of building the slag base on all the roads and utilizing it for traffic until funds for surfacing are available. One of the views shows the township unloading and distributing plant at Benton Harbor, which, with a force of only three men, keeps 16 teams and two motor trucks busy.

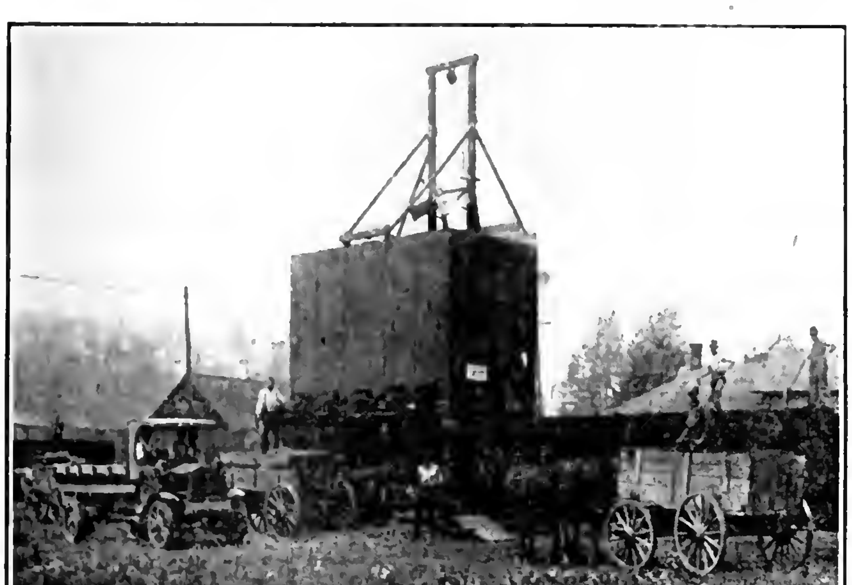
Macadam county roads for which state aid is desired must be built in conformity with the specifications of the state highway department, under whose instructions and specifications the county engineer works. Township roads are also built according to the state specifications under the supervision of a highway commissioner, the county engineer being generally employed to make road surveys, check the grade and do some inspection work. The state specifications, with few exceptions, follow those used elsewhere for macadam roads. The stone, whether limestone or slag is used, must be well graded and of sizes from 1½ to 3½ in. This grading is the same for both the top and bottom courses. Screenings are described as that portion of the crushed material passing a ¾-in. screen, including the chips, but with all but 25% of the dust removed. Dust is described as that portion passing a No. 8 sieve. The engi-

neer for the company supplying the slag maintains that this dust should be left in the screenings for the top course, as it would give better cementing properties.

Side boards, supported by iron pins driven into the subgrade, are used as forms and to insure proper thickness of material. These forms are used for both the top and bottom courses. To obtain adequate rolling, the county specifications require that, before starting to lay stone, the contractor shall have one roller on the work for each 100 cu. yd. of material which he expects to deliver per 10-hour day; also the necessary pumps and sprinkling outfits. Rollers shall weigh from 10 to 15 tons. The compacted thickness of the bottom course is required to be 4 in., while that of the top course is such as will give a final thickness of not less than 7 in. at the edges and 8 in. at the center, for 9 to 16 ft. paved width.

As a rule, the bituminous carpet cannot be applied immediately after the completion of the top course, as the road is then covered with more or less loose screenings, which prevent proper adherence. In general, it is thought best to permit the use of the top course by traffic until it has become thoroughly compacted and bound by the cementing action of the material. Experience in some cases indicates that water-bound slag macadam can carry traffic for a longer period than stone before the carpet is applied.

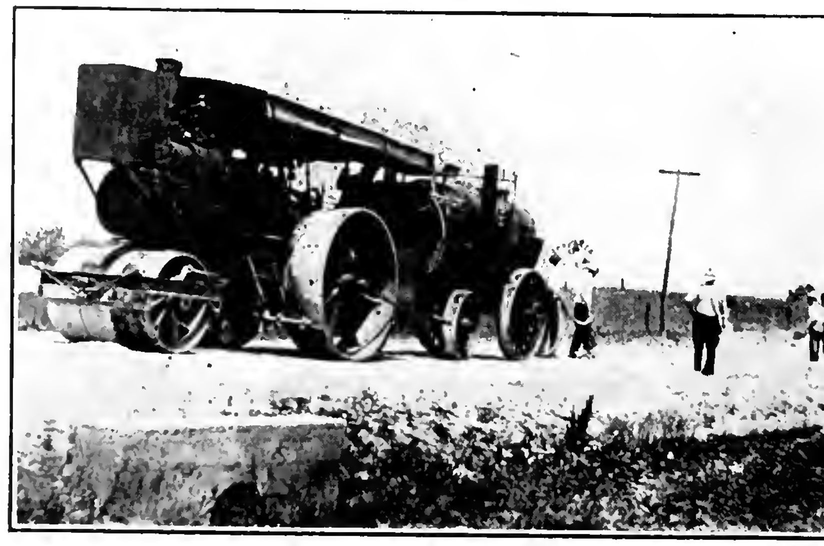
For the bituminous carpet the county uses asphalt with both stone and slag screenings from ¼ to ½ in. in



THIS UNLOADING PLANT KEEPS SIXTEEN TEAMS AND TWO MOTOR TRUCKS BUSY

size. After the surface has been swept thoroughly, the asphalt is applied at the rate of ¼ to ½ gal. per square yard, by means of a 700-gal. tank wagon having a heater to keep the contents at about 320° F., and an air pump to maintain a pressure of from 30 to 60 lb. per square inch. An illustration shows one of these outfits at work. The asphalt is usually applied with a hose fitted with a ⅝-in. nozzle, which sprays the material downward, in conical form. This enables the man in charge to vary the quantity according to the condition of the road. Screenings averaging from 18 to 25 lb. per square yard are then spread and rolled, and the road is immediately opened to traffic. The carpet is said to stand up well under heavy motor-truck traffic; what wear occurs is usually in the form of holes of varying size, rather than in long ruts.

The width of roadway is 24 ft. between ditches, and the paved width is from 9 to 18 ft., according to the importance of the road. Shoulders are built before the stone or slag is deposited, the earth being filled against the side forms. In the final rolling, after the side forms have been removed and the space has been filled, the shoulders as well as the macadam are rolled. Main county roads passing through villages are paved for the full width of the street, the village paying for the extra width over the standard 16 ft. This system has greatly



ROLLER HAULS HOT ASPHALT SPRAYING OUTFIT WHILE LAYING BITUMINOUS CARPET

facilitated the construction of through routes. In such cases the village can specify the kind of paving to be used within its limits.

Drainage of the subgrade in the country sections is provided by lateral drains of coarse stone or slag laid through the earth shoulders to the ditches. These are about 100 ft. apart on both sides of the road, and are staggered so as to give one drain for every 50 ft., with one on each side at all low points. Storm-water drainage on grades is provided for by wide concrete gutters ending in an apron or spillway at the foot of the grade, which discharges the water clear of the roadway. On high fills a similar gutter is used, with a concrete spillway down the slope to prevent washing. Under the cross roads, which are paved similarly to the main roads for a distance of 33 ft., side ditches are carried by 10- or 12-in. sewer pipe cased in 3 in. of concrete where the covering is shallow. Bridges have their decks placed 6 in. below grade to allow for the carrying of the macadam surfacing over them.

There are about 150 miles of road in Berrien County, of which 135 miles are of macadam with bituminous carpet. These are generally built by contract and are maintained by the county with state aid. The work is supervised by three county road commissioners appointed for six-year terms by the board of supervisors, and they appoint an engineer. Recently the state has created the position of county superintendent of maintenance, the incumbent, to be appointed by the road commissioners, to be, preferably, an engineer skilled in road work. In addition to the above there is a total of about 50 miles of township road, 40 miles of which are stone macadam. Some of the townships have their own rollers and other complete equipment, and take care of both the construction and maintenance, and, as mentioned above for Benton Township, the roads are frequently used for two years before receiving the bituminous-carpet treatment.

Road maintenance on the intensive or continuous plan, as practiced in Berrien County, is done by traveling gangs, as distinguished from the patrol system. From early spring to late fall the county operates three gangs, one under each of the three commissioners. They travel over routes laid out according to the traffic density and the condition of the roads, looking for and repairing incipient holes, ruts and general wear, and cleaning ditches and drainage structures. In this way heavy, periodical repair work is avoided, and the roads are maintained in good condition. The engineer states that the average cost is $250 per mile per year.

Each gang consists of a foreman and three or four helpers. The plant consists of a motor truck, a 110-gal. heating kettle and the necessary shovels and other tools. The daily pay averages $3.50 for the foreman and $3 for the laborers. The foreman receives daily instructions from the commissioner, and the distances are such that with a 10-hour working day the men can go home at night, riding to and fro on the truck.

How the Repair Work Is Done

When work is begun in the spring, the first thing is to clean out the ditches and culverts and trim the shoulders. Patching of holes and worn spots in the macadam begins with warm weather. Road asphalt, heated to about 300° F., is used for this work. Where the holes appear the surface is loosened with picks, and the dirt and loose material are swept from the road; stone screenings or slag chips are then filled in, hot asphalt or tar is poured over them, and, after a top dressing of screenings has been applied, the patch is tamped to a smooth surface. Unless the patches are large, no attempt is made to keep off the traffic. One gang will patch from one-half mile to two miles of road per day, depending on its condition.

Weekly reports are sent by the foreman to the superintendent of maintenance, who is one of the commissioners. The roads are named and numbered, while each road is divided into lettered sections. The foremen keep account of the labor and material used on each section and enter the figures on their reports; thus the bookkeeper for the commissioners can keep an accurate account for each section.

Maintenance funds for county road work are derived from road rewards and repair rewards paid by the state, supplemented by one-half the automobile license tax of the county. There is also an annual property tax of two mils for road construction and maintenance.

The county road engineer for Berrien County is James Hampton, of St. Joseph. L. Snyder, one of the commissioners, is superintendent of maintenance. The engineer is appointed by the commissioners for a two-year term, and has one office assistant and one field engineer. His main duties are to make surveys, plans and profiles for new roads, and supervise the construction. During the working season he spends about two-thirds of his time supervising the work being done on the roads.

Chicago Union Station to Spend $5,300,000 in 1919

Work Includes Deep Foundations for Head-House, Street-Approach Viaducts and Partial Rearrangement of Tracks

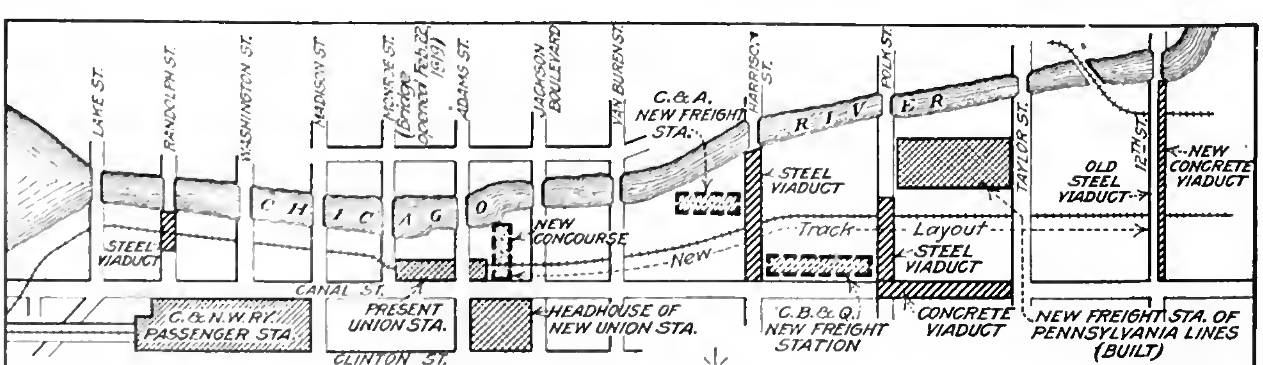
VIADUCTS of steel and reinforced concrete, foundations for head-house and concourse, and construction of a part of the permanent track layout, constitute the principal work to be done this year on the new union station, Chicago. This is estimated to cost $5,300,000 out of the total cost of nearly $60,000,000, which included $30,000,000 for land. The location of this work is shown on the accompanying plan.

Canal St., running parallel with the tracks and along the boundary of the railway property, will be elevated about 10 ft. and from Harrison St. to Taylor St. it will be carried on a viaduct, the space beneath this structure being utilized for tracks. This viaduct will be of reinforced concrete. Its construction this year will be confined to the one block between Taylor and Polk Streets.

Transverse viaducts will extend from Canal St. across the railway property to connect with the river bridges. The 12th St. viaduct will be of reinforced concrete and its south half is to be built this year. Steel will be used for the viaducts at Taylor, Polk, Harrison and Randolph Streets.

At the passenger station, old freight houses between the present station and the river will be torn down, and some of the permanent tracks will be laid in this space, thus increasing the facilities and reducing the present congestion, which results from the limited number of station tracks. Foundations of part of the concourse will be put in at the same time. This concourse will extend between the ends of two groups of stub tracks, which in the new station will take the place of the present through tracks. In other words, the station will be converted from one of the through type to one of a double-end stub type. At the same time it is expected to build four tracks of the permanent six-track approach on the south, extending from the station as far as 12th Street.

Foundations for the head-house can be put in without interfering with existing facilities, as the site is entirely outside of the present station property, and occupies an entire city block. Concrete piers built in wells or open caissons, sunk about 70 ft. to hardpan, will support the steel-frame superstructure. The site was cleared some time ago, and is now being excavated to the basement level, preparatory to sinking the wells.

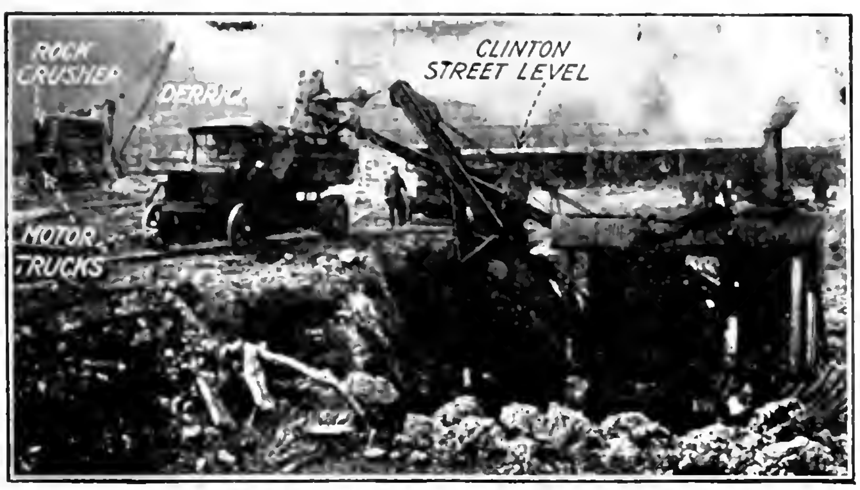


PLAN SHOWS 1919 WORK FOR CHICAGO UNION STATION

Steam shovels are used on this work, useless material being removed in motor trucks, while stone from old footings is crushed and screened on the ground and stored for use in the concrete.

In the steel viaduct construction the steel framing will be covered with concrete or gunite applied by the cement gun over wire mesh wrapping and having a minimum thickness of 1½ in. In general, the design consists of three-post bents carrying cross-girders for a 38-ft. roadway, while cantilever brackets carry 14-ft. sidewalks. Ten lines of plate-girder stringers are framed between the cross-girders, four of the stringers being directly under the rails of the street-car tracks. The roadway deck is a reinforced-concrete slab resting on the steel frame, with wood-block paving laid directly upon this. The 6-in. sidewalk slabs are carried above the girders, being supported by concrete beams at each end.

The bents are spaced longitudinally at varying distances to suit the track layout, and will be embedded



CLEARING SITE FOR HEADHOUSE

in concrete curtains or piers to form a protection against derailed trains. The columns are of H-section, built up of two channels, a web plate and four angles, with batten plates over the flanges of the channels. All viaducts are figured for a live load of two lines of 50-ton street cars on tracks spaced 10 ft. on centers in the middle of the roadway, with 100 lb. per square foot on the unoccupied parts of the roadway and on the sidewalks.

Two-post bents are required at certain points on account of track clearances. In such cases the posts are spaced about 54½ ft. on centers, coming under the sidewalks and carrying heavy cross-girders whose ends have a cantilever projection of 5 ft. 3 in. Where the viaduct is adjacent to the buildings and driveways of the new freight stations, longitudinal expansion joints are provided along the edge of the sidewalk. These are made with deep 1½-in. copper troughs or flashing, filled with asphalt mastic.

All work for the Chicago Union Station Co. is under the direction of Thomas Rodd, chief engineer; J. D'Esposito, assistant chief engineer, and A. J. Hammond, principal assistant engineer. Viaduct designs must be approved by the city authorities. All track work is done by railway forces. Contracts for the 1919 work already let are as follows: Head-house foundations, John Griffith & Sons; steel superstructures for the Polk St. and Taylor St. viaducts, American Bridge Co.; substructure for the Harrison St. viaduct, the W. J. Newman Company.

Other work which is independent of the union station, but is necessitated by the rearrangement of the terminal, includes two large freight stations for the Chicago, Burlington & Quincy R.R. and the Chicago & Alton R.R.

The former station has the foundations partly built, and it is expected that about $3,000,000 will be spent this year on foundation work and superstructure. It is expected also that work will be commenced on the latter station, which is to cost nearly $2,000,000.

Residual Strains in Cast-Iron Car Wheels

During the investigation of a railway accident caused by the breakage of a freight-car wheel, the Interstate Commerce Commission recently made measurements of the residual strains in the metal of chilled cast-iron wheels. Relatively high strains were found, of such a nature as to be readily explained by the contraction during cooling in manufacture. In spite of these high strains, the investigation showed that the wheel did not break from internal causes, but was undoubtedly damaged through external violence, probably the impact of a fallen part of the brake rigging, which cracked off part of the wheel flange, this in turn causing the wheel to break apart by its pounding on the rail. Because it represents a further application of the method of studying internal strains which J. E. Howard of the commission's Bureau of Safety has used in rail studies for some years, the investigation is of general value.

Through the cutting rings from a car wheel at six different radial distances from the center, and measuring the shortening of gage-lines on these successive rings, it was found that compressive stresses existed in the rim and the hub of the wheel, and tensile stresses in the web or plate. The hub stresses were high, ranging to more than 25,000 lb. per square inch compression; the rim stresses did not materially exceed 2500 lb. compression. In the plate there were tensile stresses in the neighborhood of 2000 lb. per square inch. These stresses were computed from the measured shortenings and extensions by multiplying by 17,000,000 lb. per square inch, the modulus of elasticity.

While these stresses are of some importance, they are not large enough to suggest danger. In the wheel which broke under the train, moreover, the investigators found clear evidence of the fracture having started at the rim and grown toward the center. There were no defects in the fracture, and the rim of the wheel showed no burned or otherwise damaged spots. The wheel had been in service only two months, having been placed on the axle in December, 1916. It broke while running in a New York Central freight train near Waterloo, Ind., on March 25, 1917. It was evident that the fracturing process had proceeded rather slowly after the piece of flange was broken off; the train ran nearly 1000 ft. before the last fragment of the wheel left the axle. While no direct proof was obtainable that a piece of the brake rigging started the breakage, the commission's report, published in a bulletin just issued, states that no other explanation of the facts of the accident was found to be tenable.

Move Bridge Spans 136 Feet Endwise on Car Trucks

Two Lines of Steel Trucks on Falsework Carry Hydraulic Jacks Which Raise Three Spans Together and Support Them While Hauled by Cables

RECONSTRUCTION of the combined railway and highway bridge of the Union Pacific Ry. across the Missouri River at St. Joseph, Mo., in 1917-18, included as its principal features the building of new piers, the shifting of three 300-ft. truss spans longitudinally into new position, and the building of a new drawspan. The bridge had to be kept in service during the work, except for the short time required to shift the spans. Traffic averaged about 75 trains and 400 teams and automobiles daily. River traffic also had to be provided for until the close of the navigation season. Indications of weakness in the old piers having made a new substructure necessary, it was proposed to build new piers on the downstream side and move the bridge laterally into its new position. The War Department, however, required that in connection with the alterations a longer drawspan should be provided. This new condition led to the plan of locating the new piers between the old ones and moving the spans longitudinally into position. The superstructure work included the following, in the order given; Rolling three spans lengthwise; building a new 465-ft. swing span; rolling an 80-ft. girder span lengthwise 28 ft. and building a new 60-ft. girder approach span; removing the old 358-ft. swing span. The alignment is straight and unchanged, but the new rail level is 18 in. higher than the original. Construction of the new piers was described in *Engineering News-Record* of Oct. 25, 1917, p. 781, while the moving of the fixed spans was noted in the issue of Nov. 22, 1917, p. 989.

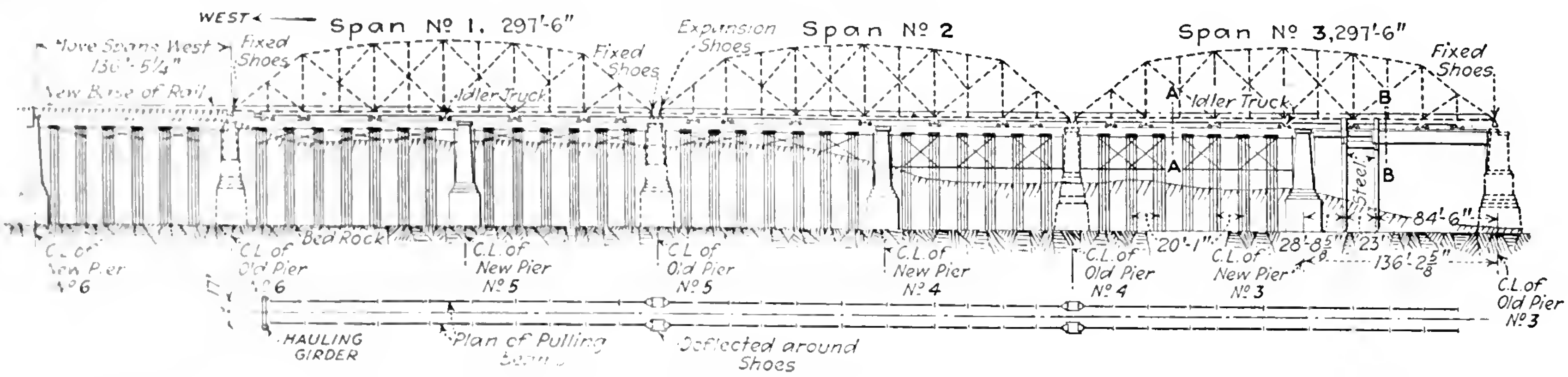
After the new piers had been built, the first stage of work on the superstructure was the shifting of the three through spans of 300 ft. each. This consisted in moving them 136 ft., to land them on the new piers. They have trusses of the Pettit type, 50 ft. high and spaced 17 ft. on centers, with a single track between them. Floorbeam brackets 48 ft. long carry 15-ft. roadways outside of the trusses.

BRIDGE SPANS ARE HAULED BY CABLES

Car trucks traveling on falsework and carrying hydraulic jacks were used for moving the 300-ft. spans. They were mounted on two tracks directly under the trusses, with the jacks at the panel points. There were 14 trucks to each span, but the two under the middle panel points carried only blocking, which was built up close to but not in contact with the trusses. This arrangement provided a rigid support in case failure of any one jack should throw excessive load on the other jacks. Semicircular shims were built up around the plunger of each jack and kept within a short distance of the plunger head, so that in case of loss of pressure or the failure of a jack while the bridge was being moved the span would come to a solid bearing with very slight settlement. No such failure occurred, however. For operation the jacks were arranged in two groups, each with its own steam pump, this arrangement being necessitated by the difference in the diameters of the jack plungers. For the west span there was a group of 12 jacks of 500-ton capacity with 12½-in. plungers. The other two spans had a group of 24 jacks of 300-ton capacity with 10-in. plungers. All jacks had strokes of 9 in. The heavier jacks were used because they were on hand. The average load on the jacks being only about 70 tons, the pressure on the jacks, piping and pumps was only 2500 lb., while the capacity pressure was 10,000 pounds.

To equalize the load on the jacks, every jack in each group was connected by ¼-in. flexible copper tubing to a pressure line of ¾-in. extra-strong steel pipe with forged fittings. The steel pipes were laid on the floor beams, outside of the track ties. A shut-off valve and bleeder valve were placed at each connection to these pipes, for convenience in changing the packing if leaks should develop, but this precaution was not required.

A denatured alcohol mixture was used in the jacks on account of the cold weather, about 400 gal. being sufficient for the raising of the spans 30 in. by the 36 jacks,



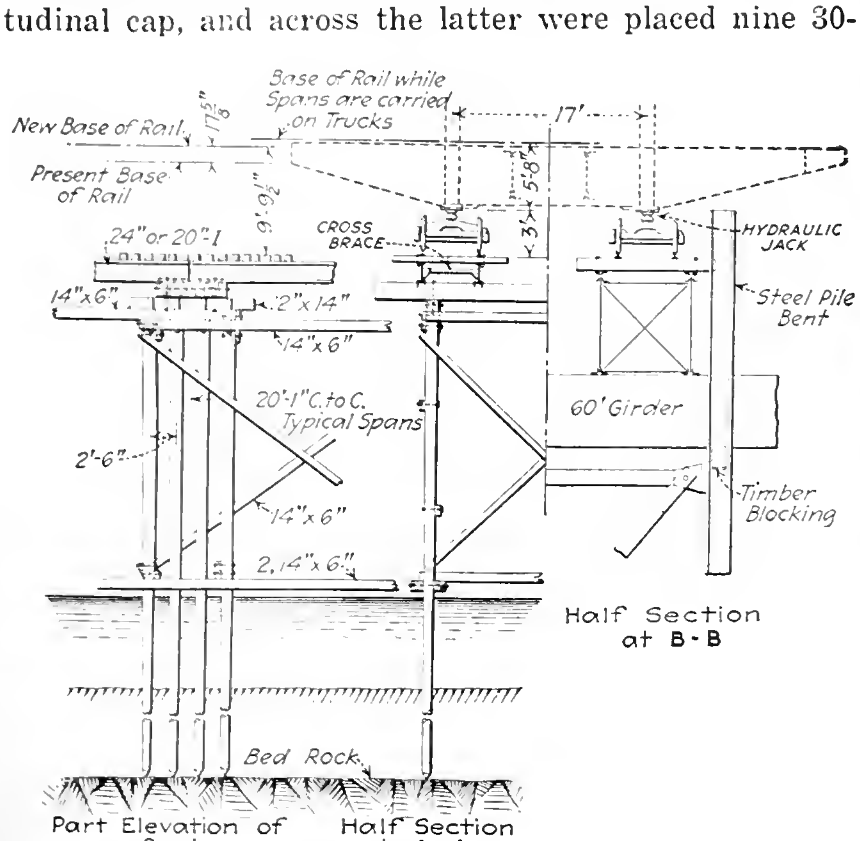
THREE 300-FOOT BRIDGE SPANS ARE MOUNTED ON TRUCKS AND SHIFTED 136 FEET TO NEW PIERS

and then for supplying them during the moving of the spans. Readings were taken at regular intervals. Static loads registered 1700 and 2200 lb. per square inch for the 500-ton and 300-ton jacks respectively, these readings being taken after the pumps were shut down. Surge loads, with the pumps in action, registered from 2300 to 2500 lb. per square inch for the heavier and 2700 to 2800 lb. for the lighter jacks.

Maximum working load for the 300-ton jacks was calculated at 2450 lb. per square inch, which was taken as the static load after the bridge was raised and the pumps were stopped. Raising the bridge 18 in. to its new grade was done with eight jacks per span. These were placed on the piers and operated gradually between trains, so as to maintain the proper run-off or incline in track on the fixed spans and the swing span. This jacking extended over a period of several days.

The falsework for the rolling track consisted of piles supporting 24-in. I-beam stringers, except that an 80-ft. girder span was used at the east end, where the water was deep and swift. Framed bents were seated on the footings of the old and the new piers, being secured by cables and fox bolts. Piles were arranged in two rows, one outside each line of trusses. They were in groups of four, those of each group spaced 30 in. on centers while the groups were 20 ft. on centers, connected by horizontal and diagonal bracing in two directions.

At each group, four cross caps carried a 12-ft. longitudinal cap, and across the latter were placed nine 30-ft. timbers 8 x 17 in. These were laid solid to form a bearing for the I-beam stringers, which were in pairs, with riveted connections between the webs. Across them were the 8 x 8-in. ties, 4 in. apart, to which were spiked the 75-lb. track rails.

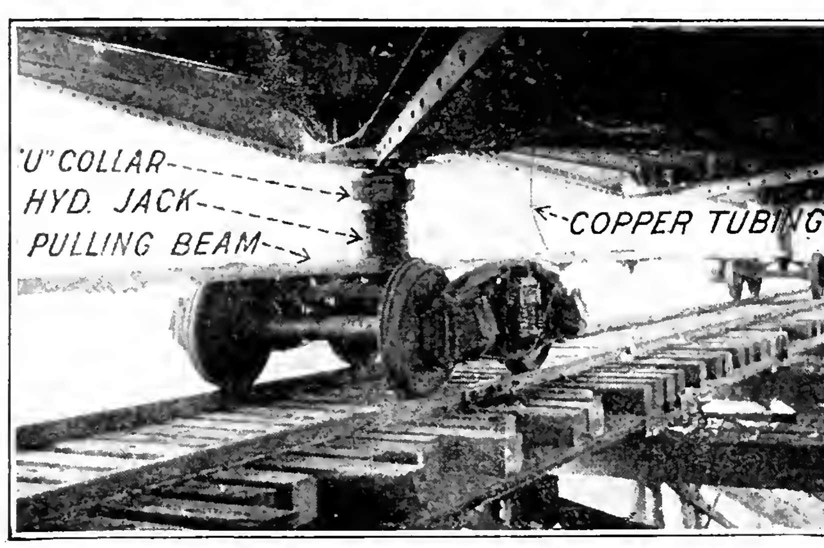


FALSEWORK CARRIES TWO LINES OF TRACKS WITH HYDRAULIC JACKS UNDER THE BRIDGE CHORDS

Piles were of longleaf yellow pine, 40 to 70 ft. long, driven to rock or to absolute refusal, and having an average penetration of 25 to 30 ft. They were driven by a steam pile-hammer in swinging leads which were suspended either from the boom of a locomotive crane or from the projecting ends of a heavy timber laid across the top chords of the trusses.

Steel trucks used for rolling the spans were of the standard type for 50-ton freight cars. They had cast-steel frames and bolsters and were rated at 160-ton capacity. The jack on each truck was seated over the king-pin and anchored rigidly by bolts passing through the flanges of its base and through timber blocks inserted in openings in the bolster. To provide against failure of some detail part every truck was tested to 100-ton load at the site, a special testing frame equipped with hydraulic jacks being constructed for this purpose.

A rigid pulling beam connected the 21 trucks on each side, this beam being composed of a pair of angles bolted to plates which fitted over the heads of the king-pins of the trucks. The upstanding legs of the angles were cut away to admit of seating the base of the jack on the truck bolster.



CAR TRUCKS WITH HYDRAULIC JACKS MOVE SPANS

Across the forward end of the two front trucks was a girder composed of a pair of heavy I-beams laid flat and connected to the two pulling beams. To this girder were attached the blocks of the hauling tackles. To transmit the pull from the girder directly to the spans as well as to the trucks, steel cables were run from the girder to one of the floor-beams of the first span, these lines being drawn tight by steamboat ratchets.

Hook bolts held the end shoes to the trusses when the spans were raised.

The hauling was done by four sets of 4-sheave blocks, each rove up with a nine-part tackle of 1½-in. manila rope. Two of these sets were handled by an 85-hp. steam hoist and the other by a 200-hp. electric hoist, these hoists being placed just back of the new west abutment. The load pulled was about 2760 tons, including the three spans, 42 trucks, 36 jacks and the pulling attachments. Of this total, the three spans represented 2520 tons.

Preparations for moving the spans were begun in August. Traffic was not interrupted until the day of the moving, Nov. 14, when the railway and the highway were closed from 8 a.m. to 5:40 p.m. The rolling of the spans a distance of 136 ft. consumed only 13 min., the remainder of the time being occupied in getting ready and in closing the 136-ft. gap left at the east end. For this latter purpose pony bents were set on blocking on the falsework used for the rolling tracks. These carried timber stringers for the track and roadway decks. Construction of the new drawspan, which was done while keeping the bridge open for traffic, will be the subject of a separate article.

The above work was done for the St. Joseph & Grand Island Railway Co., under the direction of R. L. Huntley, chief engineer of the Union Pacific System, with H. M. Stone as resident engineer, the entire project being under the general supervision of E. E. Adams, consulting engineer of the Union Pacific System. The American Bridge Co. was the contractor, and the work was carried on under the personal supervision of K. L. Strickland, division erecting manager, T. S. Melton, foreman, and A. F. McLane, resident engineer.

Transverse Fissures in Rails and Phosphorus Segregation

Longitudinal Streaks Attributed to Phosphorus Are Found at Nucleus of Rail Fracture by Copper-Chloride Etching

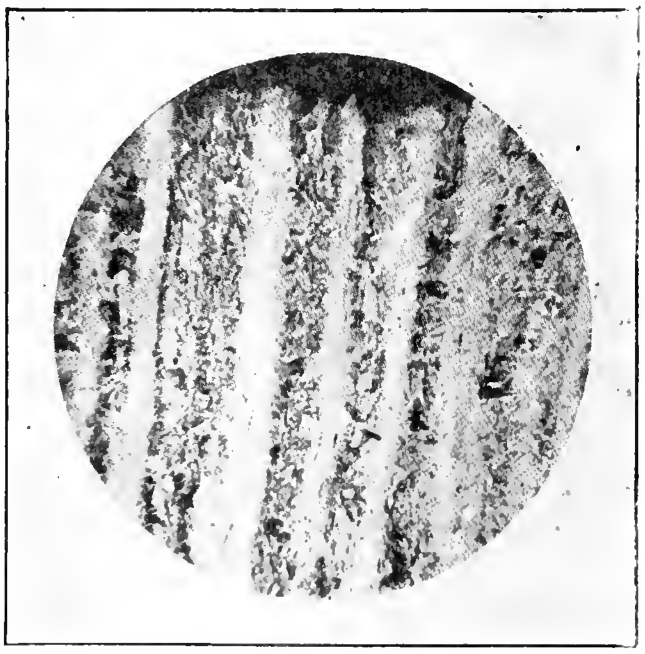
NEW micrographic studies of broken rails have recently led G. F. Comstock, metallographist of the Titanium Alloy Manufacturing Co., Niagara Falls, N. Y., to suggest an explanation of transverse fissures that in a measure bridges the gap between the opposing views current for some years past. According to his findings, brittle streaks of high-phosphorus steel in the rail head constitute the initial weakness from which a transverse fissure starts.

J. E. Howard, of the Interstate Commerce Commission's Bureau of Safety, has maintained that excessive stress in service in the track is responsible for transverse fissures, and that the only cure is the adoption of a heavier rail section. His experimental proof of high residual stresses in the center of the rail head, and his discovery of large compressive stress along the running surface from the rolling action of the wheels, which shifts the zone of maximum tension to the interior of the head and adds the effects of service stress and residual stress, supported the overstress theory. Transverse fissures are generally conceded to be detail or "fatigue" fractures, but in most cases it has been impossible to discover chemical or structural defects in the steel at the center or nucleus of these fractures, so that it seemed necessary to conclude that overstress initiated the fracture.

Railway men, on the other hand, adhered to the belief that defective quality of rail steel is at the root of the fissure trouble. Mr. Comstock presents evidence of a minute defect at the nucleus of transverse fissures, namely, streaks of steel abnormally high in phosphorus content. He has concluded that the initial crack or check in the rail head occurs in such a brittle streak and that progressive detail fracture follows. Further, he found from the records of 36 rails that long soaking of the steel in the furnace before rolling prevents fissuring, presumably by allowing the phosphorus to diffuse through the mass, and thus preventing the formation of the brittle streaks. This fact, if confirmed, provides a method of combating the fissure trouble in rails.

In these investigations, failed rails were sawed apart longitudinally at the fracture, and the surfaces so prepared were polished and then were etched with copper chloride. This reagent deposits a film of copper on normal steel, while certain special constituents, among them steel of high phosphorus content, remains bright. The inverse effect could be obtained by picric-acid etching, which darkens high-phosphorus areas.

A typical microphotograph of such an etched section is reproduced herewith, from an illustration in a paper read by Mr. Comstock before the American Institute of



HIGH-PHOSPHORUS STREAKS IN LONGITUDINAL SECTION OF RAIL AT TRANSVERSE FISSURE, ETCHED WITH COPPER CHLORIDE (× 16)

Mining Engineers at its annual meeting, Feb. 19, 1919, under the title "Metallographic Investigation of Transverse-Fissure Rails with Special Reference to High-Phosphorus Streaks." The broken line near the top of the picture is the face of a transverse fissure. The light bands extending vertically are believed to be high-phosphorus streaks. A prominent streak extends directly to the point where the nucleus of the transverse fissure was located. Closely similar conditions were found in many other rails that had failed by fissure.

Studying all the available rail material—namely, 24 transverse-fissure rails and 12 good rails—all were graded for various different defects in steel quality, including segregation (as shown by sulphur print), presence of slag and similar impurities, segregation of

sulphides, amount of free ferrite, amount of cementite, and finally phosphorus streaking. It appeared that no distinct differences of grading between the failed rails and good rails appeared under any head except that of phosphorus streaks, and under this latter head the majority of the transverse fissure rails were unsatisfactory, while the majority of the good rails were slightly above average quality.

Taking this as indicating the causal relation between the high-phosphorus streaks and fissuring, Mr. Comstock studied the same rails as to origin. So far as data could be obtained, it was found that all the failed rails had been rolled direct from the ingot, while all but two of the good rails had been rolled from reheated blooms. Since the length of time the ingot is hot suffices for carbon diffusion but probably not for phosphorus diffusion, this result appears to confirm the conclusion reached.

Concrete Is Handled in Several Ways on Bridge Abutment Job

HOPPER cars, derrick skips, elevator buckets and inclined chutes were combined in placing 3360 cu.yd. of concrete in abutments and approach retaining walls for a steel highway bridge across the Chicago & Northwestern Ry. at Wheaton, Ill. To give increased headway the bridge is at a higher elevation than the old span parallel to it, so that long inclined approaches were required, practically at right angles to the bridge, as shown by the accompanying plan. Each approach has a retaining wall on one side, and the wall on the south side of the railway is 600 ft. long.

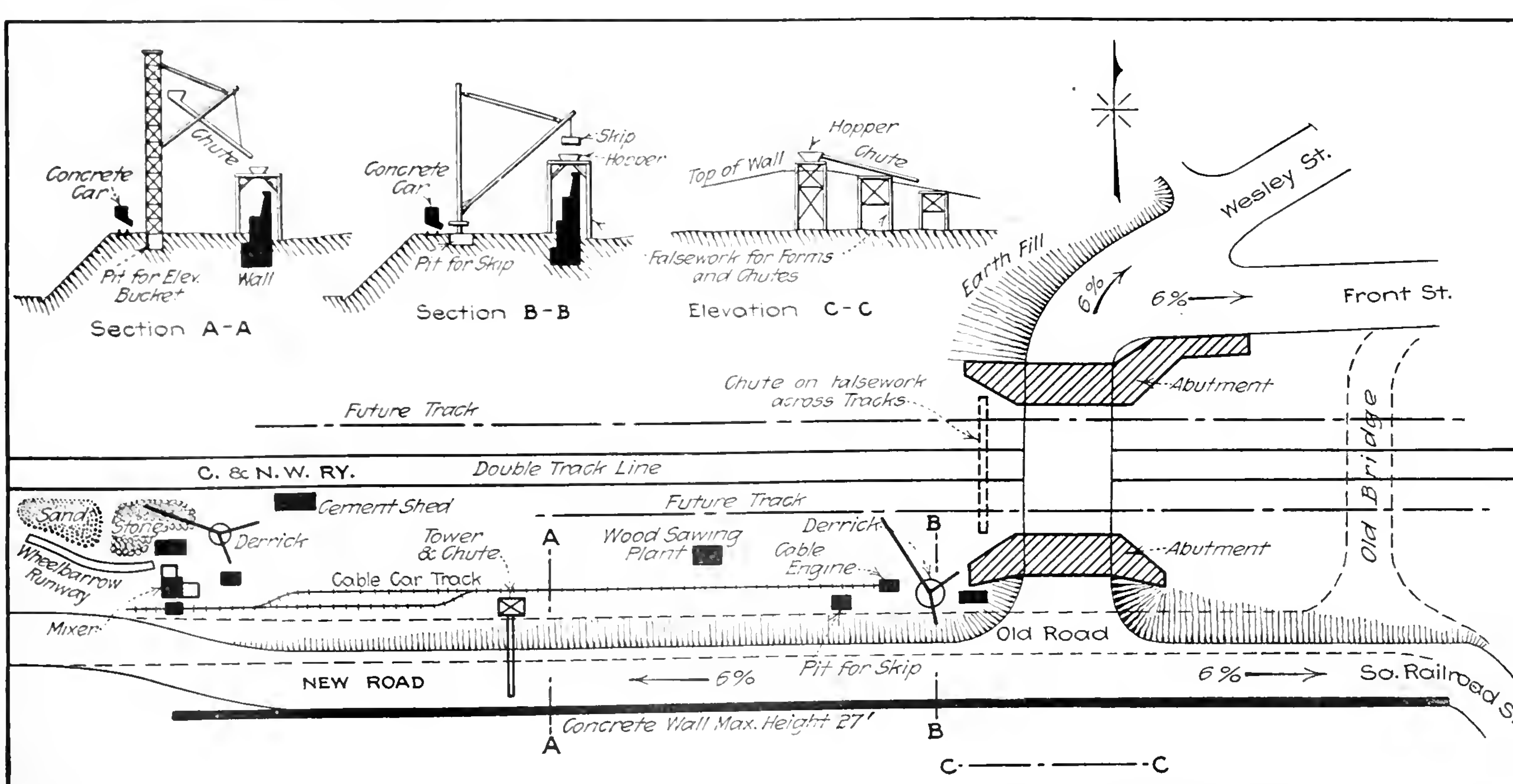
A concrete-mixing plant was located beyond the end of the cut. Sand and gravel were unloaded from cars into stock piles on the side of the adjacent fill, and the stone was loaded into an elevated bin by a derrick with a grab-bucket. The sand was wheeled to the loading chute. The mixer discharged the concrete into a side-gate hopper car.

Between this plant and the bridge site an elevator tower with a chute was erected, while beyond this and close to the abutment was a guyed derrick, both tower and derrick being on the narrow strip between the old road and the top of the cut. A narrow-gage track with one automatic siding extended from the mixer plant to the tower and derrick. This was operated by an endless cable with a hoisting engine placed near the derrick, and on it the concrete was handled in the hopper cars mentioned above.

At first the concrete was delivered to the elevator bucket and spouted to the forms. The tower chute or spout extended across the road and delivered the concrete into lateral chutes supported directly above the forms by falsework. This sufficed for about half the length of the wall.

For the remainder of the work the cars ran up to the derrick and discharged the concrete into a home-made wooden skip which was placed in a pit at the side of the cable track and was handled by the derrick. A movable gate was fitted to one end of the skip, with inclined boards on the inside to guide the concrete to the opening and prevent it from being pocketed in the corners. The skip was dumped into a feed hopper at the summit of inclined chutes carried along and above the forms for falsework.

Concrete for the abutment on this side of the railway was placed directly by the derrick and skip. For the abutment and short wall on the opposite side an inclined chute was extended across the tracks, having a feed hopper at its upper end within reach of the derrick. At its lower end was a vertical drop pipe leading to the head of the chutes over the abutment form, these being



LAYOUT OF CONCRETING PLANT FOR BRIDGE ABUTMENTS AND RETAINING WALL

shifted to deliver the concrete in the desired portions of the form.

Baffles were used at the discharge ends of the long chutes to prevent segregation of the concrete as it was deposited in place. In some cases these were short troughs secured to the trench bracing or form struts, being placed opposite the end of the chute and sloping in the opposite direction, so that the direction of the concrete was reversed just before its final discharge.

This work was done by the Widell Co., Mankato, Minn., under the general direction of O. F. Dalstrom, engineer of bridges, Chicago & Northwestern Railway.

Approximate Formulas Useful in Structural Design

A Few Serve Well When Handbooks Are Not Available—Limits of Reliability, However, Should Be Well Understood

By R. Fleming

American Bridge Co., New York City

FREQUENTLY the designer of steel structures is called upon for information when handbooks and textbooks are not at hand. It is surprising how much may be furnished at such times with a few well chosen approximate formulas. Some approximations are suggested. It is essential, however, that before they are used they be tried out and their degree of approximation well understood.

Radii of Gyration—If d = depth and b = breadth of section, for standard I-beams the radius of gyration, r, = $0.375d$ and $0.20b$. For Bethlehem girder beams $r = 0.42d$ and $0.23b$. In standard I-beams the breadth varies from 55% of the depth for a 6-in. I 12.25 lb. to 29% for a 24-in. I 80 lb. In Bethlehem girder beams the breadth varies from 100% of the depth for an 8-in. I 32.5 lb. to 50% for a 30-in. I 200 lb.

For equal-leg angles $r = 0.3$ of the width of leg when the neutral axis is parallel to either leg. For unequal leg angles $r = 0.3$ of the width of the leg to which the neutral axis is at right angles.

For well-designed columns, if of four angles latticed, $r = 0.4d$ and $0.2b$. If of one plate and four angles, $r = 0.375d$ and $0.2b$. If of one plate, four angles and two cover plates, $r = 0.4d$ and $0.25b$. If of 2 channels latticed, $r = 0.35d$ and 0.6 of the distance back to back of channels when this distance is not less than 0.6 the depth of channels used. If of 2 channels and 2 cover plates $r = 0.4d$ and $0.3b$. (In this connection see an article, "Approximate Radii of Gyration," by O. von Voigtlander, in *Engineering News* of May 23, 1912, p. 991.)

Section Moduli—If W = weight of beam per linear foot, and d = depth; for standard beams 10 in. or less in depth the section modulus, S, $= Wd/10$; for standard beams deeper than 10 in., $S = Wd/11$; for Bethlehem girder beams, $S = Wd/10$.

Safe Load in thousands of pounds for standard beams equals weight of beam per linear foot multiplied by depth in inches and divided by span in feet. (See an article, "Approximate Design in Structural Steel," by George A. Merrill, in *Engineering News* of Mar. 21, 1912, p. 540.) It may be noted that for a uniform load, $M = WL/8$; for a concentrated load $\frac{1}{2}W$ at center of span, $M = WL/8$; for two concentrated loads of $\frac{1}{3}W$ at the third points, $M = WL/9$; for three concentrated loads of $\frac{1}{4}W$ at the quarter points, $M = WL/8$, and for four concentrated loads of $\frac{1}{5}W$ at the fifth points, $M = 3WL/25$.

Area of Cross Section in square inches of all steel sections is 0.3 weight per linear foot. (Error 2%.)

Weight in pounds per linear foot of all steel sections is $3\frac{1}{3}$ times area of cross section in square inches. (Error 2%.)

Weight of Angles—Derive the weight of an angle from the cross-sectional area of a plate having the same thickness as the angle and a width equal to the sum of the legs.

Weight of Roof Trusses—The many empirical formulas that have been given for determining the weights of roof trusses fail to take into account so many varying factors that their usefulness is very limited. It is better to make deductions from the known weights of a few trusses than from inadequate formulas. The estimated weights of a series of Fink trusses for a roof sloping 6 in. per foot, carrying a uniformly distributed load of 800 lb. per linear foot of top chord, for spans of 30, 40, 50, 60, 70 and 80 ft., are 1000, 1700, 2400, 3200, 4400 and 5600 lb., respectively. Warren trusses, for a roof sloping 1 in. per foot, and for the same load and spans, weigh approximately 1200, 1800, 2700, 3400, 4600 and 6100 lb., respectively. The weight of details in ordinary roof trusses is from one-tenth to one-sixth of the total weight. This is equivalent to an addition of from 11 to 20% to the weights of main members.

Weight of Columns is approximately weight of main material, or stem of the column, plus 20% for details. The theoretical weight per linear foot of the stem of a column in a many-storied building is approximately $\frac{\text{Load in pounds}}{12{,}000} \times \frac{10}{3}$. In determining the total weight, 25% of this should be added for details and excess of actual over theoretical section. As columns are usually fabricated in two-story lengths, the load on the lower-story portion should be used for the whole length.

Weight of Plate Girders is weight of web plate and flanges plus 20% for details. Plate girders may be approximately designed by considering the depth of web plate to be the depth of girder and neglecting the $\frac{1}{6}$ web area in proportioning the flanges.

Weights of Buildings—No reliable formula can be evolved for the weight of structural steel in buildings. Neither should the weight per square foot of area nor cubic foot of volume of a structure already built be assumed as the weight of a proposed structure, unless the conditions which govern the one are found in the other. The trusses, purlins and bracing of a roof covered with corrugated metal usually weigh from 5 to 8 lb. per square foot of ground area. In a one-story building, with both siding and covering of corrugated metal, and without traveling cranes, the weight of structural steel will average between 10 and 15 lb. per square foot. Plank, tile or concrete covering will add to this weight 2 or 3 lb. per square foot. If traveling cranes are used the weight will be increased from 2 to 5 lb. per square foot.

Floors in mill buildings vary from 10 lb. per square

foot for the floor of a light machine shop to 40 lb. for a heavy charging floor in a foundry.

Office buildings not more than 12 stories high in which the exterior walls are carried by steel framing will average about 1.9 lb. per cubic foot of volume; hotels and apartment houses about 1.5 per cubic foot of volume.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

Engineers to Educate the Public

On the bottom of the stationery of the Iowa Engineering Society is the slogan "Write; talk; why not? It will help. Consult the committee on publicity." Iowa is in need of more good engineers than ever before, for she is on the eve of an immense road-building program. The society realizes that engineers in the war have made a lasting impression on the layman by doing the "far-off" task in winning the war, but real work is at hand to educate the home folk that engineering of even greater importance exists right at home.

An Example of Society Disservice

An illustration of the sort of professional friendship which engineers sometimes show to one another was recently given at Cheyenne. The Wyoming Society of Engineers, at the close of a two-day meeting, gave a dinner and held an informal meeting at the Plains Hotel on the evening of Jan. 28.

There were at the hotel at that time five engineers from various states, all of whom have been identified with Government work in Wyoming. The State Engineer, who is a prominent member of the state society, invited the visiting engineers to attend the after-dinner meeting. The invitation was later recalled, with sincere regrets on the part of the State Engineer, because some of the society members objected to having outsiders among them.

Such an incident seems incredible, but it is reported on good authority.

State Society Issues Bulletins to Members

As attendance at annual meetings of the Illinois Society of Engineers averages only 20 to 30% of the total membership, the society has issued a bulletin giving a summary of the proceedings of its recent meeting, with new officers elected, resolutions passed, etc. In this way absent members are informed as to the doings of the society. Similar bulletins are issued during the year, giving information as to the society's activities, important legislation, public meetings relative to engineering, and other matters of interest, thus keeping the members in touch with the society's work and engineering developments in general and involving no great expense. This is of particular advantage in regard to members in rural districts, who usually have little opportunity of obtaining information of this kind. As a refutation of the argument that resolutions do no good, this society has the pleasure at least of seeing some Chicago newspapers mention it as among the indorsers of the new Illinois housing bill, which aims at rigid control of future building construction.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Why Not Engineers for Federal Rural Health-Protective Work?

Sir—In your issue of Feb. 13 you review the bill introduced in Congress by Mr. Lever, to provide means for the control and mitigation of the diseases of our people living in the country and in towns of not more than 5000 persons. You say that "the United States Public Health Service is designated as the agency of the Federal Government in the work, and the states to be represented by their health department or officers." This puts the work into the hands of the doctors and absolutely cuts out the engineers, particularly in this State of New York, where engineers are not eligible as health officers. Now, the duties contemplated by this bill are such as belong to the sanitary engineer and for which very few doctors are qualified. Why is not this a case where the interests of the engineering profession should be looked after and an engineering board be made the agent of both Federal and State Governments?

H. C. HODGKINS.

Syracuse, N. Y.

Ignoring Findings of Board of Engineers on Deep Waterways

Sir—Along with many others, I am wondering why Congress is passing a bill for studies of a deep waterway canal from the Great Lakes to Atlantic tidewater, and whether it is possible that the very thorough and conclusive report in the year 1900 by the Board of Engineers on Deep Waterways between the Great Lakes is so soon forgotten. This board, authorized by Congress, had as its members C. W. Raymond, colonel of engineers; Alfred Noble and George Y. Wisner. Their study and report were an elaboration of the work of the United States Deep Waterway Commission of 1897, of which James B. Angell, John E. Russell and Lyman E. Cooley were members. The board of 1900, after thorough studies of a 21-ft. and a 30-ft. channel over various possible routes, recommended a 21-ft. canal via the Lake Ontario, Oswego, Mohawk Valley, Hudson River route, at a cost of $206,358,000.

Their advice was ignored by New York State for a barge canal limited to 12-ft. depth over the lock sills, because of the opposition of the Cities of Buffalo and New York to any canal that would give through service and thus avoid their rake-off in terminal charges. It would now seem just retribution for an economic crime if the United States should build a canal for ocean steamships to protect the Central West against this extortion mentioned in the recent debate in Congress. The New York Barge Canal, conceived with such a

purposes and in defiance of economic principle, was doomed to failure as a financial burden.

Unfortunately, it is not generally known that small oceangoing steamers have for many years been going direct to the Great Lakes up the St. Lawrence River and the Lachine and Welland Canals of Canada, in spite of the statement of Lewis Nixon, superintendent of public works for New York state, that such a route would be impracticable. This information was very definitely brought to the writer's attention in 1903 while making the preliminary engineering studies for the railroad crossing at Detroit, when a record was kept of the characteristics of all steamers using Detroit River.

Your comments on the above would undoubtedly be much appreciated. BOYD EHLE,

Tulsa, Okla. Mem. Am. Soc. C. E.

Possibilities of the Fabricated Ship

Sir—I was very much interested in the editorial on the fabricated ship printed in your issue of Feb. 20. This is timely and appropriate, and the argument is sound.

As the fabricated ship yards were built and operated under abnormal conditions, the data as to time required for assembling steel of hulls and the cost cannot be used as a basis of comparison with the records in the old, established yards. There is little doubt, however, that under normal conditions the fabricated ship will be a real competitor. While the method involves extra handling of material, this handicap should be more than offset by the advantage of quantity fabrication of each item. The great importance of this principle in shop management is well known. L. G. FISHACH.

Leetsdale, Penn.

Guarantee Profit Sharing by Law

Sir—*Engineering News-Record* at different times since the entrance of the United States into the great war has published editorials setting forth the idea that the war marked the passing of the old and the ushering in of a new order in our social relations.

There is a general call for fair dealing; a call for the employer to treat the employed as he would be treated were their positions reversed; a call for profit sharing and the apportioning of dividends.

This is good, but not sufficient. The employee should not, in so fundamental a matter, be left to the nobler sentiments or higher aspirations of his employer, be he ever so highminded, for many there are who will not be so animated. Capitalists do not so trust their wealth to other capitalists. Their every interest is safeguarded by all the legal guarantees that it has been possible for able jurists to devise.

Cannot some similar legislation be worked out to guarantee to the man in the ranks a fair share in the profits in the making of which his industry has contributed so material a part? Here is a plan, and it might be styled "An Act to Compel Profit Sharing and to Regulate the Same."

The United States Government now demands an accounting from every corporation, and appropriates to itself as "excess profits" a certain portion of the income above a stipulated return on the investment. This law might well be repealed, or amended to operate after a larger income had been allowed, and in its place legislation enacted that would demand an accounting as at present, but providing that the profits above a certain stipulated return shall be divided in a certain fixed and graduated ratio between the employer and each employee. Similar legislation would necessarily have to be enacted by the various states.

By this it is not intended that every individual who works a day here or a day there will, at the end of the year, draw "dividends" from a half dozen different concerns. That can all be regulated so that an employee will not become a "stockholder," or "member of the firm" until he shall have worked a month, or two, or three months, as experience with the plan may indicate to be best, and varied to suit different industries. At first it might possibly best be limited to manufacturing plants, continuing industries, and transportation, but as rapidly as possible it should be extended so as to include, in the end, practically all activities.

The directing of the work, except in the matter of employing and discharging men, in which a committee of the employees should have the right of review, in the future as in the past should be in the hands of the owners. Some may object to this, and argue that the employee should have a hand in the managing of affairs. As a matter of fact, he would have. For as time went on the competent employee, as opportunity offered, would withdraw his "capital"—that is, his "labor"—from the concern paying small dividends and place it with the concern paying large.

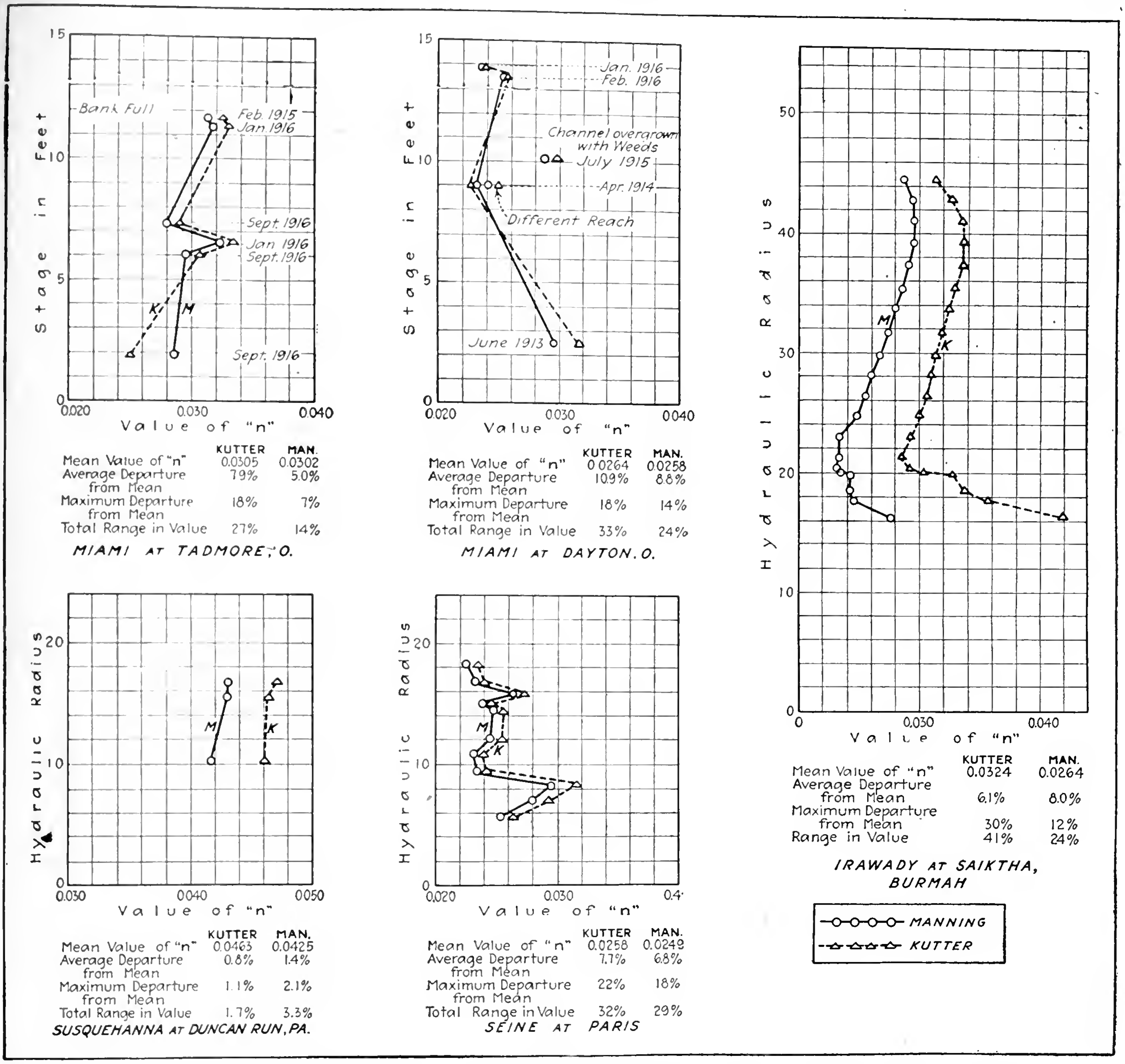
The engineers of the country represent trained intellects; to them more than to any other class has been due the wonderful progress in invention and industry, resulting in enormous increase in material wealth. With them rests in great measure the working out of measures that will make all this material progress work to the advancement of mankind. H. A. RANDS.

Portland, Ore.

Variation of Roughness Coefficient in Manning and Kutter Formulas

Sir—Robert E. Horton's review of Ivan E. Houk's excellent report on the "Calculation of Flow in Open Channels," in *Engineering News-Record* of Jan. 20, 1919, p. 149, prompts the following remarks concerning the relative variability of the roughness coefficients in the Manning and Kutter formulas. These two formulas are compared in Mr. Houk's report, and while the report is especially commendable because of the unprejudiced care with which different formulas are compared, the writer believes that Manning's formula has not received quite all of the credit to which it is entitled. The writer is strongly in favor of this formula as against the more complicated Kutter formula, not only because of its much greater simplicity, but also because the use of Kutter's n in this formula gives results practically identical in a large percentage of cases with those found by using the Kutter formula with the same value of n. This is well shown by a comparison of the two in over 250 experiments listed in King's "Handbook of Hydraulics," which Mr. Horton mentions.

In applying either of these formulas to natural streams, however, a question that has troubled the writer on several occasions is the question of the



DIAGRAMS SHOWING VARIATION OF KUTTER'S AND MANNING'S n WITH CHANGE IN RIVER STAGE

variation of n with change in the stage of the stream. Having assumed or determined by actual measurement the value of n at some given stage of a certain stream under investigation, can this same coefficient be used for others stages of the stream, and, if not, what will be the direction and probable amount of the departure from this known value? To answer this question in a small way, the writer plotted corresponding values of Kutter's n and Manning's n for various stages for a few of the streams on which the experimental data cover a fairly wide range in stage. The few examples presented above do not include all of the available material by any means, although it may be noted in this connection that experiments on natural channels which cover a large range in stage are not plentiful. Of those which do exist, not all can be used, because some minor change in conditions during the series introduces a disturbing factor which renders comparison of the different experiments uncertain.

The five examples given cover a wide range in natural channel conditions. Of these the series on the Miami River at Tadmore seem to the writer to deserve the greatest weight. Conditions on the reach selected were very favorable to good results, and the work appears to have been carefully done in all respects. The experiments cover the entire range from low water to bank-full stage. Zero of the gage is apparently about a foot above the stage of no flow. The work on the same stream at Dayton does not seem to have been done under such favorable circumstances, as the condition of the channel was not the same in all experiments. These experiments do not cover such a wide range in stage as those at Tadmore. Zero of the gage is probably about 5 ft. above the stage of no flow, while bank-full stage is given as 18.0 in the Weather Bureau description of the gage. In the other three examples given, it was necessary to plot n against the hydraulic radius, as the stage was not given. This,

however, closely indicates the change with stage. The Susquehanna experiments made at McCall's Ferry by Anderson, when compared with the Miami work, are only fair. The fourth experiment was not plotted, as a different section from that used in the first three was taken. The Irawady and Seine experiments are taken from Hering and Trautwine's translation of Kutter and are given because of the wide range in the value of r which the experiments cover. The original data on these experiments were not available to the writer, and therefore he could not form a personal opinion as to their relative weight. He well recognizes the danger of blindly presenting data without a careful examination of the original material, for often in abridging experiments for quotation the facts essential to a proper comparison of the experiments are of necessity omitted.

In referring to the diagrams, it should be noted that the lines joining the plotted points are for the purpose of bringing out their relationship, and they do not indicate values of n for intermediate stages between the points. The variability in each series is shown by the maximum, average, and range of departure of the individual points from the mean value for the series. These are expressed as a percentage of the mean value.

The results on the diagrams indicate—at least for these few streams—a greater stability on the part of Manning's n than is shown in Kutter's. It shows less variation as the stage changes and can, therefore, be used with greater reliance over a range of stage. Needless to say, the coefficient which comes the nearest to remaining constant over a range of stage is the more desirable, and Manning's n shows this property to a greater extent than Kutter's. Aside from the question of variation, it will be seen that the absolute values of the two n's are not widely different, both lying within the range of values commonly considered in connection with natural streams. The random assumption of some value of n for a given stream is at best subject to more or less doubt. A single experiment on the stream is much to be preferred, and the data obtained in this way is as easily reduced to Manning's as to Kutter's n. The engineer then has a coefficient which he can apply with greater assurance to a greater range in stage than he would be justified in doing with Kutter's n. H. R. LEACH.

Saginaw, Mich.

[On Mr. Leach's comments Mr. Horton writes as follows:—EDITOR.]

Sir—Mr. Leach calls attention to an important matter in relation to river hydraulics.

While his conclusion is undoubtedly correct, that the formula which gives the least variation of coefficient with varying stage is, other things being equal, the one to be preferred, yet it seems desirable to go a little farther and call attention to the fact that the coefficient of roughness in these and other similar formulas includes some things beside the effect of roughness itself.

The coefficient of roughness as ordinarily determined, especially in the case of low water on streams, includes ineffective fall and ineffective cross-section as well as roughness. At flood stages of a stream, practically the total fall and the total cross-section in a stream of even quite irregular channel width and depth are effective in producing velocity and transporting water. At low stages a considerable part of the fall may be lost in ripples and eddies, and if there are deep pools, numerous bends or wide shallow reaches there may be stagnant water, and the portion of the cross-section which it occupies, if included in the measured cross-sections used in calculating the coefficient of roughness, will result in an apparent coefficient of roughness larger than that for the same stream at higher stages.

The writer has seen instances where the banks of a stream were unquestionably rougher than the bed, and yet the coefficient of roughness almost invariably decreased as the stream stage increased, the coefficient being calculated, as is the usual practice, from the actual cross-section and measured slope, whether effective or not. This simply emphasizes the fact that slope formulas, like most other engineering methods, are neither automatic in their operation nor fool-proof.

In general, if a coefficient of roughness has been determined at a certain stage of a stream, its value should be somewhat decreased when applied to higher stages, and increased when applied to lower stages.

Mr. Leach's letter gives some valuable information indicative of the character and amount of the change in coefficient of roughness with changing stage.

Albany, N. Y. ROBERT E. HORTON.

Utilize the Topical Index for Reference

Sir—Your average reader probably observes the topical index on the front page for the purpose of noting the articles pertinent to his particular line of work, and then forgets it. It has been my practice to utilize this topical index in a very concrete manner by clipping the items in which I am more particularly interested, and pasting the same on a 3 x 5 card. This card is filed in a suitable card index file, which is kept on my desk for immediate reference. After the article is read carefully it is readily referred to at any future time by inspection of my card index.

In this manner I have a working index to the live articles published weekly in *Engineering News-Record*, and it is not a study to remember where and in which number a desired article is published.

F. L. BIXBY,
Reno, Nev. Senior Irrigation Engineer.

Locations for Improved Public Highways

Sir—From *Engineering News-Record* of Dec. 19, 1918, just received, I am pleased to learn of the extensive interest being shown in the United States in permanent good roads.

Having had many years of road experience both as engineer and contractor in New York State and New England, in addition to nearly a year of road work with the A. E. F., I venture to suggest that when permanent roads are constructed they be built on permanent locations. By permanent locations I mean those that will not necessitate change through any condition now foreseen. Make the location as well as the road surface permanent.

Trucks will be the most important users of good highways. Experience here and elsewhere has proved to my satisfaction that grades requiring a loaded truck to go into intermediate gear, or curves that require a material reduction of speed, are much more serious matters than I had previously believed. The capacity of an otherwise good road under heavy summer traffic

is materially decreased by even one grade requiring the use of intermediate gear, and that capacity suffers a further very material decrease during periods when snow and ice are encountered.

Location is part of the road, and a good location is an absolute necessity in order to get 100% efficiency from any given road surface. The better the surface, the more important the location. The saving in maintenance charges by a proper location, together with the saving in operating expenses of motor vehicles, will be of benefit to all generations, including the present, which must soon decide the question of permanent locations. The cost of a proper location is as proper a charge against the total cost of a permanent highway as the cost of right-of-way is against the cost of a railroad.

I believe that in many cases it is not economy to build a modern permanent road on a location made years ago under entirely different conditions. Railroad engineers have shown the wisdom and economy of expending large sums of money in order to obtain better locations. With the advent of the large, heavily loaded motor truck, the principles controlling highway and railroad location have become more closely associated, and the principles governing railroad location should be more closely followed.

HORATIO L. BAKER,
First Lieutenant, D Company, Twenty-third Engineers.
U. S. A., P. O. 903, American Expeditionary Forces.

Correction of Level Notes for Personal Equation and Other Errors

Sir—The writer had occasion last summer to work out a method of eliminating errors and personal equations in leveling which, to the best of his belief, is new and most promising. It is as follows:

In adding to the distribution system served by the Elephant Butte dam below El Paso, Tex., under the United States Reclamation Service, topography was to be taken over a strip of valley some 45 miles long. A transit control line was run, and at every sixth station a special hub was set for a benchmark. Levels were then run on these hubs, with readings to thousandths, by three level parties, working one after the other but absolutely independently. Set-ups were made at the station stake midway between the hubs, thus eliminating instrumental errors as much as possible. The three chiefs of party were not allowed to compare notes on elevations.

When the results came in, the values of the final point all checked within a foot, and considerable discussion ensued as to the proper method of evaluating them. The first levelman was a very experienced man, while the second and third were much younger, one being still graded as a rodman. The tendency of the office force was to discard the results of the two less experienced men, but the writer argued against this and won.

In order to present the matter graphically, as the chief had to be "shown" and his time was limited, the writer devised this scheme: Upon a sheet of profile paper were plotted the differences between each pair of notes for each hub. Thus, if the three sets of levels are designated A, B and C, at each point A-B, B-C and A-C were plotted, and all A-B values joined, etc. If for a given point A gave 3597.077, B gave 3597.032 and C 3597.859, A-B was plotted at plus 0.045, A-C at minus 0.782 and B-C at minus 0.827, care being taken to observe algebraic signs. These points were then joined with the corresponding points for the preceding hub, which were plotted on the preceding vertical subdivision. The result was three surprisingly regular curves, often crossing and recrossing the zero line, and with a few noticeable irregularities. These breaks, of course, were the significant features and were investigated carefully. Where all lines were running comparatively parallel and two lines dropped or rose over a certain hub and returned to the former relative positions at the next hub, it indicated a disturbed point, or dirt on the hub. However, if the two lines, after jumping, failed to return but continued parallel to the previous course an error in rod reading was thereby indicated in the set of notes common to the two lines, and the amount was evident.

Thus, if B-C and A-C lines jumped two hundredths at one hub and continued parallel afterward, it showed that C was out two hundredths from that point on. The scale was made such that thousandths were easily read. Numerous errors were detected in this way, and the notes of each party were corrected accordingly and the differential values once more plotted. This last plat showed one set of levels to be less reliable, as two of the lines were quite irregular, while the third ran smoothly throughout. The two sets of notes represented by the third line were then averaged, and the values obtained tabulated for permanent use.

A curious feature aroused some discussion regarding the third, or smoothest, curve. The digressions from the zero line were regular, nearly equal, and recurred at strikingly regular intervals, almost following a sine curve. The most plausible theory advanced to explain this was that the parties did not work at the same speed, one being noticeably slower. Therefore, one stretch would be traversed by both at the same time of day on different days, and other stretches would be covered by one party in the morning of a certain day and by the other in the afternoon. Since the daily range of temperature was high at that time, it is thought that the increased mutual discrepancies occurred at points where readings were made at opposite hours of the day, and were due to expansion and contraction of the earth's crust during the day.

It also appeared that the more experienced levelman had fully his share of errors in rod readings, while the "greenest" man had the least, showing that results should not be entirely discarded, no matter what the ability of the observer. Also, the use of the third set enabled the writer to place each error positively and correct it without another trip in the field.

All persons who inspected the curves and the results agreed that the method was novel and extremely useful, as the "why and wherefore" of all corrections was seen at a glance. I trust others may find its use convenient.

The work in question was done in connection with the Fort Hancock survey, in August, 1918, under Assistant Engineer J. G. Marzel, of the Clint, Tex., office, where the writer was chief of party acting as office engineer.

RUSSELL A. TRUFANT,
American Rio Grande Land & Irrigation Company.
Mercedes, Tex.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Side Chute Charges Wheelbarrows From Cement Wagon

BULK cement hauled in wagons and unloaded by detachable measuring chutes from the wagons to the charging barrows was used in paving 7000 ft. of Main St., North Chicago, Ill. Ten carloads, or 3000 bbl., of cement were handled, and the contractors, the James Cape & Sons Co., Racine, Wis., state that they intend to use bulk cement on all future contracts where the consumption exceeds 150 bbl. per day. The haul from the railway to the work was about one mile. Three wagons, which were equipped with 20-bbl. metal-lined grain boxes, were routed so that one wagon was at the car taking its load, one was en route between the car and the work and the third was at the work discharging its load. One team did the hauling. An average of eight wagon loads per nine-hour day was hauled.

Other Articles in This Issue of Interest to Contractors:

MEASURING CHUTE ON WAGON CHARGES BULK CEMENT INTO BARROWS

At the car, the cement near the door was shoveled directly into the wagon. When enough cement had been removed to make the distance too great for shoveling, wheelbarrows were used. A steel plate bridge from car to wagon permitted the barrows to be dumped directly into the wagon. One man did the unloading. At the work, the chute was hooked into the wagon body and one man did the unloading. The chute was a broad box 24 in. high and 12 in. square, with a hopper 18 in. high and 24 in. square at the top. A slide gate at the bottom of the chute and another at the bottom of the hopper made the chute a measuring box of 2-cu.ft. capacity. The hopper, level full, also held 2 cu.ft. By alternately opening and closing the slide gates, wheelbarrows were charged with 2-cu.ft. batches of cement, and were then wheeled to the mixer and dumped directly into the charging skip. One or two men did the wheeling.

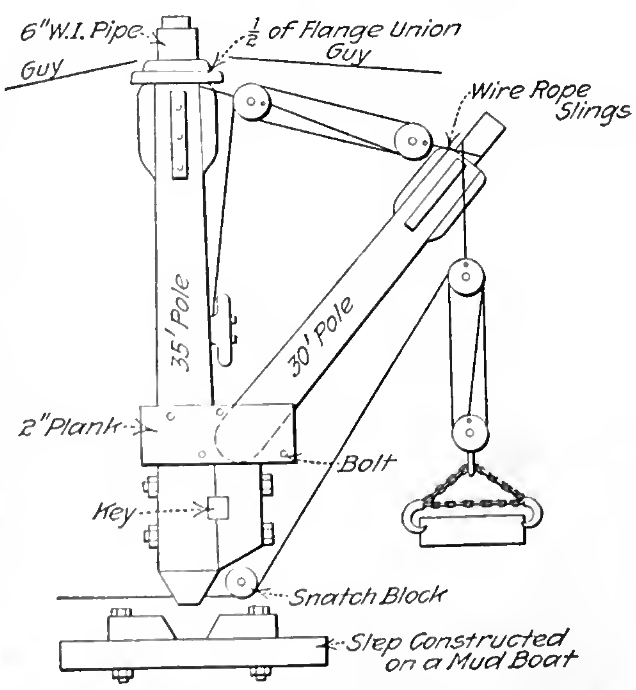
Canvas covers for the wagons prevented any loss of cement from rain.

Improvised Derrick Without Usual Irons

BY SAMUEL P. BAIRD

Columbus, Ohio

THE accompanying figure illustrates an improvised boom derrick, built without the derrick irons which would ordinarily be thought necessary. The principal features are the step-bearing for the mast, the step for the boom and the means for allowing the mast to rotate at the top. The rope used was 1-in. manila, the boom hoist was a pair of double blocks, and the main hoist was a combination of a double and a triple

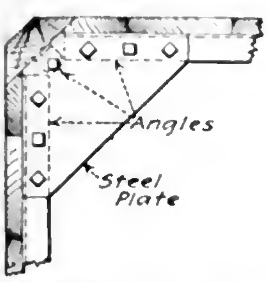


NO DERRICK IRONS USED IN THIS HASTILY IMPROVISED RIGGING

block. The main power was a steadily moving team. The loads lifted were stone weighing about a ton, and they were raised high enough for a truck to back under. A friction drag was provided on the main fall line, to lower the load and to allow the team to return as soon as the load was raised to the desired height.

Rigid Corner Frame Permits Frequent Re-use of Concrete Forms

REMOVABLE corners for concrete forms, such as the one described in *Engineering News-Record* of Jan. 23, 1919, p. 203, have been used for some time by E. H. Oneal, of Globe, Ariz. A special type for shaft concreting is shown in the accompanying sketch. It consists of a drilled and shaped steel corner plate to which are bolted angles carrying the side planks of the form and a special corner piece. While the cost of the individual forms was high, the cost per unit of conrete was low because the forms could be used over so many times. Some were re-used 26 times and were still in good condition. To strip such a form, the bolts are unscrewed and the separate plank sections lifted out.

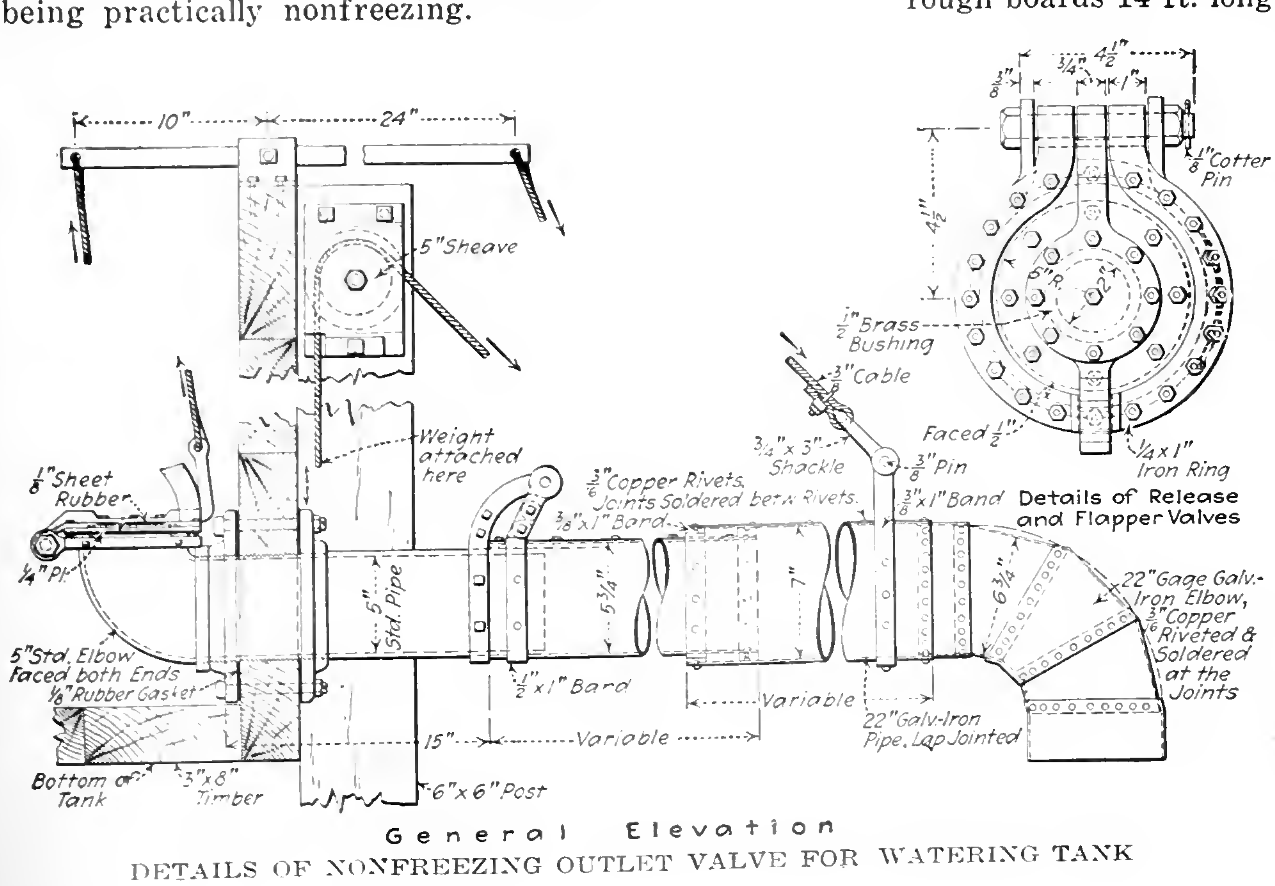


CORNER BRACE FOR CONCRETE FORM

Economical Nonfreezing Type of Outlet Valve

By John H. Sawkins
Instructor in Drawing, Civil Engineering Department, Union College, Schenectady, N. Y.

AN OUTLET valve suitable for temporary watering tanks, such as are used by contractors for watering dinkies on filling and excavation contracts, is shown herewith. The advantages of this type are: (1) It can be made at small cost, using standard pipe fittings and other material commonly found in any small machine shop; (2) it is simple both in construction and operation; (3) it is especially adapted to winter work, being practically nonfreezing.



DETAILS OF NONFREEZING OUTLET VALVE FOR WATERING TANK

As indicated in the drawing, the valve consists essentially of a standard cast-iron elbow, two cast-iron pipe flanges and a short length of common pipe. The detail drawing of the combined release and flapper valves shows clearly that all the component parts are simple pieces easily made, standard bolts being used for connecting the pieces. It is recommended that a good grade of sheet rubber be used for facing the plates, and that the elbow be faced very carefully on a ring ½ in. wide, in order to secure a water-tight connection between it and the rubber, thus avoiding undue leakage of water, which may cause the valve to freeze. The same applies to the connection between the rubber and the brass brushing.

The operating device is especially made to withstand rough usage usually given by firemen who operate such valves, simplicity in both design and operation being the feature sought. The valve is particularly designed to adapt it to winter conditions, since much trouble has been caused to contractors in obtaining an outlet valve servicable under all weather conditions.

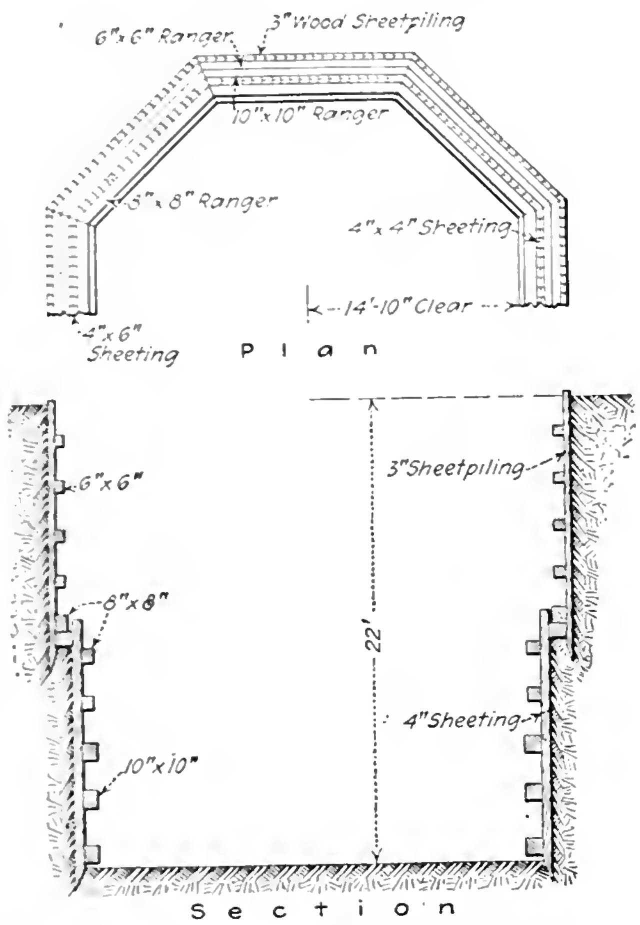
The location of the valve as shown in the general assembly view offers least chance for trouble due to freezing if the tank is at all times kept nearly full of water.

Bracing Eliminated in Sheeting Octagonal Excavation

By W. K. Knauff
Supervising Construction Engineer, Delaware City, Del.

IN ORDER to keep the excavation for a sewage pumping station at Fort du Pont, Delaware, unencumbered with braces during concreting, the layout of the sheeting as a regular octagon with mitred rangers was designed. Rangers of various sizes formed a complete octagonal ring, the rangers butting into each other at the corners with a miter cut. Vertical blocks, two to each side, supported each set of rangers from the one below, and no other bracing was employed.

The first set of sheeting was made up of 3 x 6-in. rough boards 14 ft. long, spiked together three to a pile, and arranged to give a 2-in. tongue-and-groove. A plank templet was made with inside dimensions equal to the outside dimensions of the excavation, and eight special corner piles were made up and started, one at each corner of the octagon. The flat sheeting was then placed to complete the sides. As the excavation progressed, 6 x 6-in. oak rangers were placed about 2 ft. 6 in. on center, the joint between the first and eighth sides being made by raising these pieces sufficiently to bring the lower edges of the miter together, and then forcing them back to the horizontal by jack screws. In this way each set was brought to a



EXCAVATION KEPT CLEAR BY OCTAGONAL LAYOUT

firm bearing against the sheeting itself. At about 8 ft. the sheeting could not be driven more than a foot below the lowest set of rangers without curling badly and having to be cut off on account of lack of stiffness. The trouble was overcome by making a ring of 8 x 8-in. timbers and jacking it down as the excavation progressed. The upper set of sheeting was carried to a depth of 12 ft., a set of 10 x 10-in. rangers being placed near the bottom and used as a templet by the lower set of sheeting.

The lower sheeting was composed of 4 x 6-in. yellow pine, 12 ft. long, tongued and grooved and center matched, the eight corner pieces being made up and spiked together as before. The rangers were made in complete rings, two sets of 8 x 8-in. timbers and two sets of 10 x 10-in. One set of 10 x 10-in. timbers was jacked down as the excavation progressed, to keep the sides from curling in, because even the 4 x 6-in. sheeting was not stiff enough to resist the side pressure. This set of sheeting was carried down to the bottom of the excavation about 22 ft. below the surface of the ground.

The site of the excavation was in low-lying ground near a marsh, and the excavated material was fine mica sand, water having been encountered about a foot below the surface. Although at times the pumping capacity of the plant was taxed to keep the water low enough for the men to work, comparatively little difficulty was experienced in the wash around the timbering. The excavated material was handled by a small derrick operated by a 12-hp. gasoline hoist. The sheet piling was driven by a 4-in. McKiernan-Terry sheeting hammer. The scheme was devised to enable the work to be carried on with as little delay as possible, utilizing the equipment and material available locally, sheet-steel piling and an orange-peel excavator not being procurable except at the cost of considerable delay.

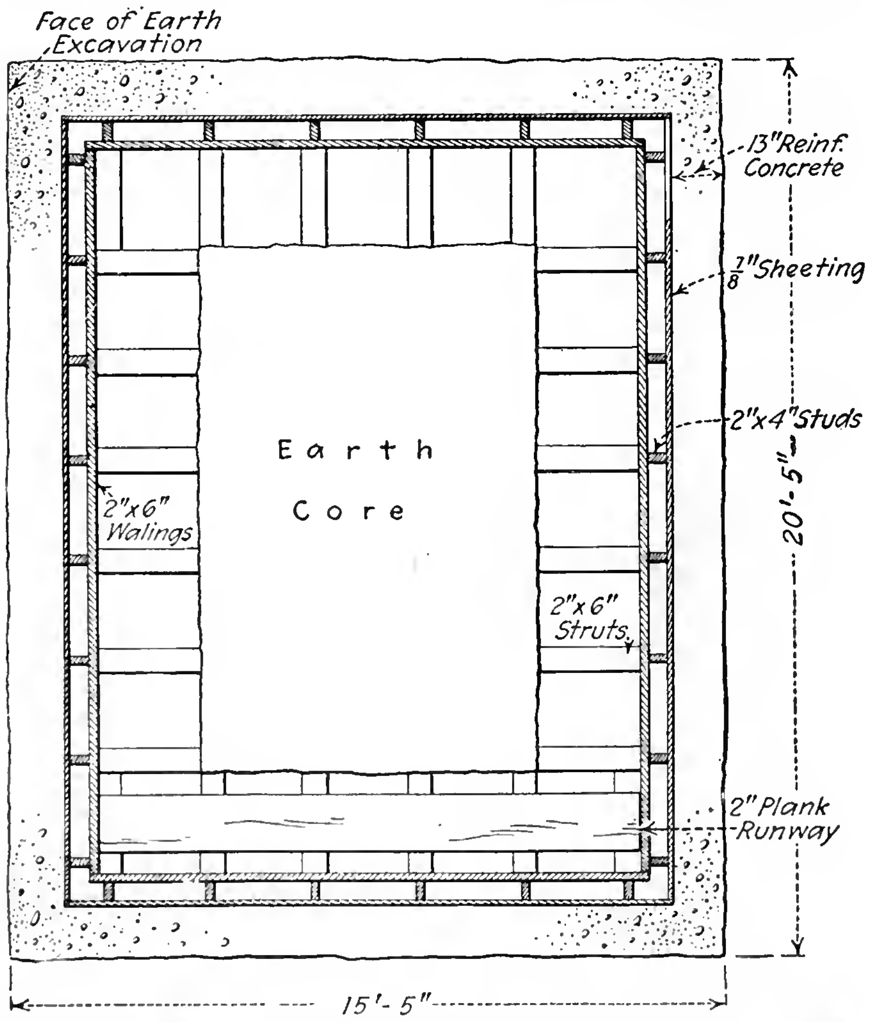
The work was performed by R. G. Collins, Jr., general contractor, under the direction of Capt. J. A. Sears, constructing quartermaster, U. S. A., with the writer as supervising construction engineer.

Concrete Walls Poured Before Core is Excavated

By D. H. Fleming

Assistant to City Engineer, St. Catharines, Ontario, Can.

A RECENT Canadian contract called for the excavation of a pit 15 x 20 ft. in section and 30 ft. deep, and the construction of reinforced-concrete walls, etc. The material encountered was a hard, tough clay and the contractor excavated a trench about 4 ft. wide around the outside, in much the same manner as for a sewer trench. The reinforcement was then tied in place and inside forms were erected in 4-ft. lifts, constituting a day's work. After the concrete walls were poured and the forms taken out, the earth core was excavated. This



30-FOOT PUMP WALL SHOWING CORE SUPPORTING FORMS

method enabled the contractor to save the expense of large timbering, which would have been required for struts or props. It aided in the protection of the concrete from freezing and enabled the contractor to pour the concrete during a spell of good weather, leaving the excavation work to be done later.

Seattle Plans for Reconstruction

Reconstruction questions of the City of Seattle, Wash., and King County are to be considered by a large commission which has been appointed by Mayor Hansen and which will coöperate with similar commissions throughout the state. In addition, the authorities are planning to commence work on a water-supply extension to cost nearly $4,000,000, a hydro-electric plant to cost $5,500,000, and street and sewer work totaling about $3,000,000.

NEWS OF THE WEEK

New York, March 13, 1919

Price Stabilization Board Appointed

Action on Secretary Redfield's plan for a stabilization of prices by co-operation between the producer and the Government has been started by the appointment of the members of the Industrial Board of the Department of Commerce, which, with the Council of National Defense, will act for the Government. The chairman of the board is George N. Peek, of Moline, Ill., formerly with the War Industries Board and vice-president of Deere & Co. The other members are Samuel P. Bush, Columbus, Ohio, president of the Buckeye Steel Castings Co.; Anthony Caminetti, Washington, D. C., commissioner general of immigration, Department of Labor; Thomas K. Glenn, Atlanta, Ga., president of the Atlantic Steel Co.; George R. James, Memphis, Tenn., president of the William R. Moore Dry Goods Co.; T. C. Powell, Cincinnati, Ohio, director of the Capital Expenditures Committee, United States Railroad Administration.

The board expects to begin immediately conferences with representatives of various basic industries, in the hope of establishing the lowest possible prices which can be offered at present. Government buying will then be made on the basis of such prices, which will not be fixed, as during the war, but will be given wide publicity for the information of the private buyer. The producer, of course, will not be forced to accept any such established price, but it is hoped that the weight of the Government statement of a fair price will serve to establish such a standard.

American Mayors' League Proposed

Immediately after the recent Governors' and mayors' conference in Washington, a number of the mayors present met and unanimously voted to recommend to all mayors of cities of 25,000 population or over the formation of a permanent organization which may perhaps become known as the American Mayors' League. A resolution was passed requesting the Secretary of Labor to call such a conference not later than Feb. 1, 1920. The opinion of all present was that there should not be over one set speech each day of a conference extending to at least four days. It was also voted that Congress be asked to adjourn at least one day during the conference, and hear the report which the mayors might have to offer. The following committee was appointed to take all matters concerned into consideration and report: Chairman, George L, Baker, mayor of Portland, Ore.; secretary, R. W. Babson, Boston; together with F. W. Donnelly, Trenton, N. J., W. Montague Ferry, Salt Lake City, Daniel W. Hoan, Milwaukee, Wis., and R. J. Wheeler, Allentown, Penn.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service; Thomas T. Read, manager Eastern zone, 16 East 42nd St., New York, and Ward R. Robinson, manager, Central and Western Zone, 63 E. Adams St., Chicago.

1518 Walnut St., Philadelphia.

16 Tremont St., Boston.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Myers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Penalty for Municipal Strikers

Loss of annual vacation has been imposed as penalty on city employees of Seattle who joined the recent general strike in that city. In addition, 15 days' pay will be withheld from those who did not respond to Mayor Hanson's demand that they return to work. A request of the Central Labor Union to rescind this ruling has been denied

Commissioner of Public Works for Oregon

In connection with a proposed $3,000,000 reconstruction bond issue to be used for public buildings and a $1,235,000 appropriation for new buildings, alterations and repairs authorized by the recent session of the Oregon legislature, provision has been made for the office of commissioner of public works. The commissioner will be under the direct supervision of the State Board of Control, which has charge of state construction work.

Proposes Rapid Transit Viaduct Across New York Bay

Rapid-transit connection of Staten Island with the main business district of New York City, brought to the fore recently by suggestions to begin the construction of the long-contemplated extension of the Brooklyn Fourth Ave. subway to Staten Island by a tunnel under the Narrows, is the subject of a remarkable alternative project submitted to the Staten Island Subway Committee recently by S. Johannesson, a New York engineer.

This project contemplates a viaduct railway crossing New York Bay from Ellis Island to Staten Island, a distance of about 22,000 ft., supplemented by a tunnel about 7500 ft. long from the Battery, Manhattan, to Ellis Island. The entire line is estimated to cost about $18,000,000.

Course of Proposed Structure

Passenger and wagon connection between Manhattan and Staten Island is made at present by a line of ferry boats running from South Ferry, Manhattan, to St. George, Staten Island, a distance of five miles. The proposed structure would parallel the course of these boats a short distance to the west, being laid close along the established pierhead line on the New Jersey shore, off Bayonne, for the entire distance south of Ellis Island. It is intended to adapt the structure to the necessary future development of this riparian district for steamship service, by placing the supports of the viaduct so that they would come within the pier areas, the spans crossing the slips between piers and giving unencumbered passage to vessels. For the present design a slip width of 300 ft. and a pier width of 150 ft. have been used, and the structure as designed consists of a series of steel arch spans across the slips, shaped so as to give a full)0-ft. clearance height for the entire width of the slip, and connected by girder spans over the piers, these spans preferably to be masked by stone or concrete face walls. At the south end of the line, where the route crosses the Kill von Kull, the entrance to Newark Bay and Staten Island Sound, a clearance height of at least 140 ft. will be required, and here two 500-ft. spans across the channel are provided. The water and ground conditions over the entire length of the viaduct are favorable, it is asserted, the water depth varying from 5 to 20 ft., and rock being found at relatively shallow depth. The tunnel under the Hudson River from the Battery to Ellis Island would have

to deal with a maximum channel depth of something over 50 ft. At its southerly end it would rise on a 3% grade to the Ellis Island portal.

Great saving of transportation time as compared with the route through Brooklyn is claimed for this project. Furthermore, as the Fourth Ave. subway is largely taken up with Brooklyn traffic, only a small margin of capacity is available for through traffic to Staten Island, whereas it is asserted that the bridge route would provide all needed capacity. The structure as designed, and the estimate above quoted, contemplates a two-track railway and a two-line vehicle roadway.

Why More Catskill Water is Needed by New York City

Rainfall of but 43 in., compared with 47 in. as the average on the Catskill drainage area for the past 13 years, and a large use of Catskill aqueduct water to save pumping for Brooklyn Borough, had drawn down Ashokan reservoir storage to 56,000,000,000 gal. and Kensico reservoir storage to 17,000,000,000 gal. Mar. 1, according to information from the engineering department of the Board of Water Supply, New York City.

The maximum capacity of these reservoirs is 128,000,000,000 and 29,000,000,000 gal., respectively. The safe daily capacity of the area tributary to the Ashokan reservoir is 250,000,000 gal., but for more than a year the reservoir has been delivering 380,000,000 gal. a day and the city has been using 430,000,000 gal. daily from the Catskill supply. The excess of use over Ashokan reservoir delivery has been made up of 30,000,000 gal. a day drawn from storage in the Kensico reservoir and 20,000,000 gal. from area tributary to Kensico. Indications are that pumping may again be necessary to supply Brooklyn. There is no danger of a water shortage, it is said, as the Croton reservoirs are about full, but Catskill water can be delivered so as to avoid pumping. Already some $2,000,000 of pumping costs have been saved by the Catskill gravity supply.

The Board of Water Supply is now building the Shandaken tunnel, which will divert water from the Schoharie drainage area to the Ashokan reservoir and make possible a delivery of 500,000,000 gal. a day through the Catskill aqueduct. The tunnel is 18 miles long and will not be completed for some five years. Plans are being made for a dam at Gilboa to store Schoharie water, and it is hoped that its construction can soon be undertaken, both as an essential part of the Catskill supply and to help furnish employment. The cost of pumping the 250,000,000 gal. a day which the Schoharie will yield would be about $2,000,000 a year. The entire estimated cost of the Schoharie project is $22,175,000. J. Waldo Smith is chief engineer and Thaddeus Merriman is deputy chief engineer of the Board of Water Supply.

Hurley Reports on Cancellations of Ship Orders

In a statement to the chairman of the House Appropriations Committee, E. N. Hurley, chairman of the Shipping Board, has given the first definite facts on the cancellations of ship orders by the Emergency Fleet Corporation. In this statement he says that up to Jan. 1, 1919, contracts for 107 ships (55 steel, 32 wood, and 20 concrete) had been suspended or canceled. Up to Feb. 15, 1919, the cancellations and suspensions had increased to 550 vessels, most of them steel. The total represents about 2,700,000 dead-weight tons carrying capacity, and over $400,000,000 in cost.

Present construction by the Emergency Fleet Corporation totals roughly 10,000,000 dead-weight tons. This, with foreign construction, is expected to produce by 1921 a world's fleet about 5,000,000 tons ahead of that of 1914. With respect to further cancellations, Mr. Hurley stated: "We are already presented with heavy claims for damages as the result of the cancellations we have already made. To make many more would . . . . disturb the labor conditions of the country . . . . cause failures in the shipbuilding trade . . . . destroy the fortunes of people who have invested in these industries." And he advised against attempting to cancel more contracts.

Report on Federal-Aid Highways Misleading

Federal-aid highways to the amount of 793 miles, instead of 45 miles as indicated by a recent report of the Department of Labor, have been constructed, according to a statement of P. St. J. Wilson, acting director of the Bureau of Public Roads. The Department of Labor apparently only considered completed and accepted projects instead of completed miles of highway. Inasmuch as over $2,000,000 had been paid to the states, and as the reported condition was being used as an argument against further appropriations for this purpose by Congress, Mr. Wilson prepared for publication a report of which a part follows:

"Of the appropriations made by the Federal-aid road act, as approved July 11, 1916, $30,000,000 is now available and $20,000,000 additional will become available July 1, 1919, which amounts, less the 3% deducted for administration, have been apportioned among the states. To Jan. 31, 1919, projects had been approved involving a total of 8903 miles of road and $23,526,102 of Federal aid. Of this mileage, notwithstanding war conditions and the restrictions necessarily resulting therefrom, the equivalent of 793 miles had been completed on the above date, requiring an expenditure of about $2,096,000 of Federal funds. Of the mileage represented in approved projects, there remain yet to be constructed about 8110 miles, which will involve about $21,430,102 of Federal funds. The indications are that an immense amount of construction work, both delayed and new projects, will be undertaken during the 1919 construction season."

Reports received by the bureau indicate that $385,000,000 will be spent for roads and bridges during the coming season in the United States, and the new Federal-aid appropriations approved by Congress, if utilized by the states, will add several million dollars to this sum.

Oregon Reconstruction Bond Issue

The legislature of Oregon has passed a bill providing for a $3,000,000 reconstruction bond issue, subject to popular approval at an election to be held June 3. The money will be used for various public buildings, including $500,000 for a new penitentiary, $350,000 for a reconstruction hospital with a possible expenditure of $500,000 under certain contingencies, and $500,000 for buildings at Corvallis for the Oregon Agricultural College, and another $500,000 for buildings at Eugene for the University of Oregon, the college work to be carried out jointly by the regents of the two institutions.

Improve Kansas City Water-Works

Improvements to the water-works of Kansas City, Mo., interrupted by the war, will be put under way at once, according to information from W. G. Goodwin, chief engineer and superintendent. The city expects to advertise within two or three weeks for bids for a 16,000,000-gal., reinforced-concrete reservoir. A contract for the excavation for this work has already been let. Plans are being prepared for a new high-service pumping station. Bids will soon be advertised for a 50,000,000-gal. low-service pump. A 20,000,000-gal. high-service steam turbine pump for the new station has already been contracted for. Possibly the low-service station will be moved to the Missouri side of the river. It is hoped that filtration will be taken up in the near future. Water-works improvement bonds to the amount of $1,500,000 were authorized about a year ago.

Professional Employment Service Opens New Offices

In order better to place the many returning Army officers in suitable business positions, the United States Employment Service has opened two zone offices in addition to the main ones in New York and Chicago. Besides the two just ready for business at 1518 Walnut St., Philadelphia, and 16 Tremont St., Boston, other offices will be opened soon, each to serve the particular zone in which it is located.

Applicants are required to make out detailed statements of experience and are personally interviewed, in order to determine just what work they are best fitted for. Likewise, employers are requested to be as specific as possible regarding their requirements.

Every soldier—officer or private—on leaving the Army is reminded that the Employment Service stands ready to help him hunt a job, and a surprisingly large number are taking advantage of the offer. Employers who desire to build up their organizations with discharged officers are requested by the Employment Service to get in touch with the nearest Professional and Special Section office.

Propose Conference on Column Formula and Train Loading

Appointment of a conference committee of the American Society of Civil Engineers, to obtain joint action on a column formula and a standard train loading for use in bridge design, was proposed at the meeting of the society Mar. 5. The American Railway Engineering Association has under consideration revised specifications for railway bridges, which contain a column formula of the parabolic type, a form hitherto not used in bridge or structural practice in this country. In view of this, C. E. Fowler moved that the Board of Direction of the society appoint a committee to confer with the association "in regard to delaying the adoption of the proposed column formula, which is somewhat revolutionary in character." The same committee is to attempt to secure agreement on a new train loading for bridge design, in place of the Cooper loading now widely used and adopted also in the new specifications. J. E. Greiner seconded the motion, which was passed by the meeting.

New State Highway Commissioner Nominated in New York

Governor Smith of New York has sent to the Senate the nomination of Col. Frederick Stuart Greene of Sands Point as state Commissioner of Highways to succeed Edwin Duffey, who was appointed during Governor Whitman's administration.

Goethals Retires to Civil Life

Maj. Gen. George W. Goethals, director of purchase, storage and traffic, General Staff, U. S. A., has retired to civil life. In a letter to General Goethals, made public by the War Department, Secretary Baker says:

"The success of your work is manifest, and I have no doubt when the history of this great undertaking comes to be written, your contribution to the success of the country in the war will be an outstanding feature."

Will Be Renamed Newlands Project

The Truckee-Carson irrigation project in Nevada, it is announced by Secretary Lane, will be known hereafter as the Newlands project, in commemoration of the late Senator Francis G. Newlands, who was the father of the reclamation law.

Notes from the Field

Confidence is one of the necessary ingredients for sustained relations between buyer and seller. So, too, is it a condition for lasting industrial peace. That such peace is not impossible of attainment is shown by the following story, told by an engineer who adjusted labor controversies during the war. When trouble impended he put the determination of the proper wage up to a single individual—sometimes a manager, sometimes an employee. Invariably both sides were satisfied with the award.

The selection of the man in whom implicit confidence could be placed was made in a variety of ways. Sometimes a labor leader would suggest the right man, at other times a banker, another employer, or some citizen whom the adjuster could trust. It so happened that a manager was selected quite as often as a worker. The critical point was to get a man who knew the situation and could be trusted. The procedure was something like this:

The individual chosen would be invited to the adjuster's hotel. "I'm told," the adjuster would begin, "that you are perfectly square and that I can rely on you to deal honestly with me and with the Government. Forget now that you are an employer [if such were the case] and consider yourself just a patriotic American, trying to help win the war. The employees demand 75c. an hour. You and your fellow employers are standing for 60c. I want you to write down the proper scale. Whatever you write, I'll approve. In other words, you, acting for the Government, must determine the award in this dispute. You know the whole situation. I do not. I'm acting in this way because So-and-so has told me that you are square, that you will not "double-cross" me and the Government.

Invariably there was a refusal, the individual protesting that he could not depart from the figure his confreres were fighting for. In the end, though, the adjuster's appeal would win, and only in one instance did the selected individual, by setting the wrong figure, betray the confidence that had been reposed in him.

But the important part of the story is this—that if the new scale had been set by a labor representative, the employers invariably wanted to know by what process the adjuster had been able to hit on just the right figure, while if a manager had set the wage for settlement, labor was mystified as to the process by which the right figure had been reached. In other words, both sides knew what was right. Traditional antagonism and hope that by strike one of them might gain an advantage or additional concessions kept them apart.

Had there been confidence that both parties would be fair, the mediation of the adjuster would not have been needed.

The great industrial problem is to establish this confidence. E. J. M.

West Virginia Legislature Votes Large Highway Bond Issue

After a vigorous campaign, the West Virginia legislature has adopted unanimously an amendment to the constitution, providing for a definite system of state roads and for the issuance of $50,000,000 of state bonds, outstanding at any one time, for highway construction and maintenance. At the same time the legislature passed unanimously a provision reëstablishing the road school at the state university. The system as proposed will connect the various county seats.

Form American Welding Society

The formation of the American Welding Society is announced in a recent statement from H. C. Forbes, secretary of the temporary organization, at 29 W. 39th St., New York City.

This society will be a merger of the Welding Committee of the Emergency Fleet Corporation, and the National Welding Council, and will include others who may be interested.

It is the purpose of the society to become a disinterested and dependable source of information on welding, not only for the benefit of the manufacturers of welding apparatus and supplies, but also to aid those who use welding in their production and those who purchase goods into which the welding process enters.

The first meeting will be held Mar. 28, 1919, at the Engineering Societies' Building, 29 W. 39th St., New York, at 10:30 a. m.

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission, for form 1312.

United States.—Superintendents of road construction, Bureau of Public Roads, Department of Agriculture, Mar. 25: Class A (candidates with four years' responsible charge of construction) $150 to $175 per month: Class B (six years' responsible charge) $185 t o$225; Class C (eight years' responsible charge) $230 to $250 a month. File applications before Mar. 25.

United States.—Assistant examiner, Patent Office, Washington, Mar. 26-28, and May 21-23 and July 23-25. Pay, $1500 per year. File applications in time to arrange for examination at place selected by applicant.

United States.—Chief physicist, qualified in aëronautics, National Advisory Committee for Aëronautics, Langley Field, Hampton, Va., Mar. 25, $3000 per year. Also physicist, $2100 per year. File applications before Mar. 25.

United States.—Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agricul-

ture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3400 per year. File application before Apr. 1.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 910 Michigan Ave., Chicago; Mar. 18-20; Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The National Highway Traffic Association will hold a public meeting at the headquarters of the Automobile Club of America, New York City, Mar. 21. The Hon. Francis M. Hugo, secretary of state, New York, will speak on "Qualifications for Operators of Motor Vehicles and Revocation of Licenses," and Shirley W. Wynne, Department of Health, New York City, on "Regulation of Pedestrian Traffic." Elmer Thompson, secretary of the Automobile Club of America, will read a paper on "Signposting for Detours and Through Routes in Municipalities." A committee report will be presented on "General Highway Traffic Regulations for Drivers, with Directions for Pedestrians."

The New York Chapter of the American Association of Engineers will hold a meeting at the Hotel McAlpin Mar. 28. C. E. Drayer, national secretary, will speak on "The Aims and Accomplishments of the American Association of Engineers." All engineers, whether members or not, are invited to attend and participate in the discussion. Mr. Drayer will spend two weeks in the East, studying the field in order to find how the association can best serve the profession in that part of the country.

The Engineers' Club of Columbus, Ohio, has made arrangements for permanent quarters in the Southern Hotel. Dudley T. Fisher addressed the club Feb. 28 on "Why Does the Inventor Fail to Receive the Expected Reward?" The legislation committee reported that Senate Bill No. 2 permitting chemical closets in school buildings had passed the Senate in spite of efforts against it by the club's committee and by the State Board of Health.

The Detroit Engineering Society held a meeting Mar. 7 at which David A. Molitor delivered an address on "The International Metric System of Weights and Measures." The society will hold a joint meeting with the Detroit Section of the Society of Automotive Engineers Mar. 21. Elmer A. Sperry will speak on "The Gyroscope in Modern Warfare."

The Colorado Association of Members of the American Society of Civil Engineers held a regular meeting Mar. 8, which was addressed by F. A. Banks, engineer, United States Reclamation Service, who spoke on "The Jackson Lake Dam, Wyoming." Mr. Banks' paper dealt with a description of development of storage and construction features and methods of delivering the stored water in the Snake River Valley, Idaho.

The Brooklyn Engineers' Club will be addressed Mar. 13 by James A. Donnelly on "Air Return Systems of Steam Circulation." Mr. Donnelly's paper will deal with steam and return mains and air-valve systems. On Mar. 20 Charles Evan Fowler will address the club on "Bridge Architecture and Construction," illustrated with lantern slides.

The Engineers' Club of Philadelphia was addressed Mar. 7 by Col. Edwin A. Havers, who spoke on "The Evolution of the Pen." I. W. Litchfield, director, technical division, United States Employment Service, will speak on "The Work of the Professional Section of the United States Employment Bureau," at the weekly luncheon Mar. 18.

The Michigan Engineering Society Feb. 28 appointed a special committee to consider the proposal for reorganization for the purpose of broadening the influence of the society by affiliating with it all the local engineering societies in the state, as mentioned in *Engineering News-Record* of Feb. 27, p. 448.

The Philadelphia Chapter of the American Association of Engineers recently elected the following officers: F. P. Roth, president; L. F. Boon, vice-president; M. F. Frick, recording secretary; H. F. Kuzel, David Lupton Son's Co., corresponding secretary.

The Montreal Branch of the Engineering Institute of Canada will be addressed Mar. 20 by W. H. C. Mussen on "Ball-Bearing Jacks" and by Ernest V. Moore on the subject of "Peat."

The Louisiana Engineering Society held a meeting Mar. 10 at which W. T. Hogg read a paper on "Suggested Changes in the Operation of the Street Railway System of New Orleans."

The Engineers' Club of Trenton will be addressed by William G. Thompson, state engineer of New Jersey, on "A National Highway Policy and Plan," at the meeting Mar. 13.

Personal Notes

MAJ. MARSHALL R. PUGH, Engineers, U. S. A., previously post engineer, Bordeaux Embarkation Camp, is now engaged in the cancellation of contracts for the United States Shipping Board, Emergency Fleet Corporation, having been discharged from Army service. Before the war he was in private practice as a member of the firm of Pugh & Hubbard, civil and sanitary engineers, of Philadelphia.

DR. HARLOW S. PERSON, director of the Amos Tuck School of Administration and Finance, Dartmouth College, and professor of organization and management, has resigned to become managing director of the Taylor Society, which will open permanent offices in the Engineering Societies' Building, 29 W. 39th St., New York City, Apr. 1. For several years Dr. Person has acted as president of the society, to which he will now devote his entire time.

MAJ. BRINTON BUCKWALTER, Ordnance Department, U. S. A., has been appointed manager of the New York branch, at 25 Pine St., of the Thompson & Lichtner Co., industrial and management engineers of Boston.

MAJ. WILLIS B. HAYES, Engineers, U. S. A., has been detached from the 210th Regiment at Camp A. A. Humphreys, Virginia, and has been appointed chief educational officer for occupational training at Base Hospital No. 31, Carlisle, Penn.

LIEUT. C. W. MARSHALL, Construction Division of the Air Service, U. S. A., previously assistant engineer, Bates & Rogers Construction Co. at Cleveland, has received his discharge and become sales engineer, Concrete Steel Co., western division, with office in Chicago. Lieutenant Marshall entered the service in 1917 and afterwards became assistant superintendent of construction at Ebberts Field, Arkansas, and Payne Field, Mississippi. He was later superintendent of construction at the flying field at Babylon, Long Island.

R. H. ROWLAND, previously associated with T. E. Murray, consulting engineer, New York, has engaged in private practice with office at 50 Broad St., New York City, as a designing and consulting engineer, specializing in mining, sugar and industrial plants.

J. C. MCVEA, office engineer, engineering department, City of Houston, Tex., has been appointed city engineer, succeeding E. E. Sands, who resigned

to engage in private practice, as noted elsewhere. Mr. McVea, who is president of the Houston Engineers' Club, is a graduate of the University of Texas and had been in the engineering department of the Southern Pacific Co. for about 10 years.

Arthur S. Hobby, previously associated with the Snare & Triest Co. at Havana, Cuba, has become assistant to the president, North Coast Rys. of Cuba, with headquarters at Moron, where he will have charge of construction work.

Lieut. Walter S. Anderson, of the Aviation Corps, formerly in the Chicago office of the Universal Portland Cement Co., attached to the inspection department, has been discharged from the Army and has entered the paving-plant department of the Lakewood Engineering Co., as field engineer, located in the Chicago office.

C. F. Horneffer, chief draftsman of the Austin Co., Cleveland, will be engineer in charge of design and construction of a destroyed glass plant at Maubeuge, France, which his company will build for Pilkington Brothers Co., St. Helens, England. Mr. Horneffer will organize his engineering staff and undertake the design entirely in England, employing English engineers.

R. H. Ford, engineer of track elevation, Chicago, Rock Island & Pacific Ry., Chicago, has been appointed principal assistant engineer with headquarters at the same point. The office of engineer of track elevation has been abolished.

Capt. H. K. Talbot, of the Construction Division of the Army, has resigned and accepted a place in the selling organization of the Koehring Machine Company.

John F. Greene, formerly construction engineer, Carter-Halls-Aldinger Co., Winnipeg, Man., has become associated with the firm of C. D. Howe & Co., consulting engineers of Winnipeg and Port Arthur, as manager of the Winnipeg office, in charge of bridge and structural work.

Capt. John H. Anderson, of the 212th Engineers, formerly of the technical staff of the Universal Portland Cement Co., has received his discharge from the Army and has become field engineer in the paving-plant department of the Lakewood Engineering Co., with office in Cleveland.

Charles A. Pohl has finished his work as head of the Concrete Shipyard Construction Section, Emergency Fleet Corporation, and has returned to general engineering practice in New York as a member of the firm of Bogart & Pohl, civil engineers. He will give his attention largely to hydraulic and steam electric powers, water-front developments and manufacturing plants.

L. C. Welch, chief engineer of the Midwest Refining Co., Casper, Wyo., has been appointed manager of the paraffine oil department of the company.

E. B. Ford, office engineer, Great Northern R.R., with headquarters at St. Paul, has been appointed assistant engineer, northwestern region, with headquarters at Seattle, succeeding T. G. Hastie, who has been appointed resident engineer, Great Northern R.R., with headquarters at Great Falls, Mont.

Capt. Frederick L. Jones, Construction Division, U. S. A., has been discharged from the service and has returned to his work in the firm of Jones & Hazel, engineer-appraisers, Watertown, N. Y.

T. G. Hastie, assistant engineer, northwestern region, United States Railroad Administration, with headquarters at Seattle, has been appointed resident engineer, Great Northern R.R., with headquarters at Great Falls, Mont.

Capt. John P. Wentworth, Sanitary Corps, U. S. A., has received his discharge from the service and has returned to his former position as assistant engineer with Metcalf & Eddy, consulting civil engineers, Boston.

Maj. E. L. Deacon, Air Service, U. S. A., formerly superintendent of construction, George A. Fuller Co., Detroit, has organized the E. L. Deacon Construction Co., with headquarters in Detroit.

Charles Carroll Brown, formerly of *Municipal Engineering*, has been appointed assistant maintenance engineer, Division of Highways, Illinois Department of Public Works and Buildings.

Capt. Edward Wright, Jr., Sanitary Corps, U. S. A., having received his discharge, has returned to his former position as assistant engineer, Massachusetts State Department of Health.

Lieut. Robert Goelet Carraway, U. S. A., recently returned from overseas, has received his discharge from the service and has resumed his work as managing engineer, Henry Exall Elrod Engineering Co., Dallas, Tex.

E. E. Sands, for the past five years city engineer of Houston, Tex., has resigned to enter private practice with headquarters in New York City, specializing in port and terminal development. He is a graduate of the University of Wisconsin, and for a number of years was connected with the United States Reclamation Service in the West, and with the Canadian Pacific Ry. Land Development Department.

Lieut. George A. McClellan, U. S. A., has been discharged from the service and has become associated with the Henry Exall Elrod Co., Dallas, Tex., as highway engineer for the northern and eastern portions of the state.

W. D. Shannon, inspector of hull fabrication, American International Shipbuilding Corporation, Hog Island, Penn., has resigned to return to his work with Stone & Webster in Boston.

Haven C. Kelly, divisional superintendent, track and roadway, Chicago City Ry., has been appointed superintendent of the department.

Obituary

Ralph H. Brown, vice-president and chief engineer of the Eastern Bridge & Structural Co., Worcester, Mass., died in that city Feb. 22. He was graduated from the Thayer School of Civil Engineering in 1885, previous to which he had served in the engineering department of the Painesville & Youngstown R.R. and in the office of the city engineer of Youngstown, Ohio. In 1885 he became associated with the Boston Bridge Works as assistant engineer, six years later becoming engineer in charge of the estimating department. From 1894 to about 1900 he was chief engineer of the company. He afterward became associated with the Eastern Bridge & Structural Co., of Worcester, and became vice-president and chief engineer.

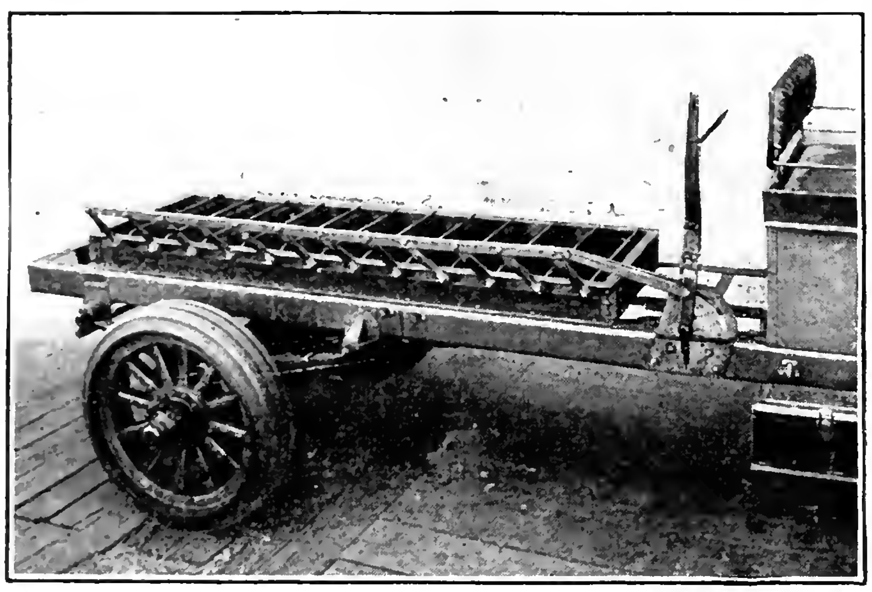
Frederick Hobart, for many years a member of the editorial staff of *Engineering and Mining Journal*, died in Flushing, N. Y., Mar. 9, in his 77th year. He had been in retirement since 1917. Immediately following his graduation from the College of the City of New York, he entered the Federal Army in the 9th New Jersey Cavalry, attaining the rank of captain. Returning to civil life, he became connected with the Jersey City Locomotive Works and was afterward assistant editor of the *Railroad Gazette*. He joined the staff of *Engineering and Mining Journal* as assistant editor in 1893.

George Welsby Scott, consulting engineer, Chicago, died Feb. 28 in Battle Creek, Mich. He had been engaged largely in appraisal work and at one time was associated with the Pullman Company.

Dump-Bottom Truck Body for Spreading Road Material

As a byproduct of his work as a highway engineer, W. L. Goodwin, 1515 N. 40th St., Seattle, has invented a device for spreading road material from a moving truck. It consists of a truck body bottom made of a steel frame with pivoted steel plate panels resembling in principle the old-fashioned wooden window shutter.

The bottom of the truck is made of steel channels forming a frame, which holds the cross-plates. There are 12 plates, each [illegible] in. wide, made of ¼-in. iron and with [illegible] x 1½-in. strengthening rod which acts as an axle. The picture shows how each of the panels is fastened by a crank handle to a longitudinal bar connecting all of them together. To the end of this bar is connected the lever which controls the dumping of the truck. This lever locks forward like a wagon brake, pulling all of the small steel panels into a horizontal position so that the bottom of the truck is closed to hold fine material. To dump the load in the truck this handle is released and, as the axis of each steel panel is off center, the weight of the load in the truck is heavier on one side of the axis than on the other, facilitating dumping. As the control lever may be locked at any one of several points, it is possible to leave the panels turned so that the material in the truck will work out gradually and evenly, according to Mr. Goodwin, and thus be distributed over a roadbed without hand labor.



DUMP BOTTOM FOR TRUCK INVENTED BY ENGINEER

The dumping bottom is designed for use with any motor truck or trailer where the machinery underneath the body will not be damaged by the falling material.

The device is now manufactured for local trade by the C. J. Young Iron Works Co., Seattle, Wash.

Hines To Address American Lumber Congress

A general lumber convention or congress, to which all branches of the industry are invited, on Apr. 14-16, will overlap the annual meeting of the National Lumber Manufacturers' Association on Apr. 16-17. Both will be held at the Congress Hotel in Chicago. Walker D. Hines, new director general of railroads, will address the Congress on Apr. 16.

Methods of retail service and the merchandising of lumber will be discussed Apr. 14, problems of manufacturers and distributors on Apr. 15, and questions of Governmental relations on Apr. 16, according to announcement. Lumber men hope that the congress will result in the formation of a national policy for the lumber industry.

Trade Publications

The Brandell Co., Union Central Tower, Cincinnati, Ohio, has issued a 6 x 9-in. 24-p. catalog which illustrates and describes "The All-Automatic Brandell Concrete Stone Machine."

Dimension drawings for the use of designers are included in a 95-p. book on the Jeffrey bucket conveyor, issued by Jeffrey Mfg. Co., Columbus, Ohio.

"Lighting from Concealed Sources" is the title of an 8 x 10-in. 245-p. cloth-bound book published by the engineering department of the National X-Ray Reflector Co., New York and Chicago. It is "a practical treatment of lighting problems to obtain satisfying illumination and individual effects without exposed light surfaces," and is profusely illustrated with half tones, line cuts, diagrams and tables.

"Insley Steel Guy and Stiffleg Derricks" is the title of Bulletin No. 110 of the Insley Mfg. Co., Indianapolis, Ind., illustrating and describing its products.

The J. D. Fate Co., of Plymouth, Ohio, has issued a series of bulletins covering industrial haulage by classes. The object of these bulletins is to show the application of the Plymouth gasoline locomotive to various industries.

The Joseph Dixon Crucible Co. has issued a pocket catalog listing lubricants and paints and pencils for mill, railroad and automobile use. The catalog also describes pencils.

The Brown Hoisting Machinery Co., Cleveland, Ohio, has issued Catalog K, 1919. It is an 8½ x 11-in. 93-p. paper-bound book illustrating, describing and giving diagrams and tabular data regarding the Brownhoist locomotive cranes.

The Blaw-Knox Co. announces its "products booklet," indicating the fields covered by its products.

"National Pavement—The Right Road" is the title of a 6 x 9-in., 20-p. pamphlet issued by the Permanent Highways Corporation, 50 E. 42nd St., New York City. It gives descriptions, illustrations and references regarding the work done by the corporation in various parts of the country.

The Novo Engine Co., of Lansing, Mich., has issued Bulletin No. 11 describing and illustrating hoisting outfits manufactured by the company.

Steel forms for concrete and monolithic brick pavements, for integral base and curb work, for curb and gutter building, and for beveled edges on concrete roads, are among the subjects included in a new booklet by the Blaw-Knox Co., of Pittsburgh.

Portable air compressor outfits is the subject of Bulletin No. 15 of the Novo Engine Co., Lansing, Mich.

Business Notes

The Moore Trench Machine Co., Rockaway, N. J., is about to resume operations with a full force of men, after a period of wartime idleness of about a year.

Export sales of railroad supplies to the West Indies and South America is the field of the M. C. Fairchild Co., with offices at 347 Madison Ave., New York. Mr. Fairchild has been with Fox Bros., New York, in the same field for a number of years.

A. S. Blagden, director, Air Reduction Co. has been elected president, succeeding W. W. Birge. A. R. Ludlow has been appointed vice-president; C. E. Adams treasurer, and M. W. Randall secretary. The Air Reduction Co. manufactures oxygen, hydrogen, nitrogen, acetylene, calcium carbide, and cutting and welding apparatus, under the trade name "Airco."

H. Y. Smith, formerly vice-president of the Kern-Hunter Co., Milwaukee, Wis., is now engaged under his own name in the handling of contractors' and industrial plant equipment, at 1227 First National Bank Bldg., Milwaukee.

The Clydesdale Brick & Stone Co., of Pittsburgh, Penn., announces that on Mar. 1 its office was moved from the Oliver Bldg. to 907-908 Hartje Bldg., Wood St. & First Ave., Pittsburgh.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 NEW YORK, THURSDAY, MARCH 20, 1919 Number 12

Meeting the Cost of Water-Main Extensions

HOW best to meet the cost of extending water mains is not so easy a question to answer as may appear at first thought. Practice varies widely and does not seem to be based on comprehensive scientific study. The path of least resistance is the one most likely to be followed. Beyond attempts to avoid legal pitfalls, local feeling seems to control. The policy of the water board or city council may be liberal or the reverse, according to whether there prevails the idea of water service to all on easy terms, or strict regard for revenue in excess of capital and operating charges. Or the practice may range between these two extremes. The variations thus far considered relate to the division of responsibility for extensions between individuals and the city. Where the individual property owners must bear the whole or part of the responsibility there still remains the question: Shall they pay the first cost of the extension, or shall they guarantee a revenue for water which shall be a stated percentage of the first cost? If the property owners pay all or part of the first cost, how shall it be apportioned among them? The easiest way is to adopt the pro rata frontage basis. Is it the fairest and best way? If the property owners voluntarily and unanimously agree to such a plan, perhaps no one need complain, but if the city must use compulsion on some property owners then the question arises, Is the plan equitable? The subject bristles with questions.

Assessment of Benefits Deserves More Attention

INCREASED attention might well be given to assessments for benefits, as a means of meeting the cost of water-main extensions. This proposition was brought before the New England Water-Works Association at Boston last week. The discussion, briefly summarized on p. 591, was quite extended, but it ranged over the broader field of paying for water-main extensions discussed in the note preceding this one, and showed the diversity of practice already mentioned. The discussion indicated that the practice of making individuals assume responsibility for water-main extensions is common, and that often it is the property owner rather than the water consumer who must shoulder the burden. The examples cited did not show that an out-and-out benefit plan is commonly used, but, rather, that where the property owners are made responsible frontage is the basis of dividing first cost. More commonly, it appeared, there is a voluntary assumption of responsibility, whether on a first-cost or a revenue-guarantee basis. The discussion, common observation and any considerable knowledge of human nature, combine to show that such a plan leads to unfairness. Sooner or later, those who assume none of the responsibility get water without bearing their share of the burden. Taking all the foregoing facts and opinions into account, as well as the increasing difficulty in finding money for municipal improvements, the case seems to be strong for a thoroughgoing study designed to show for a considerable number of water-works, well distributed geographically, what the current practice is as to meeting the cost of water-main extensions, the details of the assessment-for-benefits plan whenever it is used, and the wisdom of extending that plan. The study should include consideration of how the benefits-assessment plan may best be adapted to water-works conditions.

Lessons From Spring Breakups

TIMES of excessive moisture are generally admitted to be the most critical periods in the life of road surfacings. This was abundantly proved by the experiences of last spring, when large sections of roadway which had successfully carried equal or greater traffic over dry subgrades were broken through as the frost left the ground. As excessive moisture is the recognized cause of these failures, the least that can be done at such times is to keep the ditches open so that the saturation of the subgrade will not be increased by standing water. A second precaution which might well be employed is to regulate heavy traffic at the critical time. If roads which will carry the loads for 360 days in the year are broken down by the traffic in the other five, as was the case in some instances last spring, it would seem the height of maladministration to allow the same thing to occur again. While in many sections there is little depth of frost this year, due to the clemency of the past winter, there is certain to be a season of excessive moisture, and every effort should be put forth by highway officials during the next two months to safeguard the public investment.

Highway Lettings Should Be Expedited

EVIDENCE of delay in the authorization of projects and the preparation of plans for country highway and city paving is making its annual appearance. Although March is nearly gone and plans should be ready for the spring opening, little work is being advertised for letting. Much of this delay is no doubt due to the hope among officials that there will be a decline in the prices of highway materials. This is a mistaken policy, both because investigations by economists indicate no immediate prospect of such a movement, and because the monetary value to the communities of immediate use

of good roads would largely counterbalance any possible saving in the cost of road materials. The disadvantage of a late start in highway work is apparent to all engineers. It means late fall work, under frost conditions, and possibly a shut-down for the winter months, thus delaying the completion of the contract and the utilization by the public of the money already invested. To these arguments against delay may be added the patriotic incentive to help out in the unemployment situation confronting the nation. The road-building season is short at the best, and highway engineers should urge their commissioners, councils and boards of public works to expedite the lettings.

Some Mayors Need Education

IN THE last minutes of the recent Governors' and mayors' conference in Washington the presiding officer read a resolution signed by a number of the 130-odd mayors present. It set forth that whereas a number of cities are interested in the purity of their water supplies, etc., etc., therefore be it resolved that Surgeon General Rupert Blue of the United States Public Health Service be requested to investigate the many systems of sewage purification—it may have read "sewerage" purification—and, as a result of this investigation, recommend the best system to use. This was the purport of the text; the exact words are not available, and it was not only signed, but advocated on the floor, by several of the distinguished heads of cities. This is not a joke, but a veritable occurrence. Engineers who are inclined to laugh at it should rather bestir themselves in their towns. Dissemination of the facts underlying great engineering operations or principles is apparently needed in many quarters.

No Military Control of Public Works

ALTHOUGH lost sight of in the confusion of the last days of the 65th Congress, the idea of a Federal Department of Public Works must not be allowed to die. Now is the accepted time for this most necessary change in the control of Government engineering operations, when Congress, through repeated appropriations, is alive to the extent of those operations, and, what is more important, to their divided control. Individuals must urge the Public Works Department idea; engineering societies must push it, but everyone should insist on a subordination of the military in this civilian department. Particularly will it be necessary to combat the idea that engineer officers of the Army must take charge of civil engineering works of the Government in order to provide them with the practical engineering experience necessary in war.

Granted that the Army's own work—barracks, fortifications, etc.—will not be sufficient to ground the Army engineer in the fundamentals of the construction and administration end of his profession, there is no reason why the engineer officer cannot be *assigned* to the civilian operations under the direction of a Department of Public Works, as has been done for many years in the British colonies. Let the Army engineer spend the proper amount of time in the Army organization—commanding men, studying and developing purely military engineering, building the structures and equipment necessary to the Army itself—and every so often let each officer be detached from his unit and assigned, as a civilian, with only a civilian's privileges and rights, to one of the multitude of engineering constructions that a proper Federal Department of Public Works would control. He could not thus carry over the asperity sometimes peculiar to the military uniform. That uniform would not bar the way of his subordinates to promotion. He would be, for the time being, a civil engineer in a civilian organization, learning many things of value to him in his profession of military engineer, and giving to the Government and to the job the benefit of his education and his experience.

A most powerful influence to bring about such a development will be found in the thousands of discharged soldiers. The Army, to these men, while a most necessary thing to have ready for war, demands a routine and a régime not at all fitted for the less rigorous operations of peace. They will insist, especially the engineers among them, that the Army stick to its military functions and leave Government civil construction to the less rigid and more democratic control of a peacetime civilian organization.

Plan to Eliminate Jurisdictional Strikes

EMPLOYERS and employed have taken an important step toward cementing the building trades into a league for the settlement of disputes as to union jurisdiction over work. The immediate purpose of the league, or board, as it is called, is to create a means for preventing strikes of building trades unions due to jurisdictional arguments.

Some months ago, at the separate but simultaneous instance of the American Institute of Architects and the Building Trades Department of the American Federation of Labor, the United States Department of Labor undertook to canvass the situation and suggest a working plan. After various conferences with labor leaders and representatives of the American Institute of Architects, a formal plan was drafted by John A. Lennon, and on Mar. 3 and 4, at Cleveland, Ohio, this plan was submitted for action to representatives of the building industry.

The plan submitted called for the creation of a body to be known as the National Board of Jurisdictional Awards of the Building Industry, to consist of eight members and eight alternates, four to be selected by the Building Trades of the National Federation of Labor and one each by the American Institute of Architects, the American Society of Civil Engineers, the Associated General Contractors of America and the National Association of Builders' Exchanges. The duties of the board are to hear and determine claims for jurisdiction over work performed, and make award in conformity with the facts. A three-fourths majority vote of the full board is required to fix the award, and it is provided that all local arbitration committees shall insert in the agreement between employers and employees a clause as follows: "The decisions of the National Board of Jurisdictional Awards of the Building Industry shall be final and binding upon the parties to this agreement."

Engineers, contractors and union labor have thus demonstrated their capacity for coöperative action for mutual benefit. This is an attainment which looks far beyond the immediate object sought. It promises, ultimately, a real partnership of management and labor in the construction industry.

Will Prices Fall?

WILL PRICES FALL, is the national question of the day. Upon its answer depends to a large extent the business activity of the near future, and upon that business activity in turn depend social questions of tremendous import. From time to time *Engineering News-Record* has commented upon the situation, the sum total of that comment being that prices are not likely to fall to any material extent in the near future. This conclusion has been predicated upon the belief that the total of the peace-time demand will not be far short of the war demand itself. During the war there was produced a tremendous shortage in practically every kind of commodity. There is an oversupply here and there, but the instances are isolated and entirely out of harmony with the general situation. That shortage must inevitably be overcome unless the peoples of this world lower materially their standards of living. History and the disposition of the public in every country of the globe give us the assurance that living standards will not be lowered. In fact, they are quite likely to be raised, still further increasing the post-war demand and assuring that it will be not much below that of the maximum war demand itself.

Reinforcing this point of view is the testimony of the periods following the Napoleonic and Civil Wars, graphed and discussed by Morris Knowles in *Engineering News-Record* of Feb. 27, 1919, p. 414.

Now Irving Fisher, professor of political economy in Yale University, approaching the problem from an entirely different standpoint, draws the same conclusion.

He takes the position that the world has advanced to a new price level, and that this new price level is no more likely to be receded from than were the price levels brought about by the great influx of gold and silver into Europe from the mines of the new world in the sixteenth century, or that caused between 1896 and 1914 by the discovery of the gold fields of South Africa, Cripple Creek and Alaska, the invention of the cyanide process in mining, and the vast extension in the use of bank credits. In other words, he sees in the present price advance, even though brought about by the urgency of war, a permanent change in the plane on which the world must do business.

Explaining his position, Professor Fisher adverts to the well known and thoroughly established fact that the general level of prices is dependent upon the volume and rapidity of turnover of the circulating medium in relation to the business to be transacted thereby. As he puts it, "If the number of dollars circulated by cash and by check double, while the number of goods and services exchanged thereby remains constant, prices will about double. Over $1,000,000,000 in gold has come into this country from abroad since 1914, and a large amount has disappeared from domestic circulation. On June 30, 1918, the portion of the gold reserve of the Federal Reserve banking system which supported national bank deposits and Federal Reserve notes was more than three times as large as the gold reserve under the old national banking system on June 30, 1914—$1,786,000,000, as compared with $592,000,000. During the same period, credit instruments (demand deposits and notes) increased about twofold—from $6,100,000,000 to $11,700,000,000. It is this increase of credit instruments, typical of the banking situation for the country as a whole, which, Professor Fisher points out, largely explains the present high level of prices.

Moreover, we are not at the end of the possible limit of expansion even now, provided we take the same view of our financial structure, or at least of the ratio between credit and gold, as we did in the pre-war period. At the present time the ratio of gold to credit has risen from 9.6% to 15.3%, while the reserve requirements of the present system are such that for 1918 there was an excess of gold above legal requirements of more than $700,000,000. The reserve required by law to support the $11,700,000,000 of credit instruments of 1918 is $1,070,000,000. The $700,000,000 of free gold could support an additional superstructure 70% as large as the existing one, which indicates that for the banking of the country as a whole a potential future expansion of 50% is a conservative estimate.

Discussing the situation from the standpoint of so-called "inflation," Professor Fisher points out that by inflation we mean merely the use of more circulating medium than is needed to transact the business of the country on a given price level. Whether or not we have inflation, therefore, depends upon the price level. If the price level of 1913-14 be considered normal, there would certainly be inflation now, but our currency is not inflated at the present time relative to the new level of prices in the world which the war has brought about. In other words, any expectation that there will shortly be a disappearance of this so-called "inflation" is based on the assumption that normal prices are those of 1914.

Looking to the future, there is no hope in sight for credit contraction; another large Government bond flotation is at hand, with the possibility of still another. After that there should be some contraction in the volume of credit, but Liberty and Victory bonds then in the hands of the people will be unrivaled bases of credit, and, experience shows, will undoubtedly be used for that purpose, thus tending to keep up the outstanding credit volume. He does not contend that it is absolutely impossible to bring down the price level, but argues that the experience of history and the possibilities now open for world-wide expansion point to the maintenance of present prices permanently or at least for a long period of years. Between the period of temporary and of permanent effects there may be a slight dip in the price level, say a year from now, but the possibility of that, he holds, is all the more reason why business should proceed now and not wait a year for the dip.

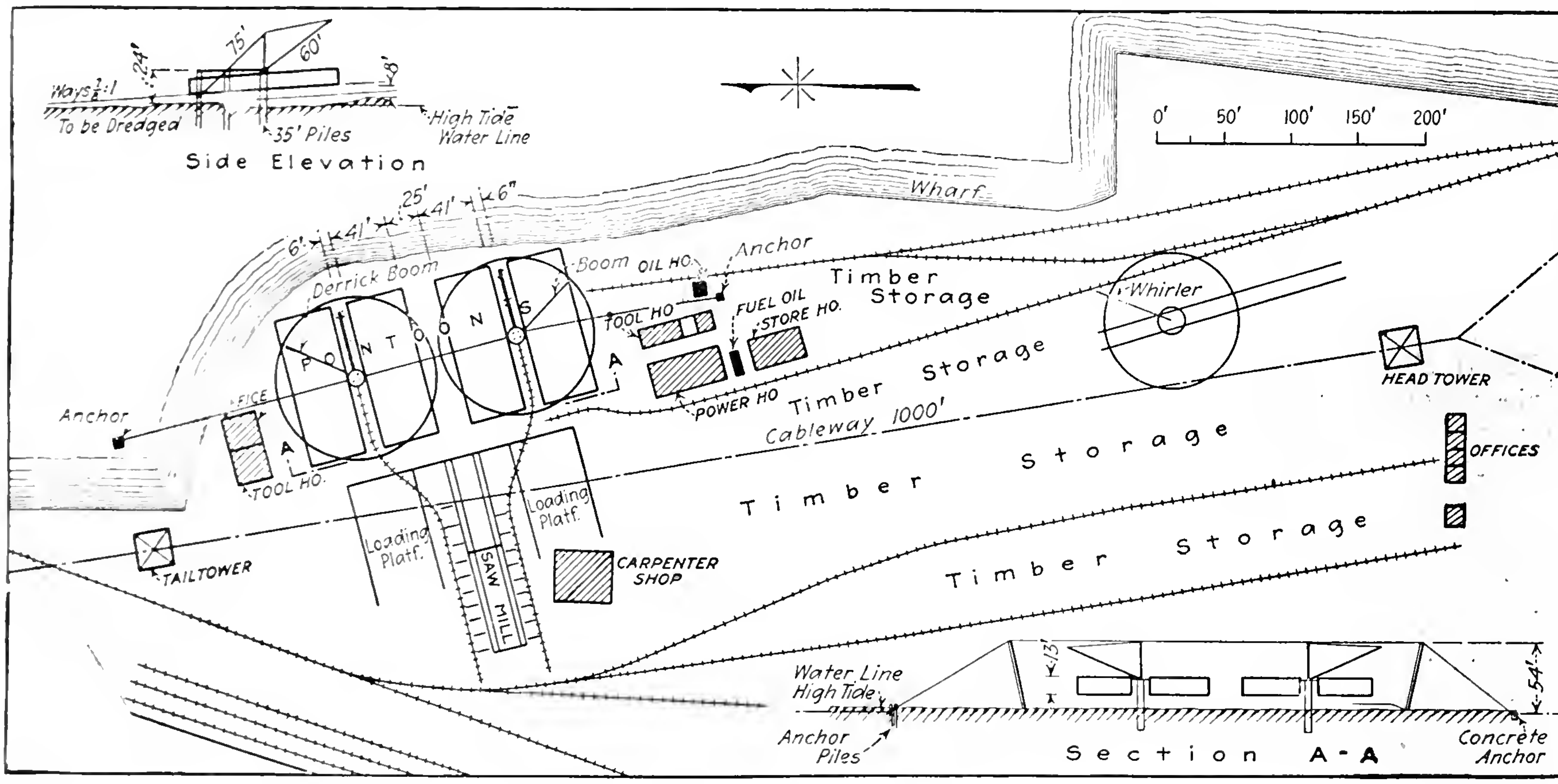
The conclusion to be drawn from this situation is that the sooner the business men of the country take the view that we are on a permanently higher price level and adjust themselves to it, the sooner will we save ourselves and the nation from the misfortunes that will come if we persist in our present false hope of expecting prices to come down, meanwhile creating a dangerous unemployment situation. Since the armistice, the buyers of the country have made an unexampled attack upon prices through their waiting attitude, and yet price recessions have been insignificant.

The clever man, Professor Fisher concludes, "is not the man who waits, but the one who finds out the new price facts and acts accordingly." What applies to the business man applies to Government officials, local, state and national, who hold a greater responsibility just now than the individual business man, for in their keeping rests national stability. If they will proceed with public works, the mills and the mines will operate, the whole industrial fabric will be strengthened, and the ominous prospects of business depression will disappear.

Building a Floating Dry Dock in Well Laid Out Yard

Cableway Assisted by Whirler and Derrick Car Keeps Heavy Timbers Ready for Carpenter Crews—Large Band Saws and Cutoffs Frame 12 x 12's Handled on Two-Way Roller System

MATERIAL for the 10,000-ton floating dry dock now under construction at Galveston, Tex., for the Galveston Dry Dock and Construction Co., moves through the yard with order and precision. To this fact and to the layout of the yard which permits this ready hauling of material, is attributed much of the speed and efficiency with which the work is being forming the heart of the material-transportation system on the job. At one end of the yard a whirler derrick on a 12-ft. track was set up between the cableway and the railway siding, and is used to unload material directly to skids under the cableway. The sawmill was placed at the other end of the lot between the other track and the cableway at a point opposite the four



LAYOUT OF YARD WHERE FLOATING DRY DOCK IS BEING BUILT AT GALVESTON

carried out. The dry dock consists of 11 wooden pontoons each 41 x 110 ft. in plan and 13 ft. high which are built on four parallel ways and launched endwise, to be tied together afterward by the plate-covered steel frames which form the dry-dock wings.

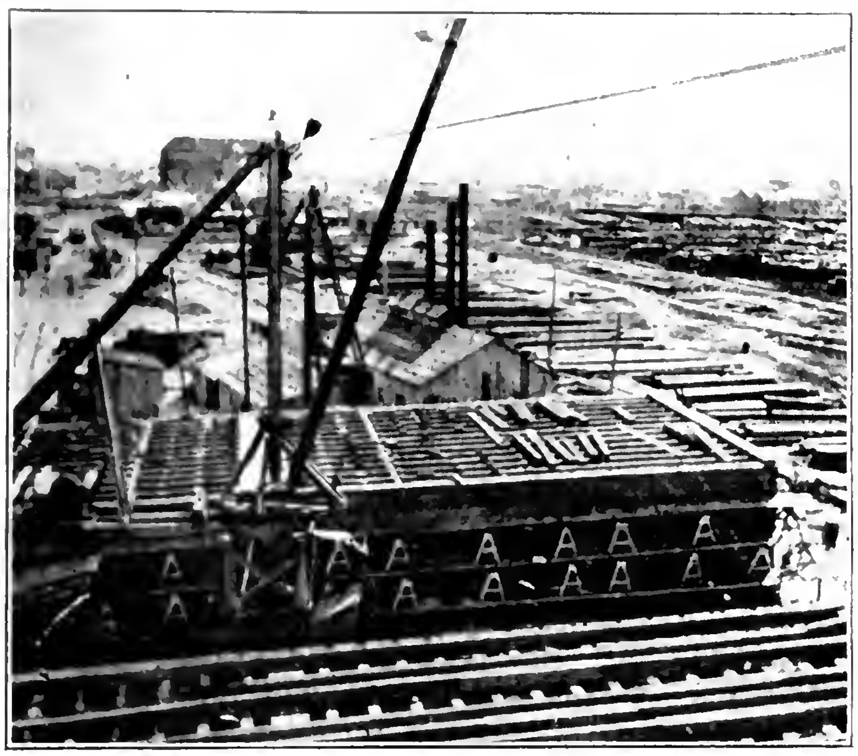
The ground selected for the construction of the pontoons, as shown in the drawing, afforded two railroad connections and a wharf. A cableway was laid out along the length of the lot between the railway tracks, ways. A derrick car unloaded onto the storage skids and platforms near the mill that part of the material which required framing. Other material was unloaded at the other end of the yard directly under the cableway. The storage piles were so laid out that the longest timbers required could pass between them while going from the mill to the derricks on the standard-gage four-wheel cars of the feeder tracks. Each track fed one derrick. As the tracks passed under the cable-

PANORAMA FROM CABLEWAY TOWER AT END OF YARD USED FOR BUILDING PONTOON UNITS FOR A FLOATING DRY DOCK FOR GALVESTON, DRY DOCK AND CONSTRUCTION COMPANY

way the cars also received material for the derricks from the cableway.

The mill itself is composed of two units, although under one roof, run by one engine and fed by a derrick car and cableway. Each unit consisted of a 36-in. band saw and a cutoff, one 36 and the other 42 in., and a roller conveying system from the storage piles. One joiner and one rip-saw served both sides, and one engine drove the two lines of shafting which took care of all equipment. Each side of the mill supplied the derrick nearest it.

Large saws were used, as the timber to be cut was all of large dimensions. The swinging cutoffs were found very useful in squaring ends and cutting lengths, while the band-saws were used for bevel work where the weight of the piece to be cut would permit maneuvering at all readily. Extremely heavy pieces were cut with a pit-saw by hand. A box templet was used to

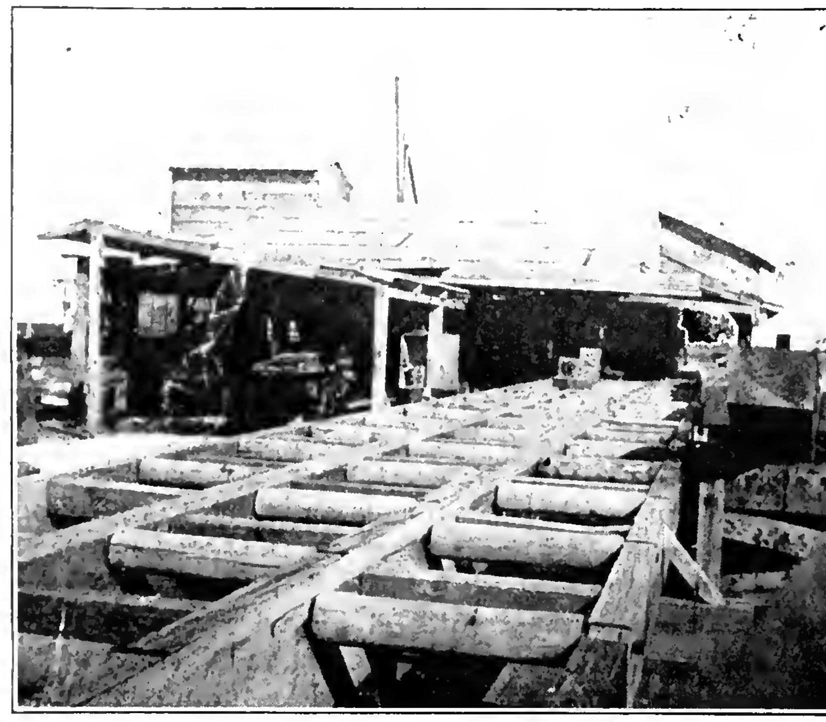


THIS DERRICK WAS ABLE TO BUILD TWO PONTOONS SIMULTANEOUSLY, EACH 41 x 110 FEET

get a true cut, and the timber was placed on a platform to eliminate the necessity of a pit.

The platforms adjoining the mill were built of timbers bought for the pontoons and used in them at the end of the work. As pieces requiring but little framing were selected, there was little mill work left to be done after the platforms were torn up. The ground blocks and the struts which sat on them were the only timbers bought for the platforms.

To facilitate easy handling, the tops of the mill platforms, skids and rollerways were made level with the tops of the saw tables. Rollerways on both sides, running close to the cutoff, led from the end of the platform by the switch to the end of the pontoon ways. On the switch side two more rollerways were placed beside the one toward the center of the mill. Outside were 8-ft. horses built with cast-iron rollers projecting from their tops, for the purpose of conveying timbers in a direction across the length of the piece. These rollers overlapped each other in plan, so that an 8-in. piece would always be on two of them and not edge between the rollers and the stick. The idea of these rollers was obtained from work of the Midland Bridge Co. in Houston.

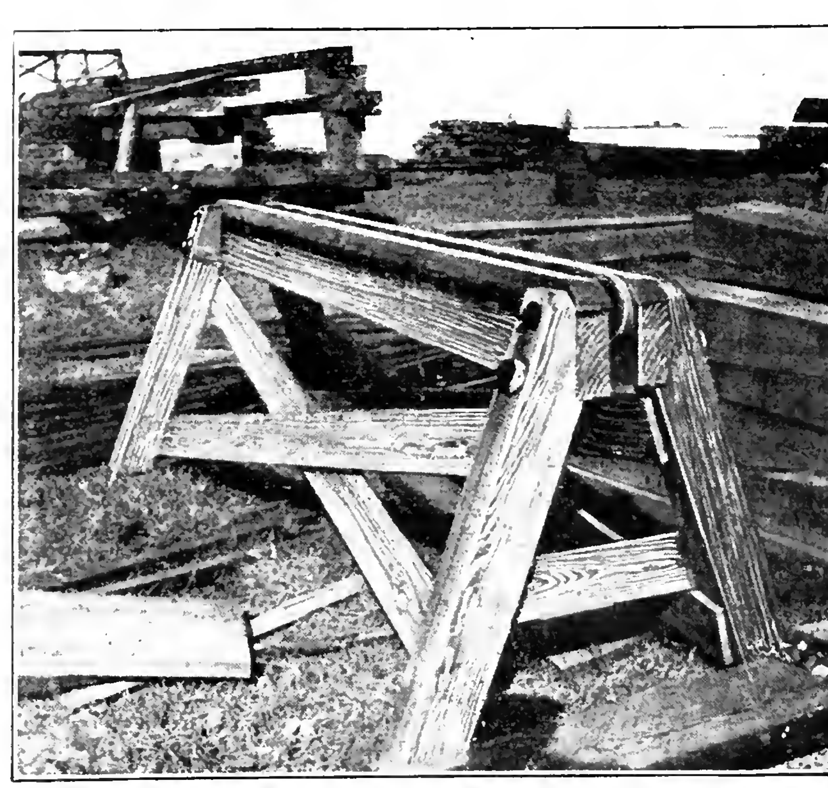


ROLLERS THAT HANDLE HEAVY TIMBER AT SAWMILL

Timber was stored in a long pile under the cableway and in several piles around the mill. The cableway pile held the material for six pontoons when piled to a height of nine feet.

The skids away from the mill were only built high enough to keep the timber off the ground and to allow a chain to be passed readily underneath.

Another point that made for smooth, quick work was the fact that the derricks at the ways were raised high above the pontoons. The engine runners could see directly and at close hand the placing of almost every piece they handled. Free motion of the boom is afforded by this elevation, as well as by the use of a single stiffleg and an overhead guy. One cable runs over the top of the two derricks and on over two masts, one at each end, placed clear outside of the area occupied by the pontoons. The ends of this cable are anchored after passing these outside masts. The stiffleg on each derrick secures the mast in two directions, and the guy

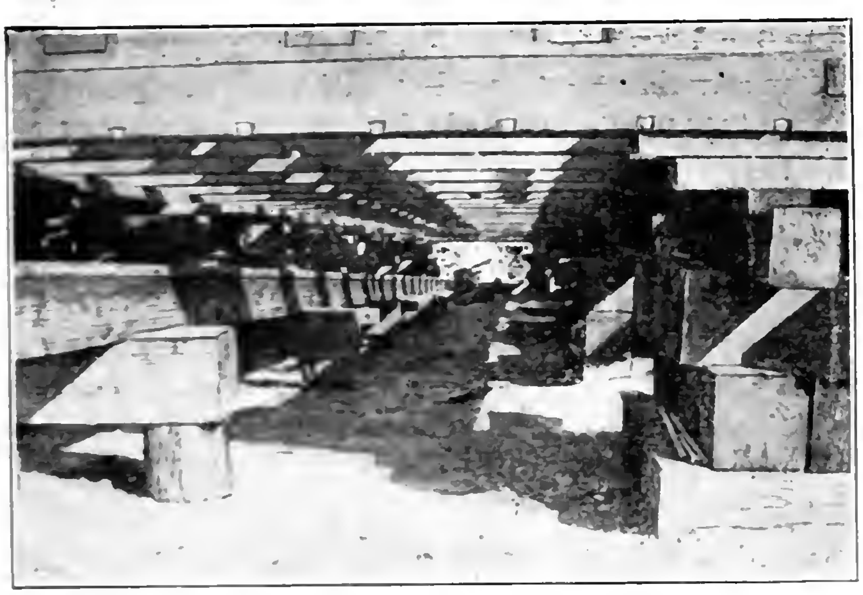


A HEAVY TIMBER LAID ON SEVERAL OF THESE ROLLER HORSES PLACED SIDE BY SIDE IS EASILY MOVED

over the top holds it in the two opposite directions, thus securing the derrick.

Support of the pontoons during construction was provided at the ways by piles of blocking topped by 8 x 12-in. wedges, as shown in one view. The flooring on the bottom of the pontoon was then placed, and the sliding ways were set and blocked against the bottom of the finished pontoon. The fixed ways were built of 9 x 9-in. timbers bolted together to form a 9 x 18-in. piece with staggered joints. This was laid flat on the supporting pile caps. With the blocking snugly set between the ways and the pontoon, the weight of the latter was delivered to the former by loosening the wedges on top of the blocking upon which the pontoons had been built. In one or two cases it was necessary to dig under these blocks and allow them to settle, but usually the wedges themselves moved readily enough. The upper or sliding ways were flanged instead of the lower or fixed ones, which required less flange material, as the upper ways were the shorter.

After it was launched, but before it was towed to the assembly slip, each pontoon was loaded with steel for the wings. These wings are water-tight steel walls which are continuous over the several pontoons, and so assemble them into a unit, the finished dry dock. A joint is made in the wings, however, so that the 10,000-ton dock may be divided into two units, using four and seven pontoons, respectively. The framework of the wings is erected by a derrick barge which also handled the outside plates. The inside plates are raised by a hoisting engine using a line through a block fastened to the top of the framework. A permanent compressor plant was outfitted early so as to supply air for driving the 300,000 rivets used in the wings.



DETAIL OF BLOCKING AND WAYS

In order to hold the pontoons firmly in the correct position during the placing of the wings, four wooden trusses are bolted to the pontoons, holding the two pontoons being attached to those already assembled. When new pontoons are to be attached the trusses are moved ahead.

The construction and assembly of the dry dock are being done by a Missouri Valley Bridge and Iron Co. organization headed by F. E. Washburn as engineer in charge. C. W. Cubbage is superintendent on the work in the pontoon-building yard, and F. L. Brock is superintendent of steel erection. H. A. Treat is general manager of the Galveston Dry Dock and Construction Co. The dry-dock design, including assembly trusses, was made by William T. Donnelly, of New York.

Army Trade Skill Tests Applicable in Construction

Half an Hour Tells Whether Workman is Expert, or Merely Skilled, or Is a Novice—Clerks Can Conduct Tests

BY SIMPLE oral, picture and performance tests any contractor or works manager can determine whether a workman seeking employment is an expert, or is merely skilled, or is only a novice in his trade. This is the conclusion which may be drawn from the experience obtained in classifying the men of our new National Army, stated Col. Walter Dill Scott in an address before the Chicago Chamber of Commerce, Feb. 12, 1919.

Half of the men in a modern army must be skilled at special trades in order to perform their duties. The new Army had, of course, to avail itself of the trade knowledge and experience which recruits brought with them from civil life, since time was not available for training men in trade skill. To discover this talent and assign it where needed was the task of the Army personnel organization, in which Colonel Scott served.

Until Nov. 11, 1918, when the armistice went into effect, 250,000 men who had professed trade skill had received special trade tests. There had at that time been standardized 71 oral, 12 picture and 19 performance trade tests, and 42 additional picture tests and six additional performance tests were in preparation. Some of these main tests were subdivided, so that in reality the count was greater than the figures given indicate. For example, there was a test for carpenters and an extension of this test for ship carpenters. A single test, or any two tests, or all three tests were employed, depending upon the man or upon the trade.

Oral tests consisted of a series of weighted questions. If the applicant's answers counted less than 15 points he was graded among the novices; if they counted from 16 to 31 points he was graded among the apprentices; if they counted from 32 to 55 points he was graded as a journeyman; and if they counted over 55 points he was graded among the experts. Every question was written and had to be put as written; it could be repeated, but its wording could not be changed in the repetition. Thus the test could be conducted by any intelligent clerk, after a little training.

Performance tests were equally simple. If a carpenter, for example, the man received a rough-sawed 2 x 4 in. timber, say 2 ft. long, to fashion according to a blueprint plan. This print called for one end to be beveled, a dove-tail mortise to be cut in the opposite end, all four sides to be dressed, etc., all to the exact dimensions shown. All the tools necessary for the work were provided, and a time was set for completing the job. At the end of the period set, the work was examined, and by its approach toward completion and its quality and exactness the man was rated as an expert, a journeyman or an apprentice in skill, or merely as a novice. In the same way a blacksmith was required to make to blueprint a simple eyehook, using two pieces of metal so that his skill in welding would appear. As in the case of the carpenter, all needed tools were provided and a time limit was set.

Picture tests were intended to show the man's knowledge of the tools of his trade. If he were a horseshoer a large card on which were pictured ten or a dozen numbered tools and articles commonly used in horse-shoeing was shown him. He was asked to name No. 1, No. 2, and so on and was marked on the accuracy and precision of his designation of the tools and articles. Precision of definition was held important. For example, if picture No. 5 showed clinch tongs, it was reasoned that anyone could answer "tongs," but only a man who knew about horseshoeing would answer "clinch tongs."

An average of about 30 min. per man was required to make the tests. To determine how and where to place the men, job analyses were made. These gave for each department of the Army the number and kind of skilled men needed, and designated the degree of expertness required for each position. The task of fitting the man to the position was then comparatively certain.

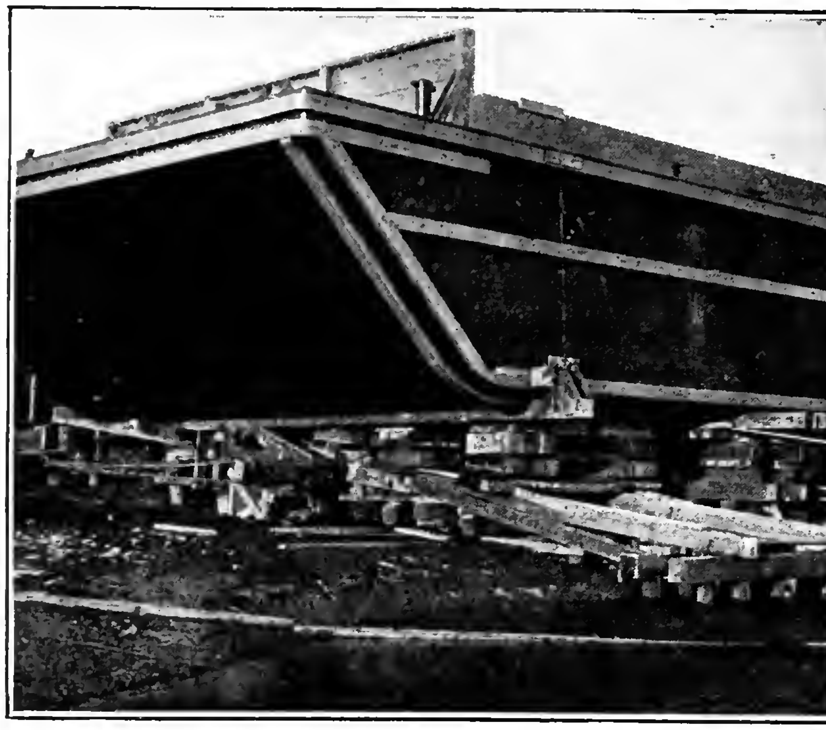
Trade tests only have been mentioned; as a matter of fact, classification by similar methods was made of 3,365,000 enlisted men and 194,000 commissioned officers. When the war stopped, stated Colonel Scott, "the work was well under way, and in another year we should have had a real army in which we would have known the capacities of the men and the positions in which men of these capacities were needed. The process is equally applicable to any kind of business."

Side Launching a Concrete Lighter

After Concreting, Boat Is Lowered to Four Sliding Ways by Jacks and Is Launched by Releasing End Cables

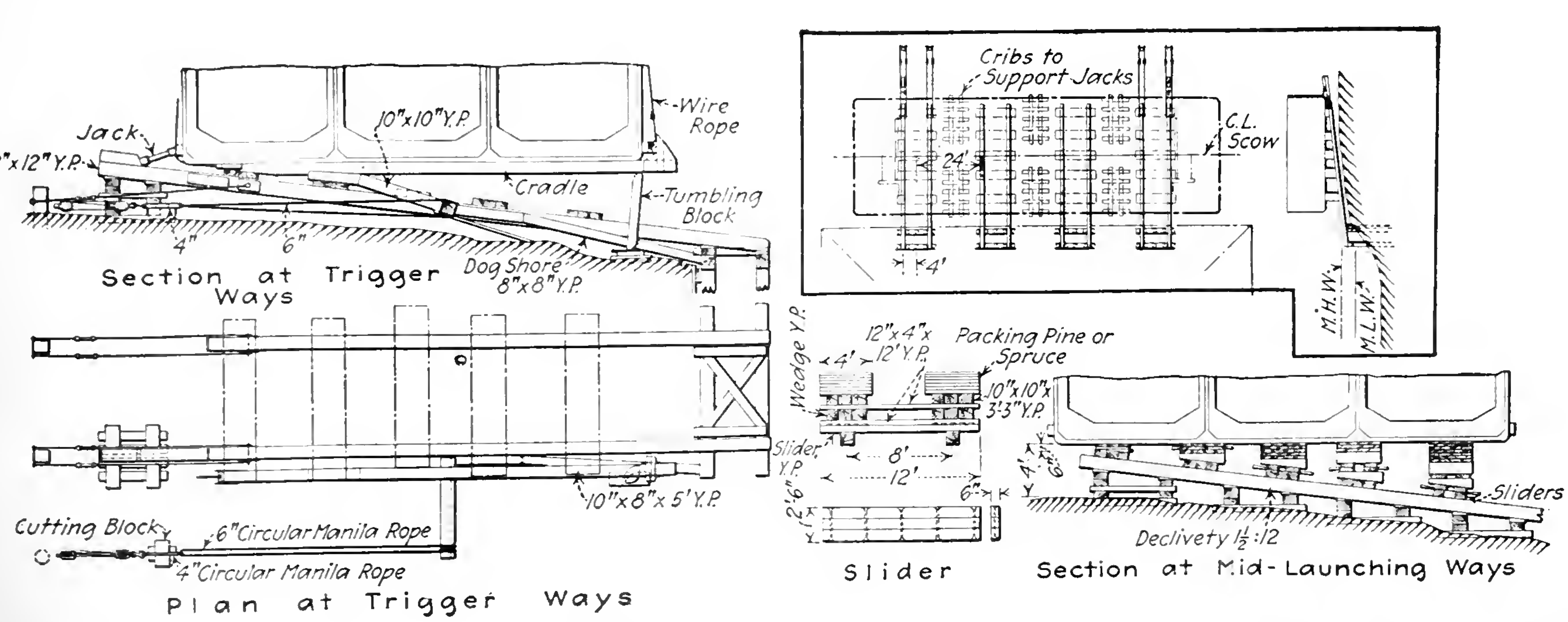
CONCRETE lighters 112 ft. long, $11\frac{1}{2}$ ft. deep and of 34-ft. beam, weighing about 500 tons, have been launched sideways at the yard of the Aberthaw Construction Co., at Providence, R. I. The construction of the lighters was described in *Engineering News-Record* of Oct. 7, 1918, p. 704.

Four pairs of launching ways were placed under each lighter, the ways being built at mean high-water level, with the outer ends just awash at high tide, and the area immediately in front of the ways, 100 x 130 ft., was dredged out to a depth of 4 ft. The ways are set at an incline of $1\frac{1}{2}$ in. in 12 in. and are built of 12 x 12-in. yellow pine, dressed smooth on the top and resting on sills laid in trenches, the outer end being supported on piling. Each pair of ways is 9 ft. wide, outside measurement, and the pairs are set at an interval of 24 ft. between centers. Across each pair of ways, under each longitudinal bulkhead and in the center of each water-tight compartment, was placed a yellow-pine slider which carried the wedges and blocking.



ONE END OF CONCRETE BARGE ABOUT TO BE LAUNCHED, SHOWING CRADLE AND TRIGGER

The outer unit of each pair of ways at either end of the lighter constituted the trigger way, being extended to the rear and capped with a piece of yellow pine to afford a bearing surface for the base of jacks which served to start the vessel on the ways. The trigger ways were reinforced by two 1-in. round steel



DETAILS OF LAUNCHING AND TRIGGER WAYS FOR SIDE LAUNCHING OF THE ABERTHAW CONCRETE BARGES

bars fitted with turnbuckles and running back to deadmen which also served to anchor the block and tackle which formed part of the releasing gear.

Under the lighter at either end was placed a cradle of 10 x 10-in. yellow pine fitted with an eye at one end and at the other a lip which set against the side of the barge, the shoe being held snugly against the bottom of the lighter by a ½-in. wire rope running up to the deck. On the under side of the shoe is a recess to take a strut running down to the trigger bar, which was a piece of 10 x 10-in. oak; the outer end of this was fastened to a deadman by a manila rope 6 in. in circumference, doubled and made taut by means of a block and tackle attached to the deadman in the rear of the launching way. The block is connected to the 6-in. cable by a double strand of 4-in. manila rope passing over the cutting block. From the outer side of the trigger a dog shore, 8 x 8 in., butted against the piling on the outer end of the launching way. Directly under the side of the barge was placed a tumbling block, beveled at either end; this fell clear when the lighter started down the ways.

When the concreting had been completed the barge was jacked up on building movers' jacks, carried on railroad ties on either side of each launching way, and the formwork was removed. The barge then was lowered to the blocking on the sliding ways. From this point, the barge was kept in place on the ways by the cradle shown, the strain being taken by the manila cables attached to the trigger bars.

A few turns on the jacks served to loosen the ship on the sliding ways, and, the signal being given, the releasing gear was severed simultaneously at the two cutting blocks. The resistance of the vessel striking the water broadside was sufficient to arrest the momentum, no rope stops being necessary.

Chloramine Tried by New York City

THE application of the chloramine process to the somewhat polluted water of Esopus Creek before it goes into the Ashokan reservoir at the head of the Catskill Aqueduct was described at the February meeting of the New York Section of the American Water-Works Association by Dr. Frank E. Hale, director of laboratories of the Department of Water Supply, New York City.

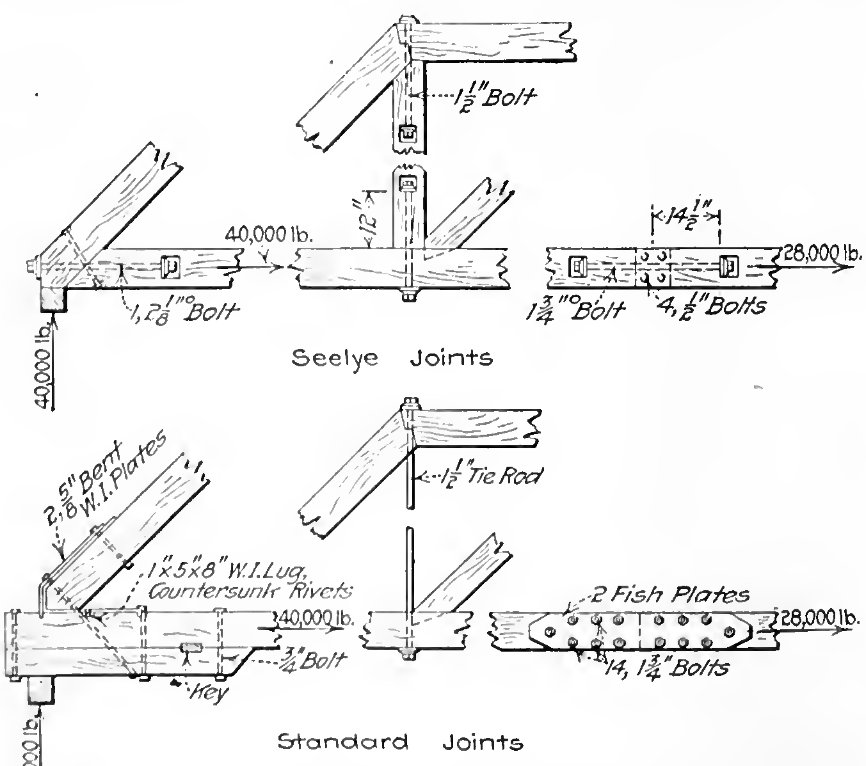
Although the water from the Ashokan reservoir has a long period of storage and is subjected to treatment with liquid chlorine before it reaches New York City, chlorination of the water of Esopus Creek before it reaches the reservoir was considered desirable. This was decided on in 1917 as soon as control of the Catskill watershed was taken over by the department. Local conditions prevailing at that time led to the adoption of hypochlorite instead of liquid chlorine for the Esopus Creek water. Immediately upon introduction of the hypochlorite (0.4 ppm.) complaints were received that the water was killing trout in the creek. This led to trial of the chloramine process (ammonia used with the hypochlorite), in an attempt to reduce the amount of chlorine and sludge. A material reduction in the unit rate of free chlorine applied (from 0.4 to 0.1 ppm.) was found to be possible, with good bacterial results and elimination of the fish problem, but the comparison of results obtained throughout more than a year's study indicated that equally good results were obtained by the use of hypochlorite alone. For example, the total bacteria and the B. coli removal with application of 0.05 ppm. available chlorine, bleach compared with chloramine, was, respectively, for bacteria 71% and 74%, and for B. coli 98% and 96%. These results indicated that the cost per unit of available chlorine applied for chloramine was double that of hypochlorite alone, since the ammonia cost four times as much as the hypochlorite, and the relative amounts of each applied were in the inverse ratio of one to four. This ratio was indicated by the experiments to be the correct ratio, the formation of chloramine being shown by a decidedly larger amount of free chlorine in the treated water than when bleach alone was used.

An important point brought out in the paper was that a given amount of available chlorine applied, and found by analysis to be actually in the water, did the same work—that is, percentage removal of bacteria and of B. coli—*at all temperatures,* winter or summer, from 32° F. to 76° F. Another point to be emphasized is that very small amounts of available chlorine may be effective in waters of low mineral and organic content.

The paper and discussion following brought out the fact that chloramine cannot safely be used except where there is very strict laboratory control, since otherwise the hypochlorite and the ammonia are likely to result in a variety of reactions and compounds, depending chiefly upon the proportion of chemicals applied and the strength of the solutions.

New Tension Joint for Wood Truss

BY APPLYING a type of tension joint common to certain kinds of cabinet work to wood trusses, Elwyn E. Seelye, consulting engineer, New York City, has made possible the framing of a truss in wood without the use of special plates, beveled washers, long



UPPER DETAIL SHOWS SEELYE WOOD-TRUSS JOINT AND LOWER SHOWS TYPICAL FRAMED JOINT

bolts, keys or complicated mortices. The joint, shown in the upper part of the cut, consists of a central bolt seated against the sides of through holes in the truss members. Comparison with the usual type of truss framing is made in the two drawings.

Fabricated Ship Construction at Bristol Yard

Plant and Operating System Closer to Precedent Than Those of Other Agency Yards—Reinforced-Concrete Shipways Flush with Ground—Tower Jib Cranes Traveling On Trestles—Pre-Assembly Practice

FABRICATED-SHIP construction at the Bristol yard of the Merchant Shipbuilding Corporation involves fabricating about 17% of the hull material in the yard shop. The working system, therefore, differs radically from that of Hog Island and Newark Bay, the two other original agency yards of the Emergency Fleet Corporation. Of these two, the former was planned for 100% and the latter for about 95% bridge-shop fabrication, as compared with the 83% of Bristol. In the planning of the Merchant yard this condition exerted a controlling influence, and led to close co-ordination of shop and berths. In this as well as in most other points of layout, shipyard precedent was largely adhered to. Furthermore, the derricks which at the other fabricating yards recall the bridge erector are not found at Bristol; in their place, traveling tower derricks are provided for the ship-erection service.

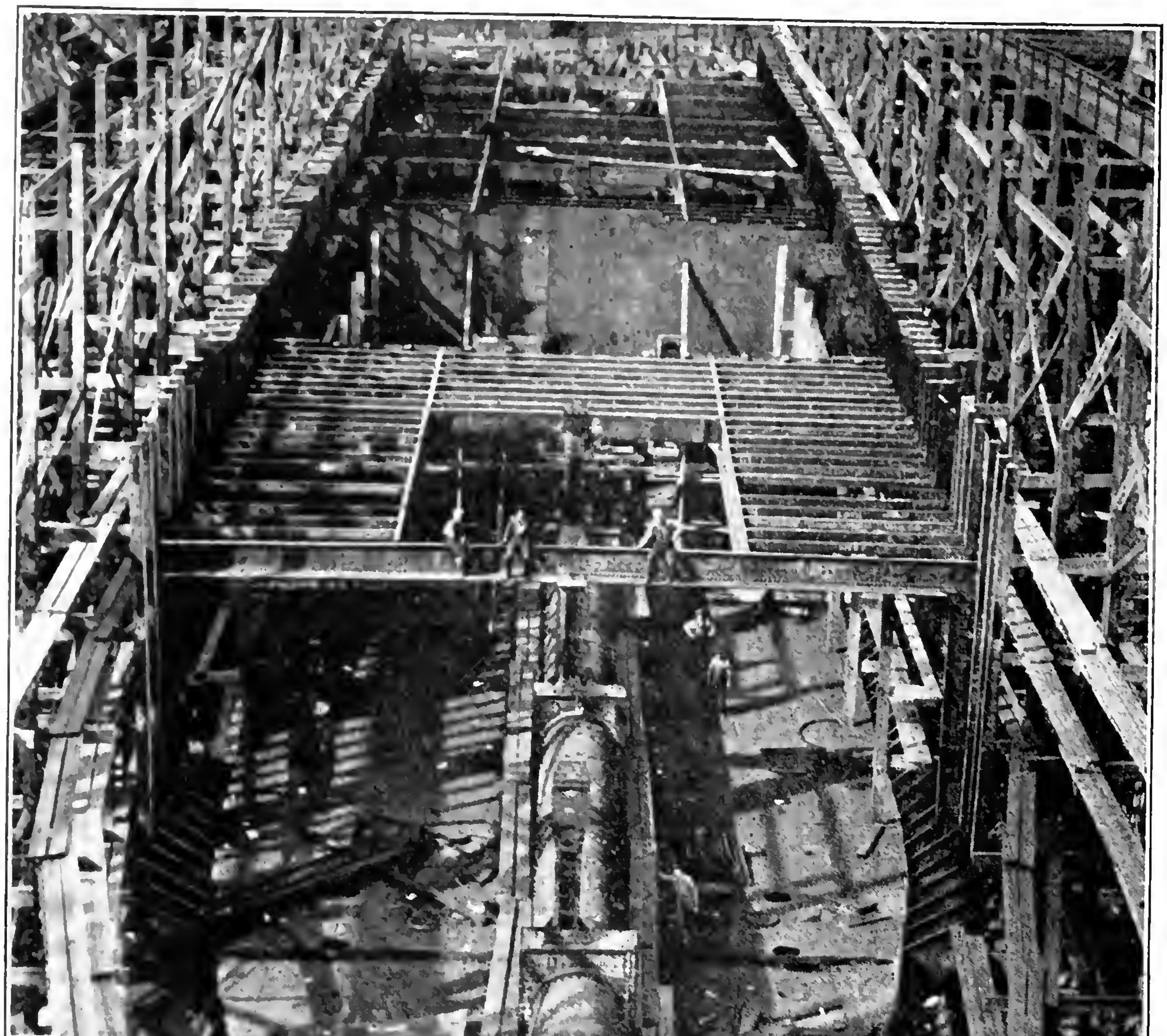


FIG. 1. MATERIAL FROM WAY-HEAD TRACK IS PLACED BY TOWER CRANES—PARALLEL MIDDLE BODY MAKES FABRICATION EASY

Included in the work fabricated in the shipyard punch shop are the following main items: All furnaced plates (in ends of shell as well as in keel and at knuckle), all bent frames, bottom angles on floor frames in forward and after sections, margin angles and web frames outside of the parallel body, frames and floors in peak, deck stringer angles at ends, ventilators and miscellaneous material. The work involved is estimated to cover about 40% of the total fabrication work required for the ship. The division was based on the desire to allot to the bridge shops only that work which they could do most economically with their existing equipment. Accordingly, of the bridge-shop material about 90% is either multiple-punched or rack-punched, and only about 10% single-punched.

To facilitate the outside fabrication as much as possible, the Merchant designers developed a transverse section of the 9000-ton ship which was to be built showing typical transverse rivet spacing, from which the shop men could set up their multiple punches direct. Pole templets for the longitudinal spacing of the multiple-punch rack could also be made from a drawing direct. The Merchant shop made templets only for the ends of the ship where the plates could not be multiple-punched; for this work it furnished the bridge company with one set of templets, which were then copied at the bridge shop to provide templets for the various plants at which the steel was to be fabricated. Rolled plates for the molded ends of the ship are punched at the bridge shop but are not rolled, so that they can be shipped flat; the rolling is done in the yard shop. Convenience in shipping also dictated the limit to which pre-assembly of parts at the bridge shops was carried. It is stated by officials that except for shipping reasons it would be possible to do approximately twice as much riveting in the bridge shop. According to the contract division of the work, the bridge shops drive about 100,000 rivets out of a total of 625,000 in the hull.

The general scheme indicated by the preceding was worked out for executing an order of the Emergency Fleet Corporation to build 40 steel cargo ships of about 9000 tons dead-weight carrying capacity. This order was subsequently increased to 60 ships of the same size. The contract time for completion of the order is about two years from September, 1917, when the contract was executed. Twelve shipways were laid out to carry this program through.

Character of Ship Design—Simplification of the design of the ship to adapt it to bridge-shop fabrication was not carried so far by the Merchant Shipbuilding Corporation as by the two other agency yards which

began work at the same time. The vessel is of the ordinary transverse-framed type with frames spaced generally 27 in. The bottom has a small amount of dead rise; the sides are vertical to the upper deck, but the bridge sides have 6-in. tumble-home. For easier fabrication, the parallel middle body was made very long, 50% of the length of the vessel, and the full decks were made flat (without sheer), sheer being given only to the forecastle and poop deck and the bulwarks. Transversely, the second deck has no camber, while the upper deck and the decks above have a straight pitch of 13½ in. to the center line amidships. The floors are, in general, alternately solid and bracket floors, the latter made of 7-in. channel frames with brackets at the center line and at the margin plate. The margin of the tank stop is turned down normal to the shell, and the floors here have no bent parts.

Shipbuilding Plant Compactly Grouped—In the layout of the shipyard, which was briefly sketched in advance of construction in *Engineering News-Record* of Jan. 3, 1918, p. 12, the important rôle assigned to the yard shop finds expression in unusually close grouping of the berths, and of shop and berths. The principal character of the layout, Fig. 2, was determined by certain local conditions, skilfully utilized by the designers to secure economy of construction.

A manufacturing plant, the works of the Standard Cast-Iron Pipe and Foundry Co., stood on the site, and two of the main foundry buildings of the plant were adaptable for use as the fabricating shop of the shipyard. These were long, narrow buildings standing end to end in a line parallel to the river bank and about 400 ft. back of the water; by a short connection between their adjoining ends they could be transformed into a

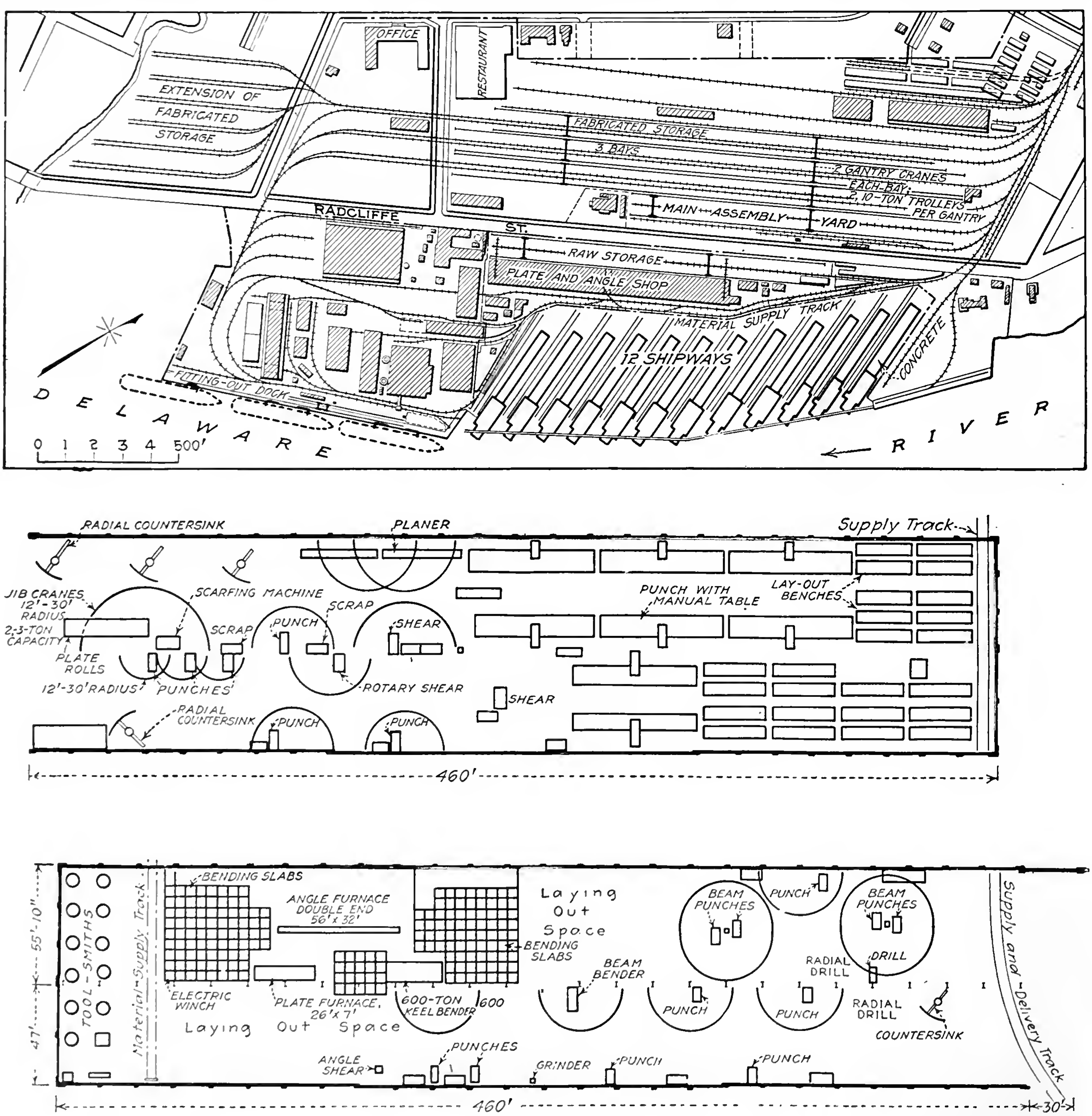


FIG. 2. GENERAL PLAN OF FABRICATED SHIPYARD AND LAYOUT OF PLATE-AND-ANGLE SHOP AT BRISTOL MERCHANT SHIPBUILDING CORPORATION, AGENT FOR EMERGENCY FLEET CORPORATION

single shop building 99 x 970 ft., giving ample space for the required fabricating capacity.

Because of these conditions, permanence of construction was made an objective in the design, at the same time with economy. Since the plant was built at the cost of the Emergency Fleet Corporation, only such expenditures were warranted as were necessary to create a shipbuilding plant of the desired capacity in the shortest possible time. However, as the site gave ideal opportunity for the construction of concrete ways, and the development of the necessary shop buildings was facilitated by the existing buildings of the pipe foundry, a shipyard of permanent character resulted quite naturally. According to the officials of the company, the concrete slab ways have proved entirely successful during the year of operation since shipbuilding started, early in the spring of 1918. There has been no settlement or other injury, and the construction has met all other service requirements.

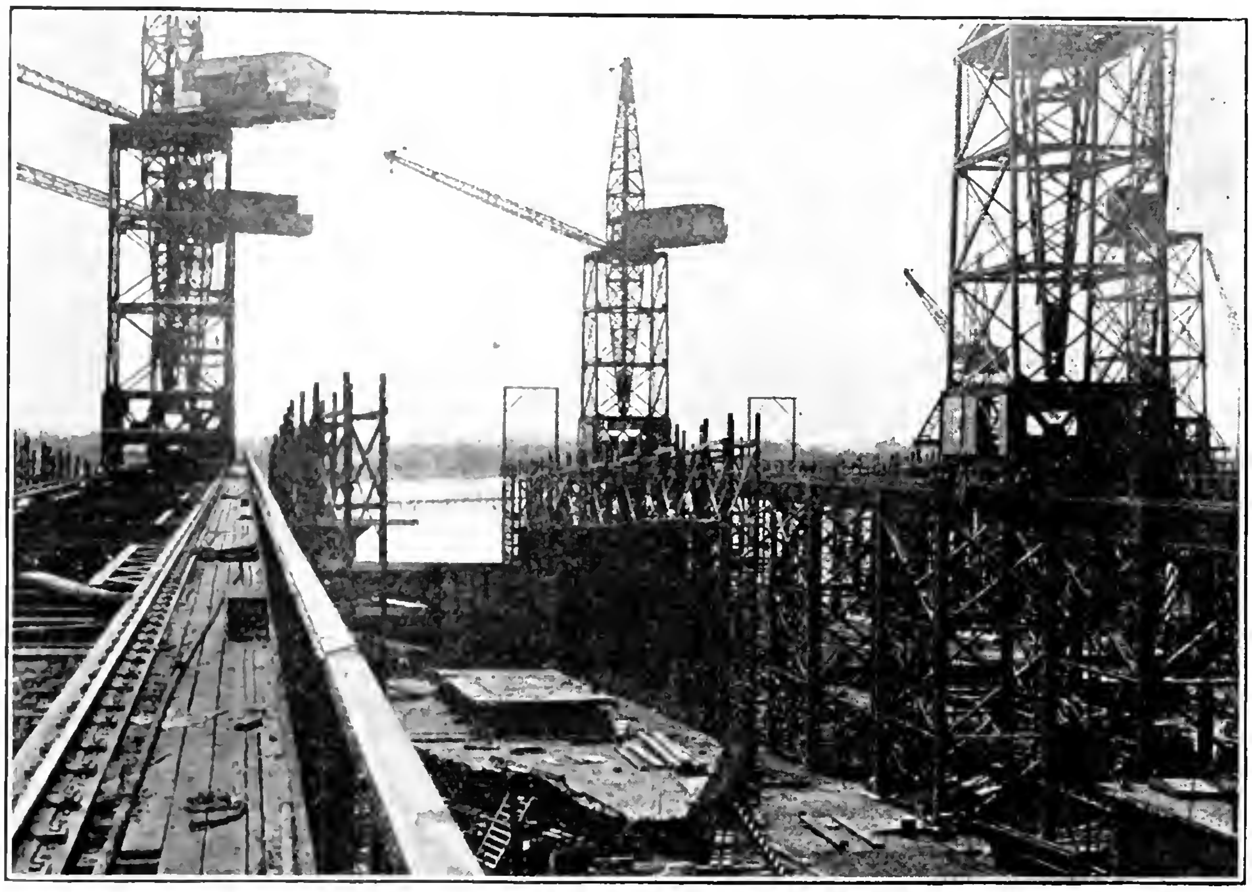


FIG. 3. SHIPBUILDING CRANES AT BRISTOL TRAVEL ON TRESTLES

In design the ways are composite (Fig. 4), consisting in part of concrete slabs 4 ft. thick by 38 ft. wide, and in part of reinforced-concrete beams supported by concrete piles. This is the typical construction above high-water mark. Below high water the ways are timber—wood piles with transverse wooden caps accommodating not only the keel blocks and the launching-way stringers but also abutments for the lateral shores of the standing ways. The sloping ground of the bank required but little grading to adjust it to the launching slope, and the ways were therefore constructed flush with the graded ground surface.

On account of the limited space between the shop building and the river, it was necessary to set the ways at an angle to the shore line in order to accommodate the 400-ft. ship length and have room for tracks and way-head storage space. This skew arrangement proved advantageous in enabling the ship-erection cranes to reach the supply tracks better than would have been the case with ways set square to the shore. The combination of skew and ground slope resulted in a slightly stepped profile in section parallel to the shore, there being a step 2 ft. high from each way to its neighbor; this, however, does not affect the shipbuilding operations.

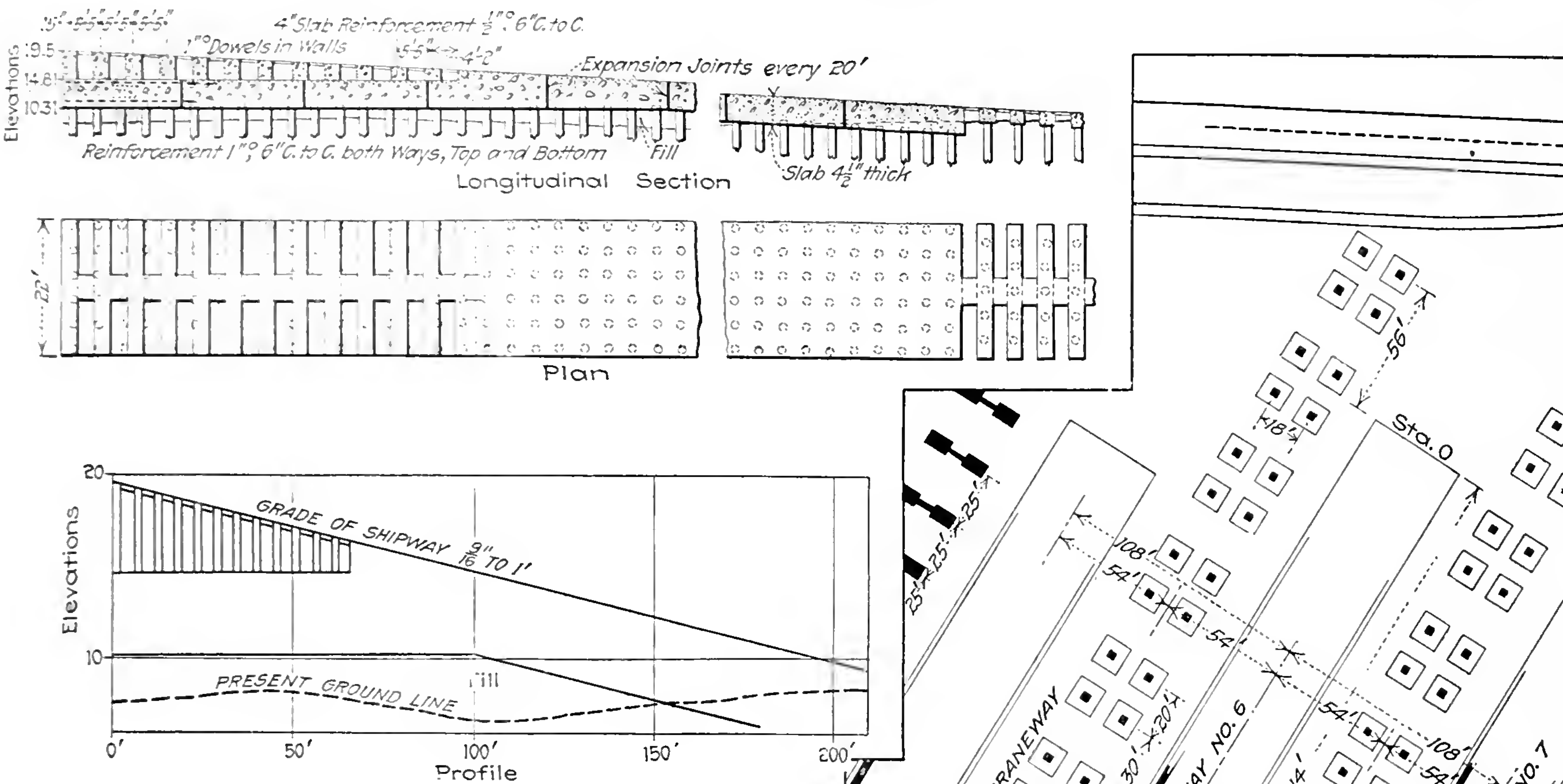
While most of the other fabricating yards adopted fixed derricks for their shipbuilding machines, Bristol chose traveling cranes; and, instead of having longitudinal supply tracks between the ways to distribute material along the length of the ship, it has tracks across the head of the ways only. From these tracks all material is handled down along the berths by cranes. Omitting tracks between the ways made it possible to group the shipbuilding berths very compactly, as the plan, Fig. 2, indicates.

For each shipway two shipbuilding cranes were provided, placed as may be seen in the view, Fig. 3. Revolving jib cranes (Fig. 5) of the type built by the Terry Manufacturing Co., of New York, which had already found use in several shipyards, were chosen as the most suitable for the present service. Nine ways are equipped with these cranes. They have 92-ft. booms, and can lift five tons at extreme reach and 15 tons at 54-ft. reach (hook at center line of ship). The three northerly ways, however, are equipped with locomotive cranes of turntable type, six of which were available for service earlier than the Terry cranes. These machines, of the Brown Hoisting Machinery Co.'s design, have 72-ft. booms and can lift 15 tons at about 40-ft. reach. To make the maximum lifting capacity available practically at center line of ship, the ways in question were spaced 86½ to 97 ft., instead of 108 ft., as are the others.

Trestle supports for the travelers were necessary to give a level track, and it was considered desirable that the cranes should travel on an elevated track for their entire length. The inshore end of the trestle, therefore, was made high enough to give clearance for trucking underneath the bracing. Trucking roads or passageways were at one time contemplated, but they were discarded in the final development of the plan. The space under the trestles is in part occupied by service buildings, and in part used for storage of material awaiting erection, though most such material is held in racks or piled at the head of the way.

On account of the angle between the supply tracks and the crane runway, all the cranes are able to take material from cars on the supply tracks. Furthermore, on all the ways except the one at the north end of the group, four cranes can be concentrated on one ship. According to the yard authorities, the crane equipment has proved to be ample in capacity for all requirements.

Storage Facilities—As material fabricated at the bridge shops could not reach the yard in such sequence in timing as to enable the berths to be supplied direct from incoming cars, storage was a vital feature, and



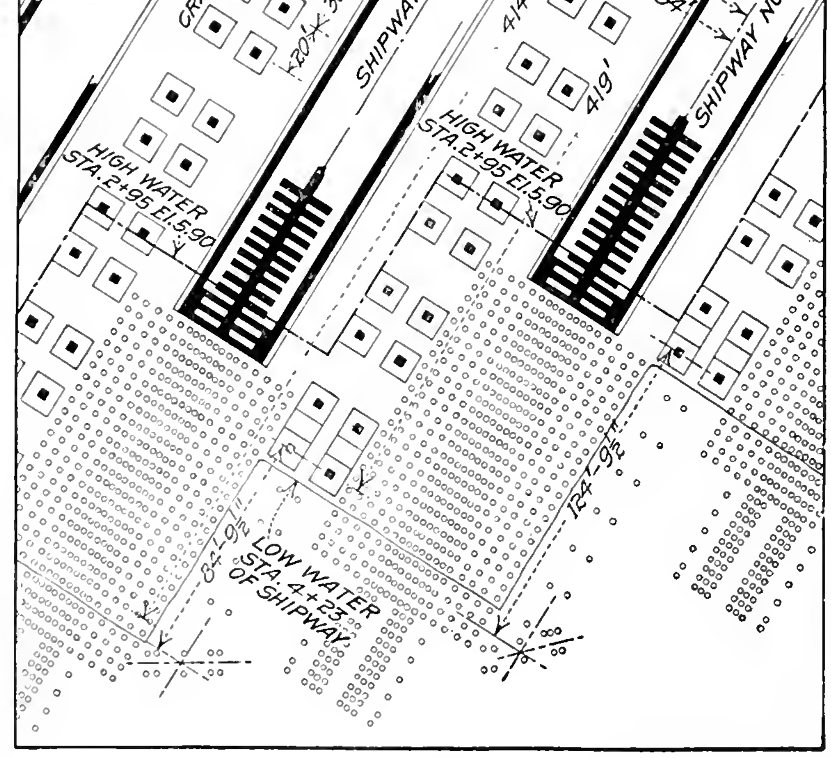


FIG. 4. REINFORCED-CONCRETE SLAB WAYS FLUSH WITH GROUND

the subject received thorough study in connection with the yard working system. The development of storage at Bristol with reference to the system of scheduling, routing and keeping track of material was discussed in *Engineering News-Record* of Jan. 2, 1919, p. 25, and drawings showing the arrangement of the main storage yard were there shown. The original fabricated storage yard was about 200 x 800 ft., but it has since been enlarged. At present the main yard for storing bridge-shop material is 300 x 2200 ft., and an extension of about one-third this size has been provided for. Raw material required by the plate-and-angle shop is stored separately in a narrow yard (100 x 1200 ft.) along the back of the shop building. The main storage yard comprises three parallel bays, 95 ft. wide. Each bay is provided with two gantry bridges equipped with two 10-ton trolleys apiece. Material cars run down the bay on two standard-gage tracks set off center of the width of the bay. Material is piled either side of the tracks, in allotted areas each about 20 ft. long in the direction of the tracks.

The storage yard is laid out with a definite space assigned to each piece in the ship. The problem of laying it out depended on the number of pieces rather than on the tonnage involved, the latter being simply a matter of higher piling.

In the operation of the plant the storage facilities are of central importance, because the whole system has been worked out to provide storage intermediate between shop and ship, and to avoid working direct from shop to ship in any department.

Shop-to-Storage-to-Ship System—Incoming cars of material fabricated at the outside bridge shops run directly into the main storage yard, and are there unloaded, and the material is placed in its allotted storage space by the gantry cranes. An essential piece of work at this point is painting the erection mark on each piece, the shop marks chosen by the bridge shops for their convenience being different from the ship erection marks. From storage, material is drawn on requisitions by any one shipway, according to the needs of the day.

Material fabricated in the yard shop is in part also worked through storage, in order to render the operation of the shop independent of the variations of the berth requirements. This material is of two kinds, templeted and lifted material. The latter, fabricated on special order from the shipway at the time when needed, does not go to storage. Templeted material, however, is worked ahead or on stock, and all this goes to the fabricated-storage yard just as does the incoming bridge-shop material. Similarly, such parts as are fabricated up to a certain point by the bridge shop and have finishing operations, such as rolling, bending or riveting, put on them by the yard shop, go from the fabricated-storage yard (where deposited when unloaded) to the yard shop, and then are returned to the storage yard to await call from the shipways.

Pre-Assembly Highly Developed—In carrying on the routine of minor assembly work, such as that on web frames, stringers, and other curved members, which, because of containing formed work, were not made or were only partly completed by the bridge shop, the Merchant yard during the year has been led to develop pre-assembly to a remarkable extent. An assembly yard 100 x 700 ft. was provided at the start, but it was

later increased to a length of 1300 ft. In addition, a space at the end of the plant north of the ways was available for assembly work.

Facilities for supplying and handling material and suitable tool equipment are features of the large assembly yard. This yard, at one end of the fabricated-storage yard, is spanned by a gantry like those of the storage yard, but has only one longitudinal track. Air-outlet manifolds are placed along the sides at about 20-ft. centers. For the smaller work, such as that on web frames and stringers, a shelter shed about 40 x 40 ft. is provided in the center of the bay, with two air-operated bull riveters. All other riveting is done by pneumatic hammers.

The larger parts that go through assembly, in its present development, are: All deck houses, shaft tunnels, bulkheads, the complete fantail with part of its plating, and the entire keelson with the flat keel riveted to it in lengths of 60 to 100 ft. The splices between these keel sections are ready reamed for final assembly on the keel-blocks. The bow section of the keel is assembled with attached frames. The heaviest members are the large bulkheads and deck houses, weighing 25 tons; these are handled by two cranes. They are assembled in the assembly space north of the raw-material yard, and when completed are loaded on cars by locomotive cranes and shifted along to points within reach of the berth cranes.

In this same assembly space the fitting up and assembling of the keel and keelson girder are carried on. The assembled keel is set up on horses for the full length of the ship, riveted complete in sections 60 to 100 ft. long, and the splices between sections are reamed ready for riveting on the keel-blocks.

This process is carried still further in the case of the bow section of the keel, where, for a length of 11 frames back of the stem, the lower pieces of the frames are riveted to the keelson girder in the assembly yard, thus making a single erection piece out of nearly 30 separate shop pieces.

A still further extension of pre-assembly is contemplated by the corporation. D. D. Smith, assistant general manager, says it is expected that ultimately something like 40% of the hull weight will be involved in the pre-assembly work. This will mean a largely increased amount of shop riveting.

Supply Racks at Head of Ways—Ship erection is carried on from a small way storage at the head of the way, and not from the supply cars direct. Steel plate-racks are provided here, with piling space alongside for floors, frames and similar members. The original intention was to stow all ship material under the crane trestles, but the way-head storage is found more convenient.

Engineering and Fitting Out—The southerly half of the yard area is developed for manufacturing and storage of engineering and ship equipment supplies and for the fitting-out work. Along the river front a timber wharf 1150 ft. long gives berthing space for three vessels engaged in outfitting. Traveling on a track laid on this dock is a large 60-ton luffing-jib crane capable of doing all the heavy hoisting work in placing boilers and machinery on the ship. This crane was described in *Engineering News-Record* of Nov. 21, 1918, p. 937. It is to be supplemented for lighter work by a quick-moving crane, on the same tracks. This will have 15 tons capacity at 54 ft., and 5 tons at 100-ft. radius.

In the case of the ships built at the Merchant yard up to the present, the boilers and turbines have been set in place before launching, and it is intended to continue this practice so long as the machinery supply keeps ahead of ship construction, though the fitting-out crane equipment is capable of setting all machinery at the fitting-out dock. The boilers of the Merchant ships are relatively light. If necessary to install Scotch boilers, however, they would have to be handled at the fitting-out dock. This was one reason for the 60-ton load capacity of the fitting-out crane.

The principal officials of the Merchant Shipbuilding Corporation are R. H. M. Robinson, president; W. T. Smith, vice-president; G. C. Thayer, general manager, and D. D. Smith, assistant general manager. H. E. Frick is the authorized representative at the plant for the Emergency Fleet Corporation.

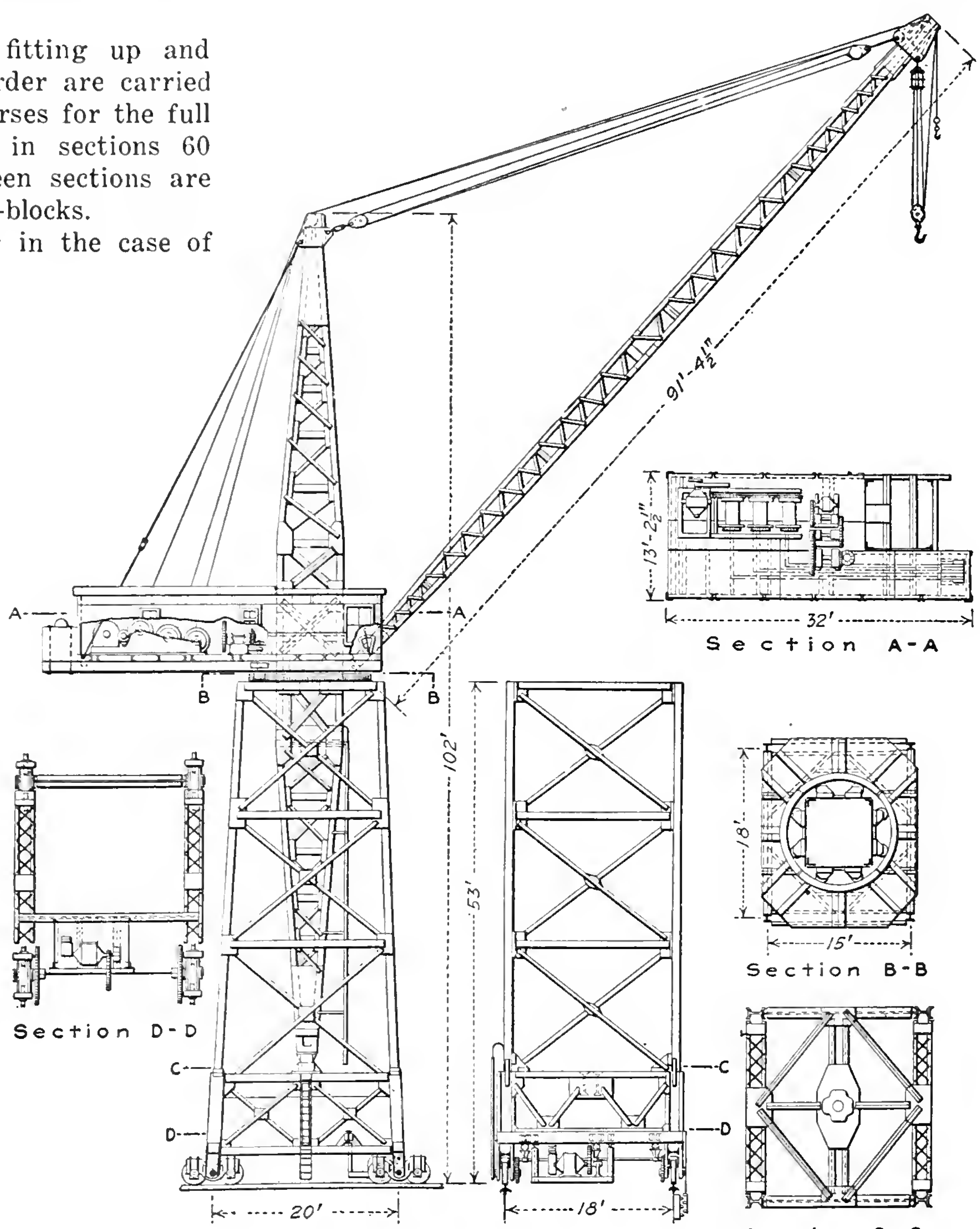


FIG. 5. REVOLVING TOWER JIB CRANES SERVE THE BERTHS

The Construction Division of Our Army: Operation and Maintenance Functions

Organized in Eight Sections—Each Completed Project in Charge of Utility Officer—Plea for Continuance as Independent Unit of Military Establishment

BY GEORGE W. FULLER
Consulting Engineer, New York City

IN A previous article, in *Engineering News-Record* of Feb. 27, 1919, p. 416, the writer sketched the development which established the Construction Division of the Army as an independent organization reporting directly to the General Staff. The magnitude of the work was set forth, and some stress was laid on the type of the responsible organization, embodying as it does the experience and personnel of numerous successful civilian concerns.

In the present article, the writer endeavors to portray briefly the organization of the Building Division and also to set out both the work and the organization of the Operating and Maintenance Division. This more detailed description of those two branches of the Construction Division is of general interest both from the subject matter itself and the bearing which it has on the important question of preserving the division as an adequate entity and with a personnel commensurate with the work still to be performed. There will be set forth in a later issue some maintenance costs and other operating data of interest to engineers engaged in the utility field.

Organization of the Building Division

The principal scheme in the organization of the Building Division is the separation of the construction work into six groups or sections, each under the direction of a section chief whose work embraces one or more types of projects. For example, one section chief handles all ordnance work, another warehouse and terminals, another camps and cantonments, and so on; each section chief has four general assisting units, consisting of an engineering unit, an administrative unit, a materials expediting unit and the unit in charge of estimates and costs. The two latter units act as liaison officers with the Procurement and Engineering Division.

Under each section chief the direction of the field operations again divides geographically under the control of four or five supervising constructing quartermasters, each of whom is responsible for the work of from five to fifteen different projects. The constructing quartermaster, who is the Army's chief representative in the field, communicates with Washington only through his supervising constructing quartermaster, who thereby is enabled at all times to keep in touch with the progress of the work.

Serving all sections and acting as a part of the Building Division there is set up a Requirements Branch, which is charged with all questions dealing with special requirements, including responsibility for the allotment of funds to the various jobs. Furthermore, it has supervision of all requests for funds and statements covering new work which are sent to the Secretary of War or General Staff for approval, and the preparation of necessary reports and statements to the various Congressional and Senate committees and the War College, and of other similar requests for data.

Even after construction is completed and the project put in use, the duties of the Construction Division are by no means finished. Indeed, the operating problem begins before the construction work ends, as the housing of troops commenced, for example, before the camps were finished. Some agency must be set up for a wide range of tasks, such as keeping the streets and roads in repair, operating and maintaining the water and sewerage systems, operating the electric-light and power systems, and making repairs and minor alterations to the thousands of buildings. These are the functions of the Operation and Maintenance branch (officially known since September, 1918, as the Maintenance and Repair Division) of the Construction Division; they have to be exercised at military posts, camps, cantonments, hospitals, terminals, depots and other establishments coming within the jurisdiction of the War Department.

Earliest Efforts at Maintenance and Operation

During 1917 and the early part of 1918, when the Construction Division (or Cantonment Division, as it was then called) was a part of the office of the Quartermaster General, the field forces engaged in operation and maintenance were under the jurisdiction of the local camp quartermasters. These officers were naturally picked for the better known duties of quartermaster—subsistence and personnel supplies, troop transportation, pay, etc.—and their hands were amply full with such duties. Naturally, their experience with operation and maintenance on Army reservations was on the small-post peace-time basis, where the big-cantonment war-time problems never arose. Therefore, the first utility officers placed in immediate charge of cantonment operation and maintenance labored under truly enormous handicaps. There were (1) a deficiency of enlisted personnel; (2) a lack of local appreciation, higher up, of the number of men and the amounts of material demanded by the situation; (3) a slowness in organizing in Washington a centralized operation and maintenance bureau to give adequate help to the local forces. The severe winter of 1917-18 still further added to the burdens of the field forces, and—in the northern cantonments, at least—the camps were kept running only by long hours of arduous duty on the part of officers and men, and by twisting the Army regulation red tape considerably out of its intended form. It is needless here to do more than mention the indefinite and apparently overlapping jurisdictions, during this period, of camp quartermaster, camp surgeon, sanitary corps representatives (medical department) in relation to the utility officers who had to deal also with representatives from numerous offices in Washington.

It was not until the Cantonment Division emerged from under the wing of the Quartermaster General's office that proper development of the operating division was possible. Then the local utility forces were dis-

sociated from the local quartermasters and made directly responsible to the military commander of the reservation and to the division now called the Construction Division, which supervised the work and the funds required therefor.

It was in May, 1918, that utility operations received their first impetus toward adequate expansion. However, the Army deficiency bill, of March, 1918, provided no funds for betterments, and the expansion program proceeded in a restricted way. With the beginning of the new fiscal year, July 1, adequate authorization came for increased personnel and for needed funds. Especially in view of shortages of men and material, much credit is due those who sought to bring methods successful in similar civilian undertakings to the aid of the large Army camps.

Organization for Operation and Maintenance

By the end of 1918 there were under the jurisdiction of the Maintenance and Repair Division the roads, buildings and public utilities in 46 camps and cantonments; 51 hospitals; 66 border stations; 25 supply depots and terminals and 171 regular military posts. For the fiscal year ending June 30, 1919, the funds for its use amount to $62,400,000.

It had as a field force, concerned with the actual operation of its functions at all of these points, 452 commissioned officers and 16,559 enlisted men. The maintenance and repair personnel in the Washington office consisted on that date of 40 commissioned officers and 126 civilians, of whom about 90 have been engaged in work for the entire Construction Division in the blueprinting and photostat rooms.

The organization of the Operation and Maintenance Division parallels the general scheme of the Construction Division of the Army in that it follows so far as practicable the precedents indicated by civilian experience on a large scale. The division is divided into a series of eight branches or sections: (1) Personnel; (2) service; (3) statistics; (4) procurement, which has been combined with the service section; (5) building repair; (6) fire protection; (7) light, heat, power and refrigeration; (8) water and sewerage.

Coördination of Central Office and Field Forces

To keep in touch with these utilities at so many posts and locations requires an efficient and complete central organization. At the same time, such a bureau must not be so highly organized as to impede its own work. The Washington office, in order to maintain intelligent supervision of these utilities scattered all over the United States, must be kept advised as to what is going on, as well as to what are the actual needs. Utilities officers look to Washington for prompt authorization of funds for repairs and extensions, for advice on matters of policy, and for information on countless points which arise.

There are two methods by which the central office acquires information. One is by reports of inspectors, and the other is by the study of the reports of the utilities officers themselves. A utilities officer is busy and has little time for the preparation of reports. Accordingly, only monthly statements, containing information in the most concise and brief forms, are required. These reports are usually headed by a summary outlining matter of particular importance, recommendations as to needs, etc.

When a report is received from a camp or other location, it does not follow the commonly supposed fate of such Government documents, that of being filed away in archives without other than a hasty examination. It is carefully studied for two purposes; (1) To find out what has occurred during the previous month at the job, and (2) to analyze the proposition better from the viewpoint of efficient and economical operation. The report is scrutinized by the chiefs of sections or branches, who attach memoranda with any comments or remarks. The officer in charge of the Maintenance and Repair Division then studies the questions of policy, and conditions requiring correction are noted, and communications with instructions are prepared through the aid of the memoranda attached by the section chiefs, and forwarded to the local or camp utilities officer.

At each completed project, in charge of the operating force is an officer selected on his record in civil life in the management of public utilities, holding a position comparable to that of a city manager, but with detailed responsibilities and duties far transcending those of such an official. Indeed, he is a composite of city manager, city engineer, fire marshal, street and building inspectors, managers of municipal water-works and sewers and telephone and electric-supply companies and cold storage, besides being general all-round handyman to whom everybody comes to get anything fixed.

The local organization is military in its character, and was worked out with a view to obtaining the greatest efficiency and the best results with a minimum of personnel and expense. A major is usually placed in charge of this highly important work, and has as assistants a number of commissioned officers of lower grade. For operative and clerical assistants there is a detachment of enlisted men, depending as to the number upon the size of the project, but varying from 300 to 800 in various camps and cantonments.

Each utilities officer maintains in his office a "trouble department"—a desk over which passes every complaint of whatever nature and every request for repairs and replacements. In addition to the written communications received, the number of telephone calls in the trouble department at each camp alone averages several hundred per day. All the work is supervised, coördinated and administered from the Washington office. Refinements and economies are constantly worked out, and their effect is always toward giving the greatest service with a minimum expenditure of public funds. The Maintenance and Repair Division of the Construction Division's office is really a huge service organization operating for the benefit of over a million persons, and designated to supply them with every convenience and comfort incident to their existence as soldiers stationed at Army posts.

Future Work of the Construction Division

The writer will endeavor to set out below a brief consideration of some of the factors affecting the future operations of the division and the volume of work to be done in peace times.

When the armistice came in November the Construction Division had under way or completed nearly 1000 contracts for new construction work and was operating utilities at and keeping in repair about 350 military establishments.

While during peace times the demands for so extensive a program will cease to exist, nevertheless, to

provide proper housing for an army of 175,000 men will call for additional permanent construction equal to nearly twice that existing previous to the war.

Undoubtedly, many of the large Army camps will be retained, and the temporary buildings will be improved to provide more comfortable quarters and to give them a more permanent character. This work will extend over a period of years and will total a substantial amount. Then, too, the housing construction on the Mexican border has been of a most temporary and frequently makeshift nature, and much new construction of a more durable type is badly needed there. With our small pre-war army of 70,000 men, the annual building operations were of considerable magnitude, so it is obvious that whether the future Army consists of 175,000 men, or 500,000 men or more, as desired by the advocates of universal military training, the annual new construction for the Army will total many millions. As a matter of fact, there is now proposed one project, a permanent school for the Corps of Engineers, which alone will probably cost from $25,000,000 to $30,000,000. If all other new construction combined for the next fiscal year is only three or four times that of the new school for engineers the total will range from $120,000,000 to $150,000,000.

It has been pointed out in these pages that operation and maintenance and ordinary upkeep form a large undertaking, involving, as they do, investments in structures of a temporary character, whose worth is about $500,000,000, and requiring at present monthly expenditures of about $4,000,000.

Operation and maintenance activities and expenditures will be reduced, but never to a point comparable with the pre-war expenditures. One reason for this is that the pre-war practice of housing troops in widely scattered posts of very small capacity prevented any possibility of training the Army in maneuvers or of mobilizing the men in any way for modern training on a large scale, and the experience of the war has clearly proved the need of maintaining large training centers such as the cantonments provide. Therefore, the operation and maintenance of at least a large percentage of them must continue, as well as many hospitals and also supply depots and terminals representing permanent investments.

Large Expenditures Required

Even though exact figures cannot be foretold, it is clear that even in peace times new construction and operation and maintenance will require large expenditures. It would be unwise and inconsistent with good business to place responsibility for such work in the hands of those unfitted by training or experience to handle these matters, and more especially is this true when it is remembered that there now exists in the Construction Division a highly specialized organization of experienced civilian engineers. These men have made good under unprecedented demands and conditions. No untried agency can handle as efficiently or economically the peace-time requirements.

Some of the lessons of the war stand out strikingly. We were entirely unprepared for war, and most of all in those lines of work of the military establishment where those in responsible positions needed a thorough knowledge of commercial practices and the hard, keen business sense acquired through commercial experience. In the regular military establishment there is no opportunity for the soldier to acquire training or experience akin to that obtained in large civilian organizations. Ordinarily, his training is such as to give him no idea of the value of a dollar or of competitive conditions of production and procurement. From the time he enters West Point the officer is in a measure set aside from commercial pursuits, and if his line of duty brings him in contact with matters of engineering or production he nevertheless loses the value of the practical and competitive circumstances under which his civilian brother labors.

Division Met All Demands

Because it was a civilian organization reinforced with a knowledge, through years of practical experience, of how to obtain materials, transportation and results in the face of adverse conditions, the Construction Division was able to "deliver the goods." The obstacles overcome were not alone those in the field or in the actual construction or operating activities. In fact, the greatest handicap, especially at the start, was the lack of preparedness for the work to be done. Obstacles could not in any large measure be studied in advance, but under the press of immediate needs each problem had to be solved as it arose, and the rapidly increasing scope of the work called for constant changes in the organization. It is fortunate that those experienced constructors who were early called to the division selected certain broad principles of organization which stood the test of constant expansion. Even so, mistakes were made, principally because when the war was started there was no complete scheme of organization susceptible of unlimited expansion and no program for immediately starting construction activities. But the division, nevertheless, met all demands made on it. Praise without stint is due those who put through and were responsible for this great engineering and constructive work, and it should be their reward, as many of them return to civil life, that they go with the knowledge that unquestionably, for the public good, profit has been taken from their successes and their failures and the organization they built shall neither pass out of existence nor lose, by absorption into some other bureaus of the War Department, its entity and that strength which it now has by virtue of the rich practical experience of its civilian engineers and constructors, whether in uniform or not.

There has been suggested a Department of Public Works to handle all construction activities of the various bureaus of the Government. The retention of the Construction Division of the Army would perhaps serve to give an instrument ready at hand in connection with the establishment of such a Department of Public Works.

Pre-War and Present Highway Costs

In 1915 the New York State Highway Department constructed 1073 miles of highways, at an aggregate cost of $11,790,000. At present prices of labor and material but little over one-half of this mileage could be awarded at the above sum, according to the annual report of Edwin Duffey, state highway commissioner. A comparison of the pre-war and present costs of pavements is given in the report as follows:

Item	Cost per Mile: Pre-war	Cost per Mile: Present
Water-bound macadam	$12,000	$18,000
Bituminous macadam	14,000	23,000
Concrete	18,000	28,000
Brick	25,000	35,000

Accurate and Compact Record of City Property

New Castle, Penn., Has System of Maps and Forms Covering Entire City to Record Property Titles and Transfers

A SYSTEM for keeping city records of real estate titles has been worked out in the City of New Castle, Penn., under the supervision of C. H. Milholland, city engineer. It consists of various maps, forms, numbering and index marks to locate readily the data for any particular parcel of land within the city limits. The aim is compliance with the Pennsylvania state law, which requires that such a record be kept in all third-class cities.

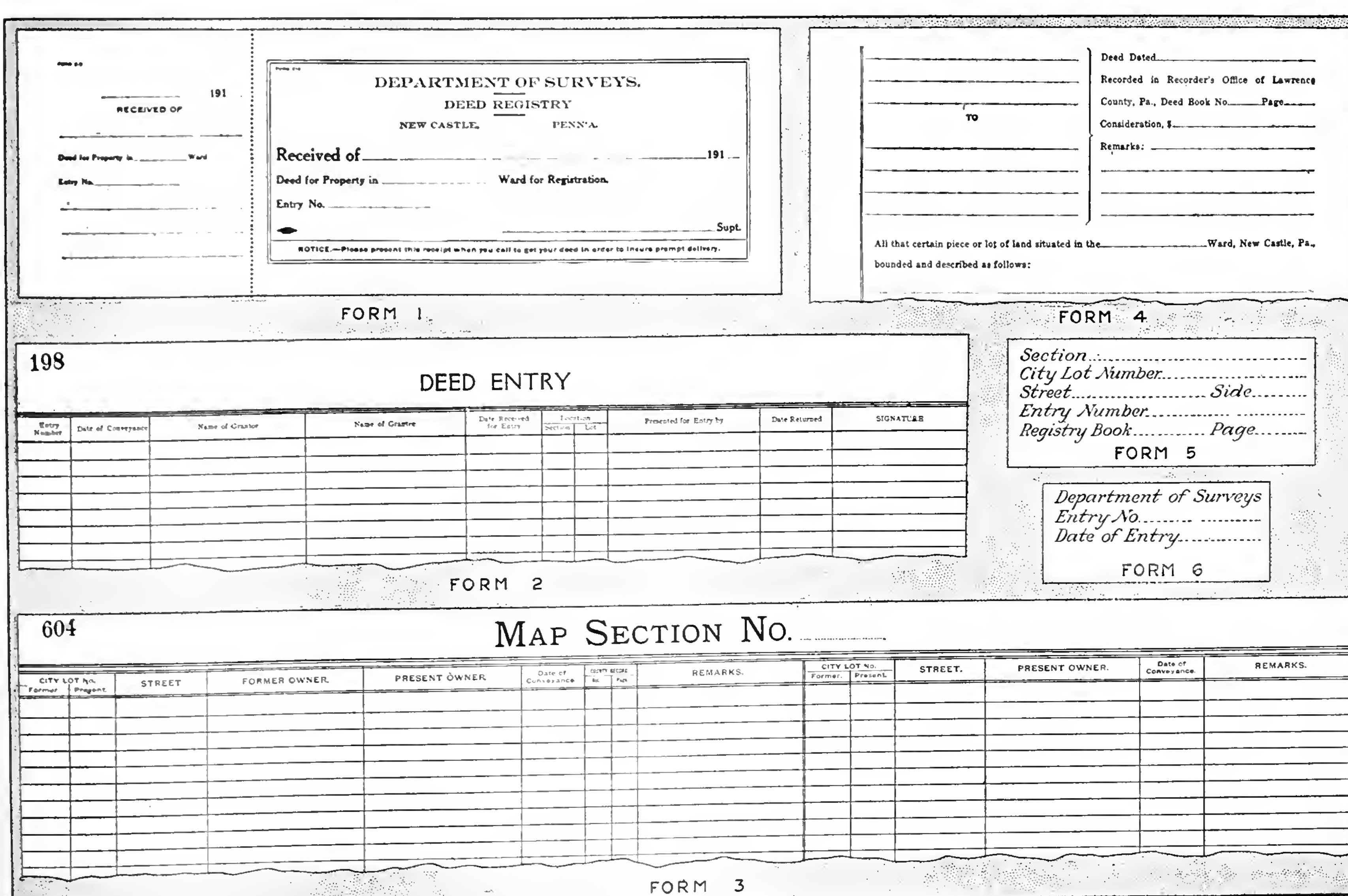
In establishing such a system the first step is to make an accurate set of maps showing the street and property lines of the city. A complete survey was made of all streets, and stone monuments, 4 ft. in length and 8 in. square, were placed at each street intersection or street corner. These monuments were also placed so as to be used as bench marks.

As a basis for the preparation of the maps, the city was divided by the city ordinance into 100 sections. The ordinance also provided that each city lot should have a number, so that each lot could be designated as lot No. ——, section ——. Where subsequent subdivision of any lot or tract of land occurs, it is prescribed that each subdivision shall receive the same number, with a letter of the alphabet added to distinguish the various subdivisions.

The scale chosen for the maps was 50 ft. to the inch, this requiring sheets 30 x 48 in. These were made of linen-backed paper. Upon them are shown the center lines of the streets, with bearing and distance in red; stone monuments as small black squares; street lines, lot lines and lot distances in black, and the recorded plot number, if there is one, in blue. Each of the 100 sections has lot numbers running from 1 to 600, and these are shown in red figures. For the purpose of obtaining the information required, the city ordinance provided that each owner of real estate should submit his deeds to the city engineer for registry and prescribed suitable penalties for failure to comply. These original drawings are not shown to or handled by the general public, but tracings of them have been made on which the name of the owner is shown in black, and when there is a transfer of ownership the name is changed.

When deeds are presented, Form 1, as here reproduced, is used to give the owner a receipt. These receipt forms are in a book of about 200 pages. When the deed is returned this receipt must be presented and signed by the owner. Form 2 is used in registering the submission of a deed for entry, and recording the various information as shown. The last column provides for the signature of the owner when the deed is returned. This form is made in a book of 200 pages.

When the registry has been made a book of 600 pages, the headings of one of which are shown in Form 3, is used to record the registry with the proper city lot number, the section number, etc. The form provides for 14 transfers of property. On the map as described above are placed in yellow figures the number of the


191
RECEIVED OF
Deed for Property in ________ Ward
Entry No.
DEPARTMENT OF SURVEYS.
DEED REGISTRY
NEW CASTLE, PENN'A.
Received of ________ 191 _
Deed for Property in ________ Ward for Registration.
Entry No. ________
________ Supt.
NOTICE.—Please present this receipt when you call to get your deed in order to insure prompt delivery.
FORM 1
TO
Deed Dated ________
Recorded in Recorder's Office of Lawrence County, Pa., Deed Book No. ____ Page ____
Consideration, $ ________
Remarks: ________
All that certain piece or lot of land situated in the ________ Ward, New Castle, Pa., bounded and described as follows:
FORM 4
198
DEED ENTRY
Entry Number | Date of Conveyance | Name of Grantor | Name of Grantee | Date Received for Entry | Location: Section, Lot | Presented for Entry by | Date Returned | SIGNATURE
FORM 2
Section ________
City Lot Number ________
Street ________ Side ________
Entry Number ________
Registry Book ________ Page ________
FORM 5
Department of Surveys
Entry No. ________
Date of Entry ________
FORM 6
604
MAP SECTION NO. ________
CITY LOT No.: Former, Present | STREET | FORMER OWNER | PRESENT OWNER | Date of Conveyance | County Record: Bk., Page | REMARKS | CITY LOT No.: Former, Present | STREET. | PRESENT OWNER. | Date of Conveyance. | REMARKS.
FORM 3

RECORD FORMS ARE USED AT NEW CASTLE, PENN., FOR REGISTRY OF ALL REAL ESTATE

registry book and the page; thus 2/25 shows that the lot is recorded in Book 2 on p. 25 of Form 3.

Records of the description of deeds are kept in a steel filing case with 100 files—one file for each of the 100 sections in the city.

Form 4, copy of the deed, is folded and stamped upon the back with Form 5 and placed in its numerical order in the files. Form 6 is stamped upon the deed when it is returned, and is evidence that the law has been complied with. The state law provides that, unless such stamp is found upon a deed, it cannot be recorded by county authorities.

This system of registry may be kept in compact form by having a combination plan case and book rack. At New Castle the plans are kept in 10 drawers, 10 plans to a drawer. The corresponding books are kept in 10 racks placed beside the drawers, the supports for the books being rollers, for easy handling.

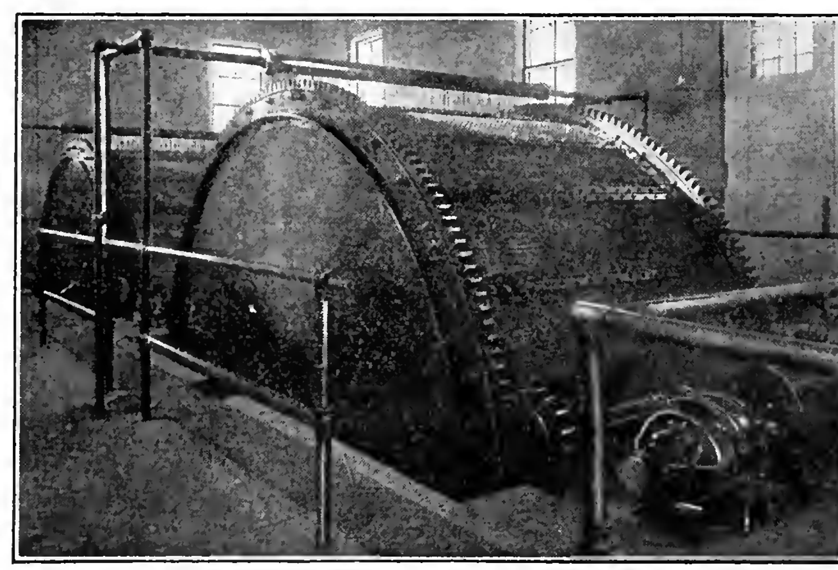
After the installation of the system the council authorized the appointment of a registry superintendent, who attends to the details, furnishes copies of transfers to the city assessors and marks same on their plans. He also acts as clerk in the engineering office, issues street permits, shows plans when requested, etc. Mr. Milholland states that, after operating for some time, these methods have been found quite satisfactory.

Rotary Screens Remove Dirt from Water at St. Paul

Drums Have Shells Built Up of Screen Sections—Wash Water Received by Hopper Is Discharged Through Axle

MOTOR-DRIVEN rotary screens of the drum or cylindrical type are being used for removing vegetation and solid particles from the drinking water at St. Paul, Minn., and, it is reported, are giving satisfaction. They were put in service in November, 1917, and have operated continuously since that time, requiring practically no attention. Two screens are installed, with space for a third. Stationary screens used previously were difficult to clean and required almost constant care.

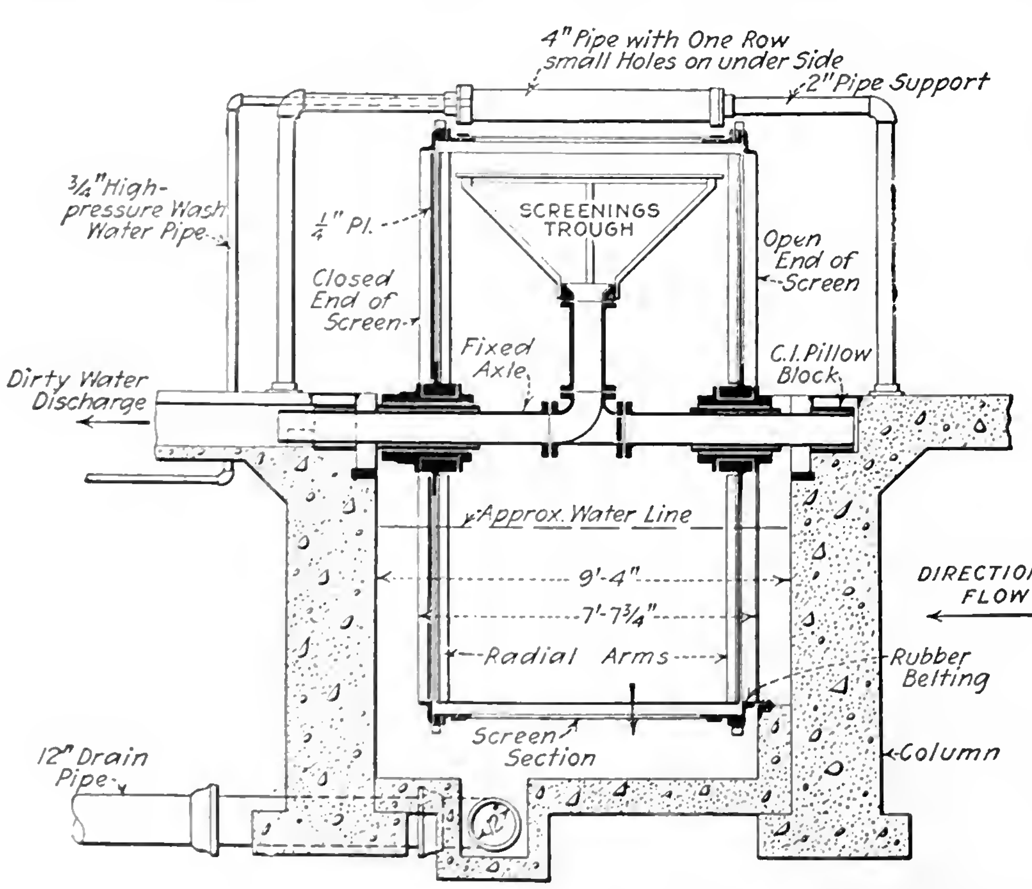
Each screen is about 14 ft. in diameter and 7 ft. long, having a framework of structural steel and being mounted on an 8-in. horizontal shaft. One end is open for the entrance of water, while the other is closed by steel plates. The frame is covered with 24 sections of 80-mesh screens of monel metal, reinforced by a ¾-in. mesh of No. 8 copper wire. The shaft is fixed and the screen drum revolves upon it, being carried by two sets of roller bearings, so that little power is required to drive the screen. For each screen there is a 7½-hp. motor geared to a cross shaft having pinions which engage two circular racks on the screen, as shown, any

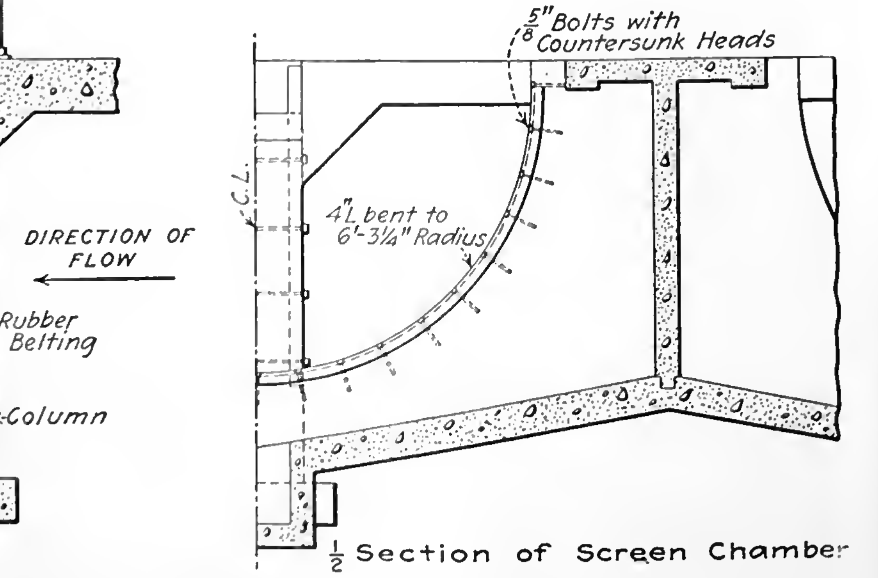


MOTOR-DRIVEN DRUMS SCREEN WATER-SUPPLY

tension being taken up by a differential gear. A speed regulator and two changes in the gears provide for varying speed to suit cleaning required. Normally, the screen makes about one revolution per minute.

The escape of water around the screen drum is prevented by a concrete wall at its open end, with an opening of approximately the same radius as the drum, the joint between the concrete and the metal frame being sealed by rubber belting. Water passes through the screens, leaving dirt and other matter on the inner face. Directly over the top of the drum is a 4-in. perforated pipe for wash water which





WASH-WATER HOPPER IN DRUM DISCHARGES THROUGH HOLLOW AXLE

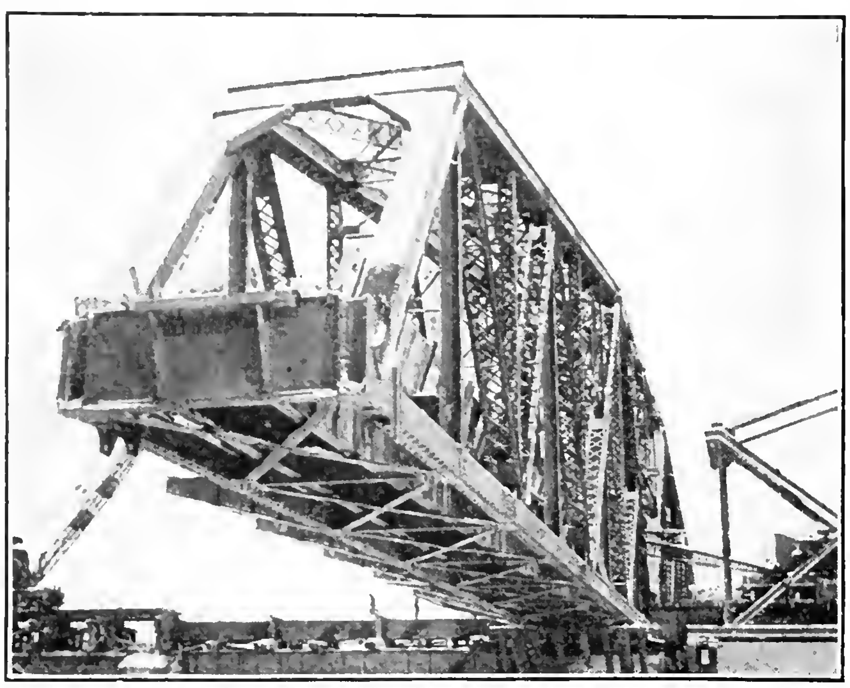
is discharged under 85-lb. pressure. Inside the upper part of the drum is a 4 x 6-in. trough or hopper, which receives the wash-water and dirt. In this way the screen can be cleaned continually with about two gallons of wash water during each revolution. It has been found, however, that the screens operate effectively when the wash water is turned on during one revolution about every 30 minutes. During 1918 the two screens passed about 17,000,000 gal. daily, while the maximum capacity per screen is estimated at 30,000,000 gal. a day. The screen chamber is so built that either or both screens can be shut off and the water passed around them without screening.

These screens were designed under the direction of G. O. House and W. N. Jones, who were, respectively, general superintendent and engineer of the Bureau of Water at that time. They were built by the St. Paul Foundry Co. The screen chamber was designed and constructed by J. W. Kelsey and L. N. Thompson, engineers of the Bureau of Water, all work being done by force account.

Cantilever Erection of Draw in Open Position While Old Draw Serves as Fixed Span

New Swing Span Part of Union Pacific Bridge Over Missouri at St. Joseph—Old Span During Work Carried Traffic

CONSTRUCTION of a new 465-ft. swing span on a new pier, to replace the old 358-ft. span, was the second step in the improvement of the Union Pacific Ry. bridge over the Missouri River at St. Joseph, Mo. The first step was the shifting of three 297-ft. fixed spans longitudinally for a distance of 136 ft. Owing to the condition of the old masonry, it became necessary to build new piers, and as an increase in length of drawspan was imposed by the War Department, it was decided to keep the bridge on its original alignment, building new piers between the old ones. The work of shifting the fixed spans into the new position was described in *Engineering-News Record* of Mar. 13, 1919, p. 550. During the erection of the new drawspan, traffic had to be maintained over the bridge, and this averaged about 75 trains and 400 teams and automobiles daily. River traffic also had to be considered, and for this a temporary lift span was provided. This was not needed, however, as all the work at the draw was done in the winter, while the river was closed to navigation.

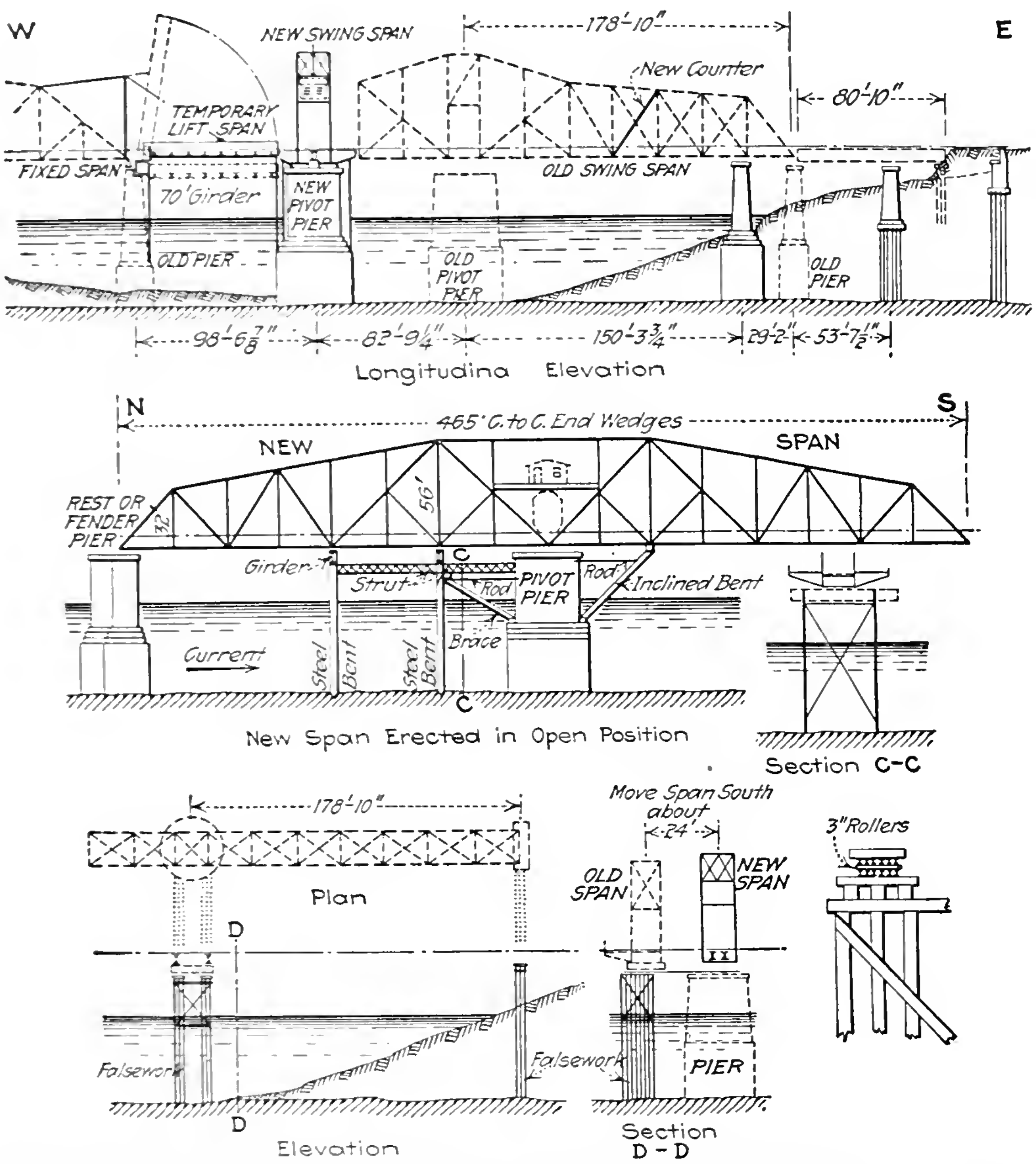

NEW SWING SPAN IS COMPLETED IN OPEN POSITION

Erection of the new drawspan was facilitated by the fact that this span was to be placed on a new pivot pier, in line with, but 83 ft. west of the old span. By erecting it in its open position the only interference was at the point of intersection. The old draw, therefore, was left in place, in its closed position, as a fixed span, but five panels of its west arm were cut off to make room for the new work. The layout of the erection scheme is shown in the accompanying diagrams. Work was commenced as soon as the shifting of the fixed spans had been completed.

A cantilever arm was formed by this shortened or bobtail west arm of the old span, with its end floor-beams only about 2 ft. from the ends of two of the roadway floor-beam brackets of the new draw, these being practically in line with the stringers of the old draw. Blocks bolted to the face of the floor-beam and to the ends of the brackets supported cross-timbers which closed the gap and on which were laid the intermediate ties. To prevent any yielding or lateral movement of the brackets they were supported by a timber bent having its cap cut to the slope of the brackets, as shown in one of the drawings. Removal of the end panels of the old drawspan, as noted above, left an opening between the new pivot pier and the west pier of the old draw. This was utilized for the temporary navigation channel, as shown. A through girder span of 70 ft. was placed here, being pivoted over the old pier and designed to be raised by tackles. Owing to the early closing of the river by ice, however, it was evident that it would not be necessary to operate it. Therefore, when the trusses of the old draw were cut off to permit the erection of the new span in its open position, the floor of the old draw was blocked up on the 70-ft. girders, and traffic was maintained over it without disturbing the track.

To carry the operating track through the new span during its erection, ties were laid temporarily on the drum of that span. The traveler erecting the new span was able to cross this track without disturbing it, by means of rails having slots cut in the webs so that they could be dropped over the rails of the operating track. These slotted rails were removed as soon as the traveler had passed.

As the bridge is raised to a new grade, a temporary



STEEL BENT AND GIRDER SUPPORT PANEL POINT OF NEW DRAW DURING ERECTION OF MISSOURI PACIFIC BRIDGE AT ST. JOSEPH, MO.

inclined runoff was required to connect the new elevation on the bridge with the old grade on shore. This was formed by laying additional ties on the stringers and placing upon these tapered jack stringers which carried the ties of the operating track.

For the new 465-ft. single-track swing span, through trusses of the Warren type are used, these being 56 ft. deep at the middle and spaced 12½ ft. on centers. Floor-beam brackets carry 15½-ft. roadways outside of the trusses. The weight of the span is about 1717 tons, exclusive of the machinery, which weighs 90 tons.

Preparation for work on the new drawspan included the driving of two steel bents, distant 58 ft. and 116 ft., respectively, from the center line of the bridge, to support the first portion of the upstream arm, leaving 116 ft. to be continued as a cantilever until it reached the fender or rest pier. Each bent was composed of two steel piles connected by diagonal bracing having pin connections to allow flexibility in sinking. Each pile was of H-section, composed of three 24-in. 80-lb. I-beams, 78 ft. long, with batten plates over the flanges and having a cast-steel point about 2 ft. long.

Sinking the piles to rock through 35 ft. of sand was assisted by two water jets at 175-lb. pressure and the points were then driven about 2 in. into the solid rock by a five-ton drop hammer. Each pile carried one of the diagonal braces, attached to a pin connection near the foot. This connection permitted the brace to be held in vertical position while sinking, and then to be swung out for attachment to a pin connection at the head of the other pile. As the bents were embedded deeply in the silt, this had to be cleared away temporarily by water jets, to enable the braces to be swung across, as described. The upper half of one brace was made wide enough to allow the other brace to lie within it. A special floating piledriver had to be built to handle these 80-ft. steel piles, each weighing about 28 tons, including the bracing.

Each bent carried a 60-ft. plate girder seated upon shoes on the tops of the I-beams which formed the webs of the steel piles, the two outer beams of each pile being extended above the girder, as shown in one of the photographs. These girders were used later in the new approach. The two girders supported the first portion of the upstream arm of the draw, as noted above. The bents were braced together and to the pier by horizontal steel struts, while the first bent was braced against the pier by a timber raking strut or bent, to resist the thrust of ice and drift in the river. After completion of the work the girders were removed and also the upper parts of the diagonal braces of the bents, the steel piles being then cut off by torches at the ice line, as they were too firmly embedded to be pulled up.

To carry the first lengths of the chords on the downstream side, an inclined timber bent was seated on the footing of the pier, with its top anchored by rods built into the pier. The cap of this bent supported the first panel points of the downstream end of the span. This method of support was planned during the early part

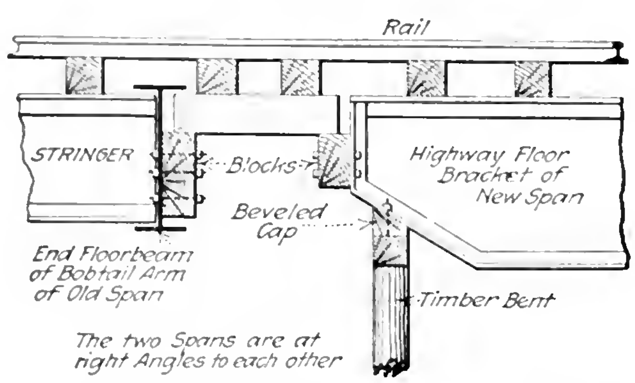
ERECTING CRANE PLACES 80-FOOT 41-TON POST OF NEW SWING SPAN; HIGHWAY PASSES THROUGH PANEL

of the work and the bent was erected, in vertical position, within the cofferdam. With the turntable center erected on the new pier, the derrick car first placed the bottom chords for the four middle panels, the outer ends of these being supported on the steel

bent and inclined timber bent for the upstream and downstream panels, respectively.

Then the panel verticals were erected, followed by the end posts extending from the turntable to the tops of the verticals. Each end post was complete in one piece 80 ft. long and weighing 41 tons. No slings were used in handling them, but hitch plates were riveted at such positions that when attached to the hoisting hook of the derrick the post would swing at approximately its normal inclined position. This facilitated setting this long and heavy member in place. Chord sections weighed from 13 to 18 tons. On the completion of the upstream arm, it served as the anchor for the downstream arm, which was built as a cantilever beyond the inclined supporting bent.

The erection of the end posts at the center of the new draw, with all those members composing the central four panels, was done with a 150-ton locomotive crane that had been built specially for the erection of the long fixed spans at the Metropolis bridge over the Ohio River. The balance of the truss was erected with a



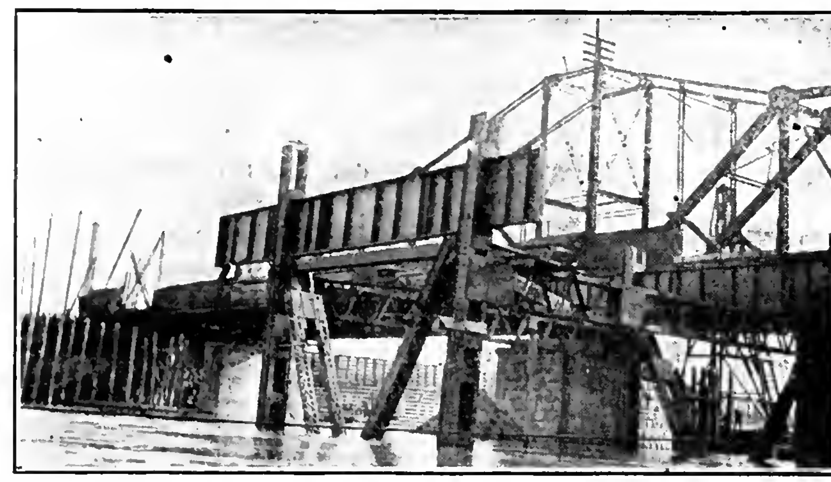
TEMPORARY TRACK CONNECTION BETWEEN THE TWO SPANS

through traveler running on the deck of the new span. This traveler was equipped with a 75-hp. electric hoist. Material was carried out to it on a track supported by the highway floor-beam brackets.

Highway traffic, during erection of the new draw, was carried on the upstream roadway of the old draw, as there was room for teams to pass under the batter posts in the upstream arm of the new span. The old roadway and the brackets on the downstream side were removed, rails being piled against the truss to counterbalance the weight of the upstream roadway. In the 136-ft. opening left by the shifting of the fixed spans for this distance, the track and the roadway were carried on timber pony bents. The main part of each bent rested on blocking on the falsework and carried the railway track, while the projecting cantilever end carried the highway. One of the views shows the crane setting these bents on the falsework.

The removal of the remaining portion of the old span, to permit of closing the new span, was effected by shifting it downstream a distance of 22 ft. This was done on 3-in. rollers laid on rails on pile falsework forming extensions of the old east pier and old center pier. The weight was about 550 tons and the span was moved by means of two nine-part tackles operated by hoists placed on each end of the old span. Both railroad and highway traffic were then operated on the track deck of the new span until the trusses were riveted, this being done to prevent any distortion in the trusses due to outside loading. With the riveting completed, the highway floor was laid on the upstream side.

For dismantling the old span, the floor-beams and bracing were first removed. Then the outer truss was

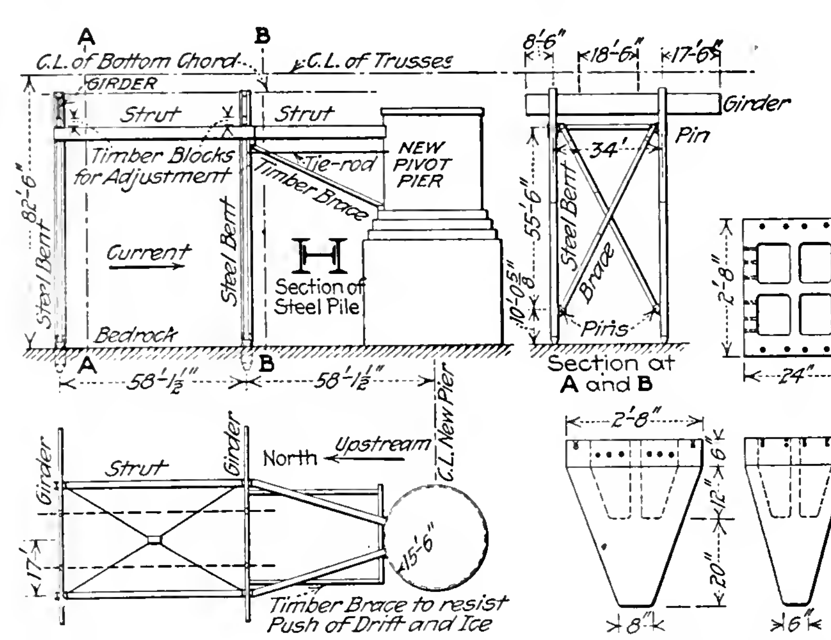


TRAVELER ON CANTILEVER CONSTRUCTION OF SWING SPAN OF ST. JOSEPH BRIDGE

moved back onto I-beam brackets attached to the new span, the latter not being required to open, as the ice still prevented river traffic. The trusses were taken apart by the aid of a derrick placed on top of the east arm of the new span.

When the old draw was rolled out and the new one closed, there was a gap of 28 ft. left between the end of the latter and the old falsework, until the old draw was taken down. Then the 80-ft. girders were rolled 28 ft. endwise to the west, and the new 60-ft. approach spans were erected.

The reconstruction of the swing span and the shifting of the fixed spans were undertaken by the American Bridge Co., under the personal supervision of K. L.



STEEL PILE IS BUILT UP OF THREE 24-INCH I-BEAMS

Strickland, division erecting manager; T. S. Melton, foreman, and A. F. McLane, resident engineer. The work was done for the St. Joseph & Grand Island Railway Co., under the direction of R. L. Huntley, chief engineer of the Union Pacific System, with H. M. Stone as resident engineer, the entire project being under the general supervision of E. E. Adams, consulting engineer of the Union Pacific System.

Immediate National Reconstruction Work in France

Improvements to Navigation of Seine and Various Canals To Be Made, and Highways and Railroads Taken in Hand

By Major Daniel T. Pierce
American Red Cross, Paris, France

FORTUNATELY for France, even while the war was going on there were a certain number of men whose duty it was to prepare for peace. A Ministry of the Liberated Regions was set up when there was scarcely any liberated region to consider. For a year before the signing of the armistice another important bureau was studying plans for the development of France's colonial possessions. At the same time, the Ministry of Public Works was considering a program of public improvements within the Republic to be undertaken immediately after the war. The Under Secretary of State, M. Cels, recently consented to outline these plans as developed up to this time.

This program of the immediate public improvements includes the enlargement and increase of port facilities, canal and road improvement, railroad reconstruction, and many noteworthy projects for increasing the utility of rivers and canals.

Projects for Which Plans Have Been Made

The following outline represents only those projects on which agreement has been reached and for which plans have already been made.

Navigation on the Seine—The work to be undertaken here consists of the reconstruction of the dams at Andressy, Méricourt, Ville-Notre-Dame, La Garenne et Poses, and the removal of the dam at Melun. At each of the waterfall locks of the Seine new locks 660 ft. in length are to be constructed.

Bridges hereafter are to have a clearance of 6 ft. above high-water level, and many tributaries to the river are to be improved and deepened. Certain parts of the navigable channels of the Seine are much in need of rectification, and this work will also be undertaken immediately. The aim is to obtain a channel depth of 15 ft., which will permit bringing up the Seine River to Paris river barges of 2400 tons and seagoing barges of 1800 tons.

North Canal—Prior to the war, extensive improvements of this important waterway were undertaken. These are to be resumed at once, with the intent of making possible the movement of barges of 600 tons instead of those of 300 tons which were the largest barges that could be handled heretofore. The improvements are now to include the repair of the canal of St. Quentin, which repair is an immediate necessity in order that coal from the Northern mines may again reach the region of Paris by canal.

The Rhine Canal—Immediate execution will be undertaken of improvements to permit the use of the canal from the Rhône to the Rhine, throughout its length, by barges of 300 tons. A navigable way from Haute Alsace and the rest of the territory will be assured, handling among other important traffic the potash of the Alsatian region. This program will be extended later on by improvements on the Rhône which is a part of the plan of internal river and harbor work.

Canals of the South—Dredging and rebuilding of towpaths to permit the use of mechanical tractors, and the reconstruction of bridges, are included in the program of improvements for the Canal of the Midi (South) and the laterals to the Garonne. The effects of these improvements will be to increase greatly the efficiency of the southern canals as a means of communication between the ocean and the Mediterranean. Some important improvements on the Loire have also been adopted for immediate execution.

Highways—In the field of road improvements there is a decided inclination to adopt other forms of construction than those which have heretofore proved satisfactory. France obtained her reputation for good roads on the basis of the service given by macadam. This, however, was before the days of war traffic and multitudinous automobiles. Some new plans for road improvement in the territory between Paris and the Marne call for granite block for considerable distances through and beyond the numerous towns and villages. Stone block represents to the Frenchman the ideal of durability under the heaviest traffic, and he is not as yet prepared to change his mind on this point.

Railroads—On the subject of railroad improvement and reconstruction, it is impossible to speak definitely, for the reason that the destruction of the war-zone railroads has been so complete that the effort is simply to put into operating condition as speedily as possible the main lines radiating northeast from Paris. Even the most important of these lines are still in a deplorable condition as to state of roadway and structures, and the available output of steel is totally inadequate to accomplish what must be done before the railroads of the war zone can be restored to pre-war conditions, much less improved as compared with their former state.

American Operation Made Good Impression

Steel bridges will be almost universally adopted and somewhat heavier rail used, for while European railroad authorities are not willing to concede the greater efficiency of the very heavy cars and locomotives preferred in the United States, a very strong impression has been made by the performance of the American equipment imported to France for war purposes, and an even greater impression has been made by the efficiency of operation that prevailed on the lines under the American Expeditionary Forces.

It is evident that the program of internal improvement which must be carried out in advance of the reconstruction of towns and villages will call for a vast amount of material and machinery which France itself cannot supply.

Correction

Several typographical errors appear in the article entitled "Tests Show High Shear in Deep Reinforced-Concrete Beams," by W. A. Slater, in *Engineering News-Record* of Feb. 27, 1919, p. 430. The test beam shown in Fig. 1 was not 26 in. deep but 36 in. as stated in the text. In the shear formula in the first column the coefficient $\frac{7}{8}$ is omitted in the vertical stirrup formula. The second formula in the same line relates to diagonal stirrups. In the second column on p. 431 the coefficient for the deflection formula is 0.0833.

Keep Accurate Costs on War-Time Fee Contract

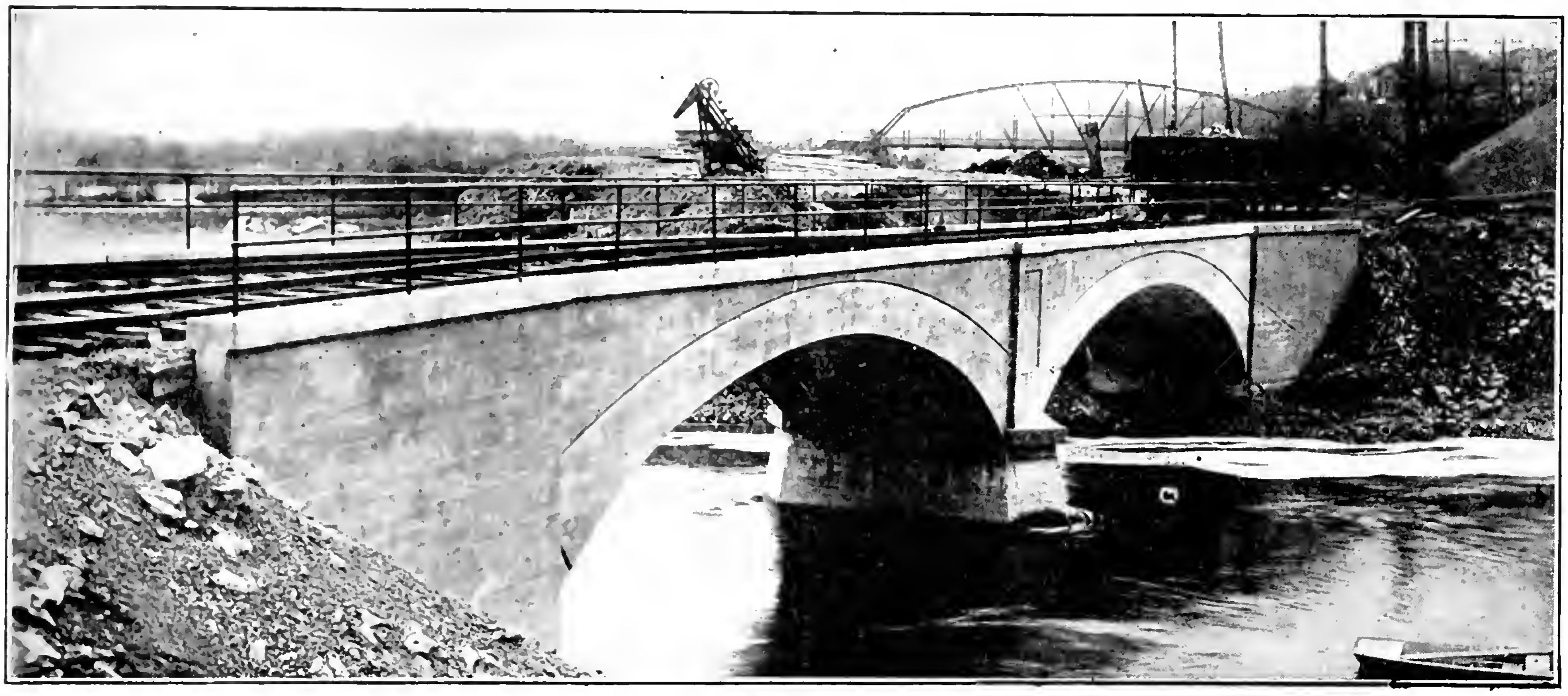
Figures on Small Concrete Bridge Job in Which Instability and Height of War Prices Prevented Lump Sum Bidding

BY FARLEY GANNETT AND J. D. CARPENTER
Gannett, Seelye & Fleming, Engineers, Harrisburg, Penn.

COSTS of construction have changed so entirely during the past three years that the engineer's customary sources of information on costs are useless today, and every new evidence of costs under present conditions is exceedingly valuable. Not only were wages and material prices high, but the efficiency of labor was so low during 1918 that it was not safe to use ordinary standards of work and apply thereto the ratio of old to present wages. The construction of a small concrete bridge in Pennsylvania during the summer of 1918 is therefore interesting on account of the cost-plus-fee form of contract used, and by reason of the fact that careful cost records were kept and worked up, showing accurately actual costs at the high point in the rising prices of 1918 in this section of the country.

The bridge was built for the York Haven Water and Power Co., which operates a 20,000-hp. hydro-electric power plant on the Susquehanna River 16 miles below Harrisburg, Penn. It is a two-span reinforced-concrete arch bridge across the tailrace of an adjoining paper mill, and carries a single-track railroad siding from the main line of the Northern Central R.R. to the power house. Its construction was imperative, as the old trestle which it replaced was unsafe for railroad use, and it was necessary to get heavy machinery into and out of the power house for repairs and replacement. Thus, the bridge had to be built, notwithstanding the high prices.

The contract was let for cost-plus lump-sum fee. The engineer's estimate of cost was $14,880 and the fee was fixed at $1860 or 12½%. Under the contract, if the actual cost exceeded the estimated cost for any reason except increased quantities, no increase was made in the fee, but if the actual cost was less than the estimated cost the owner and contractor shared equally in the saving. If, however, the quantities were increased or decreased, then the fee increased or decreased accordingly. The actual quantities varied so little on the total job that the final estimated cost was $15,000, as against the original estimated cost of $14,880. The actual cost of the bridge was $17,922.17, a little over $3000 more than the original estimate, but one-half of this excess was due to the raise in the labor wage per hour from 35c., when the estimate was made in April, 1918, and 40c. when the work was done. Before the work was let a lump-sum bid was requested from a contractor who was anxious to do the work, but, as his bid was $26,000, it was not awarded to him. This bid evidently included a large allowance for risk on higher wages and cost of materials, as any bid made at that time must have done. The company saved about $6000 by adopting the form of contract used instead of letting it on this lump-sum bid.



CONCRETE BRIDGE BUILT UNDER WAR PRICE CONDITIONS NEAR HARRISBURG, PENN.

The bridge, shown in the view, has two 50-ft. spans with a rise each of 8 ft. and a middle 5-ft. pier. It is 105 ft. from face to face of abutments, 145 ft. from end to end of wing walls and 16 ft. wide out-to-out of side walls. The tracks are carried on an earth fill. The tailrace which the bridge crosses is about 100 ft. wide, with an approximate depth of 7 ft. of water therein and an average velocity of three miles per hour. The old trestle was used to transport materials across the tailrace and to support the arch centering on the new work.

The local labor was all employed in local industries, so colored labor was imported and a bunk house had to be built for them. The only machinery used was a concrete mixer and two pumps. Steam was purchased from the adjoining paper mill. The work was started May 27, 1918, and was finished Sept. 26, a total of 122 days. No great delays occurred, but the progress was slow owing to the great difficulty in getting and keeping labor.

The first work done was the excavation of the east abutment, No. 1, then the central pier and the west abutment. After the east abutment was poured, the concrete was placed in the pier and the east arch, and then the west abutment and arch were poured.

TABLE SHOWING COST DATA ON YORK HAVEN, PENN., BRIDGE, BUILT JULY-SEPTEMBER, 1918

	Bunk House	Cement Shed and Office	Travel	Excavation Abutment 1	Excavation Abutment 2	Cofferdams Abutment 1	Cofferdams Pier	Cofferdams Abutment 2	Pumping	Small Tools
Labor at 40c. per hour	116.02	90.15	86.91	478.59	635.05	454.47	884.69	114.64	71.24	...
Number of units	...	...	...	187 cu. yd.	500 cu. yd.	60 ft.	95 ft.	...	...	...
Labor cost, unit	...	...	...	2.56	1.27	7.57	9.31	...	...	...
Material cost	403.25	229.52	...	...	...	170.00	244.71	190.00	181.31	688.46
Total cost	519.27	319.67	86.91	478.59	635.05	624.47	1,129.40	304.64	252.55	688.46
Salvage	125.00	100.00	...	...	...	...	...	...	...	273.20
Net total cost	394.27	219.67	86.91	478.59	635.05	624.47	1,129.40	304.64	252.55	415.26
Total cost per unit	...	...	...	2.56	1.27	10.40	11.88	...	...	...
Estimated cost	300.00	200.00	...	250.00	260.00	500.00	900.00	300.00	500.00	200.00
Estimated cost per unit	...	...	...	1.50	1.50	...	...	...	...	...

	Concrete Materials, Mixing and Placing 1:3:6 Piers and Abutments	Concrete 1:2:4 Arches	Concrete 1:2:4 Walls	Forms Piers and Abutments	Forms Arches	Forms Walls	False work for Arches	Reinforcing Steel	Removing Old Trestle	Taking Up and Relaying Old Track
Labor at 40c. per hour	1,181.65	751.45	417.28	511.44	476.90	987.46	780.89	598.32	215.51	62.87
Number of units	319 cu.yd.	208 cu.yd.	99 cu.yd.	319 cu.yd.	208 cu.yd.	99 cu.yd.	...	12.3 tons	...	...
Labor cost per unit	3.61	3.62	4.22	1.60	2.29	9.98	...	48.60	...	...
Material cost	1,347.92	1,334.33	645.90	230.66	552.81	317.61	360.89	1,119.77	...	...
Total cost	2,529.57	2,085.78	1,063.18	742.10	1,029.71	1,305.07	1,141.78	1,718.09	215.51	62.87
Salvage	121.00	135.00	65.00	39.53	40.00	15.00	185.00	52.80	...	...
Net total cost	2,408.57	1,950.78	998.18	701.57	989.71	1,290.07	956.78	1,665.29	215.51	62.87
Total cost per unit	7.56	9.38	10.07	2.20	4.75	13.03	...	139.50	...	...
Estimated cost	2,164.50	1,903.20	759.45	360.00	945.00	1,200.00	800.00	1,235.00	200.00	75.00
Estimated cost per unit	5.55	9.15	9.15	0.92	4.54	14.46	...	130.00	...	...

	Pipe Railing	Fill and Ballast	400 Ties	One No. 6 Frog	85-lb. Rail in Place	Waterproofing	Finishing Concrete	Cleaning Up	Totals
Labor at 40c. per hour	53.17	589.55	...	3.05	145.50	50.60	44.80	113.25	9,915.45
Number of units	290 ft.	900	...	...	4.7 tons	...	...	...	...
Labor cost per unit	0.18	0.65	...	...	31.00	...	...	...	...
Material cost	256.76	68.33	100.00	267.50	423.61	24.91	...	...	9,158.25
Total cost	309.93	657.88	100.00	270.55	569.11	75.51	44.80	113.25	19,073.70
Salvage	...	...	...	...	...	...	...	...	1,151.53
Net total cost	309.93	657.88	100.00	270.55	569.11	75.51	44.80	113.25	17,922.17
Total cost per unit	1.07	0.66	1.25	...	120.10	...	...	...	...
Estimated cost	232.00	515.00	440.00	130.85	340.00	50.00	20.00	100.00	14,880.00
Estimated cost per unit	0.80	0.50	1.10	...	80.00	...	...	...	...

It was necessary to do all excavation inside cofferdams which were mostly of double rows of timber sheetpiling, filled with clay by hand. Money was not spared in making substantial cofferdams; thus the cost of pumping was kept down. The cofferdam enclosing the east abutment was 3 ft. wide, with an average depth of 6 ft. The cofferfill was made with clay borrowed from a pit about 50 ft. distant. The pier cofferdam was also 3 ft. wide, but 10-ft. plank were used, as the water was 7 ft. deep. The wales were first framed and floated to location, where a skeleton coffer was assembled, the whole thing being supported by the old trestle and held in position in the current by wire lines. The skeleton was then sunk, sheathed and filled. Owing to the rough, rocky character of the bottom this coffer had several bad leaks, which were stopped with much trouble.

The coffer for abutment No. 2 was entirely on the bank, although rock was about 5 ft. below water level. A single row of built up tongue-and-groove sheathing was driven, making its cost considerably less than the others. The excavation here consisted of a mixture of cinders and wood scraps, which was wheeled and dumped about 100 ft. away.

One 6-in. centrifugal pump and one 6-in. siphon handled all the water coming through the cofferdams. As an indication of the items which make up the totals on the data sheet, the charge of $252.55 against pumping is distributed as follows: Rental, 88 days, at $1, $88; steam, $61.72; freight and repairs, $31.59; labor setting and moving pumps, $71.24.

After a thorough study of the materials available, it was decided that the gravel from a local deposit, which was offered at $1 per cubic yard of concrete, would be the most satisfactory. The deposit contained about 20% of clean sand under ¼-in.; 60% stone under 1 in.; 20% stone 1 to 3 in., with a few larger stones which were thrown out or used for plums in the 1:3:6 concrete. The gravel, after the sand had been removed, contained from 25% to 30% of voids. Working on the 30% basis, it was decided to use 30% of sand plus 10% of this to make a smoother mixture, or 33% of sand. In actual practice, however, this was found to make a concrete of a stony appearance and hard to work. The amount of sand was then increased to 40% of the gravel, which gave a more satisfactory mixture. A ⅓-yd. mixer was used, 10 revolutions being given the batch before dumping. Enough water was used to make the concrete easily workable, but no water collected in the form. The concrete was wheeled in buggies an average distance of 80 ft. The largest day's pouring was 110 cu.yd., dumping a batch about every two minutes.

The carpenters were local men, experienced in house building but not with concrete forms. The cost of forms ran high, especially in the beginning, on the 1:3:6 concrete.

The bents of the old trestle, used for falsework to support the arches, were cut below the spring line and capped. The centers were wedged 0.1 ft. above grade before concreting. During the pouring the arches settled about 0.15 ft., leaving the center 0.05 ft. low. The bases of the bents were on rock. The reinforcing steel was cut and bent on the job and placed by common labor. A clamshell was used for about 40% of the fill; the remainder was made with wheelbarrows with an average wheel of 80 feet.

The cost data show the total cost of each item, the

TABLE SHOWING UNIT PRICES PAID FOR MATERIAL

(All prices are f. o. b. job)

Lumber, 1-in. plank	$48.00	per M.
Lumber, 2-in. plank	48.00 to 51.00	per M.
Lumber, 6x6 in. to 10x10 in	51.00 to 61.00	per M.
Cement	2.44	per bbl.
Sand	1.50	per ton
Gravel	1.25	per cu.yd.
Reinforcing steel—⅜x⅜ in.	0.038	per lb.
85-lb. rails	75.50	per ton
1¼-in. pipe railing	.90	per ft.

labor cost, material cost, salvage and engineer's estimate. The unit costs are also shown.

The cost of excavation of abutment No. 1 was 75% above the estimate, but that in No. 2 was about 16% less than was estimated. There was, however, considerably more excavation necessary than was contemplated. The pier foundation required no excavation, as the current in the tailrace had washed the rock clean.

The costs of cofferdams, which averaged $11.30 per foot of horizontal length, were fairly near the estimate, while the pumping cost was only half what it was expected it would be. The 1:3:6 concrete in pier and abutments cost nearly 50% more than estimated, while the arch concrete came out very close to the expected cost. The reinforcing steel cost more than expected, largely because of the necessity of paying a higher price to get any steel at all.

The bridge was designed by Gannett, Seelye & Fleming, engineers, of Harrisburg, Penn., and was built under their supervision, with J. D. Carpenter as the resident engineer, by G. W. Ensign, Inc., contractors, of Harrisburg, Penn.

The cost-plus-a-fixed fee contract as illustrated by this bridge contract, wherein any saving over an agreed to probable cost is shared between the owner and the contractor, is not an entirely new form of contract, but its possibilities and equities have hardly been sufficiently appreciated. There is nothing to cause the contractor to attempt to increase costs, as in the cost-plus-a-percentage form, while there is a strong argument, in the way of additional fees, to cause him to do everything to keep costs down. There is no element of risk to the contractor, so he does not have to figure on one job to recoup losses on another. Such contracts will tend toward the employing of contractors who specialize in various forms of construction. Thus, the firm specializing in concrete bridges could be counted upon to build such bridges better and cheaper than a firm specializing in sewer work. Contractors will be employed on their professional ability rather than on their willingness to take a risk.

Under existing laws most municipalities must call for competitive bids and must let the contract to the lowest responsible bidder at a cost which is definitely set in the contract. Thus, it would not seem that much municipal work could be done under the form of contract here discussed until changes are made in the laws. Private corporations and individuals, however, may, and it is expected will, use this form of contract to their considerable advantage.

Efficient Methods of Financing Highway Bond Issues

Problem Has Many Factors Determined by Local Conditions—License Fees Work Well in States Lacking Good Roads

Many different factors, which vary according to local conditions, enter into the problem of determining the proper method of financing highway improvements. Motor-vehicle fees may be used for highway construction or maintenance, according to the condition of the highway system in the state where they are to be applied. In states having no systems, they are particularly adapted to construction purposes, while in states where good systems exist they should probably be applied to maintenance. The above conclusions may be drawn from a paper presented by S. E. Bradt, state superintendent of highways, Illinois, and read by title before the recent convention of the American Road Builders' Association. The following is an abstract of the paper:

The provisions under which state bonds are issued by the various commonwealths are determined by the constitutions, which differ to a considerable extent. They are, however, generally uniform in the requirement that a proposition to issue bonds must be submitted in some form to a vote of the electors of the state.

In addition to complying with the constitution there are many other factors to be taken into consideration, as follows: (1) Present condition of the main roads of the state; (2) amount of mileage to be improved with state funds; (3) general type of the improvement; (4) estimated cost of the improvement; (5) assessed valuation of the state; (6) present rate of taxation; (7) all other sources from which revenue may be derived; (8) amount of bonds to be issued; (9) method of taxation to be adopted in liquidating the bonds that will be just and fair, and (10) maintenance of the roads after construction.

The consideration of these different factors will indicate immediately that the proposition is somewhat complex and that the same provisions will not be applicable to all states. In fact, if the provisions of a bond issue were worked out effectively, based upon local conditions, they would scarcely be the same in any two states. For any states with similar conditions, the Illinois plan of financing bond issues is efficient, equitable and thoroughly practicable. The plan differs from others chiefly in that, while the credit of the state is used to give the bonds stability in the market, the bonds are to be liquidated, both as to principal and interest, from the proceeds of motor-vehicle license fees. In order to bring about a sufficient revenue from this source, the fees which formerly averaged $5 per car have been increased to approximately $10 per car, which is about the amount paid now in every large state.

Every state in the Union has adopted the system of requiring that all motor vehicles be registered and a license fee paid therefor. In many of the states these fees are either in whole or in part turned back to the counties or townships and expended by local officials. It is generally conceded that, very frequently, the funds used upon the roads by local authorities are expended in such a manner as to bring no lasting benefit. In Illinois the money derived from this source has been segregated and was rapidly accumulating in the state treasury.

It is contended by some that these funds should be conserved, to be used exclusively for maintenance, leaving the improvement of the roads to be financed entirely from general taxation. It is undoubtedly true that the taxing of motor vehicles originated because of the damage which they caused to our highways. This was especially true of those stone and gravel roads planned for horse-drawn traffic, and before the days of the automobile. It is also willingly conceded, without

argument, that any state has the right to maintain its roads from motor-vehicle fees. However, Illinois has practically no improved roads to maintain. Its motor-fee collections, based upon the same schedule as other large states, will yield within two or three years from \$5,000,000 to \$6,000,000 annually. The demand for a connected state highway system, requiring a large amount of money, is insistent. Local and state taxes are already so high as to limit the amount that could be raised by general taxation for road improvement, to a sum which would be entirely inadequate. With these conditions in view, the State Highway department conceived the idea of using the accumulating fund as the basis for a construction bond issue.

If Illinois main roads were improved, as are the main roads of Massachusetts, then these motor fees could properly be used for maintenance; or if Illinois had already issued bonds, as has New York, and constructed a system of roads that require \$4,000,000 to \$5,000,000 annually for maintenance, then there probably would be no question as to the necessity for using motor fees for maintenance. However, with a very small percentage of improved roads to maintain, with no bonds outstanding, and with a growing automobile fund sufficient to pay the principal and interest on a \$60,000,000 bond issue and still set aside from the same source an average of \$2,500,000 for maintenance while the bonds are being liquidated, the plan to use this source of revenue appeared to be not only the most equitable, but also the most efficient method.

Whether it is equitable to pay the entire cost of any system of roads from motor-vehicle fees is often questioned. The argument is based upon the theory that road improvement benefits all of the citizens. This is readily admitted, and if the roads in the system were to be the only ones improved, the point would be well taken. In Illinois, however, the 4800 miles to be improved with the bond issue fund comprise only 5% of the total mileage of the state and will carry probably not to exceed 50% of the total traffic. The remaining 95% of the roads will be improved largely through local taxation, so that the general taxpayer will be afforded ample opportunity to pay his share.

Motor Vehicle Owners' Protection

There appears to be apprehension on the part of some people that this method of raising funds will lead to excessive taxation upon the motor vehicle. This danger seems very remote. Motor-vehicle owners today constitute a very large per cent. of the male population, and their relative number is increasing rapidly. Their numbers and influence will be sufficient to protect them against unjust and unsatisfactory legislation.

Finally, if the people are to pass favorably upon a bond issue, which involves a debt and the levying of taxes to meet this debt, then they must be convinced that the method of taxation is fair and just; and the man who is to be taxed must be convinced that he is getting value received from his outlay. In the campaign carried on for the Illinois bond issue, every motorist organization was enthusiastically for the proposition; and, so far as we know, every motor-vehicle owner was equally enthusiastic, although understanding fully that he was to pay the cost. The voters, 35 to 40% of whom are motorists, showed by giving the plan a large majority that they are convinced of its soundness for liquidating the bond issue.

In concluding, it may be stated again that the Illinois plan will not apply to every state in the Union, and is not the panacea for all the financial ills of all the states; but in states where the situation is similar to that in our state, with practically no improved roads, and with a large registration of motor vehicles, it is believed that, with some modifications, it will afford a sound, equitable and efficient method of financing.

Greater Activity Planned for the Hetch Hetchy Project

THE annual report prepared by M. M. O'Shaughnessy, city engineer of San Francisco, outlines recent progress on the Hetch Hetchy project, as well as the extent of activity for the coming year. The project is now in such condition, the report states, that \$600,000 monthly can be expended efficiently in rushing it to completion if the bonds are sold so that this money is made available. During the past year the multiple-arch dam at Lake Eleanor has been completed and has for some time been serving the power house used to develop electrical energy for construction purposes. In addition to the power used on the project the city is deriving an income of \$9000 per month from this temporary power plant, for electrical energy sold in San Francisco.

The most important feature of construction work now under way is the 18-mile tunnel between Early intake and the reservoir for the Moccasin Creek power house. This tunnel is now being advanced from three headings: From Priest Portal the heading has been driven in 1500 ft.; at South Fork an advance of 975 ft. has been made, and at Early intake the heading is in a little more than 1000 ft. Four additional headings will be used later in the work, one at the Priest Portal and two each from the shafts that are being sunk to the tunnel line at Big Creek and Second Garrotte.

The long tunnel is being driven on the day-labor plan at a price lower, the report states, than the engineer's estimate of \$60 per lineal foot. The contractors' bids averaged about \$90 per foot.

Attention will be concentrated on the long tunnel this year, as this will be the limiting factor in the completion of the first unit; i.e., the section above the Moccasin Creek power house, where a total of 66,000 hp. is to be developed under a head of 1215 ft. The longest single section of the tunnel will be the 4½-mile length between South Fork and Early intake, of which about 2000 ft. has already been completed. Six storage-battery locomotives have been purchased for hauling muck out of the tunnels, and an electric mucking machine is also being tried out. A small dam is necessary to complete the reservoir at Priest, the lower end of the long tunnel, and this, together with the penstock and power house, will be finished before the tunnel is ready for service. In case delay in financing makes it necessary to postpone work on the Hetch Hetchy dam, it would be possible to carry the Lake Eleanor dam to a greater height and to divert water from this source in addition to the natural flow of the Tuolumne River for developing power at the Moccasin Creek plant.

The fact that \$1,000,000 worth of Hetch Hetchy bonds were recently sold, and an option on \$8,000,000 more was taken up at the same time, is taken to mean construction work can be pushed rapidly during 1919.

Salt-Marsh Sand Clay as a Road-Building Material

Abounds in Tidal Lands in Texas—Primarily a Mixture of Epsom Salts, Gypsum, Clay and Sand—Economical to Use

ROAD surfacing with a material known as salt-sand clay, taken from the tidal lands of Aransas County, Texas, is being resorted to, with what are reported to be excellent results. The chemical analysis of this material shows that it is essentially a mixture of epsom salts, gypsum, sand and clay. When spread upon the road it hardens and produces a firm surface which has the appearance of sheet asphalt. The information following is contained in a report made to the State Highway Department of Texas by R. H. Phillips, county engineer of Aransas County.

Heretofore the material used for surfacing in this section has generally been oyster shells in various forms and conditions. At some points large shells were used, followed with a coating of finer shells mixed with sand; at other points the final coating was partially disintegrated oyster shells; while at still others the final coating consisted of small, fine shells obtained from banks thrown up on the beach.

The best surfacing locally obtainable has been what is known as "mud shell," taken from reefs in Aransas Bay. The shells, in varying sizes, from ¼ in. up, had voids filled with mud and sand. This fine silica sand, having a coating of silt which acted as a binder, solidifies under traffic and becomes a firm road surfacing. The salty nature of this material holds the moisture and keeps the road compacted.

As these reefs are accessible by wagons only at very low water or by the use of barges, sufficient material was not obtainable to provide for road-building projects. This resulted in experimenting with the material, from salt marshes, which has a composition similar to the mud sand filling in the coarser particles of the shell.

Character of the Material

The deposits drawn from are located in what are known as salt flats, at a distance anywhere from 100 to 3000 ft. from low water at the shore. In some seasons, these flats are covered with salt water for from four to six months. For the remainder of the year they dry out so that the material can be excavated.

There is considerable variation in the composition. The silt content varies in color from black to dark brown and some is even a light yellow. Although called sand clay, the sand largely predominates. The best material for road-building purposes is that which has sufficient silt to coat the grains of sand, thus filling the voids and binding the material when compacted. That considerable salt exists in this mixture is not only shown by the chemical analysis given in the accompanying table, but, as the marshes dry out in the warm weather, crystallization can be noted upon the weeds and grass.

Most of the material is taken out by hand and shoveled into wagons to be hauled to the job. There is generally a film of clean sand over the top, of

CHEMICAL ANALYSIS OF SAMPLE OF SALT-SAND CLAY

Substances Determined:	Per Cent
Silica	6.10
Alumina	5.10
Ferric oxide	little
Lime	13.20
Magnesia	7.95
Sodium oxide	0.53
Carbon dioxide	2.01
Sulphur trioxide	31.79
Chlorine	2.94
Loss by ignition (water and organic matter)	30.49
Total	100.11
Hypothetical Combinations:	
Water and other soluble matter	30.49
Sodium chloride	1.54
Magnesium sulphate	23.74
Calcium sulphate	27.37
Calcium carbonate	3.44
Calcium chloride	2.19
Clay	11.20
Total	99.97

thickness varying from 1 in. to 1 ft. When this is over 1 in. it is generally necessary to skim it off. Wheel-scrapers are used to advantage in many places to dig the material and haul it to the roads. It is necessary to select it so that it will have sufficient binding material. If this is not done, the road surfacing produced will quickly break up and give a condition similar to deep sand.

When first excavated, the material contains considerable water, but it drains sufficiently to be easily handled by the time it reaches the road. The original road crust is not disturbed, unless absolutely necessary, the material being spread evenly over it to bring it to the desired surface. The usual depth used is about 6 inches.

Heretofore the surfacing has been too narrow, as it is found that when wagons get off the road in passing they very soon cut through the crust at the edge and gradually destroy the entire surface. Even 16 ft. is not wide enough, and Aransas County has designated its highways to be 24 ft. wide, with shoulders not less than 2 ft. wide, to be solidly rolled to the same slope as the sand-clay surfacing. Heavy crowns are also a detriment to this type of road. The best crown is about ½ in. to 1 ft. After the surface is spread it is customary to allow the traffic to consolidate it, material being added to fill the hollows which develop as the packing proceeds.

When the road has hardened it has an appearance similar to that of sheet-asphalt pavement. Each night, even in the hottest weather, it absorbs sufficient moisture to keep it compacted and in excellent condition. One of its faults is that it has a tendency to be slippery in wet weather; when this condition is bad it may be overcome by giving the surface a coating of sand or shell. If the crowns are low, the slipperiness has not been found to give much trouble.

The annual wear is estimated at $\frac{3}{16}$ in., which is approximately 73.33 cu.yd. per mile. Add to this 50 cu.yd. per mile for filling depressions that develop under traffic, and figuring the material at 75c. per cubic yard applied, the maintenance cost for the surfacing will run about $100 per mile per year. A small motor truck with a three-blade drag will prove to be an economical means of keeping this road surface in first-class condition, it is said. It is also believed that

an eight-ton roller would be a valuable addition to the maintenance and construction equipment.

Delivering the material upon the road costs about 34c. per cubic yard for a ¼-mile haul, with the addition of about 6c. per cubic yard for each additional ¼ mile. The spreading cost on the average is about 15c. per cubic yard. The information given was supplied by the Texas State Highway Department of which George A. Duren is state highway engineer.

Weights of Steel Roof Trusses by Empiric Formulas

Wide Variation in Results Obtained by Applying Rules to Practical Cases—Comparison With Estimated Weights

By R. Fleming
American Bridge Company, New York

Much ingenuity and study have been spent in the development of empiric formulas for determining the weights of steel roof trusses. Those given below have been brought to a common notation in which

T = weight of truss = WSD;
W = weight of truss in pounds per square foot of the horizontal projection of that portion of the roof supported by one truss;
S = span or distance between centers of supports in feet;
D = distance between centers of adjacent trusses in feet;
P = loading of truss in pounds per square feet of horizontal projection of roof;
U = allowable average direct stress in pounds per square inch (found only in the Thayer formula).

The following list includes the formulas most commonly quoted:

Cambria Steel Co., "Cambria Steel," 11th edition, 1914, for spans of 75 ft. or less.

$$T = 5SD$$

Carnegie Steel Co., "Pocket Companion," 19th edition, 1917, for loads of 40 lb. or more per square foot of ground area:

$$W = \frac{P}{40} \times \frac{1}{5}\left(\sqrt{S} + \frac{S}{8}\right)$$

Fowler, "Specifications for Steel Roofs and Buildings," 5th edition, 1909, for Fink trusses up to 200-ft. span:

$$W = 0.06\ S + 0.6 \text{ for heavy loads}$$
$$W = 0.04\ S + 0.4 \text{ for light loads}$$

Johnson, Bryan and Turneaure, "Modern Framed Structures," early editions: $W = S/25 + 4.0$. In the latest edition, 1916, the Ricker, 1907, formula is used for trusses resting on brick walls, and the Ketchum formula for trusses of steel-frame buildings.

Jones & Laughlin, "Standard Steel Construction," 1916:

$$W = \frac{P}{40}\left(\frac{S}{20} + \frac{12}{D}\right)$$

Ketchum, "Specifications for Steel-Frame Buildings," 3rd edition, 1916, for trusses up to 150-ft. span:

$$W = \frac{P}{45}\left(1 + \frac{S}{5\sqrt{D}}\right)$$

Maurer, "Cyclopedia of Civil Engineering," 1908:

$$W = S/25 + 1$$

Merriman, "Roofs and Bridges," 1888, 1911:

$$T = \frac{3}{4}DS\left(1 + \frac{S}{10}\right)$$

Ricker, "A Study of Roof Trusses," University of Illinois Bulletin, No. 16, August, 1907:

$$W = \frac{S}{25} + \frac{S^2}{6000}$$

Ricker, "Design and Construction of Roofs," 1912:

$$W = \frac{S}{25} + \frac{S^2}{12{,}600}$$

Thayer, "Structural Design," Vol. II, 1914:

$$T = \sqrt{\frac{PD}{U}}\,(4S^2 + 60S)$$

Trautwine, "Engineer's Pocket Book," 1911:

$$W = (0.05 \text{ to } 0.08)S$$

Tyrrell, "Mill Buildings," 1911, for roof load of 40 lb. per square foot of ground area, bays 10 to 20 ft., rafter slope 6 in. to 1 ft. and unit stresses of 12,000 compression, 15,000 tension:

$$W = \frac{S}{20} + \frac{12}{D}$$

The weights of trusses for other loadings and rafter slopes are obtained from a series of curves.

Conclusions regarding empirical formulas drawn from estimated weights of several hundred trusses may prove interesting. Three light Fink trusses resting on brick walls of 40-, 60- and 80-ft. spans, bays 16 ft., load equivalent to 40 lb. per square foot of horizontal area uniformly distributed on the top chord, roof slope 6 in. per foot, weighed 1370, 2550 and 4320 lb., respectively. The estimated weights of three trusses of the Warren type, same span and loading, but roof slope of 1 in. per foot, were 1500, 2900 and 4800 lb. The weights, according to the formulas quoted, for trusses with same spans and loading, are given in Table I.

TABLE I. WEIGHTS OF ROOF TRUSSES—16-FOOT BAYS; LOAD, 40 LB. PER SQUARE FOOT OF HORIZONTAL AREA
W = Weight per Square Foot of Area; T = Weight of Truss

	40-Ft. Span		60-Ft. Span		80-Ft. Span	
Formula	W	T	W	T	W	T
Cambria	5.00	3,200	5.00	4,800	5.00	6,400
Carnegie	2.26	1,446	3.05	2,928	3.79	4,851
Fowler	2.00	1,280	2.80	2,688	3.60	4,608
Johnson, B. & T	5.60	3,584	6.40	6,144	7.20	9,216
Jones & Laughlin	2.75	1,760	3.75	3,600	4.75	6,080
Ketchum	2.67	1,709	3.56	3,417	4.44	5,683
Maurer	2.60	1,664	3.40	3,264	4.20	5,376
Merriman	3.75	2,400	5.25	5,040	6.75	8,640
Ricker, 1907	1.87	1,197	3.00	2,880	4.27	5,466
Ricker, 1912	1.73	1,107	2.68	2,573	3.71	4,749
Thayer	2.75	1,760	3.75	3,600	4.75	6,080
Trautwine	2.00	1,280	3.00	2,880	4.00	5,120
Tyrrell	2.75	1,760	3.75	3,600	4.75	6,080

Again, three Fink trusses of the same span, spacing and slope as before, but with load of 56 lb. per square foot of horizontal projection, an increase of 40%, weighed 1670, 3200 and 5500 lb., respectively. Trusses of the Warren type, roof slope of 1 in. to 1 ft., weighed 1900, 3750 and 6000 lb. The formulas give weights for this loading as in Table II.

The variation—in some cases more than 100 per cent.—of weights obtained from the different formulas will at once be noted. The values obtained from a number of the formulas depend upon the span length alone, and are the same for all loadings. Other formulas make the weight of the truss vary directly as the load, which actual weights show to be an error. DuBois, in "The Strains in Framed Structures," gives a formula taking

TABLE II. WEIGHTS OF ROOF TRUSSES—16-FOOT BAYS; LOAD, 56 LB. PER SQUARE FOOT OF HORIZONTAL AREA

W = Weight per Square Foot of Area; T = Weight of Truss

Formula	40-Ft. Span W	40-Ft. Span T	60-Ft. Span W	60-Ft. Span T	80-Ft. Span W	80-Ft. Span T
Cambria	5.00	3,200	5.00	4,800	5.00	6,400
Carnegie	3.16	2,024	4.27	4,100	5.31	6,791
Fowler	3.00	1,920	4.20	4,032	5.40	6,912
Johnson, B. & T	5.60	3,584	6.40	6,144	7.20	9,216
Jones & Laughlin	3.85	2,464	5.25	5,040	6.65	8,512
Ketchum	3.73	2,393	4.97	4,784	6.21	7,956
Maurer	2.60	1,664	3.40	3,264	4.20	5,376
Merriman	3.75	2,400	5.25	5,040	6.75	8,640
Ricker, 1907	1.87	1,197	3.00	2,880	4.27	5,465
Ricker, 1912	1.73	1,107	2.68	2,573	3.71	4,749
Thayer	3.26	2,082	4.44	4,259	5.62	7,193
Trautwine	2.60	1,664	3.90	3,744	5.20	6,656

into account the load, span, slope and unit stresses, but it is too cumbersome for use. Moreover, it supposes the chords to be of constant section, and neglects the web members, assuming that these two errors compensate.

In fact, as stated by Marburg, in "Framed Structures and Girders," the variables are so numerous that no formula, for the weights of roof trusses, which is at once simple, accurate and generally applicable, can be devised. Such a formula is not necessary. In calculating stresses the weight of the truss is usually so small compared with the weight of the covering, the snow and the wind, that an error in its assumption is negligible.

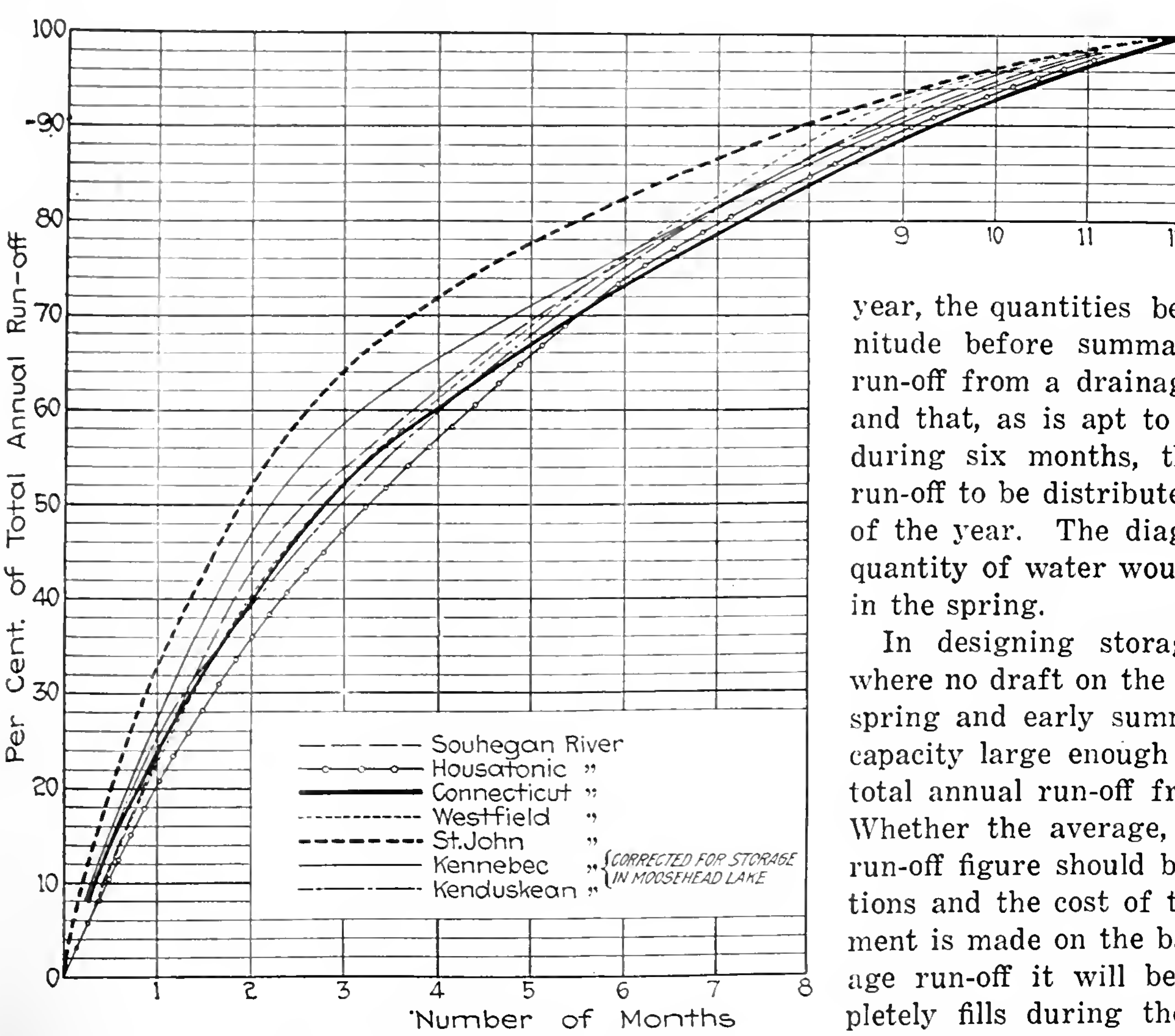
Ordinary steel roof trusses on brick walls with roof slope of 6 in. to 1 ft. and an assumed load of 800 lb. per linear foot of top chord, uniformly distributed, weigh from 30 to 75 lb. per linear foot of span for spans up to 85 ft. For less slopes the weight may be from 5 to 25% more. For different loadings the variation in weight is usually from 25 to 75% of the variation in loading. It should be noted that the personal equation of the designer and the many factors entering into the weights of roof trusses may cause a variation of 5 to 25% in the same truss.

New England Rivers Have Similar Run-Off Characteristics

In Seven Different Rivers Curves Show Half of Total Flow in Three Months and Three-Quarters in Six Months

IN THE analysis of flow records for rivers in various parts of New England the writer has found a marked similarity with respect to the quantity of water which runs off during a few months in the spring and its proportion of the total run-off for the year. The total quantity of water which passes down a river during any calendar month will naturally vary from year to year, and the month of highest run-off during one year may possibly be the month which ranks second or third highest for the next year. However, if records are available for several years so that definite conclusions can be drawn, it will be found that a certain month of the year stands preëminent as being the month which averages the highest run-off.

For the majority of New England rivers this month is April, although for some of the more northern streams May ranks the highest, and for a few rivers draining southern slopes March gives the highest run-off, the average for the one highest month being in the vicinity of 25% of the total run-off for the year. The total for the highest three months, which are usually consecutive, averages over 50% of the yearly total, while six months yield about 75% of the total. These figures are average figures based on several years' records in each case, and apply only to rivers where the flow is not regulated by the use of storage.



DISTRIBUTION OF RUN-OFF OF SEVEN NEW ENGLAND RIVERS IN A 12-MONTHS' PERIOD

The accompanying diagram shows how the cumulative run-off varies with different periods of time during the year, the quantities being arranged in order of magnitude before summation. Assuming that the total run-off from a drainage basin equals a depth of 24 in. and that, as is apt to be the case, 75% of this occurs during six months, there will remain only 6 in. of run-off to be distributed over the remaining six months of the year. The diagram shows that about the same quantity of water would go to waste during one month in the spring.

In designing storage reservoirs in New England where no draft on the reservoir is necessary during the spring and early summer, it is desirable to provide a capacity large enough to hold at least one-half of the total annual run-off from the tributary drainage area. Whether the average, or a greater than the average, run-off figure should be used depends upon local conditions and the cost of the development. If the development is made on the basis of storing one-half the average run-off it will be found that the reservoir completely fills during the spring months five years out of six, and also partially fills a second time in the autumn in some years.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Ready Reference Books for the Engineer

By RUTH CANAVAN

Librarian with Metcalf & Eddy, Consulting Engineers, Boston

The accumulation of data and the verification of detail, by research, are necessary and important steps toward the solution of engineering problems. Certain of the most helpful reference works for these purposes are cited in the following paragraphs.

First, there may be mentioned the two useful compilations, "Engineering Index" and "Industrial Arts Index," the former covering the years 1884 to date, and the latter 1913 to date. "Engineering News Index" gives in even more minute detail than does the "Engineering Index" references to the articles in *Engineering News* from 1874 to 1909. [The period from 1910 to the close of March, 1917, when *Engineering News* was consolidated with *Engineering Record* will soon be covered by a volume now in press.—EDITOR.] The annual indexes to "Chemical Abstracts" (1907 to date) cover in a most comprehensive manner the literature on public health, sanitation, the industrial arts, water-supply and sewerage. A cumulative index of the annual indexes for the years 1907 to 1916 has recently been issued, and offers valuable assistance to the research worker.

Other useful cumulative indexes covering professional papers, committee reports and treatises, have been published by the American Society of Civil Engineers (1867 to 1911), the New England Water-Works Association (1882 to 1915), the Society of Chemical Industry (1896 to 1915), the American Society for Testing Materials (1898 to 1912), the American Institute of Electrical Engineers (1884-1910) and the American Institute of Mining Engineers (1871-1904, 1905-1909).

ENGINEERS' HANDBOOKS AND THEIR INDEXES

In seeking information from indexes the many professional "handbooks" must not be overlooked, for most of the compilers appreciate that the value of their books depends largely upon the adequacy of their indexes. For example, a fruitless search of several hours, through textbooks on solid geometry, failed to reveal the method for computing the cubical contents of a peculiar form of ungula; whereas reference to the index of Marks' "Mechanical Engineers' Handbook" led to a prompt solution of the problem. Other handbooks popular in the engineer's library are Merriman's "American Civil Engineers' Pocket Book," Trautwine's "Civil Engineer's Pocket-Book," Frye's "Civil Engineer's Pocket Book," Kidder's "Architects' and Builders' Pocket Book," Ketchum's "Structural Engineers' Handbook," "The Standard Handbook for Electrical Engineers," Foster's "Electrical Engineers' Pocket Book," Gillette's "Handbook of Cost Data," Dana's "Handbook of Construction Plant," Gillette and Dana's "Mechanical and Electrical Cost Data," Walker's "The Building Estimator's Reference Book," and Hool and Johnson's "Concrete Engineers' Handbook."

Many of these handbooks are copiously interlarded with references to articles and reports from which citations were derived, and help set the searcher on the right path. Some of the textbooks and scientific treatises offer similar guidance, by means of footnotes or appended bibliographies.

A card list of bibliographies, arranged alphabetically by subjects, is extremely helpful, and obviates the necessity of retracing ground once covered. Such a list may be so restricted as to include only the results of one's own searches, or amplified to include such bibliographies as those published by the Carnegie Institute, the Concrete Institute, and also those appended to treatises and textbooks.

USEFUL GOVERNMENT PUBLICATIONS

Of great value in engineering research are the publications of the various branches of the United States Government, such as the "Water-Supply Papers," the bulletins and "Professional Papers" of the Geological Survey; the reports and bulletins of the United States Public Health Service; and the contributions of the several bureaus of the Department of Agriculture. Then there are also the reports of the Army engineers and their "Professional Papers," the reports of the Coast and Geodetic Survey, the Lake Survey series, the Weather Bureau reports, the bulletins of the Census Bureau and the many-shelved publications of the Patent Office. Some of these branches issue departmental indexes, but all of the United States Government publications are listed in a "Catalog of the Public Documents of the (various) Congresses, and of all departments of the Government of the United States," issued monthly by the Superintendent of Documents and annually in cumulative form. A "Check List of United States Public Documents, 1789-1909," is also useful as a means of tracing publications that are not very recent.

GUIDES TO ENGINEERING BORDERLANDS

But it is perhaps in the border lands of the other sciences, only occasionally invaded by the engineer, that guidance is most welcome. Chemistry and bacteriology are, as he knows, quite thoroughly covered by "Chemical Abstracts," but a problem sometimes confronts him which demands for its solution a more intimate knowledge of the pathological significance of some factor than the familiar reference works afford, and he resorts to the medical library. Here he may consult "The National Standard Dispensatory" or the "Pharmacopœia of the United States" (two works issued in alternate years), Stedman's "Medical Dictionary," Thorpe's "Dictionary of Applied Chemistry," "A Reference Handbook of the Medical Sciences," an encyclopedia of medicine edited by A. H. Buck in eight volumes, 1885 to 1889;

or for references to the literature on medicine he may refer to the "Index Medicus" (published by the Carnegie Institute) or to the "Quarterly Cumulative Index to Current Medical Literature," published by the American Medical Association.

Again, if the engineer is called upon as an expert witness and wishes to fortify his testimony by references to court precedents, he seeks the law library where, if he wishes the Supreme Court decisions of the various states, he consults one of the branches of the National Reporter System (viz., "The Pacific Reporter," the "Northwestern Reporter," the "Northeastern Report," etc.), or he turns to the "American Digest," which undertakes to cover all decisions in all American courts. "Ruling Case Law" and "The Lawyers' Reports Annotated" also cover cases in all courts to a limited extent, by footnote references illustrative of the precedents enumerated. Textbooks and treatises such as Wait's "Engineering and Architectural Jurisprudence," are similarly helpful. The "Federal Reporter," however, covers only United States Circuit and District Court cases. All opinions relating to public utilities, whether delivered by state commissions or the courts of the various states, are digested in "Public Utilities Reports Annotated" which, unfortunately, only dates back to 1915. Then there are such general reference works as Black's "Law Dictionary," "Words and Phrases Judicially Defined" (an eight-volume encyclopedia), Stroud's "Judicial Dictionary" (in three volumes), Williams' "Law Dictionary" and Wharton's "Law Lexicon."

It sometimes happens also that the engineer is called upon to decide architectural details not usually falling within his province. Reference may then be had to Kidder's "Architects' and Builders' Pocket-Book," to the "Handbook for Architects and Builders," published each year by the Illinois Society of Architects, or to the files of such publications as the *Architectural Review*, the *Architectural Record, House and Garden*, etc., some of these publications being covered by the "Industrial Arts" and "Engineering" indexes, previously mentioned.

Finally, it is useful to know of such very general reference works as "The Readers' Guide," (1901 to date), "Poole's Index" (1882 to 1906), Bartlett's "Familiar Quotations," "The American Year Book," "The International Year Book," the "Biographical Congressional Directory" (1774 to 1911), "Who's Who in America," and "Who's Who in New England," etc.

While the reference works mentioned in the foregoing paragraphs are all well-known and much used, it is hoped that their enumeration may serve to recall some source of information which otherwise might be overlooked, or to give a timely suggestion to the baffled research worker.

Barge Canal Bulletin Ceases Publication

With the January, 1919, issue, the *Barge Canal Bulletin*, which has been published monthly for 11 years under the direction of the New York State Engineer and Surveyor, discontinued publication. According to Frank M. Williams, the present state engineer, the work on the Barge Canal is so nearly completed that it does not seem worth while to continue the publication of the bulletin, which gave publicity to the progress on the various contracts and other items of interest regarding the canal work.

Johnson's Great Book Rewritten

JOHNSON'S MATERIALS OF CONSTRUCTION: Rewritten by M. O. Withey, Associate Professor of Mechanics in the University of Wisconsin, and James Aston, Metallurgist with the A. M. Byers Co. of Pittsburgh. Edited by F. E. Turneaure, Dean of the College of Engineering of the University of Wisconsin. Fifth Edition. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 829; illustrated. $6.

Those who have leaned for many years on J. B. Johnson's great book, "Materials of Construction," will study this new edition with interest and profit, and are likely to adopt it as their reference manual. It is a new work, yet it follows the spirit of the original on a modernized working basis. Such prominent features of the old Johnson as the elaborate descriptive discussion of the varieties of wood, for example, have disappeared, while a 200-page section on cements and concretes properly reflects the great advance in this field made in the 22 years since the appearance of the original work.

Under the editorial guidance of F. E. Turneaure, most of the book was written by M. O. Withey. Six chapters on iron and steel, covering the production of the metal and its constitution, were written largely by J. Aston. Fatigue of metals was handled by J. B. Kommers, and corrosion of iron and steel by O. P. Watts. This collaboration brought to bear on the work a notable wealth of ability and special knowledge. The book clearly reflects this fact; it is of high rank in balance of treatment, in judicious selection of test results and other data, and in critical judgment on the many doubtful or contentious points affecting the properties and testing of materials.

To summarize the contents very briefly: After an introductory section on applied mechanics, of 47 pages, there follow 90 pages on testing machines and testing procedure. An equal space is given to wood, and about 30 pages each to stone and clay products. Cement and concrete have 220 pages, of which 20 pages are devoted to natural cement and lime. Finally, a little less than 300 pages is given to metals, by far the larger part of this space being devoted to iron and its alloys. Cast iron has 40 pages, nonferrous metals 30 pages. The three short but important closing chapters are "Effects of Temperature on Mechanical Properties," 12 pages; "Fatigue of Metals," 16 pages, and "Corrosion of Metals," 18 pages.

Considering the inevitably great bulk of a work of this kind—not far from 1000 pages—and the great and ever extending range of subjects and questions concerned, the technical reader and user of professional works finds himself placed squarely before the question whether compendious treatises can hold their own with sets of specialist books, or whether they may not after all be the preferable thing. Clearly, the compendium must abstract, give boiled-down conclusions, and, in fact, must omit much. Yet there are many features of the present work that would support the argument for the treatise, in view of the excellence with which the work has been done.

It is well remembered that Johnson's original book possessed a strength based as much on his penetrat-

ing judgment of technical questions and discussions and his prophetic vision as on his genius for gathering and selecting data—remarkable as was this latter. This quality of judgment and vision, rare as it is, and necessarily an individual gift, has in a measure a parallel in the present work. True, the author's personality is not so characteristic of the new book as of the old. The times, of course, have changed, and it may be that a greater proportion of the subjective element would not have been wholly advantageous.

Two details of the book may be cited as bearing on the question—which, by the way, is a question to be decided by each prospective user of the book according to his mental leanings. Under the heading of the reason for the tensile test of cement, the book expresses itself very distinctly in advocacy of making the compression test the standard, and states that the reasons for adhering to the tensile test are inadequate. There is obvious conviction in the comment, and a serviceable reminder that conventional methods often lag. Rather different is the attitude of another page. In the treatment of fatigue of metals, after a descriptive review of endurance tests and their results, the text passes without comment to a statement of the use of fatigue formulas in fixing working stresses; it carefully refrains from correlating the tests at high stress ranges with service under low stress ranges. Thus it leaves untouched one of the most delicate and obscure questions in the field of steel structures.

Water-Works and Their Operation

REVIEWED BY CALEB MILLS SAVILLE
Manager and Chief Engineer of the Hartford Water-Works, Hartford, Conn.

CONVEYANCE AND DISTRIBUTION OF WATER FOR WATER Supply. Aqueducts, Pipe-Lines and Distributing Systems. A Practical Treatise for Water-Works Engineers and Superintendents—By Edward Wegmann, C. E., M. Am. Soc. C. E., American Water-Works Association, New England Water-Works Association. New York: D. Van Nostrand Co. Cloth; 6 x 9; pp. 663; illustrated. $5.

Within recent years most branches of engineering literature have received valuable contributions from authors well equipped in theory and practice. Water-supply, however, seems to have been somewhat neglected. This is particularly true of practical water-works operation, which has received little attention since the appearance in 1889 of that pioneer work, "Some Details of Water-Works Construction," by William R. Billings. A notable exception is the very complete "Water-Works Handbook," by Flinn, Weston and Bogert.

Mr. Wegmann's new book is timely. It is divided into three parts: (1) Water Consumption and Hydraulic Formulas (54 pp.); (2) Design and Construction (436 pp.); (3) Maintenance and Operation (143 pp.). In addition, there are five appendixes, three of which are devoted to standard specifications for water pipes, valves and hydrants, structural and boiler steel. Following, there is a brief description of inside fire-protection systems and a reprint of the fire stream tables of the National Board of Fire Underwriters.

The first chapter is principally devoted to data on consumption and waste of water in municipalities. The next two chapters treat very briefly of the hydraulics of water-supply pipes and conduits, and are apparently intended merely for reference. The four chapters on pipes of wood, cast-iron, steel, cement and concrete contain little or no discussion of the merits of the several materials, their applicability to special conditions or their behavior under service conditions. Brief attention is given to stress in pipes due to water pressure, water hammer and temperature. The collapse of empty steel pipes is mentioned. Little is said of stress due to backfill or the care necessary in laying large pipes of comparatively brittle material.

Two chapters on submerged pipes give general descriptions of several under-water pipe crossings. In the two following chapters a number of makes of gate valves, sluice gates, pressure regulators and hydrants are illustrated and described. A discussion of the merits of the several types mentioned, without makers' names, would have added greatly to the value of the book.

The four chapters on intakes, tunnels, aqueducts and service reservoirs, are mostly descriptive and chiefly of historical value, giving little detailed information on design, construction or cost. They appear to have been compiled from reports and technical papers. The several aqueducts of the New York City water-supply are described in considerable detail, and much of the information appearing in the annual reports of the Croton Aqueduct and the Board of Water-Supply is brought together in convenient shape for reference.

In the chapter on service reservoirs, tables of cost of covered reservoirs are given. As these tables were compiled about 20 years ago by Freeman C. Coffin, some caution should be attached to their use at the present time. A very comprehensive compilation of groined-arch data by Prof. John H. Gregory is valuable for use in connection with that kind of construction. The pages given to reinforced-concrete stand-pipe construction are descriptive of many structures which have been built, and a very excellent table is given of the principal data connected therewith.

Tanks of wood and steel are described and some information is given as to design. Under fire protection, classic data are presented regarding the number and size of fire streams required, experiments of discharge and loss of head in fire hose, and a description of the method of conducting flow tests of hydrants. There are good descriptions of the high-pressure water systems in New York, Philadelphia, Baltimore and San Francisco.

Part II closes with seven pages on the various kinds of distribution systems; they give little information as to details and methods required in laying out the work.

Part III is devoted to general descriptions of water-works maintenance appurtenances and appliances. Some brief statements concerning electrolysis, abstracted mainly from reports of the late Prof. A. F. Ganz, are given. Tools and machinery used in pipe work and methods and apparatus used in waste and leakage surveys of water-works systems are next treated. Full descriptions of the various types and makes of meters in use occupy 64 pages. Mention is made of testing apparatus which is furnished by different makers, and a brief discussion is offered regarding results to be obtained. A very interesting and instructive diagram is given as to the average accuracy of ⅝-in. disc meters both new and after service. The author fails to state the conditions under which the data for constructing the curves were obtained.

The last chapter describes various instruments for

recording the height of water in reservoirs, stand-pipes and streams. Most of the standard devices are mentioned.

The book makes some mention of almost every matter connected with water-works operation. The portion on hydraulics is rather too brief for the hydraulic engineer and perhaps not sufficiently elementary for the nontechnical superintendent.

The chapters on design and construction are mostly historical or descriptive. They contain much matter gleaned from published reports on large work and from papers which have appeared from time to time in the technical press and in society transactions.

The portion of the book devoted to maintenance and operation, and especially those parts dealing with appurtenances, seem to be mainly a compendium of information contained in trade publications and advertising literature, rather than an original and distinct contribution to engineering knowledge.

While the classical work of Dexter Brackett, in his water-waste report to the Metropolitan Water Board of Massachusetts in 1903, is well and justly recognized by the author, it is to be regretted that he did not also include mention of the truly remarkable results attained in curtailing waste in this same district which recently has come about principally through the introduction of meters.

The descriptions of water-works appurtenances might well have been supplemented by discussions of the fundamentals of the different types of apparatus and of the limitations of the appliances under certain conditions. This would be of use to water-works engineers and superintendents and would enable them to separate more quickly the grain from the chaff in the salesman's argument.

The author deserves praise for enriching a rather barren field of engineering literature. Water-works superintendents and engineers should be thankful to him for bringing together in one place information concerning so many water-works devices and methods.

For Instructors of Industrial Workers

THE INSTRUCTOR—THE MAN AND THE JOB: A Hand Book for Instructors of Industrial and Vocational Subjects—By Charles R. Allen, Sometime Agent for Industrial Training for Boys and Men, Massachusetts Board of Education, and Superintendent of Instructor Training, U. S. Shipping Board, Emergency Fleet Corporation. Philadelphia and London: J. B. Lippincott Co. Cloth; 5 x 8 in.; pp. 373. $1.50.

According to C. A. Prosser, who in the Introduction states that he is well acquainted with the author, this book is the most important contribution yet made to industrial and trade training. It deals with the vital problem of the selection and training of competent instructors, and it should give employers and foremen a clear and accurate conception of the needs and possibilities of training new workers. It demonstrates that the pedagogy of industrial education has built up a definite content for courses of its own.

The author states that his main purposes are to present a handbook to instructors in industrial plants, and furnish instruction notes for instructor-training courses. The book is the result of actual experience in training over 1000 shipyard instructors. A fairly complete idea of the contents is given by the titles of the nine parts into which the book is divided: Training in the Plant; the Analysis and Classification of Trade Knowledge; Establishing an Effective Instructional Order; Putting it Over; Methods of Instruction; Lesson Planning; Instructional Management; Organization for Training in Industry; The Use of This Material in Instructor-Training Courses.

Perhaps the essence of the author's ideas can be expressed in his concept of what instruction really is, and his proposed tests of effective instruction. He maintains that telling is not instruction, drilling is not instruction, and showing is not instructing. In every case, true instruction requires thoughtful action on the part of the learner.

The book will be not alone of great practical value to vocational instructors, but also unusually suggestive for teachers of engineering in our colleges and universities, in view of the desire to profit by the war experience which is seen in many institutions.

Sewage Disposal Brought Up to Date

SEWAGE DISPOSAL—By Leonard P. Kinnicutt, late Director Department of Chemistry, and Professor of Sanitary Chemistry in the Worcester Polytechnic Institute; C.-E. A. Winslow, Professor of Public Health in the Yale School of Medicine and Curator of Public Health in the American Museum of Natural History, New York, and R. Winthrop Pratt, Consulting Engineer, M. Am. Soc. C. E. Second Edition, Rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 547; illustrated. $4.

The present thorough revision is timely, now that a resumption of building sewage-treatment works may be expected after a suspension of activities due to the war. Moreover, the subject is so complex and so many new processes, or variations and changes in old ones, are being continually made, that any book on sewage disposal soon gets out of date. The book first appeared in 1910 and was reviewed at length in this section of *Engineering News* of Nov. 17, 1910, p. 42 of the Engineering Literature Supplement, and also in *Engineering Record* of Nov. 19, 1910, p. 591.

The principal topics which have been expanded or added in the present edition are: Data on disposal by dilution, with particular reference to the investigation and conclusions of the International Joint Commission in its studies of the pollution of the Great Lakes; fine screening, notably experimental and other installations of Riensch-Wurl screens; the present status of Imhoff tanks, with special regard to foaming and related difficulties that have led some engineers to turn away from these tanks of late; the activated-sludge and the Miles-acid processes, both of which have come to the front since the first edition of this book appeared.

The book as a whole is a well-rounded presentation of the development and present status of sewage disposal.

Industrial Democracy Illustrated

MAN TO MAN: The Story of Industrial Democracy—By John Leitch. New York: B. C. Forbes Co. Cloth; 5 x 8 in.; pp. 249. $2.

So much has been written about industrial democracy in general terms that concrete examples afford a pleasing contrast. In this readable volume the author tells how he has helped to establish a number of manufacturing plants on the basis of a community of interest between employers and employees, substituting good-will for ill-will, and coöperation in production and profit for opposing class interests. In brief, the plan is to form a system of industrial government similar to our own Federal Government, with the wage earners as a lower house—all of them in small plants, and representatives in large plants. The Senate is composed of "under-executives, department heads and subforemen, accord-

ing to the size of the establishment." The cabinet consists of the executive officers of the company, with the president of the company acting as chairman.

In place of profit-sharing as commonly practiced, which the author apparently regards as a more or less arbitrary bonus system, the author has introduced at a number of plants a wage increment based "on the efficiency of production." He says: "I take the cost of a unit of production in the period preceding the introduction of industrial democracy and compare that cost with the results after democracy has gone into effect. The gain is distributed as a "collective economy dividend," half to the employees and half to the proprietors. It is paid at frequent intervals, as every two weeks, so as to make it a constantly live issue.

Text on Strength of Materials

Reviewed by Clyde T. Morris
Civil Engineering Department, Ohio State University, Columbus, Ohio

APPLIED MECHANICS—By Charles E. Fuller, S. B., and William A. Johnston, S. B., Professors of Theoretical and Applied Mechanics, Massachusetts Institute of Technology. Vol. II.: Strength of Materials. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 556; illustrated. $3.75 net postpaid.

Considering the fact that very little space is devoted to discussion of tests or the physical properties of materials of engineering, and that centers of gravity and moments of inertia are not included, this volume of 556 pages seems unnecessarily large. In part this is due to the inclusion, at the end of each chapter, of a large number of illustrative problems, which are generally most excellent. The methods of the calculus have been employed throughout, perhaps to a greater extent than is customary, and mathematical refinements of theoretical calculation of stresses are given which are sometimes unwarranted by the assumptions made in the premises as to the properties of the materials and the conditions met with in structures. It should be noted that the authors state in the preface, "As preparation the student should have a knowledge of differential and integral calculus, the principles of statics and dynamics, and the methods of determining the centers of gravity and moments of inertia of areas and solids."

The first chapter is devoted to a discussion of the physical properties of materials, but very little is given on the results of tests. It is followed by a chapter on analysis of stress and strain, a theoretical discussion of the relations of stress intensities acting on a particle in various directions, and including the ellipse of stress. Chapters on uniform stress and uniformly varying stress and stresses in beams give the ordinary theory of flexure. In the discussion of riveted joints no mention is made of the fact that in a riveted joint the friction is the principal resisting medium and that in good work the frictional resistance between the plates is seldom overcome. The chapter on the general theory of flexure includes beams with unsymmetrical cross-sections, acted upon by oblique loads.

Combined stresses, Chapter VII, might better be discussed after Chapter IX, on columns, and should include the article in that chapter which treats of the strut or tie subjected to combined axial and lateral loading. The treatment in Chapter VII is only approximate, neglecting the effect of the deflection of the member, and might be omitted without loss.

In the chapter on arches and catenaries, after giving the equations for the reactions of arches with two hinges and without hinges, expressed in the form of integrals, the authors develop at great length the reactions for arches of uniform cross-section in which the axis is the arc of a circle. This may be good mental gymnastics for the student, but as these conditions are almost never met with in practice, and seldom attempted, it seems that the work would have been much more valuable if the axis had been made parabolic and the section variable, as in the usual case.

The last chapter, treating of reinforced-concrete beams and columns, contains the derivation of the usual formulas for simple beams, T-beams and columns, based on the straight-line assumption. The system of notation is fairly uniform throughout and conforms in the main to current usage. It would be a great help in using the book as a reference if a table of notation were given to obviate the necessity of searching through the text for the meaning of a letter or symbol.

As a textbook for class instruction, this new work may be satisfactory if supplemented with data and lectures on tests of materials, but as a reference book for the practicing engineer it does not promise to be of any great value.

The Manufacture and Cost of Liquid Steel

LIQUID STEEL: Its Manufacture and Cost—By David Carnegie, F. R. S. E., M. Inst. C. E., M. I. Mech. E., M. I. S. Inst.; Assisted by Sidney C. Gladwyn, Wh. Ex., A. M. Inst. C. E. (Bayliss Prizeman). Second Edition. New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 526; with 10 plates and 252 illustrations. $10.

This second edition of the work of a Canadian author, the first edition of which was reviewed in *Engineering News* of Aug. 8, 1913, p. 328, is unchanged except for the addition of five pages on the development of electric steel manufacture in Canada. The new matter consists of a tabular list of the electric furnaces in Canada, which were used, before the war and in 1917, mainly in the manufacture of steel for ingots or steel castings or low phosphorus pig iron. A list of companies manufacturing ferro-alloys and electrodes is added, and a typical charge for shell steel with a statement of electrode consumption concludes the new chapter.

Extending Our Foreign Trade

AMERICAN METHODS IN FOREIGN TRADE: A Guide to Export Selling Policy—By George C. Vedder. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 5 x 8 in.; pp. 204.

The extension of American contracting and industrial business into all parts of the world has created a demand for information regarding the best methods of conducting our foreign trade. Among other broad subjects the author of this book discusses the trade policies of the principal nations of the world; the Webb-Pomerene Act and combinations in foreign trade, and a variety of export problems and details, including agents, catalogs, "Heavy Machinery in Foreign Markets," "American Banks Abroad," our merchant marine, "America's Preëminence in Salesmanship," and our tariff in relation to foreign trade.

An Omission Noted

By mischance the name of George Paaswall, New York City, was omitted as the reviewer of Dozal's "Retaining Walls," in our issue of Feb. 20, 1919, p. 390.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

THE CEMENT GUN: Its Application and Uses—By Bryan C. Collier, M. Am. Soc. C. E. Reprint from Paper Read before the Municipal Engineers of the City of New York, Dec. 23, 1918. Allentown, Penn.: Cement Gun Co., Inc. Paper; 6 x 9 in.; pp. 21; illustrated.

CEMENT IN 1917—By Ernest F. Burchard; with a Section on Concrete Ships by Robert W. Lesley. Washington, D. C.. U. S. Geological Survey. Paper; 6 x 9 in.; pp. 37; illustrated.

CHLORINATION OF WATER—By Joseph Race, F. I. C., City Bacteriologist and Chemist, Ottawa; Captain Canadian Army Hydrological Corps; Member of Committee Standard Methods of Analysis, American Water-Works Association. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 158; illustrated. $1.50.

COMPRESSED AIR PLANT: The Production, Transmission and Use of Compressed Air, with Special Reference to Mine Service—By Robert Peele, Mining Engineer and Professor of Mining in the School of Mines, Columbia University. Third Edition, Largely Rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 485; illustrated. $4.25.

In this edition some chapters "have been entirely rewritten and several have been expanded," the preface states, but the size of the volume has been kept down "by condensation and omission of old matter." The first edition, entitled "Compressed Air Plant for Mines," was reviewed favorably in *Engineering News* of Sept. 17, 1908, the second edition in *Engineering News* of Jan. 19, 1911. The book is divided into two parts; (1) Production and (2) transmission and use of compressed air. Under "Use," rock and hammer drills, coal-cutting and channeling machines, mine pumps and mine haulage and the air-lift pump are described.

DESCRIPTION OF AND GUIDE TO JASPER PARK—Ottawa, Can.: Department of the Interior. Cloth; 7 x 10 in.; pp. 97; illustrated.

Based on a photographic survey by M. P. Bridgland, Dominion land surveyor. Contains handsome halftones, descriptive text and historical notes, all edited by E. Deville, surveyor general of Canada. The park is located in Alberta.

DRAFTING ROOM METHODS, STANDARDS AND FORMS. A Reference Book for Engineering Offices and Draftsmen—By Charles D. Collins, M. Am. Soc. C. E. New York: D. Van Nostrand Co., Cloth; 6 x 9 in.; pp. 149; illustrated. $2.

Notes on drafting-room organization, arrangements; drafting standards, symbols, abbreviations; drawing sizes and methods of marking and filing drawings. Contains also miscellaneous tables of use to mechanical engineers, conversion tables for metric system, weights and measures, decimal equivalents, etc.

DRAINAGE METHODS AND FOUNDATIONS FOR COUNTY ROADS—By E. W. James, General Inspector, Vernon M. Peirce, Assistant Engineer, Charles H. Moorefield, Senior Highway Engineer. Washington, D. C.: U. S. Department of Agriculture, Bulletin No. 724. Paper; 6 x 9 in.; pp. 86; illustrated. 20c. from Superintendent of Documents.

Covers soils, design of ditches and gutters, subdrainage, foundations, loads which can be carried, etc. Contains runoff tables for the capacity of various kinds of drains, and costs of drains and foundations. It should be interesting to all highway designing engineers.

IMPROVEMENT OF THE UPPER MISSISSIPPI RIVER: A Bibliography—By Miss Winifred Gregory, Chief of the Industrial Arts Division, of the St. Paul Public Library. St. Paul, Minn.: Affiliated Engineers' Societies of Minnesota. Paper; 6 x 9 in.; pp. 22.

MANUAL OF INSPECTION AND INFORMATION FOR WEIGHTS AND MEASURES OFFICIALS—By F. S. Holbrook, Inspector of Weights and Measures, Bureau of Standards, Washington, D. C.: Bureau of Standards. Cardboard; 5 x 7 in.; pp. 246; illustrated. Free on request.

MICHIGAN STATE HIGHWAY COMMISSIONER: Seventh Biennial Report, for Two Years Ending June 30, 1918. Lansing, Mich.: State Highway Department. Cloth; 6 x 9 in.; pp. 142; illustrated.

MNEMONIC NOTATION FOR ENGINEERING FORMULAE: Report of the Science Committee of the Concrete Institute; with Explanatory Notes by E. Fiander Etchells. New York. Spon & Chamberlain. London: E. & F. N. Spon, Ltd. Cloth; 6 x 9 in.; pp. 116; illustrated. $2.50.

Radical changes in algebraic symbols and related elements of formula language are proposed in this report. The "mnemonic" feature is illustrated by the author's advocacy of *B* for bending moment. Some of the innovations are of typographical nature and call for unusual fonts of type. Others are the substitution of new letters for quantity symbols now commonly used. The report has a number of appendixes, of which one, entitled "The Inter-Relationship of Nomenology and Symbology," indicates the author's viewpoint. Incidentally, the word "milai" is used as the name of the 1000-lb. unit.

MODEL MAKING: Including Workshop Practice, Design and Construction of Models; A Practical Treatise for the Amateur and Professional Mechanic, Giving Instructions on the Various Processes and Operations Involved in Model Making and the Actual Construction of Numerous Models, Including Steam Engines, Speed Boats, Guns, Locomotives, Cranes, etc. Edited by Raymond Francis Yates, Editor of Everyday Engineering Magazine. New York: The Norman W. Henley Publishing Co. Cloth; 6 x 9 in.; pp. 390; illustrated. $3.

A book for boys and men, this little work is likely to prove inspiring, helpful and instructive. Preliminary to the description of the making of various special models—of engines, hoists, boilers, boats, locomotives, and the like—there are very good chapters on the right kind of workshop, on lathes and drills, on soldering, on hardening and tempering, on the use of abrasives, and on pattern making and electroplating.

MUNICIPAL FINANCES: Report, Mar. 31, 1918; Statistics of Cities and Towns of Iowa. Frank S. Shaw, Auditor of State. Des Moines, Iowa: State Auditor. Cloth, 6 x 9 in.; pp. 294.

Among the tables of particular interest to municipal engineers is one giving the salaries of department heads in Iowa cities and towns. The report covers all the 105 cities of the state and 719 of the 789 towns listed.

THE NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES: A Permanent Association of Organizations in the Construction Industries and Professions, Succeeding the Temporary Organization Formed July 15, 1918, under the Auspices of the Chamber of Commerce of the United States of America. Philadelphia, Penn.: The Federation. Paper; 8 x 11 in.; pp. 23.

NEW HAMPSHIRE STATE HIGHWAY DEPARTMENT. Seventh Biennial Report Relative to Highway Improvement. Concord, N. H.: The Department. Paper; 6 x 9 in.; pp. 214; illustrated.

NOTE ON VARIOUS TYPES OF EXTENSOMETERS FOR TESTING BRIDGE GIRDERS—By H. S. Sales. Simla, India: Railway Board of India. Paper; 8 x 13 in.; pp. 16; illustrated.

PEARSON'S PATENT PERMANENT WAY—By J. D. Pearson, B.A., B.E., M. Inst. C. E., Executive Engineer, B., B. & C.I. Ry. Simla, India: Railway Board of India. Paper; 8 x 13 in.; pp. 4; illustrated.

Ties are dispensed with, each rail being riveted or bolted to a flat longitudinal plate 12 in. wide. Gage is maintained by tie bars. A 400-ft. length of this track has been laid.

A PLAN FOR SHOP SAFETY, SANITATION AND HEALTH ORGANIZATION—Issued Under the Direction of the Industrial Commission, John Mitchell, chairman. Albany, N. Y.: New York State Department of Labor. Paper; 6 x 9 in.; pp. 32.

A PORTABLE CUBIC-FOOT STANDARD FOR GAS—By M. H. Stillman, Assistant Physicist, Bureau of Standards. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 13; illustrated. Free on request.

PROBLEM OF RECONSTRUCTION WITH RESPECT TO URBAN TRANSPORTATION—By Delos F. Wilcox, Ph.D. Reprinted from *National Municipal Review*, January, 1919. Elmhurst, New York City: The Author. Paper; 7 x 10 in.; pp. 15.

THE RELATIVE CORROSION OF CAST-IRON, WROUGHT-IRON AND STEEL PIPE IN HOUSE-DRAINAGE SYSTEMS—By William Paul Gerhard, M. Am. Soc. M. E. New York: The Author, 736 W. 181st St. Paper; 6 x 9 in.; pp. 34; illustrated. 34c., postpaid.

REPORT ON THE BEST PROCESS AND PLANT FOR TREATING RAILWAY SLEEPERS—By C. D. Dove Wilson. Simla, India: Railway Board of India. Paper; 8 x 13 in.; pp. 12; illustrated.

This deals only with English practice in creosoting ties, including the full-cell process, the Ruping empty-cell process and the Boulton boiling process.

RHODE ISLAND STATE BOARD OF PUBLIC ROADS: Seventeenth Annual Report. Providence, R. I. Paper; 6 x 9 in.; pp. 79; illustrated.

SANITATION IN EMERGENCY SHIPYARDS—By W. L. Stevenson, Late Sanitary Engineer, Department of Health and Sanitation, U. S. Shipping Board, Emergency Fleet Corporation. Reprinted from the *Journal* of the Boston Society of Civil Engineers, January, 1919. Address the author, care Pennsylvania State Department of Health, Harrisburg, Penn. Paper; 6 x 9 in.; pp. 18; illustrated.

SPECIAL WATER POWER INVESTIGATION, STATE OF MAINE, 1918. Augusta, Me.: Public Utilities Commission. Paper; 6 x 9 in.; pp. 420; illustrated.

STEAM ENGINE TROUBLES: A Practical Treatise for the Engineer, Telling How to Locate and Remedy Troubles with a Steam Engine—By H. Hamkens, Mechanical Engineer. New York: The Norman W. Henley Publishing Co. Cloth; 5 x 8 in.; pp. 284; illustrated. $2.50.

A revision and extension of a series of articles originally published in *Power*.

STRUCTURAL STEEL FOR SHIPS: Standard Practice Recommended by American Steel Makers as Adopted by the Emergency Fleet Corporation. Revised Nov. 20, 1918. Pittsburgh, Penn.; Carnegie Steel Co. Paper; 5 x 8 in.; pp. 60; illustrated.

THE SUDD REGION OF THE WHITE NILE AND THE HARNESSING OF ITS WATERS—By Sir William Willcocks, K.C.M.G., Late Director General of Reservoir Projects, Cairo, and Director General of Irrigation Projects, Bagdad, and John Wells, Consulting Engineer and Managing Engineer Egyptian Government Research Work. Cairo, Egypt: The Authors. Paper; 7 x 10 in.; pp. 30; illustrated.

WATER CONSERVATION AND IRRIGATION COMMISSION REPORT, NEW SOUTH WALES. 1918. Sydney, Australia: The Commission. Paper; 8 x 13 in.; pp. 29.

WISCONSIN HIGHWAY COMMISSION: Fourth Biennial Report Showing State-Aid Highway Operations, 1916-18. Madison, Wis.: The Commission. Paper; 6 x 9 in.; pp. 358; illustrated.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Return Highway Engineers from France

Sir—You are probably familiar with the literature and advertising which were sent out in the recruiting of the 23rd Engineers. It was represented that this regiment was to be a special road-building regiment made up of experienced construction men—engineers, contractors, superintendents, and all classes of experienced men doing this work.

This regiment probably did a great deal of good work in France, during the year preceding the signing of the armistice. I feel now that it is needed here in the United States more than it is in France. I had a letter from my brother who is in the regiment, written Jan. 27, saying that they were building macadam roads in France on that date, and had been since the armistice was signed.

I do not believe it fair or honest to the members of this regiment to keep them there any longer. Some of the boys who were getting from $150 to $200 per month as foremen and superintendents are working over there with picks and shovels at $33 per month. They were willing and anxious to make this sacrifice during the prosecution of the war, but now that it is over I do not believe that they are willing to do this work, but are anxious to get back here, and I know that we need them. Is there not some way that we can get this regiment returned home?

The Government is urging the building of roads, pavements and buildings, and construction of all kinds, and there is going to be a great amount of this class of work started this month. The 5300 members of the 23rd Engineers, being experienced men, should be here now to take advantage of the opportunities that are opening up. J. K. Shinn.

Independence, Kan.

Injustice to Engineers Returning from Army

Sir—I beg leave to air a grouch against the engineering profession. From time to time you have printed articles regarding the underpaid younger members of the profession, but there is still a lot left unsaid.

Take, for instance, the case of the young engineers with a college education and a few years' experience who have joined the colors. Some entered engineer training camps, others enlisted in engineer regiments, and quite a few, desiring a more personal method of getting at the Hun, entered the line. For the majority of these men, their engineering education proved almost a passport to a commission, and for once at least the value of engineering training was considered at its true worth.

These men, many of whom were employed on construction work long since completed, now stand on the verge of demobilization, and few of them have their former positions open to them. Naturally, most of those who are seeking employment turn their efforts first toward the field of their profession; but what do they find? If there is any demand at all for their services, they are offered positions involving considerable responsibility at the same wage (or less) than a day laborer can demand.

Discouraged, the thought is bound to sink home: "Just what is the incentive to take up their profession where they left off?" Why should a man, well educated and reared in a comfortable home, give up almost everything in life that he has learned to consider worth while, and the best years of his life, to an existence comprised of construction camps and cheap boarding houses, deprived of the society of intellectual equals other than his companions in exile, as many of us have experienced, at less salary than that of a labor foreman in charge of a dozen or so foreign laborers? Why should a man who has spent four years or more at college be unable to demand as much pay as a man who has served an apprenticeship as a plumber, boilermaker, or the like? Take the more intimate side of his life—a man's thoughts usually turn to marriage sooner or later—can an engineer marry a girl of his own station in life, accustomed to the comforts of home and perhaps a few of the luxuries of life, and hope for real happiness with several years of bitter struggle and hand-to-mouth existence ahead? Ought he not be given some slight recompense in the way of salary for the lack of opportunity to establish a home?

The profession blames the public for failure to recognize the engineer's true value; but is the public altogether to blame? Isn't it largely the fault of the engineers themselves? Why should anyone be willing to pay the engineer in charge a fair salary when he himself hires an efficient assistant, often as good as himself, at a mere pittance, and so on down the line? It seems to me that if engineers would quit blaming the public for lack of recognition of their worth, and each and every one would try to get those under him an increase in pay commensurate with their ability, it would soon raise the scale of wages of the whole profession. A. H. Armstrong,

First Lieutenant, United States Marine Corps.

Marine Barracks, Quantico, Va.

Federation of American Engineering Societies Proposed

Sir—The question of consolidation of the engineering profession in America, ordinarily one of importance, has been brought to a head by the war and the reconstruction following it, and there is at the present time much comment upon the activities and policies of the engineering societies which are depended upon to effect the consolidation. The main object is, of course, the public recognition of the engineer, which the engineer feels has not been forthcoming so far, but which he thinks could be materially furthered by the consolidation.

There was a time when the doctors were not recognized any more than the engineers are now, but, thanks

mainly to the effective work of the American Medical Association, that condition is now past, whilst the profession's interests are guarded by a powerful organization, irrespective of whether its members are graduates of a particular university, or of a college of physicians or one of surgeons. Can this be duplicated in the engineering profession?

Influential engineers seriously considering this matter would like to see some kind of a federation of the engineering societies, with some such body as a general engineering board of direction at the head and representative of all. They would like to see a plan put through whereby each qualified engineer would be enrolled as a member of one huge organization, controlled and administered by such a board. Such a development in engineering organizations is a sweeping one, and there is very little sight of it "up the pike" so far.

Who has the scheme which will effectually coördinate all professional engineers, however specialized, and yet exclude all who are deemed insufficiently qualified, and which will not restrict the main activities of the engineering institutions but will embrace them all? Who would like to suggest a democratic Federation of American Engineering Societies?

Who, having suggested such a federation, wants to differentiate the existing organizations so that they may be assigned to their proper places in it? If this much could be worked up as a starter—just to see where we should arrive—and some publicity given to the results, then it might serve to help in many ways. In the first place, new societies might stop long enough in the framing of their charters to consider where they would stand and what little reservation they would fill out in such a federation; this might tend to reduce the number of organizations—a good thing if such reduction means simplification and tends toward better organization and control. In the second place, the older organizations who have, without exception, endeavored to "spread themselves all over the map" might also stop to consider whether "safeguarding the interests of the engineer" can be taken care of by the same organization and the same set of workers in it (for there is always a set of workers) as advance the purely educational side of the profession. In other words—none of which is meant in criticism—the organizations would begin to consider how they could all hold one another's hands without stepping on one another's toes.

All concerned would then probably arrive at an opinion that such bodies as the educational and technical societies—admirable as such—cannot properly take up economic matters concerning the financial position of their members; that such bodies as the local engineering societies should get in on the ground floor in the advancement of public affairs in state or community, and that the federation might try its hand at the national affairs.

The problem is a big one—the biggest the organizations have to face—and if a solution is attempted some organizations will stay up and some will go down. Responsible engineers would say, however, that the attempt is worth while if it only succeeds in inaugurating a legitimate movement which has the goodwill of the majority, and in which all honest organizations can fearlessly participate in the endeavor to create something for the good of all. Such a movement has not yet appeared, although some think they see it in the Engineering Council—which is no criticism of the Engineering Council. The council from the start has, however, represented the few and not the many—there are now five organizations in it out of possibly one or two hundred organizations that are eligible. Its work is being done in good faith; but the large number of societies not yet included, and not provided for in the charter of the council at the outset, would say that the organization, not representing them, is undemocratic. Whether it is or not, they would say it isn't. and so what is the use?

Mr. Flinn, secretary of the council, speaking recently at a general meeting of Canadian engineers, said that for evident reasons it would be impracticable for the Engineering Institute (of Canada) to become a member of the Engineering Council on the same basis as the other five societies, but international coöperation would be desirable, and he would suggest that the Engineering Institute and the Engineering Council should appoint a committee (another committee!) for interchange of good-fellowship and for active coöperation.

Better, then, regard the Engineering Council as what it is—a committee, a joint committee of the four national engineering societies known as the Founder Societies and one or two others, with a program of activities suggested by the participation of engineers in public affairs. It is not, and cannot become, unless its constitution is radically changed, an organization to represent all engineers, which is what we want.

The Engineering Council is apparently the only thing of its kind now existing in this country, and is the only coöperative movement representing a number of the engineering organizations—and, incidentally, it does represent probably 30,000 or 40,000 engineers. But the point is, it does not represent the organized engineering profession. These statements are not in criticism of it, but are merely to show that in this movement there is no sign of such a thing as a Federation of American Engineering Societies would perhaps provide.

WILLIAM E. BULLOCK.
Assistant Secretary, American Society of Mechanical Engineers.

New York.

Giving Credit Where Credit Is Due

Sir—In your issue of Feb. 20, 1919, p. 394, is a letter from C. E. Drayer, secretary of the American Association of Engineers, in which, among other things, he says "the efforts of the American Association to raise the pay of the technical engineer in railroad employ have been successful, much beyond early hopes." This is very encouraging and is fine work, but is the A.A.E. justified in taking all the credit to itself, as is implied by the tone of Mr. Drayer's remarks?

When it was found that the Railroad Administration had overlooked the technical engineer in the matter of increased compensation, both the A.A.E. and the Engineering Council brought the question to the attention of the administration, with the request that justice be done. Now, the Engineering Council represents six national technical organizations, with a combined membership of about 40,000 engineers, and the life history of the oldest of these member societies dates back nearly 70 years. The A.A.E., on the other hand, represents barely 3000 engineers and the years of its

life can be counted on the fingers of one hand. It is a fair question to ask, therefore, which of the two communications carried more weight with the Railroad Administration?

I am thoroughly in sympathy with the aims and work of the A.A.E. It has accomplished wonders in a short time. There seems to be a tendency among its officers and members, however, to claim for the association rather too much of the credit for results obtained, and at the expense of the old founder societies. In fact, the latter are usually ignored or destructively criticized. This attitude I have noticed in the official organ, *The Monad*, and in individual members of my acquaintance. Does this not appear to be a wrong attitude to take? Does it not tend toward bad feeling and disintegration, rather than toward enthusiasm and coöperation in the profession? The latter condition is an avowed aim of the A.A.E., I believe. Again, such an attitude is not warranted in view of the fine results recently achieved by that offspring of the founder societies, namely, the Engineering Council.

Granted that the founder societies needed prodding and awakening, and that they have been asleep to many of their opportunities and responsibilities; granted, too, that the A.A.E. was instrumental in the work of revival, still, the most unsparing critics and the most vehement prodders have been and are, themselves, members of these identical societies. So the A.A.E., after all, is only one of many instruments used in the good work.

Let me mention a few of the resultful and potential activities recently undertaken by the Engineering Council: The splendid service rendered to the Government, the nation, and the profession, during the war, by the American Engineering Service; the good work now being done by the Engineering Societies' Employment Bureau; the recent organizing of the National Service Committee of the Engineering Council at Washington, with its aim of disinterested usefulness to the nation and the profession; the formation by the Am. Soc. C. E. of its Committee on Development, from which great things are expected in the way of solidifying and otherwise helping the profession; the thorough fashion in which the council is now tackling the question of the licensing of engineers; the recent efforts to induce municipal, state and Federal officials to carry forward public works to help relieve the present industrial situation; the letter to President Wilson urging the appointment of engineers to the Commission on Reconstruction (the President's reply is aptly commented on in a letter by M. S. Parker in *Engineering News-Record* of Feb. 20, 1919, p. 395); the attempts to get justice for the railroad technical engineers, as noted above; and, finally, the action taken with regard to the unjust discharge of nearly 400 engineers of the Public Service Commission, New York.

In connection with this last, I am aware that *Engineering News-Record* in an editorial entitled "Will New York Engineers Fail in Their Civic Duty?" waxed indignant because the council at first refrained from action until the case had been presented to it in a "formal communication." A perfectly correct stand to take, was it not? Certainly, as responsible a body as the council cannot take action merely on the evidence of newspaper headlines and street gossip. Anyway, it eventually acted, and results quickly followed.

It must be recognized that the A. A. E. is doing fine work in its attempts to solve the perplexing "reconstruction" problems of the engineering profession. The task is appallingly large and complex. Does it not seem, however, that the objective of all our efforts should be a merger of the existing engineering and technical societies into one main national organization, with two distinct functional divisions; viz., the scientific or technical, and the economic or service? Affiliated district chapters in all parts of the country could take care of local requirements and be used for social and scientific purposes, as are the numerous independent engineers' clubs under the present disorganized conditions.

Some such bold and comprehensive scheme as this, through which action could be unified, is necessary in order to secure the rights of the profession and to achieve its solidarity and the public recognition to which it is entitled.

E. A. VAN DEUSEN,
Assoc. M. Am. Soc. C. E.
Charlotte, N. C.

Increase in Prices Due to Labor

Sir—I have read with much interest the article by O. M. Fox, in your Feb. 20 issue, p. 369, on "Material Prices Halt Chicago Building Operations." From a reading of this article, one would naturally blame the manufacturer for the high cost of material, but the writer has overlooked one vital feature which throws the increase in cost not upon the manufacturer, but upon the labor he employs.

In 1913 boiler makers were paid 42½c. and 45c. an hour, and the cost of a fabricated tank, steel, rivets and labor, overhead and margin, was 5c. a pound. Today, with labor 70c. an hour, the labor cost of building this tank is 10c. a pound, no steel, no overhead, no margin. In other words, if steel cost $20 a ton less than the price now being paid, it would make no material difference in the price for which a manufacturer could sell his tanks; and there will be no material reduction in tank prices until labor is willing to do a day's work for the high price they are paid.

We believe that the case cited above is parallel in almost any line of manufacture, such as engines, generators, pumps, and the manufacture and fabrication of steel structures or any other item where labor enters materially into the cost.

F. F. VATER,
President, Power Plant Specialty Company.
Chicago, Ill.

Safety of Workmen Should Receive First Consideration

Sir—The article published in your issue of Feb. 27, 1919, p. 443, with the title "Awning Reduces Lost Time by Hiding Movements of Derrick," has been read by me with much interest.

Without doubt the principle of avoiding the distraction of workmen's attention from their duties is correct and wise, but in applying it in this particular case a more important principle has been lost sight of completely. The carpenters who "stopped work every time the derrick swung its load and stood ready to dodge if it let go" had some justification for their evident fear. The placing of the awning did not remove this

fear, and I question very much whether the placing of the awning effected any saving in the long run.

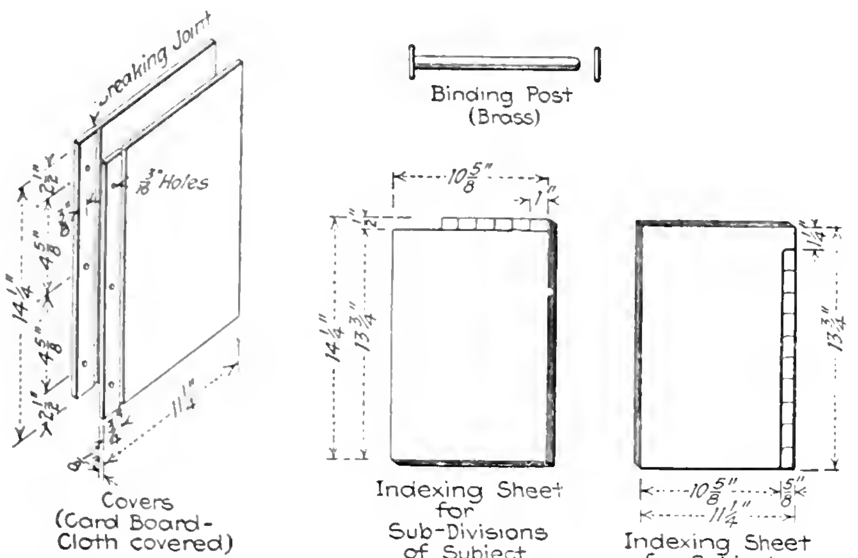
The correct procedure here should have been to avoid even the appearance of danger. The most striking point in the article referred to is that the thought of safety for the workmen does not seem to have entered the mind of the man in charge. This is surprising, considering the attention paid to the matter of safety in these days. J. JAY DUNN.

Ellwood City, Penn.

Engineer's Data File Is Compact and Convenient

Sir—The saying, "He who reads and throws away, may live to rue that very day," once heard is easily remembered, especially when you are looking for that article on a certain subject which you know you had once seen, but cannot recall where or what you did with it. It is the purpose of this article to describe a filing system used by the writer by which it is easy to locate any article deemed of sufficient importance at the time of reading possibly to make it desirable to retain it for later reference.

All articles taken from the various periodicals on subjects of interest, and sometimes the bulletins on various engineering projects, are filed, if not of too bulky a nature, by means of a pair of stiff cardboard covers, brass binding posts and paper separating or indexing sheets, as shown in the sketches. The binding



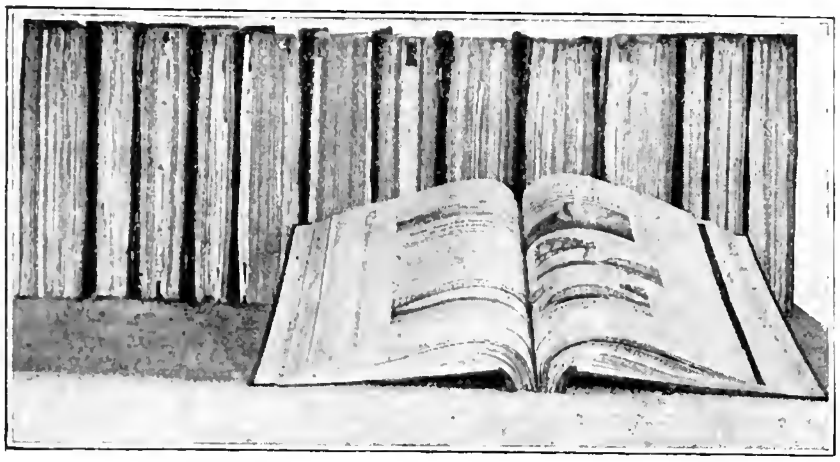
DETAILS OF CARDBOARD COVERS FOR DATA FILE

posts can be purchased from an office outfitter at about 3c. each for the 4-in. size, which is the longest made commercially. The covers can be made up for about 80c. per pair by a book-binding establishment, where the paper for the separating sheets can also be purchased and later cut as required. The size of the covers shown can be used for filing articles taken from any of the periodicals published today.

The most important part of the filing system, as regards convenience, is the separating or indexing sheets, which are bound together with the articles, according to subjects, in alphabetical order. There are subject headings at both the right-hand side and at the top of the volume. The right-hand notations indicate the subject proper, while the top notations indicate the subdivisions of the subject. For example, suppose the subject of boilers is to be referred to, the subdivisions are construction, operation, land types, testing, marine types, etc., the subdivisions being added as the articles are procured.

Articles should be removed from periodicals by pulling out the wire binders with a pair of pliers, instead of cutting the article out with a knife, which very seldom leaves a sufficient margin for filing by this method.

It can readily be seen that a system of this kind can be made very extensive when taken as a whole, yet very simple, due to the fact that all articles that are pos-



ARTICLE FILE AT ACCUMULATED IN TEN YEARS

sessed on a certain subject are all in one place, in convenient form, instead of all over the library, as they would be if put in permanently bound volumes. The photograph shows to what proportions the writer's article file has attained in 10 years.

Generally, articles are not filed as soon as they are received, due to the amount of labor involved in opening up the volumes, but are laid away until a sufficient number have accumulated to make their insertion advisable, the memory being relied upon in the meantime, or entries being made in a card index. All persons who file various data should maintain a card index in which should be listed all books, papers, etc., in the library. The card index, although not absolutely necessary for this type of article file, is nevertheless a good standby.

For the filing of catalogs, pamphlets, books, etc., the writer uses a system of numbers, combined with the first letters of the alphabet, as follows: All books, etc., are filed in four divisions of size, according to height, each size having a certain letter—i.e., those over 10 in. high are designated by the letter A, over 9 in. high and up to 10 in., by the letter B, 8 in. high and up to 9 in. by the letter C, under 8 in. high by the letter D. Filing is then done by the book or pamphlet taking the next consecutive number according to the division to which it belongs, this number being put on the outside so as to be easily seen. A standard sectional book case is used for filing; it contains also a drawer for the card index. A. H. MYERS,

Chief Inspector, Marine Department, Wellman-Seaver-Morgan Company.

Akron, Ohio.

Overhead Charge Between City Departments

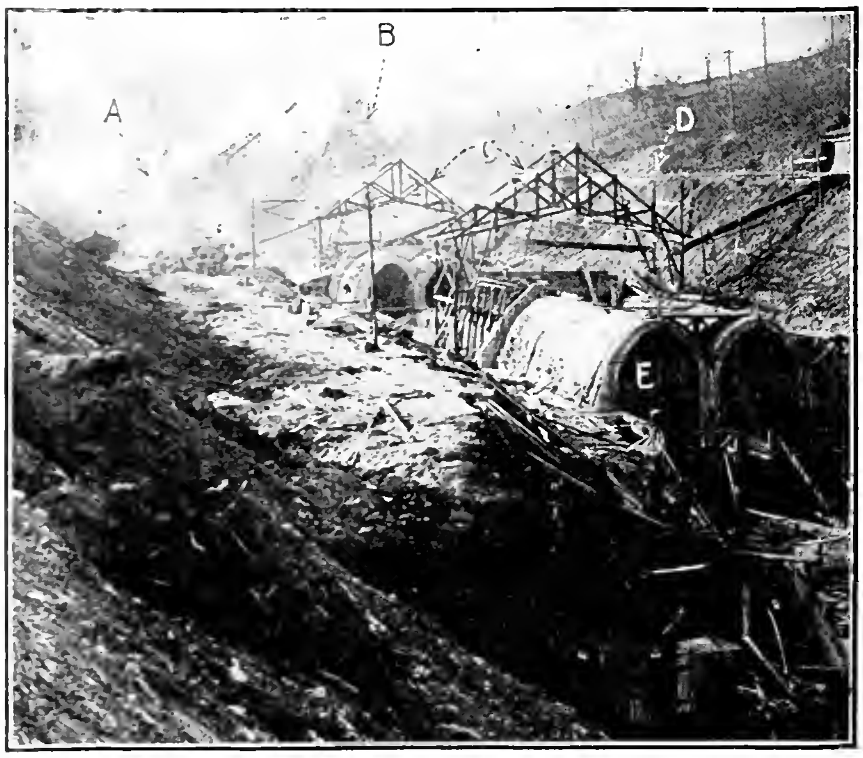
Work done by one department of the City of Detroit for another is paid for at cost plus a percentage for superintendence and overhead expense. The Departments of Public Works and of Parks and Boulevards add 15%, the Public Lighting Commission 10% and the Board of Water Commissioners 20 per cent.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

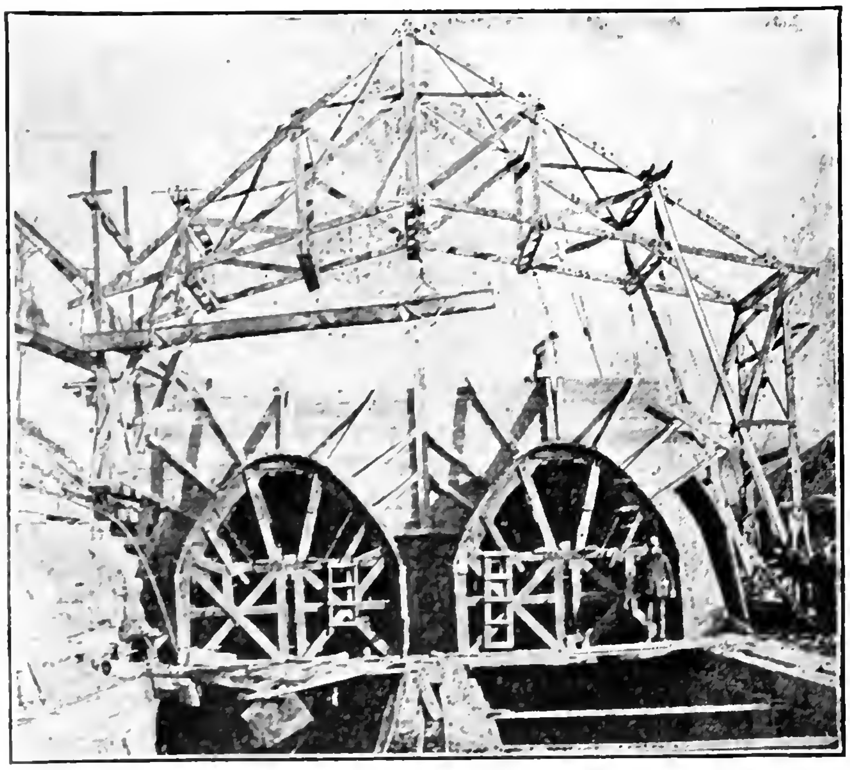
Traveler Carries Concreting Chute and Forms for Conduit

TRAVELERS carry the concreting chutes and handle the outside arch forms, in concreting the outlet conduits for the Germantown dam of the Miami Valley flood-protection works. As the conduit structure at Germantown is at the foot of a very steep hill, it was



TRAVELERS SHIFT CONCRETING CHUTES AND FORMS FROM SECTION COMPLETED TO SECTION BEING BUILT
A. Dragline digging trench for conduits. B. Gravel-washing and concrete-mixing plant. C. Travelers handling forms and chutes. D. Truck for concrete cars.

possible to place a track from the concrete mixer on the hillside well above the level of the highest concrete. From this track the concrete is conveyed to the different



TRAVELERS BUILT BY JOB CARPENTERS FROM DESIGNS OF DISTRICT ENGINEERS

Other Articles in This Issue of Interest to Contractors:

parts of the structure by means of steel chutes suspended from travelers each consisting of two trusses with the necessary supporting columns and braces. These travelers move on a track consisting of a single line of rail placed along each side of the structure.

The method of operation is as follows: When the outside arch forms are to be moved ahead, the chute, which is suspended from the traveler by block and tackle, is drawn up out of the way. The forms, which are made in three sections for easy handling, are then lifted, one section at a time by means of block and tackle, a sufficient height to pass over the collars of the conduit section already constructed, and are suspended from the traveler. The traveler carrying the three sections of the forms and the chute is then moved ahead to the new position, the forms are lowered into place, and the traveler is then moved to the best position for concreting the section and the chute is lowered to the proper angle for concreting.

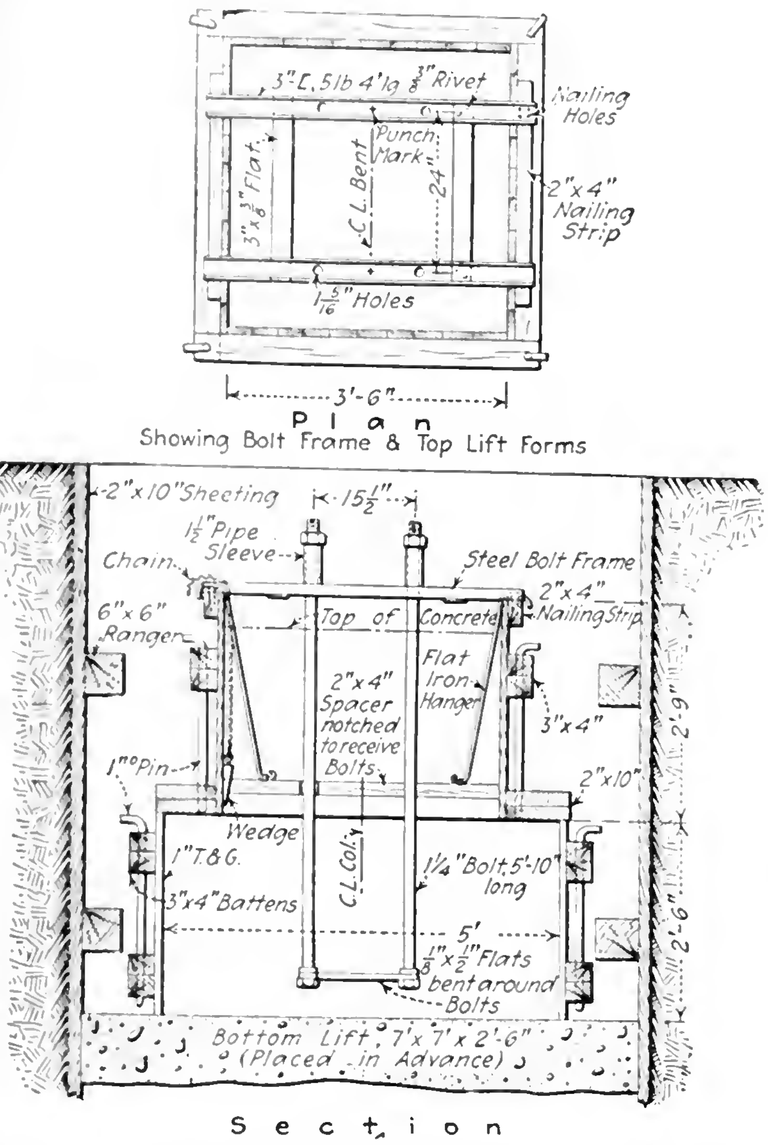
Arthur E. Morgan is chief engineer, Charles H. Paul is assistant chief engineer, and C. H. Locher is construction manager of the Miami Conservancy District.

Anchor Bolts Held in Correct Position While Concreting Footings

BY A. P. ROSCOE
Ozone Park, New York

AS THE result of experience in the construction of about a thousand column foundations for an elevated railroad in New York City, there was developed a special bolt frame and templet for facilitating the work of setting anchor bolts to exact line and grade and holding them in position while concrete was placed for the footings.

The form panels for the two upper lifts were assembled on the completed bottom lift, placed a day or two previously. The 1-in. pins used to fasten the forms were found to be difficult to remove after the concreting was done, and were later replaced by tapered pins



DETAILS OF ANCHOR BOLT TEMPLET FOR FOOTINGS OF COLUMNS

of rectangular section fitting into metal-bushed, circular holes in the battens. The completed form was then carefully braced and wedged against the rangers and sheetings so as to prevent lateral movement and to counteract any tendency of the forms to rise because of the pressure of the concrete.

The bolt frame, or templet, constructed of 3-in. channels and 3 x 3/8-in. flats, was accurately drilled for the four 1 1/4-in. anchor bolts. These frames were light and sturdy and were in good condition when the job was finished. The frame was laid on top of the form and was accurately set by a field party using the center punch marks on the frame; when set they were nailed in place through the nailing holes shown near the ends of the channels. The bolts were set and adjusted to grade by means of the sleeves and nuts shown. This afforded a quick and accurate method of setting the bolts. To hold the anchor bolts in place against the impact of concrete being placed, and to prevent their movement by workmen spading the concrete, they were fastened together at the bottom with 1/2 x 1/2-in. flats bent around the bolts; at the middle point they were stayed by 2 x 4-in. notched spacers wedged against the inside of the forms. By the time the concrete had reached these spacers the bolts were so firmly held by the concrete (and the bolt frame) that the spacing pieces could be removed and concreting completed to the finished grade. It was found to be worth while to attach a chain to the wedge and iron hangers to the spacing pieces, as shown, so as to permit their ready withdrawal, rather than to waste the time of the entire gang while a laborer fished out the wedges, etc., which operation, owing to the confined space, caused exasperating delays in the beginning.

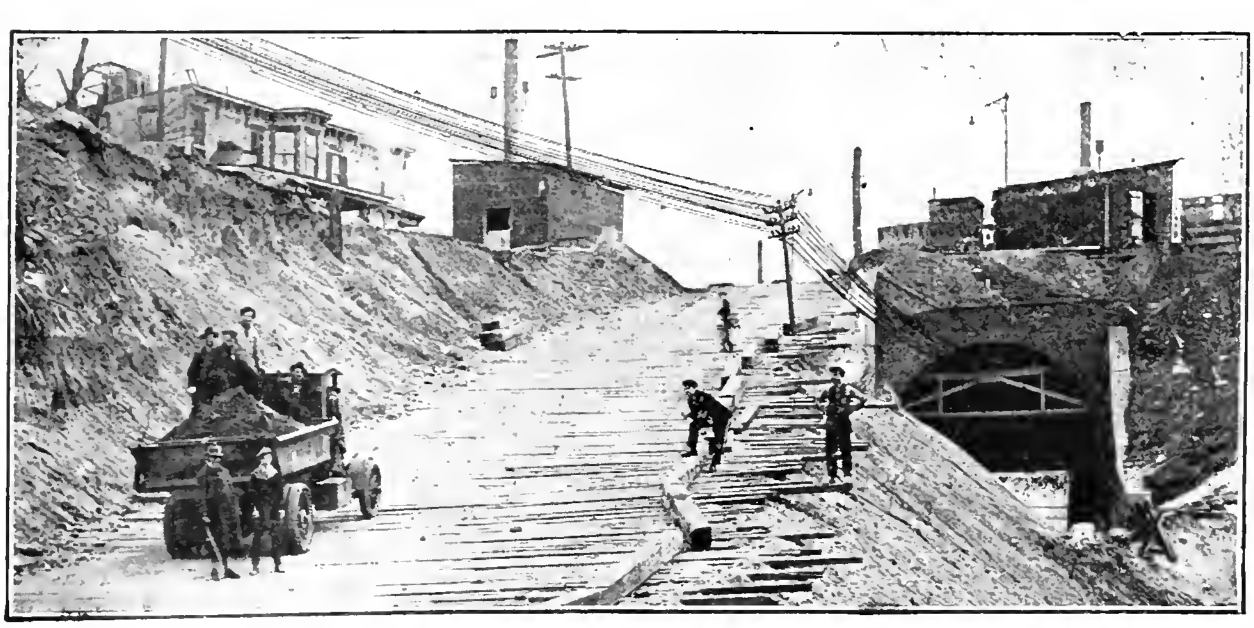
Hoisting Engines Used to Help Trucks on Seventeen Per Cent. Grade

HAULING of excavated material from the deep cut which is being widened to give railway connection to the South Brooklyn Army supply base was accomplished by means of motor trucks helped by auxiliary hoisting engines. The grade was upward of 17 per cent., and was planked, as shown in the accompanying illustration.

That the trucks might not be delayed, two 9 x 12 hoisting engines were placed at the top of the grade, one on each side. While a truck is coming up on one side, another is going down on the other. Letting the trucks down by cable was not absolutely necessary, but was considered safe and acted as a means for taking the cable down to bring up the next load.

To center the cables on the roadway a deadman consisting of a large steel I-beam, securely embedded in the ground, was placed in the center and just beyond the brow of the hill. To this two large pulleys were attached, and the lines from the engines passed through these and thence down the grade. By this means trucks carrying about four cubic yards of material were easily operated.

This work is under the supervision of the Construction Division of the Army. Brig. Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut. Col. H. S. Crocker is constructing quartermaster, and Maj. J. W. Cerny, Quartermaster Corps, National Army, assisted by Capt. L. A. Sumner, is directly in charge of the work described. The general contractor is the Turner Construction Co. of New York City, of which A. C. Tozzer is executive manager, and the subcontractor for the hauling is Rodgers & Haggerty, of New York.



TRUCK BEING HAULED UP STEEP GRADE—NOTE CABLE ATTACHED

NEWS OF THE WEEK

New York, March 20, 1919

Passaic Valley Sewage Disposal Suit Reopened

A reopening of the suit brought by the city of New York against the Passaic Valley Sewerage Commission (nominally the State of New York against the State of New Jersey) has been ordered by the United States Supreme Court. The suit was originally brought in October, 1908, to prevent the alleged pollution of the waters of New York Bay by the treated sewage of Newark and other communities included in the Passaic Valley Sewerage District. Testimony was taken from June, 1911, to June, 1913, but the case was not argued until late in 1918.

The court holds that supplementary evidence is needed. It permits the defendants to take the testimony of not more than three "sanitary or engineering experts" on (1) "any practicable modification of the proposed system of sewage treatment" that would lessen the alleged pollution, and (2) on "any practicable plan of sewage disposal or treatment" applicable to New York City sewage that would lessen the pollution of the harbor. In addition (3) both parties are authorized to take evidence on the degree of pollution of the harbor. The evidence in behalf of the defendants must be in by Aug. 15, 1919. Between then and Sept. 15 the defendants may, if desired, recall in rebuttal the experts who have testified under (1) and (2) and may also offer rebuttal evidence under (3).

After the new evidence is all in, a date for further argument will be set. The evidence will be taken by James D. Maher, clerk of the United States Supreme Court, sitting as a commissioner in New York and Newark. Mr. Maher took the earlier evidence in this case.

Engineering Regiment Cited

For conspicuous gallantry in action on the last night of the war, the Second Engineers were cited in the orders of Maj. Gen. J. A. Lejeune, commanding the Second Division. The citation reads as follows:

1. On the night of Nov. 10, heroic deeds were done by heroic men. In the face of heavy artillery and withering machine-gun fire, the Second Engineers threw two foot-bridges across the Meuse, and the first and second battalions of the Fifth Marines crossed resolutely and unflinchingly to the east bank and carried out their mission.

2. In the last battle of the war, as in all others in which this division has participated, it enforced its will on the enemy.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service:

16 East 42nd St., New York.
63 E. Adams St., Chicago.
1518 Walnut St., Philadelphia.
16 Tremont St., Boston.

N.B. Official information has been received that all offices of the Professional and Special Section of the United States Employment Service will close Mar. 22, unless they can be temporarily continued by local interests. This action is made necessary by the failure of Congress to appropriate funds.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Myers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, care of B. P. Legare, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Joint Influenza Committee

The Surgeon Generals of the Army, the Navy and the United States Public Health Service, and the Director of the Census, have created a joint committee to study and compare the influenza data of the various Government departments. The members are: Dr. William H. Davis, chairman, and C. S. Sloane, representing the Bureau of the Census; Dr. Wade H. Frost and Edgar Sydenstricker, of the Public Health Service; Col. D. C. Howard, Col. F. F. Russell and Lieut. Col. A. G. Love, U. S. A.; Lieut. Commander J. R. Phelps and Surgeon Carroll Fox, U. S. Navy.

United States Employment Service Greatly Curtailed

Failure of Congress to pass the Urgent Deficiency Bill in the last days of the session has made it necessary for Secretary Wilson of the Department of Labor to curtail by 80% the United States Employment Service to returning soldiers. It was hoped that this deficiency might be overcome by drawing on President Wilson's war emergency fund, but this has been exhausted.

It is proposed to save a skeleton by retaining a 20% organization, around which various other Government agencies, welfare organizations, etc., will be centralized to carry on the work. In doing this, the 56 regular branch offices which remain of the 750 which had been established will be located in the strategic industrial centers.

Unemployment, as indicated by reports of cities to the Department of Labor, is increasing from week to week, and this curtailment of the Employment Service is considered unfortunate. It is hoped that local communities will continue the Government work.

Training Camps Association Takes Over Employment Work

Left without funds, the Professional and Special Section of the United States Employment Service in Chicago has turned over to the Military Training Camps Association a restricted portion of its work. The association proposes to handle applications from men returning from service only. This means much to engineers, for there are approximately 500 applicants in the Federal files. The Chicago office under the new organization, with W. R. Robinson as its head, has just begun to function, having placed 26 men, exclusive of teachers, during the week which ended Mar. 15. D. A. Tomlinson, who became the head of the office Mar. 15, Mr. Robinson having gone with the Curtis Publishing Co., will remain with the service only until the shift has been effected.

The Military Training Camps Association is located at 220 So. State St., and has a strong national organization maintained by membership fees and contributions. It has the military backing of General Wood, who was recently transferred to Chicago in command of the Central Department of the Army, and has interested himself in the employment situation. For the purpose of continuity of service the association has placed the nucleus of the Federal bureau's staff on its payroll.

Government Surplus Lumber For Sale

The Director of Sales of the War Department has executed a contract with J. L. Phillips and John Stephens, of Jacksonville, Fla., the representatives of the lumber producers, for all of the surplus lumber in the War Department on projects where there is any considerable quantity to be disposed of.

Messrs. Phillips and Stephens can be reached at 708 13th St., N. W., Washington, D. C., and will receive any offers on lumber which they have for sale for the War Department. They have purchased this lumber and agree to resell it at the market price for the various species and grades of lumber, paying to the War Department the amount received for this lumber, less the actual expense of selling; and, in addition, they agree to clean up the entire surplus lumber within the coming six months.

The quantity covered under the contract with the department was 188,000,000 ft., and additional quantities in sight from the department and the Housing Corporation made the amount over 200,000,000 ft. The department has now withdrawn from the contract all the lumber at all the camps and from some storage points, the amount aggregating approximately 160,000,000 ft. This lumber will not be sold. This will leave only between 30,000,000 ft. and 40,000,000 ft. located at widely scattered points and of a variety of sizes, species and grades.

Water-Main Extension Problems Feature of Meeting

Following a short lantern-slide talk on the recent break in a 1200-hp. turbine at the Wachuset dam, by William E. Foss, chief engineer of the Metropolitan Water-Works (as mentioned in *Engineering News-Record* of Feb. 20, 1919, p. 403) the New England Water-Works Association at Boston devoted the rest of its time, after the monthly luncheon on Mar. 12, to a discussion of meeting the cost of water-main extensions. The first speaker, M. N. Baker, of the editorial staff of *Engineering News-Record,* suggested wider use of the assessment-for-benefits plan, especially in view of the fact that the war and prohibition have joined hands in making more difficult than ever the problem of financing municipal improvements.

Coupled with Mr. Baker on the program was C. M. Saville, chief engineer and manager of the Hartford waterworks. In Hartford, property owners now guarantee a yearly revenue of 10% for 10 years on the cost of a main large enough to supply the street. C. E. Davis stated that in Philadelphia property is assessed $1 a front foot for main extensions. The assessment is a lien on the property. With a prospect of diminishing revenues due to prohibition, it has been proposed that there be levied an assessment for the high-pressure fire system, based on the cubic space in the buildings projected.

A. R. Hathaway of Springfield, Mass., said that in his city property owners may divide the charge for a water main extension among themselves as they see fit. Leonard Metcalf of Boston approved the general plan of assessment for benefit, which he thought is more common than generally supposed. In the West, where lots are large and much of the city area is sparsely settled, there is a strong argument for the plan. F. P. Stearns thought that the assessment plan would discourage applications for extensions.

Alaskan Railroad Work Curtailed

Owing to the failure of Congress to provide necessary funds, it is probable that work on the Alaskan Government railroads will have to be materially curtailed. The construction work under way even may be reduced, and certainly no new work will be undertaken unless an extra session of Congress should make the needed funds available.

Illinois Has Waterway Project

A new plan for a waterway to form a link in the Lakes and Gulf waterway by connecting the Chicago Drainage Canal with the Illinois River at La Salle, Ill., is contained in a bill submitted to the state legislature. It has the backing of Governor Lowden, and was prepared by the State Department of Public Works and Buildings. The channel will have a bottom width of 150 ft., with a water depth of 8 ft. in earth sections, 10 ft. in rock and 14 ft. over lock sills. Locks 110 x 600 ft. long are provided, enabling fleets with 5000 to 7000 tons of freight to be accommodated. The cost is estimated to come within the bond issue of $20,000,000 which has already been authorized by public vote. When the bill is passed the project will be submitted to the War Department, and it is hoped that approval will be given in time to permit of starting work this season.

Outlook for Highway Improvements in California

Several county bond issues are to be voted on, and several others are proposed, in California, according to reports. A $40,000,000 bond issue is also being contemplated for the state at large.

Among the counties, Fresno will vote on $4,600,000 on May 6, while Sonoma will vote on $1,600,000 on May 27. Marin County has requested a Government engineer to prepare highway plans, and five northern counties have requested an engineer to lay out an intercounty system for them.

In addressing the State Road Supervisors' Association, Governor Stephens stated that the state-wide bond issue mentioned above is about to be proposed, and requested their united support. This was given in the form of a resolution which was passed by a large majority.

Ontario Good Roads Association Meets in Toronto

Great interest in the subject of good roads was shown at the 18th annual convention of the Ontario Good Roads Association, held in Toronto, Mar. 5-7, when 300 delegates met to discuss the road problems of the province. Public work to tide over the labor shortage of the reconstruction period, together with changes in the laws affecting labor upon the roads, was the principal topic of the speakers.

What is known as "statute labor," or working out the road tax, received the greatest amount of discussion at the convention. It was the sense of the meeting, as expressed in a resolution carried by a fair majority, that this form of road administration should be discontinued, and that the road construction of counties should be put under a competent surveyor.

A great increase in motor traffic, as evidenced by the advance in receipts from licenses from $950,000 in 1917 to $1,200,000 in 1918, makes it necessary, according to the Hon. George S. Henry, minister of agriculture, to put the township roads of the present system into such condition that they can be used all the year round.

The following officers were elected for the ensuing year:

President, K. W. McKay, St. Thomas; first vice-president, J. J. Parsons; second vice-president, W. H. Pugsley, Richmond Hill; third vice-president, Capt. Lucius E. Allen, Belleville; secretary-treasurer, the Hon. George S. Henry, member of the provincial Parliament; assistant secretary-treasurer, Maj. T. L. Kennedy.

Federal Highway Council To Hold First Meeting in Chicago

The first meeting of the newly organized Federal Highway Council, described in *Engineering News-Record* of Feb. 6, 1919, p. 303, will be held at the Congress Hotel, Chicago, Apr. 7-8. The meeting will open with an informal "get-together" dinner on Monday evening, Apr. 7.

Representatives of 38 state highway departments, together with 190 prominent men representing civic organizations throughout the entire country, have accepted membership in the council and are expected to be in attendance. Indorsement by many organizations of the national highway policy and plan outlined at the Chicago Highway Congress by E. J. Mehren, editor of *Engineering News-Record,* indicates the interest in highway work throughout the country and suggests a wide field of action for the Federal Highway Council.

Road-Bond Issue Submitted to Vote by Legislature

Another state was added to those which have submitted large highway bond issues to a vote of the people, when the Governor of Washington signed a bill passed by the legislature

providing for a referendum on an issue of $30,000,000. The measure will be voted upon at the general election in 1920 and, if it is carried, the funds will be used to build hard-surfaced roads throughout the state. A bill providing for county superintendents of highways reporting directly to the State Highway Commission, reported in *Engineering News-Record* of Feb. 13, 1919, p. 351, was defeated.

Interior Department Obtains High Explosives for Road Work

High explosives worth $10,000,000 and consisting largely of TNT have been turned over by the War Department to the Department of the Interior for reconstruction purposes. It is reported that Secretary Lane, of the Interior Department, plans to use much of this material for blasting on road-building projects.

Federal-Aid Highway Appropriation Goes Through

Federal aid for highways received a large addition when the Postoffice appropriation bill went through the Senate carrying $200,000,000 for this purpose. The bill, which was noted in *Engineering News-Record* of Jan. 30, 1919, p. 251, now awaits the signature of the President.

The provisions of the bill greatly enlarge the scope of the term "rural post road," to cover roads that either are used or can be used for transportation of the mails. It also increases the maximum payments which the Federal Government can make per mile from the previous amount, $10,000, to $20,000. This will allow the building in coöperation with the states of roads costing $40,000 per mile.

Canada Takes Over Grand Trunk Pacific

The Grand Trunk Pacific Ry. has been taken over by the Canadian government, which assumed control at midnight Mar. 9. The Hon. J. D. Reid, minister of railways, was appointed receiver. This action was caused by an official notification received by Sir Thomas White, acting premier, from the vice president of the railway, that, in view of the fact that the increased rates have not been sufficient to meet the increased operating expenses, it would not be possible for the company, owing to lack of funds, to continue its operations beyond Mar. 10. The War Measures Act was held to provide adequate authority for immediate action by the Government to prevent interruptions in the operation and management of the system.

W. P. Hinton, the general manager, has agreed to conform to the requirements of the Government and to facilitate the carrying out of the powers and duties required by the minister of railways as receiver. The acquisition of the road adds 1964 miles of main road and about 1000 miles of branch line to the Government system.

Oklahoma Society Considers Paving Brick and Concrete Tanks

Influenza compelled the postponement of the annual meeting of the Oklahoma Society of Engineers in October last, and the deferred meeting was held in Oklahoma City, Mar. 6. Trouble with reinforced-concrete tanks was described by R. E. Brownell, district engineer of the Portland Cement Association, and the discussion indicated a general opinion that tanks 12 to 30 ft. high, made with 1:2:4 concrete, should be waterproof if properly built. Mr. Brownell pointed out that to produce strong concrete the water must be measured as carefully as the other materials.

Officers of the society for the short term of 1919 were elected as follows: President, T. P. Clonts, county engineer, Muskogee; vice-presidents, Col. Frank B. King, R. E. Brownell and D. W. Patton; secretary, H. V. Hinckley, Omaha City, Okla.

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission, for form 1312.

United States.—Superintendents of road construction, Bureau of Public Roads, Department of Agriculture, Mar. 25: Class A (candidates with four years' responsible charge of construction) $150 to $175 per month: Class B (six years' responsible charge) $185 to $225; Class C (eight years' responsible charge) $230 to $250 a month. File applications before Mar. 25.

United States.—Assistant examiner, Patent Office, Washington, Mar. 26-28, and May 21-23 and July 23-25. Pay, $1500 per year. File applications in time to arrange for examinations at place selected by applicant.

United States.—Chief physicist, qualified in aëronautics, National Advisory Committee for Aëronautics, Langley Field, Hampton, Va., Mar. 25, $3000 per year. Also physicist, $2100 per year. File applications before Mar. 25.

United States.—Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agriculture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3400 per year. File application before Apr. 1.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Mar. 26-27 and Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

United States.—Aëronautical engineering draftsman, National Advisory Committee for Aëronautics, Apr. 1, $1500 per year. File applications before Apr. 1.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The Niagara Peninsula Branch of the Engineering Institute of Canada was formed at a meeting at Niagara Falls, Ont., Mar. 11, attended by members of the Engineering Institute of Canada and other engineers resident in the Niagara district. Frazer S. Keith, general secretary, explained the scope and functions of the Engineering Institute to a large gathering of representatives from St. Catharines, Thorold and Niagara Falls. Visiting engineers were present from New York City, Philadelphia and from the Hamilton branch. The following officers were elected: Chairman, A. C. D. Blanchard, Niagara Falls, Ont.; vice-chairman, W. P. Near, St. Catharines, Ont., and secretary-treasurer, R. P. Johnson, Niagara Falls, Ont.

The Society of Polish Engineers and Business Men in America, with headquarters in the Engineering Societies' Building, 29 West 39th St., New York City, has been organized to work in conjunction with the Commercial and Industrial Bureau of the Polish National Department, 33 West 42nd St. The organization is headed by Ralph Modjeski, as honorary president. Steven de Csesznak, publisher of *Export American Industries*, is president.

The Iowa Section of the American Water-Works Association will hold its fourth annual meeting at the State University of Iowa, Iowa City, Apr. 16-17. Preliminary plans for the meeting indicate that a prominent place will be given to the reconstruction and extension problems of water-works under existing abnormal conditions.

The Engineers' Society of St. Paul held its regular monthly meeting Mar. 10. A motion picture, "From Ore to Finish 'National' Pipe," produced by the National Tube Co. of Chicago, was shown. The society was recently represented by a committee which addressed the appropriations committee of the state legislature on the neces-

sity of having an appropriation to continue the topographic mapping of the state, and hydrographic surveys, in conjunction with the United States Geological Survey. The committee representing the society was composed of E. V. Willard, state drainage engineer; G. O. House, general manager of the Northern States Power Co.; L. P. Wolff, consulting engineer, St. Paul, and E. C. Dugan, of the United States Engineer's office, St. Paul.

The Bankhead National Highway Association will hold its third annual meeting at Mineral Wells, Tex., Apr. 18-19. Delegates from all the states along the line of the Bankhead Highway, from Virginia to California, are expected to attend. The United States Good Roads Association, of which Senator Bankhead is president, will also meet during the same week at Mineral Wells, beginning on Apr. 14. There will be an exhibit of machinery and materials. J. A. Roundtree, Birmingham, Ala., is secretary of the Bankhead National Highway Association.

The American Association of Engineers will hold a meeting in Chicago, Mar. 21, at which W. E. Skinner will speak on the proposed $10,000,000 soldiers' memorial building.

The Engineers' Club of Philadelphia will be addressed by Joseph A. Steinmetz on "News from the Peace Zone," at the weekly luncheon Mar. 25.

The Technology Club of Syracuse, N. Y., was addressed Mar. 17 by Henry C. Allen, city engineer, on "The Water Supply of Syracuse." On Mar. 24 C. E. Drayer, secretary of the American Association of Engineers, will speak on the work of the association.

The Quincy, Ill., Engineers' Society elected the following officers at the recent annual meeting: President, W. F. Gerdes; vice-president, W. C. Dowd; secretary-treasurer, Dwight P. Child. A paper on street paving, by Webster P. Bushnell, was presented.

The Montreal Branch of the Engineering Institute of Canada will be addressed Mar. 27 by R. de L. French, who will read a paper entitled "Some Notes on the Design and Construction of Reinforced-Concrete Covered Reservoirs."

The Southern California Association of Members of the American Society of Civil Engineers has planned a series of discussions on flood control in southern California. The regular meetings of the association have been changed from bimonthly to monthly. After the first topic has been covered, other "local engineering problems of vital consequence to the community" will be considered along professional lines. At the first meeting, which was held on Mar. 12, there was an introduction of the flood-control subject by George G. Anderson, a historical sketch by F. H. Olmsted, and a talk on the physiography involved, by A. L. Sonderegger.

The New England Water-Works Association will hold its next annual meeting in Albany. The time will probably be the second week in September.

The Duluth Engineers' Club held its monthly meeting Mar. 15, at which the committee on local transit reported on Duluth street-railway conditions with respect to factors attending impairment of the service last winter.

The Engineers' Club of Seattle, at a recent meeting, was addressed by Maj. William F. Allison, who spoke on "The Work of the Sanitary Engineers with the American Army in France."

The Engineers' Club of Minneapolis was addressed Mar. 17 by Professor Comstock of the Minnesota State University of Mines, who spoke on "The Mining Industry of Minnesota."

Personal Notes

COL. F. A. MOLITOR, Twenty-Second Engineers, has been discharged from the Army and has returned to New York to resume his consulting practice. The Twenty-Second Engineers, which Colonel Molitor commanded, was assigned to the construction of light railways. In November Colonel Molitor was detailed from his regiment and placed in charge of engineer supplies.

ROY MULLINS, division highway engineer of New Jersey at Trenton, has been appointed division engineer in charge of the northern division, with headquarters at Newark, succeeding E. M. Vail, who has been put in charge of the new department of maintenance, as noted elsewhere.

MAJ. I. S. OSBORN, Quartermaster Corps, U. S. A., has been discharged from the service and has returned to engineering practice with the Allen-Osborn Co., engineers and architects, of Cleveland, Ohio. At the request of Herbert C. Hoover, he organized the Garbage Utilization Division, United States Food Administration, later resigning to enter the Army to organize the Reclamation Division in the Quartermaster Corps, of which he was chief during the first part of 1918. During the latter part of the year he was assigned to special duties and inspection work in connection with the Salvage Division, Office of the Director of Purchase, Storage and Traffic.

HENRY E. ELROD, DAVID DRENNAN and FRANK S. TAYLOR, formerly of the engineer firm of Lyndon, Taylor & Perrilliat, New York City and New Orleans, have become associated under the firm name of the Henry Exall Elrod Co., Dallas, Tex., consulting engineers, successors to Henry Exall Elrod. The new organization will continue to specialize in municipal work, utility valuation and regulation, and highway engineering.

H. A. SCHAFFER, previously of the firm of Harrison & Schaffer, consulting engineers and chemists, Easton, Penn., has joined the staff of the Portland Cement Association as chemical engineer to conduct conservation studies. From October, 1918, he was acting as advisory chemist and assistant to the Director of Building Materials, War Industries Board, Washington.

MAJ. W. A. WELCH, Air Service Aircraft Production, U. S. A., division engineer, Spruce Production Division, and chief engineer, Spruce Production Corporation, has been discharged from the service and has returned to his former position as chief engineer of the Palisades Interstate Park Commission.

MILO S. KETCHUM, assistant director of the United States Government explosives plant, who since February, 1918, has been in charge of the construction of the smokeless-powder plant at Nitro, W. Va., has returned to the University of Colorado to resume his duties as dean of the College of Engineering and professor of civil engineering.

CAPT. A. U. WETHERBEE, Chemical Warfare Division, U. S. A., who was formerly chief engineer and assistant works manager of the Niagara Alkali Co., recently received his discharge from the service and has become chief mechanical engineer, Powdered Coal Engineering & Equipment Co., Chicago.

LIEUT. C. F. URBUTT, Construction Division, U. S. A., has received his discharge from the service and has been appointed district engineer, Chicago, Milwaukee & St. Paul R.R., with office in Chicago, succeeding W. L. Webb, assigned to special work in connection with the Chicago Union Station, as noted elsewhere.

ARTHUR H. BLANCHARD, consulting highway engineer, New York City, has been appointed chief of the Bureau of Public Works, Department of Citizenship, under the Army Overseas Educational Commission of the Y. M. C. A. General Pershing has requested the Y. M. C. A., through its commission, to take charge of the development of instruction and courses for all educational work of the Army overseas. The staff of the Bureau of

Public Works and Army instructors, in 500 post schools throughout France, will give lectures and courses relative to waterways, railways, highways, bridges, water-supply, sewerage, waste disposal, public utilities, and irrigation.

LIEUT. WILLIAM H. HOBBS, 332nd Field Artillery, American Expeditionary Forces, has received his discharge from the Army and resumed his work as assistant engineer, Louisiana Division, Missouri Pacific R.R., with headquarters at Monroe, La.

H. W. SKIDMORE, construction engineer, Department of Public Works, Village of Oak Park, Ill., on Apr. 1 will become associated with Lester Kirschbraun, consulting and testing engineer of Chicago, and will become associate director of the Chicago Paving Laboratory, devoting practically all of his time to the paving field.

LIEUT. G. D. SHANNON, Ordnance Department, U. S. A., formerly highway division engineer, Vermilion County, Illinois, has received his discharge from the service and has become highway engineer of the Joplin, Mo., road district, in charge of construction.

LIEUT. WILLIAM F. BROCK, Engineers, U. S. A., stationed at Camp A. A. Humphreys, Virginia, has received his discharge from the service and has returned to his work with the Interstate Commerce Commission, Division of Valuation. He is at present located at Newbery, Fla.

L. P. SCOTT, assistant engineer, Road Department, Office of the Constructing Quartermaster, Camp Henry Knox, Kentucky, since his discharge from the service, has become constructing engineer on highway work for Sedgwick County, Kansas, with headquarters at Wichita.

U. S. MARSHALL, senior highway engineer, Bureau of Public Roads, who has just completed the paving work at Camp Lewis, Washington, has been transferred to Missoula, Mont., in charge of Federal road work in the state, succeeding J. S. Bright, transferred to District No. 3, Denver, as noted elsewhere in this issue.

E. M. VAIL, division state highway engineer in charge of the northern division, New Jersey, with headquarters in Newark, has been promoted to head the new department of maintenance.

COL. WILLIAM D. WRIGHTSON, chief of the Sanitary Corps, U. S. A., has received his discharge from the service and has resumed his connection with the International Health Board of the Rockefeller Foundation as sanitary engineer and member of the yellow fever commission. He will sail this month for South America, in company with Maj. Gen. William C. Gorgas, chairman of the commission, and Brig. Gen. Theodore C. Lyster, member of the commission, to investigate yellow fever conditions in Central and South America.

COMFORT AVERY ADAMS, previously professor of electrical engineering and Lawrence professor of engineering, Harvard University and Massachusetts Institute of Technology, has been appointed dean of the School of Engineering at Harvard.

CAPT. ALLAN V. ELSTON, 314th Engineers, American Expeditionary Forces, has received his discharge from the service and has resumed private practice in the firm of Wood, Elston & Witten, consulting engineers, Tulsa, Okla.

JOHN FLYNN, JR., who recently completed his work as project and supervising engineer, United States Housing Corporation project, Watervliet, N. Y., has been appointed village engineer of Green Island, N. Y., for the ensuing year.

LIEUT. FRANK W. VARDEN, U. S. A., formerly with the Koppers Co., has been discharged from the service and has entered the technical department of the Barber Asphalt Paving Company.

O. H. FRICK, field engineer on valuation work, Chicago, Milwaukee & St. Paul R.R., has been appointed district engineer, middle district, with headquarters in Milwaukee.

G. H. BISHOP, previously with the United States Public Health Service, Montgomery, Ala., has become chief engineer for the Cement Products Co., manufacturer of "Sanisept" portable sewage-disposal systems.

J. S. BRIGHT, engineer in charge of the branch office of the Bureau of Public Roads at Missoula, Mont., has been appointed engineer in charge of District No. 3, with headquarters in Denver.

W. F. CRAWFORD and R. N. WHITTESEY have become associated under the firm name of Crawford & Whittesey, civil and consulting engineers, Sapulpa, Okla.

MAJ. JAY A. ROSSITER, formerly track elevation engineer, Chicago, and CAPT. C. C. SANER, assistant engineer, on the city engineer's staff, Chicago, announce the opening of a sales engineer's office in the Union National Bank Building, Houston, Tex. Major Rossiter and Captain Saner were connected with the 108th Engineers, formerly a Chicago National Guard regiment. The new firm, Rossiter & Saner, represent the following manufacturers: Page-Burton Boiler Co.; F. C. Austin; Yeomans Bros.; Williams-Wendt Co.; Austin Manufacturing Co.; Baylis Sanitary Supply Co.; Chicago Waste Co.; American Steam Conveyor Corporation; Boland Construction Co.; Municipal Supply Co.; Universal Engineering Co., and Typhoon Ventilating System.

W. L. WEBB, district engineer, Chicago, Milwaukee & St. Paul R.R., with headquarters in Chicago, has been assigned to special work in connection with the Chicago Union Station.

JOSEPH W. HUNTER, formerly state highway commissioner and since 1911 first deputy highway commissioner of the Pennsylvania State Highway Department, has been appointed township commissioner of the department.

LIEUT. ALLEN F. SHERZER, 301st Feld Artillery, American Expeditionary Forces, has resumed his work with the Kingsford Foundry & Machine Works, Oswego, N. Y., having received his discharge from the service.

ROBERT C. BERLIN,, PERRY W. SWERN, and FRANK A. RANDALL have become associated as the firm of Berlin, Swern & Randall, architects and engineers, 19 So. La Salle St., Chicago.

GEORGE H. BILES, second deputy highway commissioner of Pennsylvania for the past three years has been appointed assistant highway commissioner.

R. A. BOOTH has resigned as state highway commissioner of Oregon.

OBITUARY

LYNDEN B. SCHOEMAKER, for the past nine years engineer of distribution, Department of Water Supply, Brooklyn, N. Y., died in that city Mar. 10, at the age of 34. He was graduated from Princeton in 1906 and served as an instructor during the following year, afterward entering the service of New York City.

THOMAS FLETCHER OAKES, former president of the Northern Pacific R.R., died in Seattle Mar. 14 at the age of 76. He directed the construction of the road from Spokane to Seattle. In 1863 he entered the service of the Kansas Pacific Ry., from which he resigned as vice-president in 1879 to become general superintendent of the Kansas City, Fort Scott & Gulf R.R. He later served as vice-president and general manager of the Oregon Ry. & Navigation Co. In 1881 he became vice-president of the Northern Pacific, and served as president from 1888 to 1893, when he was appointed receiver for two years.

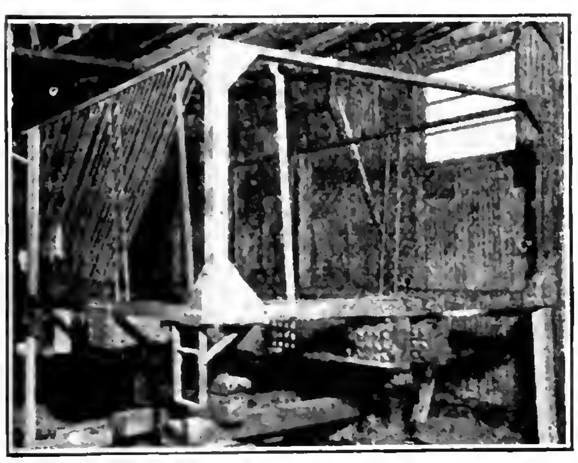
Concrete Freight Car Designed to Relieve Steel Shortage

A reinforced-concrete gondola car, having concrete sides, ends and floor with a steel skeleton body frame, and mounted on a steel underframe, was on exhibition in Chicago recently and represents a new development in the use of concrete. It was designed during the war as a means of relieving the shortage of steel and the demand for cars, but plans are being made for

FREIGHT CAR HAS CONCRETE SIDES AND FLOOR ON STEEL FRAME

manufacturing various types of concrete cars on a commercial scale.

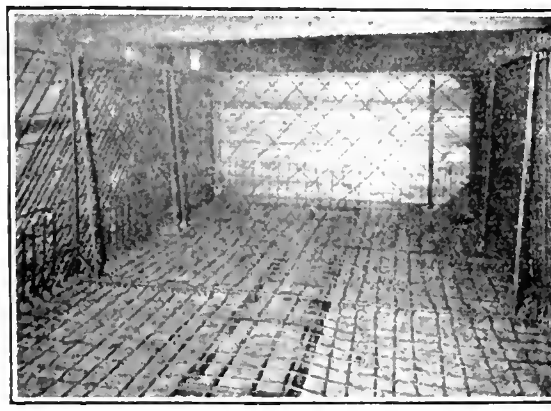
The car has a body 41 ft. long, 9 ft. 8 in. wide and 4 ft. 8 in. deep. It is designed for 50 tons load capacity plus 10% for overload. Unit stress was taken at 16,000 lb. in steel and 1000 lb.



STEEL FRAME AND REINFORCEMENT OF CONCRETE FREIGHT CAR

in concrete. Impact was computed at 25%. As the thickness of the concrete is only 2½ in., it was decided to use the cement gun for making the sides and floor, the cross-bearers being poured in the usual way. Forms were placed on the outside of the frame, and the concrete was shot from the interior. The density of the concrete applied in this way increased the weight, but it is estimated that cars of this size and design can be made weighing 23 to 24 tons. A new light-weight aggregate, known as haydite and invented by Stephen J. Hayde, of Kansas City, was used. This makes concrete said to weigh 104 lb. per cubic foot, with a compressive strength of 4450 lb. in 28-day tests.

The car was designed by J. B. Strauss and built by the R. F. Conway Co., while many parts of the equipment were contributed by the Illinois Central R.R. After 30 days' service on that road it will be turned over to the United States Railroad Administration. The



REINFORCEMENT FOR CONCRETE FLOOR, SIDES AND ENDS OF CAR

Concrete Car Co. has been organized by J. J. McCarthy, Joseph B. Strauss and F. E. Sullivan, of Chicago.

Business Notes

The Sullivan Machinery Co., Chicago, announces the establishment of a branch office at Edificio Oliver No. 3, Mexico City, in charge of Joseph F. Bennett. The appointment of Chester Mott as manager of the Denver, Colo., office, succeeding Wallace T. Roberts, resigned, is also announced.

Twenty-one years' of service have brought G. W. Burrell to the assistant vice-presidency of the Wellman-Seaver-Morgan Co. He will have entire charge of the company's work, both at Cleveland and Akron.

The Chicago Pneumatic Tool Co. announces the removal of its Cleveland district office from Room 813 to Rooms 406-408 Engineers Building, effective Mar. 1. The new headquarters will serve the company's interests within the Cleveland district. Ross Watson is district manager.

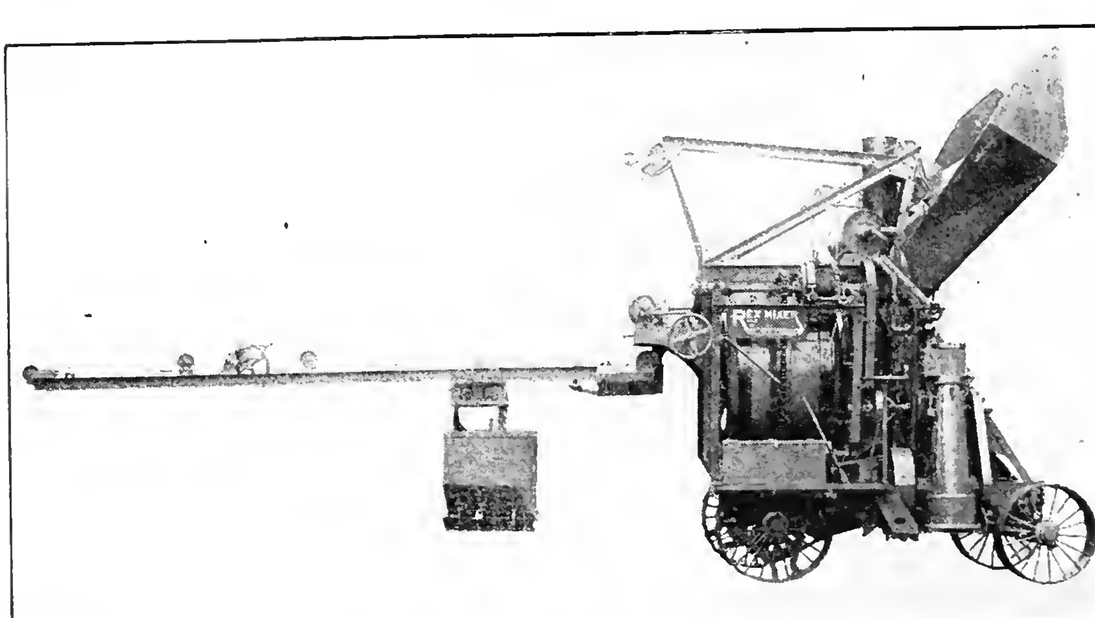
Turning from war to peace interests, the Associated Metal Lath Manufacturers have moved from Washington to their pre-war offices in the Swetland Bldg., Cleveland. During the war, Wharton Clay, who is the new commissioner, was connected with the Military Training Camps Association, in the work of placing men of special qualifications. The assistant commissioner is C. O. Powell, formerly with the Northwestern Expanded Metal Company.

Andrew Barr, who has been associated with the United States Wind Engine and Pump Co. since 1914, has accepted a position as superintendent of the foundry of the Waterloo Gasoline Engine Co., Waterloo, Iowa.

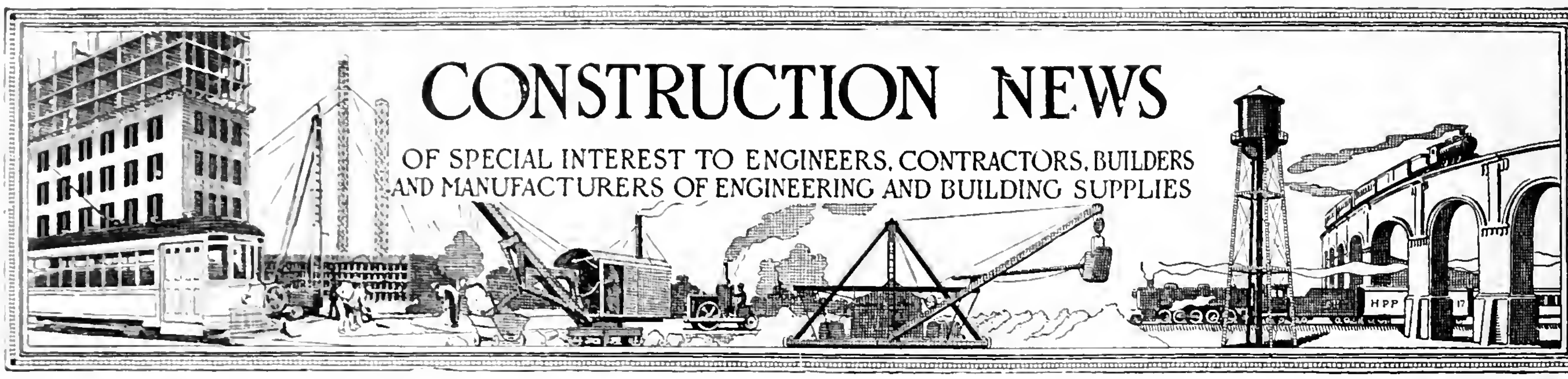
The Appraisal Engineering Co., Seattle, has opened offices at 409 Burke Bldg., as engineers and building contractors. Joseph Klein is superintendent.

New Paving Mixer Has Inclosed Transmission

A step toward automobile practice is marked in the concrete paving mixer field by the announcement of the 1919 model "Rex" 14-E, manufactured by the Chain Belt Co., of Milwaukee, shown in the cut. The sprocket chain drive is retained in the new model, which has rated forward speeds of 84 and 120 ft. per minute and a reverse speed of 90 ft. per minute. As suggested by its number, the machine has a wet concrete capacity of 14 cu.ft. It has a 90-in. loader, allowing the use of two wheelbarrows, and is equipped with either a 20-ft distributing boom or a 15-ft. spout, which receives the concrete at a height of 60 in. above the ground. The power plant is underslung, in order to lower the center of gravity. The overall width of the machine is 8½ ft., and the total height is 13 feet.



MIXER HAS INCLOSED TRANSMISSION GEARS SIMILAR TO AUTOMOBILE'S



PROPOSALS

For Proposals Advertised See Pages 63-69 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 24	Minot, N. D.	Mar. 6
Mar. 25	Jersey City, N. J.	Feb. 20
	Adv. Feb. 27 and Mar. 13.	
Apr. 15	Duluth, Minn.	Mar. 13
Apr. 16	Kansas City, Mo.	Mar. 20

SEWERS

Mar. 24	Detroit, Mich.	Mar. 13
Mar. 24	New York, N. Y.	Mar. 20
Mar. 25	Youngstown, O.	Mar. 20
Mar. 26	Brooklyn, N. Y.	Mar. 20
Mar. 28	Chicago, Ill.	Mar. 20
Mar. 30	Hagerstown, Md.	Mar. 20
	Adv. Mar. 20.	
Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Apr. 1	Great Falls, Mont.	Mar. 20
Apr. 1	Harrison, N. J.	Mar. 6
Apr. 1	Newark, N. J.	Mar. 6
Apr. 2	Hamilton, Ont.	Mar. 13

BRIDGES

Mar. 22	Taylorville, Ill.	Mar. 20
Mar. 23	Buckhannon, W. Va.	Feb. 13
Mar. 24	Middlebourne, W. Va.	Mar. 6
Mar. 24	Roundup, Mont.	Mar. 20
Mar. 25	Jersey City, N. J.	Mar. 13
Mar. 27	Janeville, Wis.	Mar. 6
	Adv. Mar. 6 to Mar. 20.	
Mar. 28	St. Remi, Que.	Mar. 20
Apr. 1	Peterborough, Ont.	Mar. 13
Apr. 1	Ft. Dodge, Ia.	Mar. 20
Apr. 7	Adna, Wash.	Mar. 20
Apr. 7	Rawlins, Va.	Mar. 20
Apr. 7	Stella, Va.	Mar. 20
Apr. 8	Lewisburg, W. Va.	Mar. 20
	Adv. Mar. 13 and 20.	
Apr. 10	Clarksville, Pa.	Mar. 20
Apr. 11	Holyoke, Mass.	Mar. 13
	Adv. Mar. 13 and 20.	
Apr. 15	Copper Valley, Va.	Mar. 20
Apr. 16	Ottawa, Ont.	Feb. 20
Apr. 22	Kingston, N. Y.	Mar. 20
	Adv. Mar. 20.	

EXCAVATION AND DREDGING

Mar. 26	Marion, Kan.	Mar. 13
	Adv. Mar. 13 and 20.	
Mar. 27	North Bergen, N. J.	Mar. 20
Mar. 31	Cleveland, O.	Mar. 20
Apr. 4	Whiteside, Ill.	Mar. 6
	Adv. Mar. 6 to 20.	
Apr 8	Hollandale, Miss.	Feb. 13
Apr. 10	Newport, Ark.	Mar. 13

INDUSTRIAL WORKS

Mar. 24	Newark, N. J.	Mar. 13
Mar. 25	Charleston, S. C.	Mar. 6
Mar. 28	New York, N. Y.	Mar. 13
Mar. 31	Orillia, Ont.	Mar. 6
Apr. 1	Quebec, Que.	Mar. 13
Apr. 1	Sioux City, Ia.	Jan. 16
Apr. 1	Boonville, Mo.	Mar. 20
Apr. 1	Astoria, Ore.	Mar. 20
Apr. 18	Sheboygan, Wis.	Mar. 20

BUILDINGS

Mar 23	Dayton, O.	Mar. 13
Mar. 24	Hawley, Minn.	Mar. 20
Mar 25	Bath, N. Y.	Feb. 27
Mar. 28	West Unity, O.	Feb. 27
Mar 31	Ottawa, Ont.	Mar. 6

Bids Close		See Eng. News-Record
Mar. 31	Edgard, La.	Mar. 13
Mar. 31	Charlotte, N. C.	Mar. 20
Mar. 31	Chicago, Ill.	Mar. 20
Apr. 2	Fairfield, Cal.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 6
Apr. 2	New York, N. Y.	Jan. 23
Apr. 2	Duluth, Minn.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 20
Apr. 4	Seattle, Wash.	Mar. 13
Apr. 7	Ordway, Colo.	Mar. 20
Apr. 10	Newaygo, Mich.	Feb. 6
Apr. 15	Newark, N. J.	Feb. 6
Apr. 22	Bovey, Minn.	Mar. 20
May 1	Wakefield, Minn.	Mar. 20

FEDERAL GOVERNMENT WORK

Mar. 24	Dredging — Wilmington, Del.	Feb. 27
	Adv. Feb. 27 to Mar. 20.	
Mar. 24	Valve Operating Machinery—Wheeling, W. Va.	Mar. 6
	Adv. Feb. 27 to Mar. 20.	
Mar. 24	Boatshead—Spec. 3472—Pensacola, Fla.	Mar. 6
Mar. 24	Fuel Oil Storage Plant—Spec. 3631—Mare Island (Valleyjo P. O.), Cal.	Mar. 13
Mar. 24	Cranes—Spec. 3822—Boston, Mass.	Mar. 13
Mar. 24	Forced and Induced Draft Fans—Spec. 3793—Norfolk, Va.	Mar. 13
Mar. 24	Incinerator—Spec. 3790—Indian Head, Md.	Mar. 13
Mar. 24	Extension to Fresh Water System—Spec. 3805—Pensacola, Fla.	Mar. 13
Mar. 24	Forced and Induced Draft Fans—Spec. 3793—Philadelphia, Pa.	Mar. 13
Mar. 24	Water Tanks—Spec. 3826—Newport, R. I.	Mar. 20
Mar. 24	Swimming Pools—Washington, D. C.	Mar. 20
	Adv. Mar. 20.	
Mar. 25	Remodeling Post Office, etc.—Providence, R. I.	Feb. 27
Mar. 26	Drainage—St. Louis, Mo.	Mar. 6
	Adv Feb. 27 to Mar. 20.	
Mar. 26	Post Office — Youngstown, O.	Mar. 13
Mar. 26	Alterations — Meridian, Miss.	Mar. 20
Mar. 26	Grading — Washington, D. C.	Mar. 13
	Adv. Mar. 13.	
Mar. 27	Barracks — West Point, N. Y.	Mar. 6
	Adv. Mar. 6 to Mar. 20.	
Mar. 27	Post Office and Custom House, Albany, N. Y.	Mar. 13
Mar. 29	Lock and Abutment-Greenup, Ky.	Mar. 6
	Adv. Feb. 27 to Mar. 20.	
Mar. 31	Coal—Memphis, Tenn.	Feb. 27
	Adv. Mar. 6 and Mar. 20.	
Mar. 31	Dredging—Wilmington, Del.	Mar. 6
	Adv. Mar. 6 to Mar. 20.	
Mar. 31	Power Plant Improvements—Spec. 3389 — Pensacola, Fla.	Mar. 13
	Adv. Mar. 13.	
Mar. 31	Boathouse—Spec. 3786—Newport, R. I.	Mar. 20
Mar. 31	Dredging—Spec. 3597—Ft. Lafayette, N. Y.	Mar. 20
Mar. 31	Quay Wall, etc. — Spec. 3726—Newport, R. I.	Mar. 20
Mar. 31	Cranes — Spec. 3794 — Alexandria, Va.	Mar. 20
Apr. 1	Cement—Conneaut Harbor, O.	Mar. 13
Apr. 2	Post Office—Honey Grove, Tex.	Mar. 6
Apr. 2	Sewer and Water Supply—Stapleton, N. Y.	Mar. 13
Apr. 4	Post Office—Eldorado, Kan.	Mar. 6
Apr. 4	Bear Trap Leaves—Cincinnati, O.	Mar. 6
	Adv. Mar. 6 to Mar. 20.	
Apr. 5	Pass, Weir, etc. — Wheeling, W. Va.	Mar. 20
	Adv. Mar. 13 and 20.	
Apr. 7	Timber Wharf — Spec. 3801—Chelsea, Mass.	Mar. 20

Bids Close		See Eng. News-Record
Apr. 7	Roads — Spec. 3796 — Chelsea, Mass.	Mar. 20
Apr. 15	Pumps, etc.—Omaha, Neb.	Mar. 6
	Adv. Feb. 27 and Mar. 6	
Apr. 18	Post Office—Mt. Pleasant, Mich.	Mar. 13
Apr. 21	Post Office — Rhinelander, Wis.	Mar. 13
Apr. 23	Post Office—Gilmer, Tex.	Mar. 13

MISCELLANEOUS

Mar. 23	Structural Steel — New York, N. Y.	Mar. 20
Mar. 24	Gasoline and Kerosene — New York, N. Y.	Mar. 20
Mar. 25	Foundation — Philadelphia, Pa.	Mar. 13
Mar. 25	Air Compressor — Marion, Ind.	Mar. 13
	Adv. Mar. 13 and 20.	
Mar. 25	Paving Material—Detroit, Mich.	Mar. 20
Mar. 25	Ballast—New York, N. Y.	Mar. 20
Mar. 26	Truck and Miscellaneous Supplies — Schenectady, N. Y.	Mar. 20
Mar. 27	Pier—Philadelphia, Pa.	Mar. 13
	Adv. Mar. 13 and 20.	
Mar. 27	Rebuilding Crib Bulkhead—New York, N. Y.	Mar. 20
Mar. 31	Boardwalk—Seaside, N. J.	Mar. 13
Apr. 8	Road Materials—Columbus, O.	Mar. 20
	Adv. Mar. 13 and 20.	

STREETS AND ROADS

Mar. 21	Rhode Island	Mar. 13
	Adv. Mar. 13.	
Mar. 24	Rugby, N. D.	Mar. 6
Mar. 24	Stony Creek, Pa.	Mar. 20
Mar. 24	Grafton, N. D.	Mar. 20
Mar. 24	Beaumont, Tex.	Mar. 6
Mar. 24	New Haven, Conn.	Mar. 20
Mar. 24	New York, N. Y.	Mar. 20
Mar. 25	Buffalo, N. Y.	Mar. 20
Mar. 25	North Bergen, N. J.	Mar. 20
Mar. 25	Kearney, N. J.	Mar. 20
Mar. 25	New Essington, Pa.	Mar. 20
Mar. 25	Massachusetts	Mar. 20
Mar. 25	Salt Lake City, Utah	Mar. 20
Mar. 25	Bottineau, N. D.	Mar. 6
Mar. 25	Mt. Olive, N. C.	Mar. 13
	Adv. Mar. 6 and 13.	
Mar. 25	Pillsburg, Pa.	Mar. 13
Mar. 25	Youngstown, O.	Mar. 20
Mar. 25	Wheaton, Minn.	Mar. 20
Mar. 26	Baltimore, Md.	Mar. 20
Mar. 26	Fairmont, W. Va.	Mar. 6
	Adv. Mar. 6 to Mar. 20.	
Mar. 26	Delaware, N. J.	Mar. 6
Mar. 27	Danville, Ill.	Mar. 20
Mar. 27	Michigan	Mar. 13
Mar. 27	Devils Lake, N. D.	Mar. 6
Mar. 27	Center City, Minn.	Mar. 6
Mar. 27	New York, N. Y.	Mar. 13
Mar. 28	Wheaton, Ill.	Mar. 20
Mar. 28	Buffalo, N. Y.	Mar. 20
Mar. 28	New York, N. Y.	Mar. 20
Mar. 28	Toledo, O.	Mar. 20
Mar. 28	Ohio	Mar. 20
Mar. 28	Anoka, Minn.	Mar. 13
Mar. 28	Dayton, O.	Mar. 6
Mar. 28	Pennsylvania	Mar. 6
	Adv. Mar. 6 to Mar. 20	
Mar. 31	Lockport, N. Y.	Feb. 6
Mar. 31	Ottawa, Ont.	Feb. 27
Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Mar. 31	Youngstown, O.	Mar. 20
Apr. 1	Raleigh, N. C.	Mar. 20
Apr. 1	Salt Lake City, Utah	Mar. 20
Apr. 1	Billings, Mont	Mar. 20
Apr. 1	Kansas City, Mo.	Mar. 20
Apr. 2	Gold Beach, Ore.	Mar. 13
Apr. 2	Michigan	Mar. 13
Apr. 2	Santa Ana, Cal.	Mar. 13
Apr. 2	Boston, Mass.	Mar. 20
Apr. 2	Durham, N. C.	Mar. 20
Apr. 2	Bamberg, S. C.	Mar. 20

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A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 82 — NEW YORK, THURSDAY, MARCH 27, 1919 — Number 13

Time Economy in the Use of Society Lists

THE latest issue of the *Proceedings* of the American Society of Civil Engineers carries the information that the Publication Committee recommended to the Board of Direction, as a measure of economy, the omission of the alphabetical and deceased-members lists from the forthcoming "List of Members." If the society wants (1) to save money, (2) to economize in the time of its members, (3) to cease the absurdity of publishing a directory of the directory, it will eliminate the present alphabetical direct-you-to-the-proper-page-to-find-the-address list and consolidate the names of all members, no matter what the grade, into a single list. The national mechanical and electrical societies have long since done it. It is a time-saver. One search gives all of the information, instead of the two searches required now.

Criticism of Bureau of Public Roads Unfounded

RECENTLY criticism has been heard that the Bureau of Public Roads has been delaying the states in their Federal-aid work, the delay being attributed to the failure to appoint a new director. To ascertain the facts, *Engineering News-Record* sent telegrams to 10 state highway engineers, well distributed geographically. The answers are unanimous that there has been no delay. In fact, some of them indicate that there has been improvement. However, some of the officials feel that injury to the organization and work will result if the appointment of a director is unduly delayed. In this feeling all will concur. The sooner the new director takes office, the better it will be for the road-building interests of the country. Disorganization is bound to follow if the present uncertainty is allowed to persist much longer.

A Fair Day's Pay for a Fair Day's Work

IN THIS issue will be found a brief article, by J. B. Lippincott, which goes to the heart of one of the critical situations of the day—that of wages. Mr. Lippincott shows that on a certain operation excellent results were accomplished in an endeavor to persuade the men that, in order to maintain the war wage-scale, they had to give an adequate day's work. The closing down of the operation prevented carrying the work to a very much higher stage of efficiency, but the incident is sufficient to indicate both to employee and manager that the way out of present wage controversies is for the one to guarantee a fair day's work and the other to guarantee a fair day's pay. The disposition among employers, so far as we have been able to ascertain, is to maintain the present rate of wages, asking in return either pre-war efficiency or an efficiency readily attainable by the average worker. If the worker will see the need of fair production and will be guaranteed a good wage for it, many of our industrial difficulties will be quickly cured.

First Big, Worth-While Step In Compensation Efforts

LAST week's conference on salaries of engineers in railroad service, held under the auspices of the American Association of Engineers, marks the first big, worth-while step in the long discussion on compensation. Various societies have standardized the fees of consulting engineers, and here and there have even suggested the proper rates for employed engineers. For the first time, though, a nationally representative meeting of engineers has proposed a schedule of salaries for a large section of the profession. Furthermore, they propose to get action, to press home to the Railroad Administration the fairness of the approved schedule. The action at Chicago is certain to have a stimulating effect on the whole compensation discussion. It will give it definiteness. There is now a norm to which discussion can be referred. The men who did the work of the conference and the society, the American Association of Engineers, which arranged it, deserve great credit for their accomplishment. Every engineer will be with them in their future steps with the adopted schedule.

Resort to Primitive Tools Often Wise Plant Selection

SELECTION of a hand derrick instead of a more modern hoisting machine to place the considerable volume of stone required to repair the masonry dam described in *Engineering News-Record* of Mar. 13, 1919, p. 517, demonstrates a more alert perception of the art of plant selection than is apparent in many construction operations. With the multiplicity of highly perfected power tools, the constructor falls very easily into the habit of regarding the choice of a less modern tool as a violation of good practice. Instead, as was the case in the dam work at Willimantic, the truly scientific procedure often is to revert to a primitive tool. The installation of a power derrick on this work, however efficient it may be by itself, would have been an error in plant selection. The speed and output of the power derrick could not have been utilized, while the cost of getting the heavier plant onto the work and of keeping it supplied with fuel might easily have increased the cost per unit of output to a figure which would show no economy, compared with the use of a hand derrick. It is as easy to over-plant a construction operation as it is to fail to provide sufficient equipment. The resultant lack of economy is often quite as great.

A Forward-Looking Railway Convention

IN ITS record-breaking meeting at Chicago last week the railway engineering profession made full response to the call of the times. Coming after the stress and confusion of war railroading, the inspiring energy and hopefulness evident at the meeting gave unmistakable promise of a broadening and deepening of technical work in the railway field. Yet even during the war research was active in the solution of transportation problems. The notable studies of rail quality recorded on another page open the first definite prospect of distinct advance in this subject that has appeared in years. Remarkable work, too, was done in the study of bridge specifications, a foundation stone of structural safety. The greatest achievement of the past year, however, was the liberalization of thought among railway engineers of which the meeting gave repeated evidence. With new views on the engineer's relation to labor, and a coöperative spirit forming with regard to the manufacturers who aid in developing railway materials and methods, a basis is given for progress greater than that of any prior period.

Conference on Federal Public Works Department

A NATIONAL convention of engineers representing every branch of the profession, made up of delegates chosen by all classes of engineering societies, local and state societies as well as national, has been called by the Engineering Council to assemble at Chicago Apr. 23-25 to discuss the proposed Federal department of public works. Never before has it been attempted to bring the influence of the entire engineering profession to bear on a great project for public welfare. In fact, no such convention representing all branches of the engineering profession has ever been laid. The nearest approach to it was a convention held in Cleveland 33 years ago, or Mar. 31, 1886, when delegates from 23 local societies of civil engineers met to organize to further the project, then as now a matter of deep interest to engineers, for a national department of public works. It is not strange that the movement of that day failed of success. The total membership of all the 23 engineering societies which joined in that Cleveland convention 33 years ago was less than the number of members in any one of many of the representative local engineering societies of today, to say nothing of the huge roll of members in the national societies. More than 50,000 engineers will probably be represented at the Chicago convention. If the united influence of this great body of engineers can be put behind a well worked out plan for a Federal department of public works, at this time when the public is demanding greater efficiency in Governmental business, there is good hope for success.

Simple Tests Disclose Trade Skill

MANAGERS of the "practical" school as a rule believe that the engineer's methods of analysis fail when the problem of appraising applicants for work is up for solution. The work of a few pioneers in recent years has gone far to discredit this belief. Unfortunately, this work is not generally known. Even engineers do not know it well. And, because in all problems of human relations there is a residuum which does not break down under analysis, even some engineers have dismissed the problem as unsolvable by engineering methods. It is these conditions which lend special interest as well as value to the experience of the personnel organization of our new Army in appraising the trade skill of thousands of recruits. The general method of conducting trade-skill tests for Army workers were outlined on page 554 of last week's issue. The simplicity of the operation is exceeded only by the conclusiveness of the results obtained. The Army experience has demonstrated other facts of equal importance to construction and to industry generally. Trade-skill tests are expensive neither in time consumed nor in equipment required, nor in the cost of skilled direction. They operate as well in selecting men for the industries as in selecting men for warfare. They involve no previously unknown methods. War experience here, as in a score of other directions, has rendered a service to business.

Discussion for the Guidance of the Development Committee

SEVERAL members of the Development Committee of the American Society of Civil Engineers have recently expressed their disappointment at not having received from the members suggestions regarding the conduct and desirable activities of the society. Some local sections have given expression to views on certain topics, but on the whole the membership has remained inarticulate. Naturally, the Development Committee needs to have the best thought of the whole membership. Individual opinion, however, is not likely to be freely offered until the committee takes the initiative by presenting something concrete for discussion. It need not be the conclusion of the majority. In fact, alternative plans will be as effective in stimulating discussion as would a single plan more or less matured.

But while individual expression of views may not be readily forthcoming, there is another means—through studies and reports of local association of members—of learning what a large part of the membership desires. The Philadelphia and Pittsburgh groups have already pointed the way. Both have organized section development committees, which, in turn, have been divided into subcommittees paralleling those of the Development Committee itself. These local development committees have already sent to their respective associations reports that have had intelligent and eager discussion. At Philadelphia the report has been circulated confidentially to the members, in order that they may give it close study and be prepared to discuss it with greater thoroughness at the April meeting.

In both cases the local associations' representatives have attended the meetings and have looked upon the work as a process of formulating the opinion of the local members for their (the representatives') guidance.

What Philadelphia and Pittsburgh have done the other local associations should proceed to do. Then, as the conclusions of each section are formulated, they should be published. They will thus not only stimulate the thinking of the other sections, but also of individuals without local-section affiliations. The resulting discussion should furnish information and suggestions that will help the parent Development Committee in the discharge of its weighty but inspiring duty.

Road Contractors Must Prepare for Dry Concrete

CONTRACTORS for concrete roadwork must be prepared to alter their construction methods. The star of dry concrete is ascendant. Convinced by the tests of Prof. D. A. Abrams, described in *Engineering News-Record* of May 2, 1918, p. 873, many road engineers are barring the use of the wet mixes of past years. Specifications already prepared for considerable mileages of concrete road to be built this year call for mixtures so dry that they must be tamped. It is known that these specifications are but forerunners of others covering the work of whole states.

This change in concrete-road practice is of direct concern to contractors. New and different equipment will be required, and greater working capital will be needed to conduct construction operations.

In these conditions there is no reason for alarm. The danger, if there is any danger, lies in ignoring them. Nor need contractors anticipate a wholesale change to the dry mix in the specifications for this year's road construction. A few specifications will call for mixtures so dry that the concrete must be heavily tamped to flush the water to the surface. Most specifications will call for only moderately stiff mixtures, or for no change until engineers are more fully convinced that the mechanical means for handling abnormally dry concrete are assured. In the end, however, contractors must look forward to the use of drier concrete for road construction, a mixture so dry that it must be compacted by tamping, and they must be prepared to change their practices to meet the conditions.

New Prospects for Improving Rail Steel

WITH the discovery in recent months of a wholly new means for investigating rail quality, a start has been made toward the acquisition of new truths whose magnitude and importance can hardly be estimated as yet. Laboratories all over the country are engaged in examining good and bad rails by etching with strong acid, and they have begun to coördinate the interior conditions disclosed by the acid with failures of rails in track service. It is nearly eight years since the transverse fissure was discovered; yet in that period hardly as much advance has been made toward locating its source as within the past few months.

An appreciation of the power of the new method of study may be obtained from the light it throws on the part played by "bad heats." During the past years of investigation not a few rail men came to believe that fissure troubles reside not in the individual rail but in the ingot or in the heat. Yet this conclusion did not impress itself on all, and further conclusions of possibly great moment were thereby forestalled. With deep etching, however, the parallelism of acid-unsoundness and transverse-fissure troubles appeared early, and further investigation showed a tendency for all or a large part of a furnace heat of steel to be unsound in the acid test. It was natural to conclude that the transverse-fissure danger affected the whole heat or the part which the acid test pointed out as suspicious. Joining this conclusion to the known fact that, in many cases, two or more rails of the same heat had failed in the track, a tentative conclusion has been established that transverse-fissure troubles must be blamed on defective quality of the heat.

Two important deductions follow: First, that if one or two breakages in service give warning against all other rails of the same heat number, possible further breakages (or accidents) may be avoided by taking out these rails at once. Second, that there is more promise in metallurgical studies of rail steel and examination of furnace and mill conditions than in study of track service.

As the facts stood until recently, the case was equally unsatisfactory for both of the opposing theories: That overstress in the track is the cause of transverse fissures and that mill defects are the cause. Against the latter stood the fact that no defects of the steel could be discovered by any known method of examination, as well as the fact that the breaks develop on the gage side of the rail, where the service is most severe. On the other hand, the stress theory was confronted by the unanswerable objection that out of many like rails in a given stretch of track only very few developed transverse fissures. Moreover, light rails often survived where an adjacent rail of heavier section broke—though its stresses were lower; under the stress theory it should not have broken. Furthermore, a rail that had one transverse fissure often, or usually, contained several, and sometimes many, and it seemed undeniable that the material itself, the rail, was defective.

Today it appears clearly established that the stress action—that is, the production of a progressive or detail fracture—does not begin until a steel defect gives it a starting-point. The search is narrowed down to the nature of the defect that causes a star-shaped break, or a "gray spot," or a transverse fissure. Does nonhomogeneity of the metal, whether visible under the microscope or not, cause the trouble? Are there cracks in the steel, little discontinuities that never were welded up firmly, and that the acid seeks out and enlarges into sawcut-like gashes? Such questions are likely to be answered soon during the inquiry into what material dissolves out of the gashes made by the acid.

Doubtless, the defects revealed by the acid go back to an early stage in the rolling. Dr. P. H. Dudley's statistical demonstration that rails rolled from reheated blooms do not break seems to make this fact certain. Reheating allows the alloying elements of the steel to diffuse. It also, perhaps, furnishes heat enough for the welding up of cracks that developed in the ingot or during the blooming. But the latter probability is less attractive, in the light of the fact that direct-rolled rails often break; time of heating seems to be the factor, and this means diffusion rather than welding.

So close a similarity exists between the transverse-fissure trouble of rails and the "snowflake" trouble of nickel-steel gun forgings discussed at the American Institute of Mining Engineers' convention a month ago, that the tendency to look for identical causes is but natural. The rail question, however, is more easily solved, perhaps, as an independent study. In discussing snowflakes, in our issue of Feb. 27, 1919, p. 408, we spoke of the essential unity of steel study. It is more probable, however, that rail study will throw light on snowflakes than that the converse should happen. The new acid-etching process gives immediate promise of advance in our knowledge of rail quality.

Cost of Camp Utility Operation by the Construction Division of Our Army

Roads, Buildings, Fire Protection, Electric Service, Heating, Water-Supply, Sewerage and Sewage Treatment with Grease Recovery, Refrigeration and Railroad Service

By George W. Fuller
Consulting Engineer, New York City

THE history, functions, organization and major operations of the Construction Division of our Army were outlined by the writer in *Engineering News-Record* of Feb. 27, p. 416, and the organization set up by the Construction Division to operate and maintain the buildings and utilities at the Army camps was described by the writer in *Engineering News-Record* of Mar. 20, 1919, p. 562. Some of the operating records and costs are summarized in the present article. Efficiency in control of camp water-supply both as to quality and quantity is an outstanding feature. Among the more novel experiences is that of removal of grease from kitchen wastes in order to lessen the difficulties with floating solids and acid fermentation in the treatment tanks at the sewer outlets.

Roads—At the camps and embarkation ports alone there were during 1916 nearly 750 miles of highway. Since early August each camp and cantonment has received an appropriation of $15,000 for road maintenance. In addition to this amount, special sums of from $10,000 to $25,000 each have been alloted in the case of some camps for road reconstruction.

The original specifications call for four standard types of roads, but no single type was adopted in all camps and cantonments. The four used at the various places were bituminous macadam, asphaltic concrete, brick, and cement concrete. The main arteries of traffic were in general paved with one of these types, depending, of course, upon such factors as the availability of materials, the character of construction equipment, the nature of the soil, and the speed of construction. These roads, considering the rough usage which they received, have stood up very well, but almost constant repairs are necessary.

Buildings—Demands for roof repairs have been so great that special study was made to determine the cheapest effective method of making such repairs, taking into account the temporary character of the buildings in other than permanent Army posts. The buildings constructed since the spring of 1917 have for the most part been roofed with two-ply roofing paper. The drying out of decking naturally caused the roofing paper to buckle, in some cases to such an extent as to crack it or pull it around flashings, thus causing leaks. A good deal of damage was also caused to the roofs by walking on them for signal practice, for use as observation posts and similar activities at the camps. In co-operation with the Bureau of Standards, an economical method of roof repairing with plastic cement was adopted, and by the proper use of this material the roofs have been kept reasonably water-tight, at an annual cost of about 10c. per square. At the principal camps alone, for 1918 the average cost of maintenance and repair was $\frac{1}{24}$c. per cubic foot, while the total population housed approximated 1,000,000. On this basis the cost of maintenance and repair of buildings for the six-month period which ended with the calender year 1918 was $4.05 per capita, or $8.10 per capita per year. The total number of individual buildings which have to be maintained is nearly 55,000, with a combined volume of 1,705,625,000 cubic foot.

Fire Protection—As fire marshal, the utilities officer at each large project has organized an efficient and up-to-date fire company for the protection of buildings and stores. The general policies maintained in the design of the camps, of providing an ample number of hydrants and automobile fire trucks, and of leaving "fire breaks" and sufficient space between the individual buildings, has been well justified. At each camp the fire company has been organized at a strength of about 60 men, commanded by an officer corresponding to the municipal "fire chief," who has had experience in municipal fire department work. Similarly, the enlisted men, so far as possible, were chosen for their previous fire-fighting experience.

The fire loss per capita has been kept down to a remarkable low figure, considering the character of the construction. The total fire loss in the Army camps, with average populations of about 30,000 men during the year 1918, amounted to 46c. per capita as against the loss of $2.10 per capita throughout the whole United States. This is noteworthy in view of the fact that the standards of the National Board of Fire Underwriters designate as a low annual fire loss in municipalities one that is below $2 per capita. Thousands of fires, of course, broke out, but only four got beyond the buildings in which they originated, and in each case the camp fire department succeeded in saving a part of the building in which the fire started and a part of the single adjacent building to which it spread.

Electric Light and Power—One of the routine duties of the utilities officer in the field consists of seeing that the necessary generator capacity is actually available at the power station, that the transmission lines are af sufficient size and properly protected, that the necessary transformers and service stations meet adequately the demands, and that the electric energy is properly distributed where it is needed. The secondary distribution circuit, including street lighting, service entrances to buildings, all interior wiring in buildings, together with supplying and maintaining the electric power equipment of the pumping stations, refrigeration plants, laundries, and so on, all falls within the duties of the utilities organization. In the 32 organized camps and cantonments alone electric wiring averages about 1,000,000 ft., or 190 miles.

The average cost to the Government for electric energy has been kept down to about 2.5c. per kilowatt-hour. The cost of electric current varies according to local conditions. At Camp Lewis, Washington, with water-power generation, it costs approximately 0.9c. per kilowatt-hour, while at Camp Mills, with steam gen-

eration and under somewhat unusual conditions, it cost about 7.5c. The average per capita consumption for all camps is about 7 kw.-hr. per month.

Heating Service—In connection with the heating operations, the conservation of fuel has been of great importance. The records of the Maintenance and Repair Division show at 14 central heating plants a saving by careful operation alone of almost 50% of the estimated cost. The estimated daily average of coal required was 360 tons, while the actual consumption was 179 tons. These figures were taken from Northern camps, where the cost of the coal was \$8.21 delivered at the boiler houses, and the saving over the estimated requirements amounted to \$313,213. Something over 5,000,000 sq.ft. of cast-iron radiation are used in the camps alone. Tens of thousands of room heaters and stoves are used, and all must be kept in good order.

The amount of coal consumed in the camps reaches nearly 2,000,000 tons per year at an average cost of \$5.03 per ton delivered, or \$10.01 per capita per year. Approximately a third of the total cost consumed in all camps was used to heat buildings. For example, during the extremely cold weather of a year ago Camp Funston used 8640 tons of coal per month for heating purposes alone, and to heat the 2000-bed hospitals at Camp Dix during November, 1918, required 1271 tons.

Control of Water Supply

The average cost of purchased water-supply has been 8.16c. per 1000 gal., varying from 4c. at Camp Doniphan to 17.5c. at Camp Frémont. With an average total daily population in the larger camps of 506,882 persons, from January to October, 1918, inclusive, and a total daily consumption of 26,166,000 gal., the total daily cost amounts to \$2135 per day, or \$1.54 per capita per year for a daily average of 52 gal. per capita.

In a number of instances the Government maintains a booster station on the force mains in addition to the station at the camp or project, hence there is an additional item of expense. Although precise figures are not available it is estimated that 2½c. per 1000 gal. for boosting is approximately correct. This would make a total cost of 10.7c. per thousand gallons.

In the month of January, 1918, for example, when the peak per capita consumption was reached at the camps, one camp reported the maximum average per capita daily consumption for the month at 123 gal., while another reported the minimum average of 42 gal. The high consumption may be attributed to some extent to allowing water to keep running from the outlets to prevent freezing, and also to central heating plants without return systems. The water-supply in most cases is designed on a daily 55 gal. per capita basis at a pressure of 60 to 85 pounds.

The majority of the National Army cantonments have wood-stave pipe for their distribution mains, some 3,500,000 ft. in all having been laid in the National Army and National Guard camps. At Camp Dix there are approximately 19 miles of water main, one-third of which is cast-iron with leadite joints. There are approximately 25 miles of service pipe, ranging in size from 3 to ¾ in. and about 15,000 water fixtures.

By careful test at Camp Dix it was determined that fixture waste and legitimate use accounted for 400,000 gal. of a minimum night rate of 600,000 gal. per 24 hours. It was also determined that the filling of the railroad water tank accounted for another 100,000 gal. This leaves an unaccounted-for flow of 100,000 gal. daily, which may be attributed to underground leaks. At Camp Grant, with a total of 48,840 ft. of main and 55,900 ft. of service pipe, a careful test showed a total underground leakage of 35,588 gal. per 24 hours.

Soon after the camps and cantonments were placed in operation it became apparent that at some the water consumption in winter exceeded the 55 gal. per capita per day basis. Inasmuch as military discipline was commonly supposed to be a corrective for various shortcomings, a campaign of water conservation was undertaken through the issuing of military orders and large posters. But this did not bring about the desired result in all cases. From the very start round-head self-closing faucets were repeatedly recommended by the advisory engineer for water-supply, but for various reasons their use was not then authorized. Since last July self-closing faucets have been used on all new construction.

Attention Directed to Defective Fixtures

Investigation revealed large quantities of water being lost through careless use and defective plumbing fixtures. It was felt that efforts to control this waste would be productive of better results in less time and with less labor than to center major efforts on elimination of the usually small underground leakage.

Some of the more common methods for restricting waste included the lowering of float balls in flush tanks and the reduction of pressure by inserting, back of the faucet, rubber tubing, buttons with two thread holes, glass marbles or tapered lead plugs with small orifices. The latter were inexpensive and easily installed. Since July, 1918, water consumption at practically all camps has been kept within the established quantity.

No case of water-borne disease has so far been attributed to a water-supply installed and operated by the Construction Division.

Sewerage—The construction of 455 miles of sanitary sewers for the 16 National Army camps, approximately 300 miles for the National Guard camps, and approximately 400 miles for various special projects, was an undertaking of no small magnitude. During the 15 months the sewer systems have been in operation very few defects have developed, a rather remarkable fact considering the haste and other unusual conditions under which they were installed

Sewer sizes range from 6 to 30 in. Manholes were designed to be built as cheaply as possible, and were provided with wood covers. During the past summer most of these covers were equipped with locks to prevent the throwing of garbage or refuse into the manholes.

Every effort is made to prevent the access of surface water and the infiltration of ground water to the sewers, particularly at camps having sewage-treatment plants. Utilities officers were instructed to watch for any indication of surface water during periods of rain, and to use every effort in locating any defective sections. Investigations at a number of camps showed that in the haste of construction the manhole tops had not been made high enough and that surface water was gaining access to the system. Orders were issued that all such manhole tops should be raised.

At a few camps trouble was experienced with sand, which found its way into the system through such low manholes as are mentioned above and partly filled the first compartments of the settling tanks. In one or two

instances the trouble was due to defective sections of sewer which had to be relaid. In the few instances where clogging of sewers has been reported, grease has usually been the cause.

Grease—One of the most interesting developments in connection with sewerage at Army camps has been the importance of intercepting grease from kitchens. This subject, up to the time the camp sewage-works were put into operation, had been practically overlooked.

The typical plans at first adopted in connection with sewerage systems at camps provided that an 18-in. tile grease trap should be installed on each kitchen line.

The flow from kitchens comes in sudden gushes. Experiments conducted at Fort Myer by the Sanitary Corps showed that the average flow per capita per day from the kitchens was 2.4 gal. A maximum rate of flow of 1.5 to 2 gal. per capita per hour was observed. However, these sudden gushes cover short periods varying from 5 to 15 min. During a 10-min. interval, therefore, the flow from a kitchen serving 200 men on the basis of the above figures would be from 50 to 67 gallons.

A trap is required of sufficient capacity to take care of these sudden surges, to allow for some cooling of the liquid in passing through the trap, and to permit the accumulation of grease during the period of a week without any great reduction in the capacity of the trap. The tile traps were entirely too small to take care of the peak flows. At such times grease which accumulated in the trap was partly washed out through the outlet. The shape of the trap also has a great deal to do with its efficiency. For instance, the outlet must be so arranged as to prevent as far as possible accumulation of organic matter in the bottom. Traps of the new type installed at the various camps (see sketch) had capacities ranging from $\frac{1}{4}$ to $\frac{3}{4}$ gal. per capita, based on the number of men served in the kitchen. The early records of quantities of grease recovered indicate that a capacity of $\frac{2}{3}$ gal. per capita for the latest type of trap is perhaps sufficient. Such a trap requires cleaning weekly.

Camp data from various sources during last autumn show that the quantity of grease recovered per capita per year is about 10 to 12 lb., and the market value of this grease at the present time is about 10c. a pound, or in round numbers, $1 per capita per year. The population of all the principal camps during the past summer was about 1,000,000 men. If all the kitchens had been provided with traps the total potential income per day, on the basis of the above figures, would have been $2750, equivalent to $1,000,000 per year. Thus, the installation of grease traps, instead of being an item of expense, should be a source of profit. However, the money returned is in reality a secondary consideration in comparison with the needs of these traps for protecting the sewer lines and preventing grease from interfering with the proper functions of tanks at the treatment works. Grease trap skimmings contain some water and impurities and will apparently yield about 65 to 70% of grease.

Cold weather promotes the separation of grease, as shown by records from grease traps of various capacities during a period beginning about the middle of November last, as follows:

CAMP MERRITT

Capacity Gals. per Capita	Number of Cleanings	Pounds per Capita per —ea
0.30	3	17.9
0.50	7	7.2
0.60	82	16.1
0.70	22	7.4
0.80	9	11.8
0.90	3	11.1
1.00	12	27.3
2.00	2	77.7
3 00	16	100.1
	156	

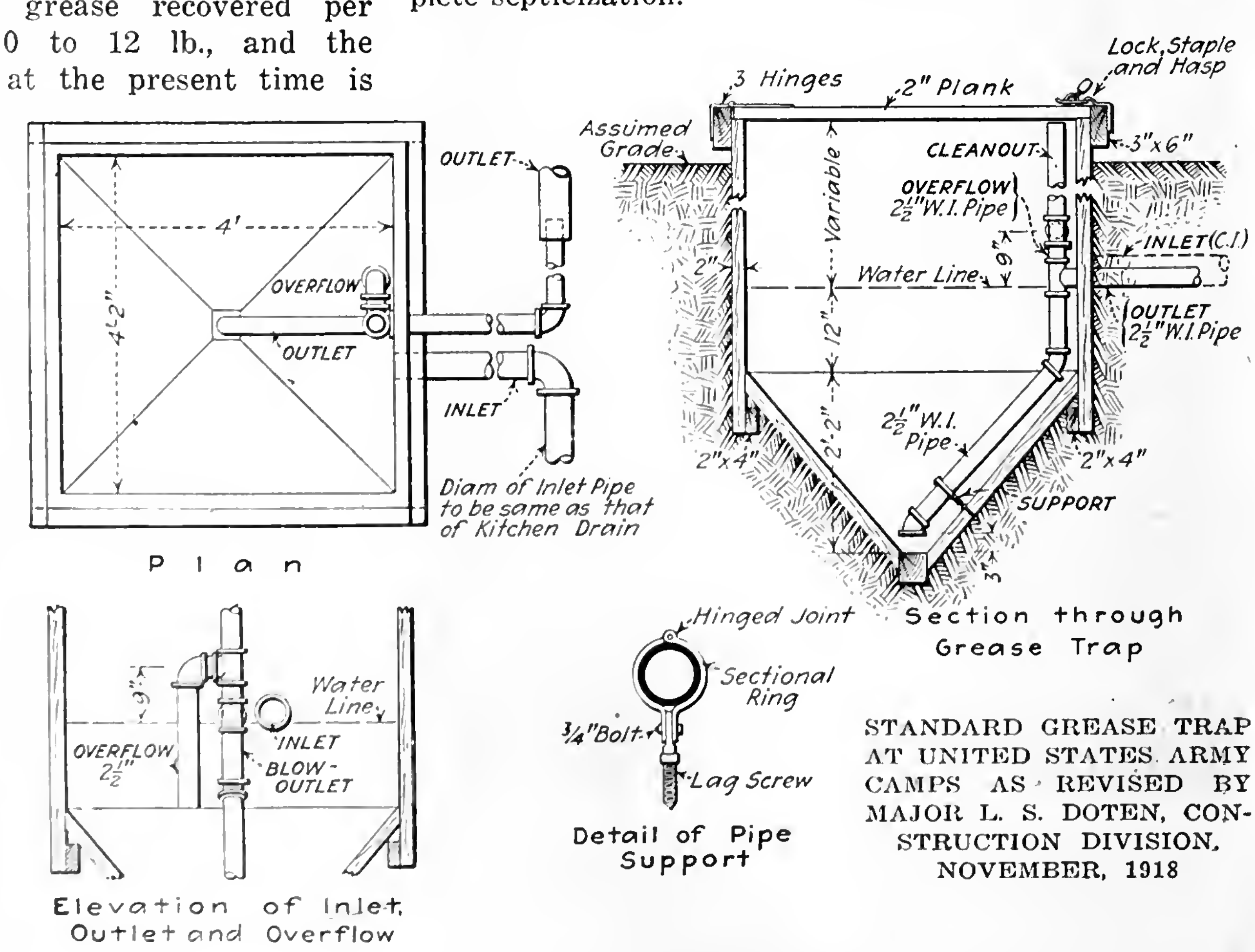
CAMP MEADE

0–0.5	2	11.7
0.5–1.25	143	18.8
1.25–2.00	68	23.2
2.00–3.00	27	69.7
3 00–4.00	25	65.7

The capacities refer to persons served in the kitchen, to the drain of which the trap is attached. These data show advantages in still larger traps than were installed last summer. At some institutions a trap of 2.5 gal. per capita is favored. More data, especially in regard to summer conditions, are needed.

Tank Treatment of Sewage—Chlorination has been generally practiced at the outlet of the camp sewers, but tankage is the feature most worthy of comment in this article. Briefly, the tanks were unusually small in size, about 10 gal. per capita connected with the sewers. At some plants, as at Fort Myer, Camp Sherman and Camp Custer, septicization became established more quickly and completely than at other camps.

At all plants the freshness of the sewage and the unusual grease content made the sewage solids in the tanks float to a large extent, as compared with the sedimentation more generally noted at city plants. The grease, furthermore, seemed to promote acid fermentation, which generally interfered with prompt and complete septicization.



STANDARD GREASE TRAP AT UNITED STATES ARMY CAMPS AS REVISED BY MAJOR L. S. DOTEN, CONSTRUCTION DIVISION, NOVEMBER, 1918

Absence of funds retarded the program in the spring and early summer of 1918, but solids were removed promptly and carefully, beginning in July. The small tanks have much to be said in their behalf in connection with an efficient operating schedule and adequate grease removal arrangements. Larger tanks (35 gal. per capita) were ordered installed at some of the camps, especially those whose capacity was generally enlarged.

Refrigeration—Data indicate that it costs about $2 per capita per year to operate camp refrigeration plants. These plants comprised a meat-storage room and an ice factory.

Railroad Maintenance—There are 844 miles of railroad at the camps, terminals, depots, etc. Averages of maintenance records show costs of about $1400 per mile per year.

Concrete Consistency Measured by New Device

Method Developed for Concrete-Ship Work Determines Amount of Water to Use in Field Operations

By Herbert A. Davis

Engineer, Concrete Ship Section, Emergency Fleet Corporation

DEVICES to determine the proper consistencies of concrete have been put forward from time to time, but, so far as the writer has noted, none has been put into practical use. In the concrete ships now under construction by the Emergency Fleet Corporation, however, a field instrument has been developed that has proved quite satisfactory.

Soon after its inception the Concrete Ship Section of the Emergency Fleet Corporation recognized that the concrete to be used in the construction of concrete vessels must be of a high quality and special character, due to the relatively thin concrete sections, high steel areas and high working stresses employed for the purpose of reducing the weight of such ships to a safe minimum. Furthermore, it was seen that the concrete for such construction must not only have sufficient strength to meet the high stresses it is called upon to carry, but such concrete must be sufficiently mobile or workable properly to fill the forms and completely embed the reinforcement, with reasonable care and workmanship.

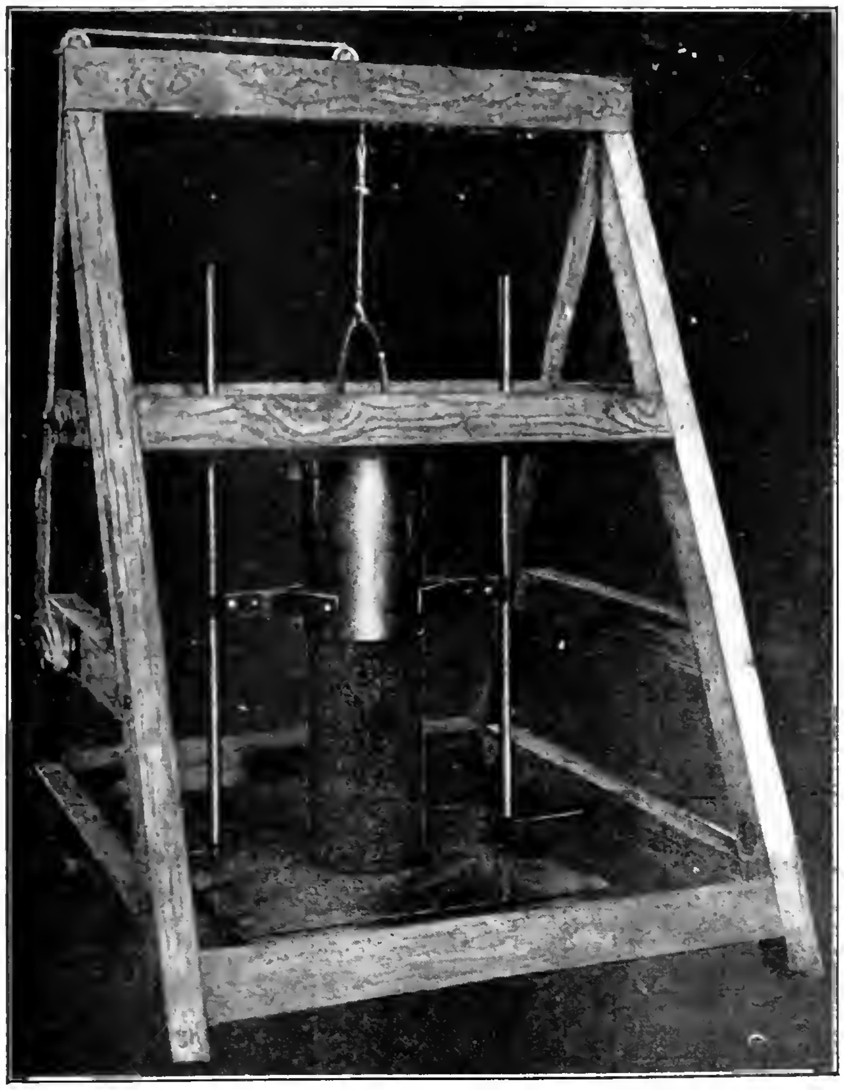


FIG. 1. CONCRETE WHICH DOES NOT DROP IN THE TEST IS TOO DRY FOR PRACTICAL USE

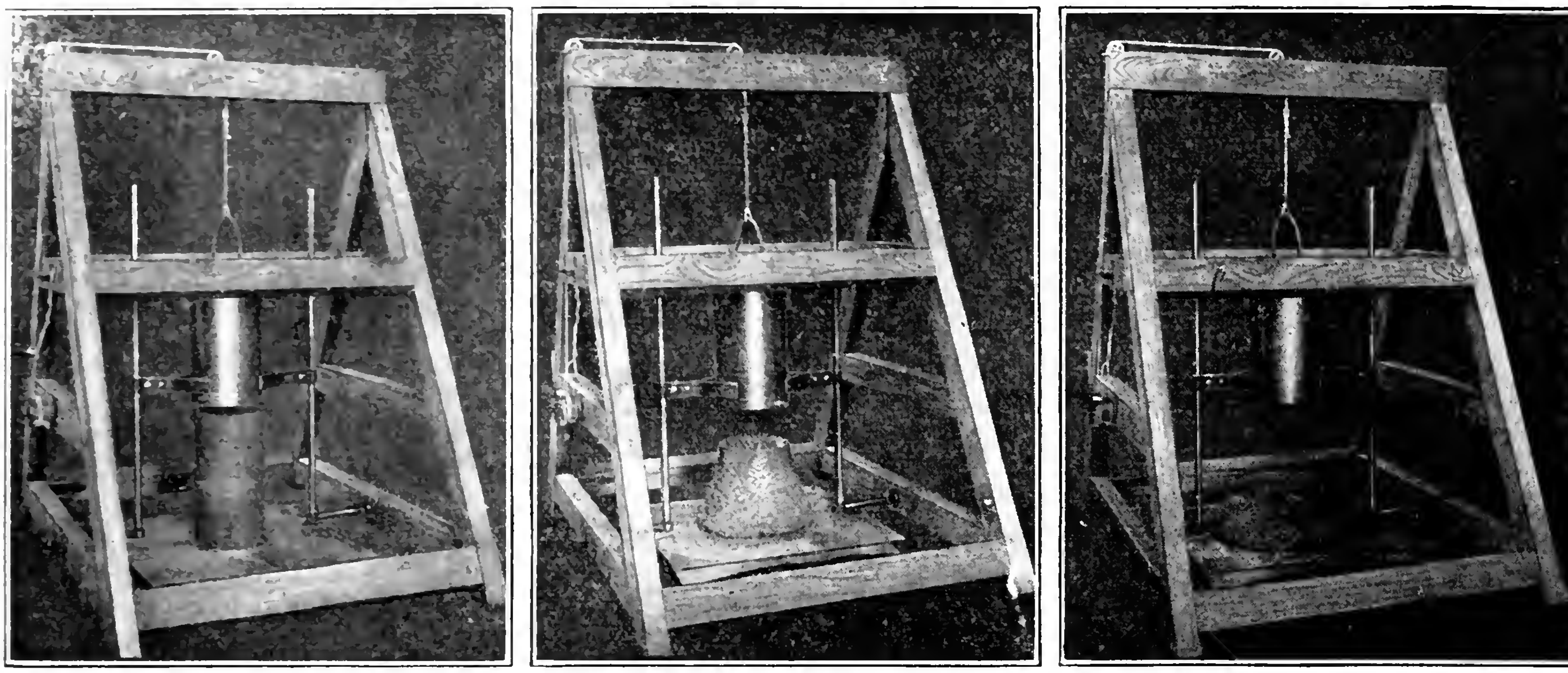
With these factors in mind experiments were made in the laboratory on a large number of materials as aggregates, used in different proportions and with varying amounts of water—that is, with different consistencies. From such studies the aggregates and proportions to be used in concrete-ship construction at various places were established, and data as to the effect of varying the water content of such concretes over a reasonably large range were obtained.

Assuming that all the concrete materials as delivered on the work are inspected to guarantee their quality and uniformity, and that steps are taken to insure the proper proportioning and mixing of the concrete, there still remains the need of a reliable means of regulating the amount of water which the laboratory studies indicated was required to produce a concrete of the strength and workability desired. In the field it has been noted that where the operator judges the consistency of the concrete by means of the eye, such concrete is far from uniform in most cases, and there is a general tendency to use an excess of water far beyond that necessary to give the desired mobility. Furthermore, it has been observed that the judgment of different operators, depending on the superficial appearance of the concrete, as to what is the desired consistency will vary widely.

In an effort to meet this obvious need of a reliable criterion for determining the proper consistency of concrete, the apparatus described has been developed. This consistency apparatus consists essentially of a metal cylinder whose inside surface is perfectly smooth, mounted on metal slides that direct the movement of the cylinder so as to be truly vertical, and this cylinder rests on a smooth glass plate supported horizontally and independent of the supports of the cylinder.

To operate this apparatus, the cylinder resting on the glass plate is filled as a mold with the concrete, the top surface is struck off level and the metal cylinder is slowly raised, leaving the concrete unsupported. It was found that this unsupported concrete took various shapes, dependent on the amount of water used in gaging the concrete. Furthermore, over a considerable range it was noted that the loss in height of the concrete cylinder on removal of the metal cylinder bore a definite relation to the amount of water used in gaging the concrete.

In the original experiments both the loss in height



FIGS. 2 TO 4. CONCRETE CONSISTENCIES SHOWN IN NEW TEST MACHINE

Fig. 2. While probably giving the maximum strength, can only be used in plain concrete work, such as sidewalks, concrete roads, and in large mass work. Fig. 3. Can be successfully used in practically all ordinary reinforced-concrete work, with excellent results. Fig. 4. Suitable for use in concrete-ship construction where it can be placed with reasonable care in spite of the thin concrete section and high steel areas employed in the design of such vessels

of the cylinder and the diameter of the base when left unsupported were measured, but it was found that the loss in height was a much more reliable criterion for determining the amount of water used. The measurements taken of the diameter were somewhat irregular, but in all cases, where care was taken to produce a symmetrically shaped figure, the diameter of the resulting cone was fairly reliable as a measure of consistency

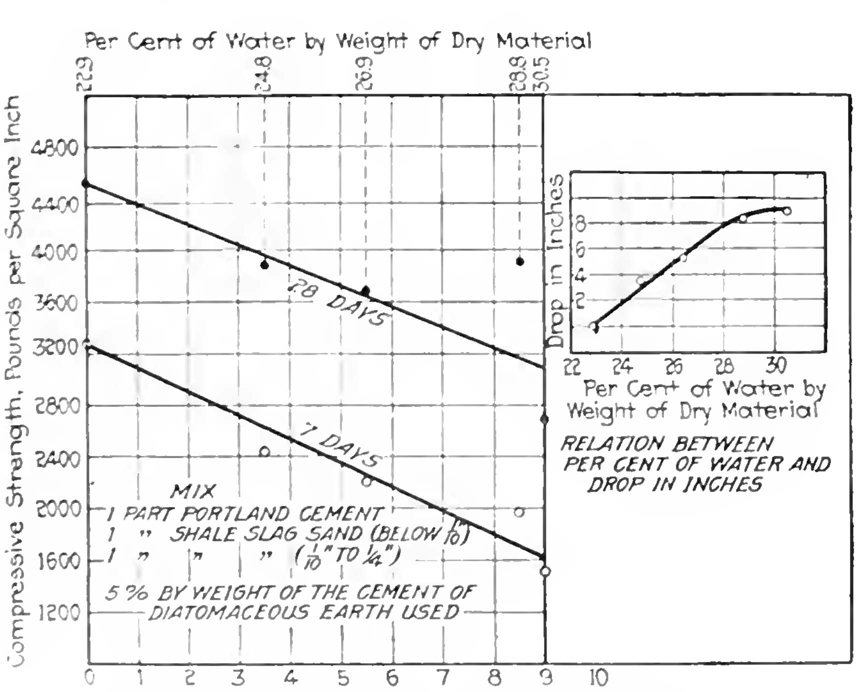
Typical curves, showing the relation between compressive strength, the amount of water used and the loss in height of the unsupported concrete cylinder, as determined by this apparatus for two different concretes, are given.

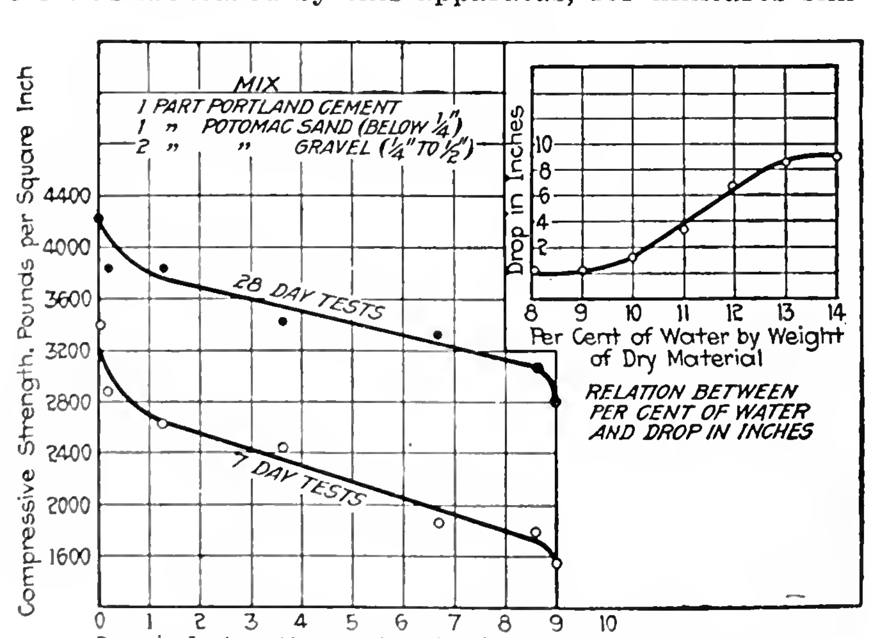
It should be recognized that the aggregates as stored on the work have varying moisture contents, which would materially modify the amount of water needed to produce a given consistency in the field, and further experience has shown that even with mixers equipped with water-measuring devices it is difficult to obtain the same amount of water in each batch. For these reasons it was deemed necessary to measure the consistency of resulting concrete with the "consistency machine" to determine the actual amount of water in the concrete, and to decide, from previously made laboratory studies of such concrete, whether the amount of water used was in excess of that necessary to give the required strength.

Practically, this means that in the field the loss in height of the concrete cylinder as measured by the "consistency machine" should not exceed a given maximum percentage of its original height.

In fixing a maximum limit of drop permissible for the consistency of concrete in the field, the general tendency of contractors to use an excess, rather than too little water, was in mind. It is believed, furthermore, that a certain amount of freedom should be permitted the contractor in this matter of consistency, provided he does not produce a concrete that is too wet. Accordingly, in the field work the effort was made to secure a concrete in which the drop was approximately 75% of the original height of the cylinder—that is, nine inches.

The consistency of the concrete which has a drop of 9 in. as measured by this apparatus, for mixtures sim-





FIGS. 5 AND 6. EFFECT OF WATER ON CONCRETE CONSISTENCY AND DROP AS SHOWN IN TESTING MACHINE

ilar to those used in the construction of concrete ships, may be described as semi-fluid or very mushy.

This method of controlling the amount of water used in the concrete has been tried out on practically all the ships or barges constructed to date, and it may be said to have accomplished with a reasonable amount of success the purpose for which it was designed, as attested by the results of tests made on the concrete cylinders taken from the work. This was accomplished with little or no interference with the work, and in general the consistency of concrete as regulated in this manner satisfied both the contractor and the Government representatives.

The author wishes to express his appreciation to G. V. Marconi and Watson Davis, of the Bureau of Standards, for assistance given in obtaining some of the data published in this article.

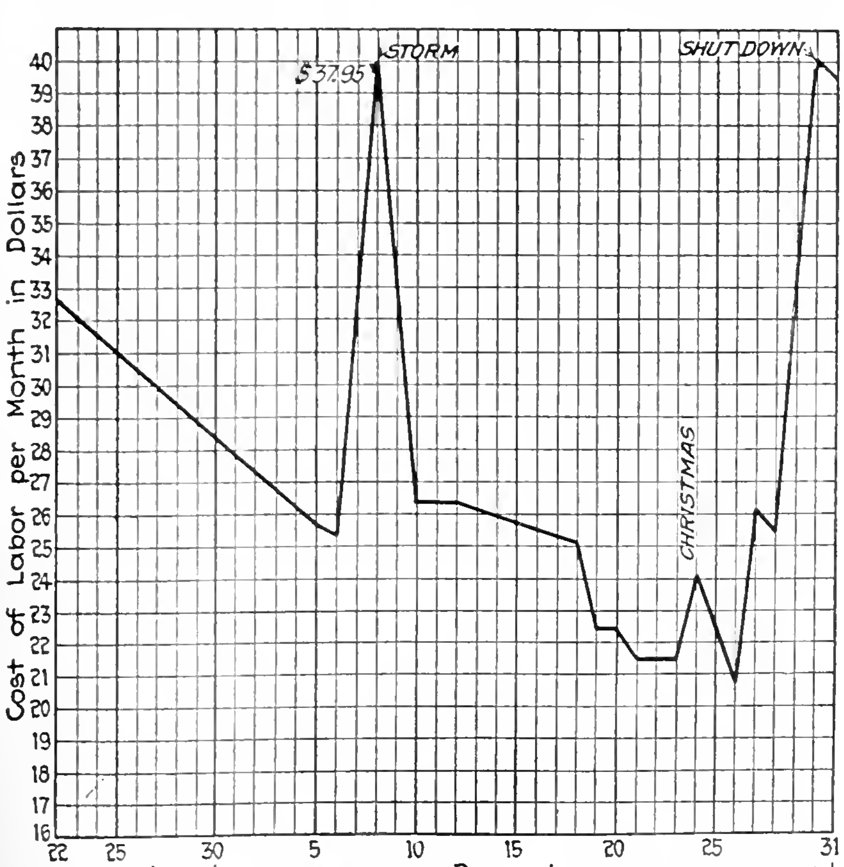
Unit Costs Lowered Without Cutting Wages

By J. B. Lippincott

Consulting Engineer, Los Angeles, (recently engaged in war work in the East)

During the war, high unit costs of construction have been due to the low output per man-day rather than to high wages, though the latter is, of course, a factor. Whether the bricklayer is paid 65c. or 85c. per hour is less important than that he has reduced his output from 1000 to 300 bricks per day. The experience here related and illustrated in the diagram shows strikingly the effect of increasing output, for the wages were not changed.

The incident is all the more important because the present inactivity holds grave possibilities, a fact realized by the Government, financiers and others. Labor is organized because it has to be for its own existence. It has taken advantage of its opportunity during the war to advance its rate of pay. I believe from personal contact with the unions that the skilled trades will not reduce that scale. The wage of common labor probably will go down, as it is not organized. However, *it is more important that wages be stable than that they be lower.* As compared with war conditions, overtime, which is paid at the rate of time and a half or double time, has been eliminated. This means a substantial reduction in the average wage rate per hour. I believe mechanics will endure much and go hungry a long time before they will reduce their scale. On the other hand, it is folly for them to try now under existing conditions to ask for an increase. It should be the problem of all to work for a resumption of business and to avoid placing any obstructions in the way.



COST OF BRICKWORK JOB ON ATLANTIC SEABOARD, NOVEMBER AND DECEMBER, 1918

The diagram shows the decrease in the labor cost of laying brick at a point in eastern Pennsylvania, following the signing of the armistice. The wage was 87½c. per hour. The writer was assigned to this work Nov. 16. The project was suspended Dec. 27; consequently, the unit costs cannot be given for a greater range of time. The costs were averaged for the week. The sharp rise Dec. 10 was due to interruption of the work by storms. That on Dec. 27 was due to the shutdown. Christmas week also shows a peak.

This diagram is fairly typical of other decreasing costs. The general decrease was brought about as follows: Overtime was eliminated as labor became more abundant. The personnel was much improved by a process of segregation. Those that remained did more work. The output per man-day was nearly doubled. The cost in November (1918) was outrageously high. It remained too high by far when the job was shut down from Washington, but there was a reduction in labor costs from \$33 to \$20 in 37 days. This reduction in cost was accomplished during a period of increasingly bad weather and in spite of much rain and bad roads. If the work could have been continued through to spring weather the reduction would probably have continued down to a reasonable unit cost. *No reduction was made in the wage.*

The union local and state officials took a keen interest in assisting in improving the unit costs. They realized that this should be done in order to encourage resumption of normal conditions. They also appreciated that if improvements were not shown by their trade other trades would supplant them—for example, that concrete buildings would supplant brick structure. In other words, the union in this case was an agent in helping to improve conditions.

This experience is a suggestion for reducing unit costs elsewhere, a move essential for the resumption of building. It is difficult to accomplish, doubtless, but probably far less so than to attempt to reduce the wage scale. Moreover, the possible results offer greater opportunity for larger cost reductions. The most effective way to reduce these costs is to adopt a piecework policy. If this is untenable, then the establishment of a reasonable day's output per man should be sought. At least in one case organized labor coöperated in this policy.

It is to labor's interest to assist in establishing efficiency so that it may not be vitally necessary to reduce the wage scale or defer starting new work.

Stream Flow Article by C. H. Pierce

The article "New England Rivers Have Similar Run-Off Characteristics," in *Engineering News-Record* of Mar. 20, 1919, p. 577, should have been accredited to C. H. Pierce, district engineer, United States Geological Survey, Boston, Mass., as author.

Railway Engineering Association Has Active Meeting

Tentative Rail Specifications Mark New Views of Quality and Tests—Rail-Joint Test Methods Adopted—Proposed Bridge Specifications to Be Reconsidered—Large Attendance and Atmosphere of Coöperation

IMPORTANT progress in technical railway matters, progress made despite unfavorable conditions, was put on record by the annual meeting of the American Railway Engineering Association at Chicago last week. In the fundamental subject of rail quality and rail testing a new field of study was opened up, and improvement of the specifications for rails to apply the new views was begun. Even more active work centered on the subject of steel bridges. A radical revision of the standard bridge specifications was worked out during the year, but the association, at its meeting, decided that it could not be accepted without full consideration, and referred the draft back to the committee for another year.

Significant of the unusual success of the meeting was the record-breaking attendance. Over 500 members were registered, a number considerably higher than at any previous meeting. In part, this is credited to the action of the Federal Railroad Administration, which, recognizing the importance of the technical studies carried on by the association, urged the various Federal managers to induce as many members as possible of the engineering organizations to attend.

The atmosphere of the meeting expressed the unusual character of present railway conditions and the exceptional importance of the railway engineering work that must be done during the next few years. President-elect Earl Stimson brought this matter to the fore in his inaugural remarks at the close of the meeting, in urging the technical committees to early and energetic attack on the problems submitted to them.

Relations to Railway Managers and to Manufacturers

New conditions will surround the association's work henceforth, due to the formation last month of the American Railroad Association as a consolidation of and successor to several executive and technical railway associations which heretofore covered the field—the American Railway Association (executives), the Master Car Builders' and Master Mechanics' Associations, and others. An engineering section of the new American Railroad Association has been created, but the Railway Engineering Association will remain independent of it, though actually furnishing the substance for the recommendations and conclusions which that section will report to the larger body.

More coöperative relations to manufacturers have also come into fairly definite prospect. President C. A. Morse, in his address to the meeting, laid special stress on the results accomplished by the committee on track, in working out new standards for frogs and switches in collaboration with manufacturers. It has been the policy of the association in the past to restrict its committee membership rather closely to railway men, in sharp distinction from the policy of the American Society for Testing Materials in balancing its committees as between producers and consumers. The spirit of President Morse's words may lead to a liberalization of the committee work in this latter direction, and some steps of the kind have already been taken by the rail committee.

An outstanding feature of the rail committee's report is a new method of studying rails for interior defects, contained in a series of reports on special investigations. The method consists of etching horizontal sections of the rail head with strong acid, hot, for several hours. It produces remarkable pitting or fissuring in certain rails, and all observations so far indicate that this pitting and the occurrence of "transverse fissures" in the rail while in track service are intimately related. Studies of defective rails by the "deep-etching" method are being made in rail laboratories all over the country at present. A brief summary of the subject is given in another column.

Among the other special-investigation reports presented by the committee are: Tests of various splice-bars (summarized on page 611), the quick-bend test by W. C. Cushing, interior transverse fissures by P. H. Dudley, and a statistical study of the service obtained with narrow-head rail (the so-called frictionless rail) on curves. This rail was found to be in use on about 25 roads, with results that are in general satisfactory, the rate of rail wear being reduced in most cases.

Besides these several matters covered by the report of the rail committee, there was discussion of the relations of wheels and rails by the track committee and on curve wear of rails by the committee on economics of railway location.

Proposed Rail Specifications Raise Quality and Provide New Test

Small but important changes in the association's specifications for steel rails, proposed by the rail committee, led to a call for coöperative work from the manufacturers' rail committee. The changes would (1) result in harder rails; (2) make more severe the criterion of acceptance of rails, and (3) establish a radically new form of test as an alternative to the time-honored drop test. The practicability of furnishing rails under existing mill practice would thus be affected, and, as stated by the manufacturers' committee, the mills have had no opportunity to consider the new test and acceptance requirements properly. In acknowledgement of this fact, a joint meeting of the two interests is to be arranged for, where differences of view may be considered and ironed out. The proposed specifications are in the meantime to be published only for consideration and discussion during the coming year. The essential changes from the present specification are the following: The required percentage of manganese in open-hearth rail of all weights is raised by 0.10%, making the limits read 0.70 to 1.00%. For the heavy weights of open-hearth rail, 111 lb. per yard and over, the required amount of carbon is raised by 0.05%, to the figures 0.67 to 0.80%. Both changes mean harder rail. At the same time, however, a higher ductility is demanded, the elongation (in drop test) being

changed from 6% to 8%. Furthermore, acceptance is made less easy by the requirement that all three drop (or bending) tests representing a given heat must pass if the heat is to be accepted.

Hitherto, the drop test has been the determinative physical test of rails. Experience on the Pennsylvania R.R., however, has developed so clearly and convincingly the value of a bending test made in a hydraulic press, that the committee adopted this test as an alternative to the drop test. The bend test is specified to be made with a 350-ton press on a 48-in. span, and autographic records of load and deflection are to be taken; the test is to be made preferably with the rail head in tension.

The specifications contain an unusual "information" clause, which states that transverse fissures have been more numerous in the product of mills that roll rails direct from the ingot than in material rolled from reheated blooms; it also states that six mills reheat the blooms and eight roll direct. The clause makes no recommendations or requirements, but contains a note stating that it is given merely as information derived from the statistics of rail failures.

Standard Specification for Tests of Rail Joints

Elaborate experimental studies of the strength of rail joints made by the Altoona laboratory of the Pennsylvania R.R. brought out so much valuable information concerning rail joints that the Rail Committee formulated a specification of test methods for rail joints, with a view to securing comparable results from tests made at different laboratories. The test is to be made in a press, the rails being supported on two supports 48 in. apart and the load applied over the joint midway of the span, measurements of deflection and set being made at 3000-lb. intervals of load. From the results of the test the efficiency of the rail joint is to be computed as the ratio of the elastic limit of the rail joint (in pounds) to the elastic limit of the continuous rail. This efficiency is to be stated both for head up and for head down. Furthermore, the rigidity of the joint is to be stated, expressed as the ratio of the deflection at the elastic limit of the joint.

By vote of the meeting this test specification was adopted, and is to be included in the "Manual."

Under the chairmanship of O. E. Selby, the committee on iron and steel structures studied and reported on several bridge subjects. By far the most important of these was the association's standard specification for steel bridges, which was first adopted in 1906 and was slightly revised several years later. Wholly new specifications were drafted by the committee.

They differ externally from the old ones in being much more elaborate as to design details and workmanship, having nearly twice as many clauses. A new train loading is specified—Class 60 in place of Class 50—but the Cooper type of engine and train is retained. The Turneaure impact formula is substituted for the old Schneider formula. Secondary stresses are taken into account. Reduction of live load on multitrack bridges is allowed. Reversed stresses are treated in a new way. A parabolic column formula is substituted for the old straight-line formula, and the limit of 12,000 lb. per square inch is fixed as the basal figure of column loading in place of the former 14,000 lb. In all parts the proposed specifications represent a wholly new departure from the old. However, they were printed so late that they did not reach the members of the association until two days before the convention, so that study with a view to adoption by the meeting was impossible. For this reason, after discussion on the floor revealed serious differences of opinion, the committee's motion that the new specifications be adopted in place of the old and printed in the "Manual" as standard was declined, and the subject was referred back for reconsideration during the coming year.

Remarkably broad discussion developed, in spite of the late printing, and points of fundamental importance to bridge design were raised. A few notes follow.

W. H. Courtenay questioned the ambiguity of the requirements as to lateral forces, wind effects being apparently omitted from an important clause. F. E. Schall asked whether the new specifications will produce weaker or stronger bridges than the old; until careful study can answer this question, they should not be made standard.

Referring to the clause reducing the live load on multitrack bridges, J. J. Yates suggested that the center girder in a 100-ft double-track bridge will be burdened with 70% impact under the new clause, as against 60% under the old. The new would increase both floor and girders, but experience shows that many floors are weak while the girders are still adequate.

A wholly new basis of design was advocated by A. C. Irwin, a member of the committee but not in agreement with its conclusions. He urged that bridges must be designed with a view to carrying the heaviest loading likely to come on them, and that designing for an artificial loading without much margin over present-day railway service makes it necessary to use low unit-stresses, the latter giving the margin necessary to provide for future load increase. An unbalanced bridge is the result, and one that is not designed for the heaviest load that may come on it. The cure for this condition is not the proposed specification, but one that will provide for the heaviest possible loading and allow the highest unit-stresses for this. With low unit-stresses there is continual trouble from the effect of the ratio of dead load to live load. Mr. Selby replied that these arguments had been considered very carefully. The committee recognized that low unit-stresses do not give a balanced margin for live-load increase, but gave heed to the psychological effect of specifying very high dead-load stress and an enormously increased live load.

The Proposed Specifications Criticized

E. A. Frink, characterizing the proposed specifications as an admirable piece of work, said that many serious faults need to be corrected. The loading adopted is the principal point of trouble. With Class 60 the engine loading is about 8800 lb. per foot, while heavy Mallet engines give about 8000. For present service the use of Class 60 gives an uneconomical bridge, with too much metal in the trusses and too little in the floor, in long spans. It is time to adopt a loading nearer the actual than is the Cooper series; the association should devise a new standard loading.

Moreover, it is questionable whether a loading as high as Class 60 should be prescribed. Such a capacity is not needed everywhere, and even Class 50 is not needed in some regions. In view of the great influence exerted by a bridge specification printed in the

"Manual," it will be hard for a bridge engineer to use a lower loading than Class 60 even if the conditions on his line justify it, and for this reason the best course might be to omit specifying a standard loading. In that case, the specification would say that bridges should be designed for the actually used train loads, with a given margin for probable increase of train weights. Mr. Frink also criticized the stresses in cross-ties as too high, and commented on the enormous loading specified for floors composed of transverse beams —over 25,000 lb. per linear foot of track, static equivalent.

Criticism was presented also by P. B. Motley, although a member of the committee. He asked that the specifications be referred back for further consideration. The new specifications of the Engineering Institute of Canada, drawn up under his chairmanship, were arranged to present successive subjects in the order of design, and differ in arrangement from the proposed specifications. It is necessary to have a Canadian specification to which Government bureaus can refer by name, and though it is desirable to have it agree with the American, this result could not be reached during the past year. However, there should be no international boundary in science.

European Plan Is Suggested

After dealing with several specific points, Mr. Motley said that he largely agreed with Mr. Irwin, and felt that the specifications "are not yet down to brass tacks in design." If the Mallet engine were to be adopted as basis of bridge loading now, we might have a quite different engine in ten years. It may therefore be wise to adopt the European plan of designing for a wisely selected uniform load.

Prof. F. E. Turneaure, speaking for the committee, dealt with the question of basing design on ultimate (maximum) unit-stresses.

Some years ago the association adopted 26,000 lb. per square inch as the stress defining the limit of safety of an old bridge. The committee considered whether this method could be applied to the designing of a new bridge; thus, 24,000 lb. per square inch. (or 22,000) might be used for the dead load and for the ultimate future live load, taking for the latter a loading that might exist 30 or 40 years hence. If the live-load stresses were properly increased by impact addition, this method would give a balanced bridge. But, Professor Turneaure asked, is 24,000 a safe figure to place before engineers as the allowable unit for static loading? We now use 16,000. The committee did not feel that it could substitute 24,000 for this figure. And the same view held against accepting 22,000, or even 18,000, as an allowable dead-load unit-stress. The resulting conclusion is what the proposed specifications embody, namely, 16,000 lb. as dead-load tensile stress.

Unbalanced design is guarded against by a clause which requires web members to be designed for two-thirds dead-load stress plus 1⅓ of the live-load stress plus impact. A span of 200 ft. so proportioned will have webs and chords of uniform strength; a shorter span has the web system stronger, while a longer span has its chords stronger.

A special proviso limits the proposed specifications to spans not over 300 ft. long, as B. R. Leffler pointed out. Longer spans, in his opinion, are subjects of special design. Unbalancing is guarded against not only by the clause quoted by Professor Turneaure, but also by a clause which requires that in ballasted-floor bridges only three-fourths the floor weight shall be considered.

Other Work on Steel Structures

Specifications for movable bridges presented by the committee a year ago and printed in the *Proceedings* are still under advisement. Revision has been considered, but few comments or criticisms have been sent to the committee. A special request for such assistance was made at the meeting, in order to permit the carrying out of the revision this year.

No experimental work on impact and secondary stresses was done during the past year. The research is now regarded as concluded, and the subcommittee on the subject has been discharged. The conclusions already reached "are not likely to be modified by any further work of that kind which the committee might be able to do in the near future." Column testing, however, is to be continued, and steps have been taken to enlist the help of the Bureau of Standards, now that its war work is closed.

Plastic compounds for protecting structures of steel and concrete from the blast action of locomotive exhaust are being studied. Some experimental applications are under observation, but no report was made. Waterproofing is also to be worked on during the coming year.

Track-scale girder designs which had been prepared by the committee on yards and terminals were approved by the committee on iron and steel structures. They cover the design data and the girder sections for three sizes of track scale.

Improving the Quality of Concrete

Carrying forward his tests on excess water in mixing concrete, Prof. D. A. Abrams has obtained a large number of results confirming and supplementing his findings given in *Engineering News-Record* of May 2, 1918, p. 873. These additional results were presented by him in a paper forming an appendix to the report of the committee on masonry. Wear resistance, Professor Abrams found, is almost exactly proportional to strength. Both strength and wear resistance are greatly increased by limiting the amount of mixing water to a much lower point than common practice allows. Attention to the conditions of seasoning of the concrete is also important. Concrete made under favorable conditions as to consistency and curing showed an increase of 275% in compressive strength and 240% in wear resistance over concrete made under distinctly unfavorable conditions.

Prof. A. N. Talbot, in discussing this paper, gave a careful analysis of the factors correlating the moisture conditions, the mixing operation, and the strength of concrete. He called attention also to the effect of moisture on concrete that has been cured under insufficient supply of water. The later supply gives a great gain of strength. Some specimens in dry storage that were under observation and test for various ages showed at 7 years 3 months a strength of 3000 lb., but when thereupon placed in moist storage for 9 months they had a strength of 5000 lb. per square inch. However, while the supply of moisture during seasoning is vital, surface sprinkling may be ineffective and is often over-rated.

Discussing the time of mixing, B. R. Leffler stated it as his conclusion that the proper time for good mixture and adequate mobility of the concrete depends on the type of mixer. A time of 1 min. may be satisfactory for certain types of mixer, especially those of ½ cu.yd. and smaller, but not enough for others. From his experience, however, it is believed that many contractors are likely to protest strongly against a 1-min. mixing time.

Track Questions

Unsatisfactory relations between rails and wheels were indicated in the report of the track committee. The opinion was expressed that the present heavy wheel coning of 1 in 20 has disadvantages, and that the coning which gives minimum wear of wheels—which was the purpose of changing from 1 in 38 to the present 1 in 20—is not a condition favorable to economical wear and least stress of rails. Furthermore, a 1 in 20 canting of the rail is considered too steep an inclination, as it conforms to the present wheel coning and thus practically nullifies the objects aimed at in this coning.

Possible injury to rails by flat spots on wheels led the track committee to recommend that the present 2½ in. limit of length should be reduced to 1½ in. The impact effect increases with heavier and stiffer rails or with rigid, frozen roadbed. C. E. Lindsay, of the United States Railroad Administration, pointed out that the likelihood of damage by heavily loaded wheels having long flat spots is not generally realized. The recommendation was adopted and will be submitted to the Master Car Builders' Association with a request for the reduction of its present 2½-in. limit.

Cost of Curvature

A change in methods of valuating rail wear on curves was suggested by the committee on economics of railway location, in a statement to the effect that rail wear on curves, as compared with tangents, increases approximately as the square of the degree of curve. The importance of this was stated to be evident from the fact that heretofore it has been customary to estimate curve expense directly with the central angle, or with the degree of curve when a different length is considered. Individual experiences with rail wear on curves were brought out in the discussion.

Consolidation of the subgrade by a 10-ton roller to prevent water pockets in the roadbed was advocated by the roadway committee, which also suggested methods of curing such pockets by drainage and filling with porous material, while concrete filling for such pockets and wet spots was suggested by the ballast committee. Concrete-slab construction to carry the ballast was discussed by the latter committee, but it did not include the extensive experiments on the Northern Pacific Ry. which were described fully in *Engineering News-Record* of Dec. 12, 1918, p. 1071.

Screw Spikes

Screw spikes appear to be showing less favorable results than was anticipated a few years ago, when they began to be used to any large extent. Doubt as to their value in increasing the durability of ties was expressed by the tie committee, except under such special conditions as on elevated structures and in track having a more substantial foundation than the ordinary tie and ballast construction. It was explained by F. Boardman of the N. Y. Central R.R. that this statement was based on unfavorable reports from most of the roads using screw spikes.

As an offset to this statement, however, extended and favorable experience on the Delaware, Lackawanna & Western R.R. was recorded by G. J. Ray, formerly chief engineer. On a 30-mile stretch of double track laid in 1911 the only spikes which were loose after eight years' service were those in about 100 ties which proved to be rotten. A standard form of thread is important, as the replacement of one spike with another having a different pitch and form of thread will destroy the threaded groove in the wood, and after a few such replacements there will be no effective hold of the spike.

Expansion of the present allowable working stresses for structural timber to include treated timber is inadvisable without further experiments on treated and untreated timber in large sticks. This conclusion was presented by the committee on wooden bridges and trestles. Tests indicate that neither the character nor the quality of the preservative causes any appreciable decrease in the strength of timber, but that such effect is due entirely to the process of treatment and that this may affect different timbers in different degrees.

Zinc as an Alternative for Creosote in Treating Railway Ties

ZINC-CHLORIDE treatment for railway ties is justified where, for economic reasons, creosote oil is not available, or where conditions of maintenance will not warrant the expense of application of the latter. Furthermore, zinc treatment will secure at least double the life given by an untreated tie of the same kind in the same location, no matter whether oak or pine is used. In dry climates this increase in life may be still greater. These conclusions are given in the report presented by the wood-preservation committee at the annual meeting of the American Railway Engineering Association. The committee frankly says that creosote is the best timber preservative for all purposes, but points out economic limitations to its use.

Climatic conditions qualify the above conclusions favorably to zinc chloride, the Eastern and Southeastern states generally being excluded from the field for zinc-treated ties. Introduction of some lubricating agent with the zinc, to correspond with the action of creosote oil, is recommended where excessive rainfall and humid atmosphere would cause the zinc in the ties to be influenced unfavorably by leaching; also, where checking of the timber or its mechanical wear is likely to be excessive, but where it is not possible to secure a straight creosote treatment.

One of the objections urged against the use of zinc chloride has been that, as the salt is soluble, it will leach out of the wood by moisture and cannot be expected to give permanent protection. The committee finds, however, that leaching does not take place as rapidly as has been assumed. In ties which have been in the track for several years, especially in the drier climates, the zinc chloride has been found well distributed through the wood.

Air seasoning for 60 days after treatment is recommended, as it results in greater strength of the tie, increased resistance to wear by spikes and tie-plates, less leaching of the zinc, and less disturbance of signal circuits by leakage of current from the rails.

Progress in Study of Rail Quality

American Railway Engineering Association Research—Deep Etching of Longitudinal Sections of Rail Head Brings Out Network of Lines Present Before Rails Are Straightened—The Quick-Bend Test

EXTENSIVE studies of rail quality made during the past year under the direction of the Rail Committee of the American Railway Engineering Association led to results that represent marked progress and give a distinctly better understanding of rail troubles. An important factor in the matter was that, due to the increasing interest in the subject on the part of the railroads, more investigators worked on the problem than ever before, according to a statement by P. H. Dudley of the New York Central Lines. "This is due," says Dr. Dudley, "to so many officials of the railroads having found from the service records that some brands of rails in the track had a large number of failures, while other brands rolled under a different mill practice did not have one failure in the same section, though subject to the same wheel loads and tonnage."

Three prominent points of the new research work are: (1) The discovery of the value of deep etching with strong acid to bring out hitherto unrecognized defects in the interior of the rail head; and the discovery through such etching that defective rails show a startling degree of non-homogeneity, streaks running in various directions through the rails; (2) statistical proof that rolling rails direct from the ingot contributes to the production of transverse fissures in the rail; rolling from reheated blooms is a preventive; (3) study of a new toughness test for rails, a bending test in a hydraulic press, as a substitute for the drop test, long the traditional standard of rail acceptance testing.

Depp Etching Brings Out Extensive Flaws

F. M. Waring, engineer of tests at the Altoona laboratory of the Pennsylvania R.R., last summer developed the use of deep etching with strong mineral acid to bring out defects in longitudinal sections of rail heads. This laboratory and the rail officials of the Pennsylvania system have for a number of years centered their attention on non-homogeneity of rail metal as a responsible cause of rail failures, and in this line of thought some years ago decided that chemical analyses of samples from different parts of the cross-section of the rail must not show large variations of composition, if the rail is to be regarded as satisfactory. Pursuing the same line of thought, laboratory studies were made to discover indications of unsoundness, by etching longitudinal horizontal slices cut from the heads of rails and carefully smoothed and polished. The usual micrographic etching solutions did not bring out any special appearance, although this method in some prior cases had revealed hair cracks in the metal. It was then decided to use a more drastic etching process. Trial was made of successive etchings in a number of the solutions, still without result. But very definite results were attained when the specimens were etched for two hours in hot, strong, mineral acid (nine parts of hydrochloric acid, three parts sulphuric acid, and one part of water, kept at 200° F.). This brought out a remarkable number of longitudinal, transverse and irregular marks or depressions. These marks, representing streaks of more soluble material, proved the existence of serious non-homogeneity, likely to lead to irregular stress distribution in the rail and therefore create opportunities favorable to cracking in service.

These deep-etching studies were applied to a number of rails that had developed transverse fissures in the track (or in some cases while being tested), and the same irregular markings were found in nearly all cases. On the other hand, a rail that performed well under the drop test, though made from the same heat of steel as a number of the defective rails, showed uniform metal when etched by this method. Mr. Waring in a report to the railroad company says, "Since these rails were all from one heat, of a fairly uniform chemical composition, and rolled at the same time, and since they were all subjected to approximately the same amount of service in the track, it would appear as if these defects found in the rail heads are associated in some manner with the process of manufacture."

Trial was then made to see whether similar defects could be found in a rail that had never been in service. The deep etching with mineral acid brought out the markings, though picric acid etching had failed to develop anything unusual.

"An examination of all these deep etchings," says Mr. Waring, "brings out the fact that these small internal transverse ruptures correspond in their location and appearance with the nuclei of transverse fissures, and it is possible that they may be the original cause of such fissures."

Closely related to this investigation is an observation made by J. B. Young, chemist of the Philadelphia & Reading R.R., a few months ago. Test specimens cut from the center of the head of a 100-lb. rail that had never been in track, and had not even been on the hot bed, showed cracks in various directions through the metal. The cracks were noticed after the standard test specimen was fractured in the testing machine. Hitherto, many rail experts have believed that small cracks are produced in the rail head during the straightening process, in the gag press, but in the present case there had been no gagging or other straightening. Mr. Young therefore holds that his findings "are conclusive evidence that flaws and cracks exist in new rails which have been subjected to no strains except those developed in the rolling."

Reheated Blooms Make Good Rails

Reporting on the subject of transverse fissures, Dr. P. H. Dudley, consulting engineer, New York Central Lines, brings sharply into view various discrepancies of fact that have surrounded the two opposing theories on the cause of transverse fissures. As against the theory of James E. Howard that repeated stresses in track service produce the transverse fissures (as fatigue fractures), Dr. Dudley directs attention to the fact that the nucleus is not a point but is of measurable size, and, from its appearance, obviously resulted from a process different from that of the rest of the area. He emphasizes the fact that such fissures occur only in an occasional rail head, although design, traffic conditions, and stresses are alike for many rails, and there-

fore, if stress is the cause of the fracture, most rails should break in the same way.

That transverse fissures in their development are fatigue or detail fractures is conceded by Dr. Dudley: "There is no difference of opinion about the growth in the track of the specular surfaces which start from and around the nuclei of interior transverse fissures." What fault or flaw at the nucleus gives opportunity for the transverse fissure to start remains the essential problem. Dr. Dudley refers to the discoveries of Mr. Waring and Mr. Young, above mentioned and to the discovery of streaks of high-phosphorus metal in defective rails by George F. Comstock, as reported in *Engineering News-Record* of Mar. 13, 1919, p. 532. Without expressing an opinion on these discoveries, however, he brings out other facts on the influence of reheating the steel before rolling.

Statistics prove, Dr. Dudley shows, that about all transverse fissures occur in rails rolled direct from the ingot, while rails from reheated blooms virtually never fail in this way. This appears to establish beyond question that qualities or defects of the steel are responsible, rather than excessive stress.

The service records of eight railroads for the seven years 1909-1915 exhibit a total of 559,644 tons of rail produced by direct rolling; in these rails 1054 transverse fissures developed. The same road had 322,593 tons of rail made from reheated blooms, and these developed only 59 transverse fissures, or less than one-tenth as many per ton of rail as by the direct-rolled material. The rails were rolled at 11 mills, and thus represent a large variety of mill conditions. Moreover, 27 of the 59 failures of rails made from reheated blooms came from a single mill, and are said to have been rolled at a time before the mill practice was made uniform and good. It should be mentioned that the whole group of statistics concerns only heavy rails; that is, rail weighing 100, 101 and 105 lb. per yard.

Whether finishing the process of rolling the rail at a low temperature is advantageous was also studied by Dr. Dudley. Some years ago it was a common charge that steel rails were put through their finishing passes too hot, and thus did not go through the grain-refining process which cooler rolling would have brought about. Dr. Dudley cities experiences showing that a low temperature in the last pass of the rail mill is apt to produce brittleness. This brittle metal is capable of being restored to a tough condition by annealing. General experience leads him to conclude that chemical composition has an important influence on toughness or brittleness, and he concludes that steel with more than 0.85% carbon is particularly likely to have its toughness destroyed in the rolling or in the cooling of the rails on the hot beds with the effect of producing brittleness.

Surveys of rails by a magnetic tester to detect internal flaws were made by Dr. Dudley recently. He gives no detail results, but states that the leakage curves of rails obtained with this apparatus furnish much information about the physical properties in rails and about the disturbance of the metal by the gag press used in straightening it.

Rails are tested for acceptance by the Pennsylvania R.R. by means of a press bending test in addition to the regular drop test. The press is in a hydraulic machine operated by an intensifier standing alongside, and capable of exerting a pressure of 378 tons. The main ram is 16 in. in diameter and has a 12-in. stroke. The machine weighs 11 tons. The supports for the rail, under the press ram, may be set at various spacings; tests have been made with supports 24 to 51 in. apart. A hydraulic pressure indicator records on a drum turned by a connection with the main ram, so that an autographic diagram is produced.

Deflections at ultimate load of rail specimens bent in this machine are found to be an indication of the ductility of the material, just as well as is the elongation in the drop test of the rail. It is also belived that the deflection is in a measure an indication of the toughness of the rail, or rather its capacity to resist shock.

Tests made with the head down (in tension) gave more satisfactory and uniform results than those made with the head up. In the former, breaks were obtained in nearly all cases, while with the head up the breaks were apt to be branching or irregular. Furthermore, the tests made with different lengths of span of the rail showed closer agreement between the test results and theoretical curves, for the tests with head down than those with head up.

One of the striking results of tests with the bending machine brought out in a report on the subject submitted by W. C. Cushing, chairman of the subcommittee on the quick bend tests, is the distinct superiority in quality of the rails produced by one mill as compared with those of another. A large number of tests of 130-lb. rails from three mills, plotted to show elastic limit as ordinates and ultimate deflection as abscissas, placed the rails from one of the three mills in a group distinctly above and to the right of the groups representing the other two mills. This comparison shows greater ductility and strength, on the average, for the rails of the first mill, though all were rolled to the same specification and the same section and weight.

In another experiment, a rail that failed in the bend test at a small deflection—in other words, was brittle—was retested after annealing, and the deflection was increased more than four times, indicating a curing of the brittleness by the heat treatment.

Rail-Joint Tests Show Heat Treatment and Short Bars Advisable

THAT plain angle bars, if heat treated, can make a rail joint having strength and efficiency equal to that of the solid rail, is the important conclusion of a report submitted by the rail committee of the American Railway Engineering Association as an appendix to its own report. This rail-joint report was made in 1915 by C. D. Young, then engineer of tests of the Pennsylvania R.R. It was based on tests made at the Altoona laboratory covering different forms of plain angle bars, splice bars with stiffening flanges depending below the rail and joints giving a base support to the rail.

Heat-treatment results constitute the main feature of the report, showing an increase in elastic limit ranging from 60% in solid 100-lb. rail to 79% and 150% in plain angle-bar joints with six and four bolt holes, respectively. In the rail the elastic limit was raised from 175,000 to 280,000 lb., while in the bars it was raised from 70,000 and 50,000 lb. to 125,000 lb. in both cases. From this the conclusion was drawn that heat treatment was one of the simplest and most economical means of increasing the efficiency of the joint.

The treatment mentioned consisted in heating the material above the recalescence point (approximately 1500° F.), quenching in water, and then annealing the hardened steel at about 1050° F. It was estimated at that time (1915) that this should not add more than $5 to the cost of the steel, while it would increase the stiffness of the bar at least 50% and still leave the metal softer than the rail.

Mr. Young pointed out that a joint equal in efficiency to the solid rail could be obtained by heat treatment of some of the patented types of joint, or at less cost by similar treatment of a special angle bar. The joint with this bar showed a strength, at the elastic limit, equal to the rail, and would cost less than the then standard angle bar, which had a strength about 33% that of the rail. The new bar was to be used with heat-treated bolts, as, being shorter than the standard bar, it might require greater bolt strength.

Comparison of joints having four and six bolts indicated that the two additional bolts gave no increase in strength in transverse loading. It was concluded that a four-hole splice is sufficient for 100-lb. rail if it is of proper section and material. It has fewer parts and greater cross-sectional area for the same weight. As to bars 26½ in. and 18½ in. long, tests with 20-in. and 26-in. spacing of supports indicated no loss of efficiency in the joint having the shorter bars.

Switching Cars Into Station Order at Large Freight Yards

METHODS of sorting cars or switching them into station order for outbound trains are discussed briefly in the report presented by the committee on yards and terminals at the annual meeting of the American Railway Engineering Association. Suggestion has been made for the provision of a small gravity yard for this purpose, located between the classification and departure yards, but the committee finds that such an arrangement is rarely provided or, at least, rarely included in yard construction. In some gravity classification yards, such sorting is accomplished by means of a yard tributary to the hump, having its ladder next to the outside track of the main yard and its short body tracks diagonal to this. The same purpose might be effected by intermediate ladder tracks subdividing a few of the main classification tracks at one side of the yard.

In the opinion of the committee, secondary sorting of cars for station order or other similar grouping can be accomplished satisfactorily by supplementing the gravity switching for classification with flat switching by engines at the foot of the hump yard or in the departure yard. This would save the additional investment and increased length of terminal involved by an auxiliary sorting yard, and it would avoid the delay attending the delivery and removal of cars at such a yard.

In certain situations, however, the auxiliary yard may be necessary, as where it is impossible to provide a sufficient number of tracks in the classification yard, or where the number of cars to be handled is too great to permit of switching them at the outgoing end of the classification yard or in the departure yard without hampering the flow of traffic. It should have assisting grades if practicable, and the length of its tracks would be governed by the requirements of each case.

Railroad Engineers' Conference Adopts Wage Scale

Representatives of Fifty Roads Meet—Chief Discussion on Pay of Chief Engineer, Division Engineer and Tapeman

(*Editorial Correspondence*)

FOR the first time in the history of engineering a body of 350 engineers, representing fifty railroads, met in Chicago Mar. 17 to discuss openly and above board a minimum salary schedule for every technical position from chief engineer to tapeman. No unusual demonstration preceded this history-making meeting, only the usual setting of a well planned, well carried out convention of engineers who always take their society gatherings seriously. Born of experience gained by years of handling the intricate problems on the greatest transportation systems of the world, the men proceeded to business with reference to their own economic welfare in somewhat the same manner as has been the custom in getting practice and procedure ironed out in the American Railway Engineering Association. In railroad parlance, it might be said that the schedule was adopted as "recommended practice," but was not ready to be "incorporated in the 'Manual.'"

The program, carried out by the American Association of Engineers, was well planned. The chairman was one who all felt had given justice to young as well as old engineers. Willard Beahan is a white-haired engineer, revered by hundreds whom he has fathered into real usefulness from the time of his experiences with General Dodge, finding the line for the Union Pacific (fighting Indians meanwhile), down to his present capacity of assistant chief engineer with the New York Central.

Leading up to the main business of the meeting, which was the discussion of a "preliminary report by a subcommittee of the railroad committee," of the American Association of Engineers, was a paper on overtime by H. P. Gillette, editor of *Engineering and Contracting*, which laid down a rough rule that when the salary reached $200 a month, or when the duties became advisory, overtime allowance was not desirable. A sufficient number participated in the discussion to break the ice of acquaintance. A venerable Seaboard Air Line engineer came to mental grips with a young division engineer from the Southern Pacific. A middle-aged chief draftsman from the Missouri Pacific let the audience know that the Middle West had similar difficulties.

Discussion of Schedule

Well acquainted now, the engineers were plunged into the intricate problem of classification and salary-fixing by J. L. Jacobs, a specialist on system and organization. With his word for it that a world of work lay ahead of them in gathering statistics, standardizing positions and nomenclature, the conference was in a proper frame of mind to appraise the work of the subcommittee, a work which the Wage Board in Washington gave up in despair. W. C. Bolin, chairman, explained that the subcommittee had been at work night and day for two weeks on the problem after the paid staff of the committee had gathered a mass of information from all over the country as to existing schedules, in and out of the profession. Three elements of the schedule—the salaries of chief engineer, division engineer and tapeman—were attacked first, for, said Mr.

Bolin, with these points fixed the determination of the intermediate salaries became a matter of mathematics tempered by good judgment. Reasons for every piont were forthcoming immediately from Mr. Bolin. No question seemed to have been without consideration, and so well had he and his co-workers hit the consensus of opinion that only six salaries proposed, out of 36, were revised. A surprising unanimity of opinion was found as to nomenclature and definition. Only one position, that of assistant electrical engineer, was added, and only one name changed, that of detailer to junior draftsman.

With the schedule adopted, the conference was not ended, for still, holding to engineering procedure, the next step was a set of specifications for the plans, a paper by W. W. K. Sparrow, corporate chief engineer of the Chicago, Milwaukee & St. Paul, on "How Shall Proper Recognition Be Obtained?" Walking still on crutches from a recent accident, dramatically he called on engineers inside and outside of railway service to unite for proper concerted action all engineering societies of the country into a United Engineering Society of America. But Mr. Sparrow is not an impractical dreamer, and, until the constitution of a league of societies has been drawn—which, he well said, should not be so hard to frame as that for a league of nations—he proposed to support the organization which had fathered the conference and to urge every engineer of his acquaintance to do likewise. And when, in answering the question of a skeptic as to what he would do should the railroads refuse to consider the schedule proposed, he said, "I would not strike," the spontaneity of the applause said louder than words, "We are not that kind of an organization." "But," said Mr. Sparrow, "after the lessons of the war I believe men will get what, in justice, they are entitled to get." Organization for the purpose of giving the profession a single voice with authority back of it, licensing to give political and social status, and a broader education, with interest and activity in other than purely technical matters, were his suggestions for obtaining greater recognition.

The committee's next step is the presentation of the schedule to the Wage Board in Washington, for it is the opinion of many that that body will not refuse to reopen the hearings of February, 1918, to listen to the united voice of the railroads' most valuable and trusted class of employee.

SCHEDULE OF MINIMUM SALARIES ADOPTED BY RAILROAD CONFERENCE OF AMERICAN ASSOCIATION OF ENGINEERS

The duties of resident engineers involve construction work of ordinary magnitude. Where exceptional work is undertaken it is assumed that the assistant district engineer, district engineer or assistant chief engineer will take charge personally.

The duties and qualifications attached to the positions named are generally well understood. Any schedule of rates promulgated should specify that the work actually performed should govern. Thus, if a railroad calls a man an assistant engineer and he is actually performing the usual duties of a division engineer or other position, he should receive the pay of that position.

The rates for the higher positions do not apply to short lines, terminal railroads and roads of similar character, the rates in these cases to be in proportion to the duties and responsibilities assumed, based upon the schedule.

The schedule is not to operate to reduce any salaries now existing.

Expenses away from headquarters or in connection with moving headquarters are to be allowed.

No pay is to be allowed for overtime.

Civil service rules are to apply as to annual and sick leave.

The following schedule of salaries is adopted:

Chief engineer	$15,000 to $9000
Assistant chief engineer	9000 to 7200
District engineer	6000 to 4800
Assistant district engineer	5400 to 4200
Division engineer	4800 to 4200
Assistant division engineer	3600 to 3000
Resident engineer	4200 to 3000
Office engineer—field engineer	5400 to 3600
Engineer of bridges	7500 to 6000
Assistant engineer of bridges	5400 to 4800
Signal engineer	7200 to 4200
Assistant signal engineer	4800 to 3000
Building engineer	6000 to 3000
Valuation engineer	8400 to 7200
Assistant valuation engineer	6000 to 4800
Chief pilot engineer	4800 to 3600
Pilot engineer	3600 to 3000
Engineer accountant	4800 to 3000
General superintendent of motive power	15,000 to 9000
Assistant general superintendent of motive power	9000 to 7200
Mechanical engineer	7500 to 6000
Assistant mechanical engineer	4800 to 3600
Engineer of tests	7500 to 6000
Electrical engineer	8000 to 6000
Assistant electrical engineer	4800 to 3000
District electrical engineer	3600 to 2700
Shop engineer	4800 to 3600
Chief draftsman	3600 to 3000
Leading draftsman or designer*	200 to 250
Draftsman*	150 to 200
Junior draftsman*	125 to 150
Tracer*	100 to 120
Engineer inspector*	150 to 225
Instrument man*	200 to 225
Rodman*	125 to 150
Tapeman*	100 to 120

*Rates per month stated for junior positions cover the length of service in the respective positions, an increase of not less than $5 for each six months' service to be granted up to the maximum rate of the position.

Without the efforts of the American Association of Engineers, in bringing the conference together, in financing the machinery necessary to gather the data on which the schedule is based and in energizing individuals to action, the movement could not have been consummated. On that organization still remains the burden of opening the way to the Wage Board and of keeping the schedule up to date as conditions change. It may rest assured that support will be forthcoming from the railway engineers. W. W. D.

Machines Cut Water-Main Costs in Detroit

Shortage of labor and high wages have been largely counterbalanced by the Board of Water Commissioners of Detroit, Mich., by extensive use of machinery in laying water mains. Mechanical appliances are now used nearly exclusively for trench excavation, backfilling, tamping and pavement cutting, pumping and pipe handling. The savings per foot effected by machines in constructing pipe lines of smaller sizes are given as follows:

Size of Pipe	Hand	Machine	Saving
6	$0.59	$0.35	$0.24
8	0.58	0.40	0.18
12	1.11	0.49	0.62
16	1.62	0.99	0.63

Labor per foot in laying 42-in. and 48-in. pipe will average $8.70 by hand, and $3.50 by machinery; calking averages $1.32 per joint by hand, and $0.49 using pneumatic hammers; handling and lowering each pipe by hand labor averages $6.70, and $1.88 using the steam crane. Backfilling ditches on small lines costs about 9c. per lineal foot by hand and 3½c. per foot by machine.

Additional Meteorological Data Needed by Engineers

Points on Which More Data or Further Study Would Be Helpful, Including Rainfall Distribution and Intensity, Precipitation and Heavy Floods, Evaporation, Vegetation, Soil Infiltration, Temperature, Run-off

By Robert E. Horton
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EVERY experienced hydraulic engineer feels the need of additional meteorological data. First of all, there are far too few rainfall stations, and where the stations are reasonably close together group records should be studied to gain light for use where the stations are far apart. Periodic distribution of precipitation, rainfall intensities, flood flows, evaporation, the influence of vegetation, soil percolation, temperatures of the air and of the surfaces of both soil and water, and, finally, the broad general phases of run-off—all need attention. A brief review of the more important meteorological needs, grouped under 10 heads, follows:

1. More Stations—A much larger number of rainfall stations is needed throughout the country generally. In the East there is generally one station in each county, an average of about one station to every 1500 square miles. In England, Denmark, Saxony, Jamaica, Barbados, St. Kitts, Victoria and Mauritius there is an average of about one station to every 40 square miles. That is sufficient to provide good data for almost any small drainage basin, such as is commonly required for gravity water-supply systems. In New England the number of rainfall records available is about twice as great as elsewhere in the United States, owing to the fact that many good records are maintained in conjunction with water-works systems. But even in New England the number of stations is by no means adequate for satisfactory determination of the rainfall on many small drainage basins used for gravity water-supply.

2. Special Group Studies—In view of the sparsity of rainfall records, special groups of stations are needed, and studies based on existing data to determine the reliability, both of the long-term mean for any one station and the actual annual and monthly amounts indicated by single gages when applied over a varying radius of 1, 5, 10 or 15 miles from the station. Data are available at Providence, Worcester, Pawtucket, St. Louis and New Orleans, where rain gages are maintained sufficient in number to determine the general accuracy of a single record as applied to larger or smaller surrounding areas in those particular localities. Undoubtedly, with more data general relations could be established which would greatly increase the utility of rainfall records, and would also increase the degree of confidence which could be placed in such records where it becomes necessary to apply a single station to a considerable area.

3. Periodic Distribution of Rainfall—Experience shows that with identically the same rainfall distributed in different ways throughout the year, especially during the summer, quite different amounts of run-off may result. In applying rainfall data, in critical cases, it is, therefore, necessary to take into account its distribution as well as its total amount. It is desirable, therefore, that the total number of rainfall days per month at each station should be published, with the amount of rainfall. For example: A rainfall of 4 in. in August may all occur in four days, with heavy thunderstorms, or it may be distributed throughout 10 or 20 days. In the latter case, the opportunity for water loss by evaporation would be enormously increased by the long continued wetting of the ground surface, and the available supply for run-off would be steadier, but much smaller in amount than in the case of concentrated rainfall. I believe that practical methods can be readily developed by which the effect of rainfall distribution can be taken into account in estimating stream yield, if the number of rainfall days is known.

4. Intensities—As regards rain intensity, there are at present about 200 stations in the United States with recording rain gages. The details of these records, some of them running back to 1896, are published in the *Monthly Weather Review* and in the annual reports of the Chief of the United States Weather Bureau. No complete, exhaustive analyses of all these records have ever been made. Partial analyses, covering the records within considerable areas, or for a considerable number of stations, have recently been made by Meyer and published in his "Elements of Hydrology," and by the United States Housing Corporation, the results not yet having been published. So far as the results go, they indicate that rain intensity formulas of the same type, but with varying coefficients, can be applied to localities having widely different amounts of rainfall.

Room for Much Valuable Work

Practice hitherto in using rain intensity data in storm-sewer designing has been in general to work out a rain-intensity curve for each different place or problem. Usually, the data of the most intense and most critical storms are meager, and the results of such scattered individual studies are unquestionably less reliable than would be those obtained by thorough, general analyses involving a large number of stations of smaller rainfall characteristics. There is room for much valuable work in standardizing and analyzing rain-intensity data along more general lines. Not only this, but all attempts hitherto to utilize such data have been wholly empirical. There is reason to believe that at least a semirational formula of general application can be developed for rain intensities of short durations.

5. Great Storms and Floods—In connection with the broader problems of flood causation and flood discharge, studies of rain intensity in great storms covering periods of one to five days are needed. A valuable start was made in this direction by the Miami Conservancy District, the results being given in its series of technical reports, Part 5. Good work along similar lines, with much more numerous records on which to base the results, has been done by the British Rainfall Organization.

One of the most fundamental problems of flood control is the determination of the relative frequency of

occurrence of floods of different magnitudes, as fixing the maximum size and cost of works economically justified for flood control. Further data and analyses along these lines are much needed, and would be likely to afford results of broad utility and permanent value.

It may be noted in passing that so far as the studies by the Miami Conservancy District go, they seem to indicate that the law covering the relative magnitudes of storms of one to five days' duration, and having different intensities and frequencies of occurrence, is very similar in form to the general law covering the relations between frequency, intensity and duration of short storms, such as are involved in storm-sewer designing—with, however, probably, the important difference that temporary storage of considerable volumes of rain by suspension in the upper air, in ascending air currents, is the important factor contributing to high intensities for rainfall duration of less than, say, one hour, but is not of importance in relation to storms of one or more days' duration.

Incidentally, there is a gap between existing results of studies covering, on the one hand, rain intensities used in storm-sewer designing and of generally less than one hour's duration, and flood intensities of one or more days' duration. This seems to open up a profitable field for investigation—a field which would be very likely to lead to results useful in both classes of studies. Furthermore, in many flood problems and in numerous litigations involving rainfall, the only data available are daily rainfall records. Data and studies showing the relation between 24 hours' rain and the average duration and intensity for the actual portion of the day during which rain fell are much needed.

6. *Evaporation*—With regard to evaporation, very good records are now being kept by the Weather Bureau and other Government organizations. It appears, however, that records obtained from the ordinary evaporation pan, say 3 ft. square, are not directly applicable to broad water surfaces. There is need for experimental determination of what may be called the area factor or average ratio of evaporation loss from a standard pan of a certain size to the evaporation loss from an area of any given size larger or smaller. A start along this line has been made in the work of Prof. F. H. Bigelow, R. B. Sleight and others.

Altitude and Evaporation

The writer, in *Engineering News-Record* of Apr. 26, 1917, p. 196, has called attention to the physical factors underlying and controlling this so-called area factor. The area factor involves, however, certain climatic conditions, especially convective action, data for which are not included in meteorological reports. In view of the complexity of the subject, further studies, especially out-of-door experiments with evaporation pans of various sizes, are greatly needed.

In this connection, too, attention may be called to the need of further data and studies on the relation of altitude to evaporation. There is a prevailing popular notion that evaporation increases with elevation. This idea is undoubtedly derived from the well known fact that water boils more readily at high than at low altitudes. This, however, is only one of the elements involved. Mean temperature at the surface decreases on the average about 1° for 300 ft. elevation. The absolute humidity also decreases with elevation, in accordance with the exponential law developed by Hann. Wind velocity generally tends to increase with increased elevation. The amount of evaporation from water surfaces is mainly controlled by temperature, humidity and wind velocity, and is affected probably to a minor extent by other factors, including so-called radiation or black-bulb thermometer temperatures, facility for convection, and barometric pressure. Some of the factors tend to cause an increase, and others tend to cause a decrease in the amount of evaporation, with increasing altitudes. The natural result would be the occurrence of some particular elevation for which evaporation losses would be maximum. While this fact never seems to have been pointed out before, yet it is confirmed by the few good observations available, especially those of Charles H. Lee. The whole subject of relation of evaporation loss to elevation is worthy of further investigation and more rational discussion.

7. *Vegetation*—The subject of interception of rainfall by vegetation will be seen to be one of great importance, when it is considered that oftentimes, especially in light showers, 50% or more of the rain is caught upon and directly evaporated from trees or other vegetation and never reaches the ground. This subject has been experimented upon in Europe, and to a limited extent in the United States by the writer, and, I believe, also by the United States Weather Bureau. Further investigation and discussion would aid in laying a foundation for more rational estimates of stream flow and better determinations of water requirements for irrigation purposes.

8. *Infiltration*—Floods are mainly the results of direct surface run-off from heavy rains or melting snows. The direct evaporation loss during flood rains is usually only a very small proportion of the available supply of water. The difference in flood-discharging capacities of different drainage areas is, without doubt, more largely due to differences in the amount of water which can percolate into the soil during heavy rains than to any other one factor excepting rainfall itself.

Soil Infiltration During Rains

Furthermore, infiltration of rainfall is the source of ground-water supply to streams, wells and artesian horizons; yet, with the exception of some meager experiments by O'Meara and the writer, practically nothing has been done in this country relative to the determination of the amount of infiltration into different soils, on different slopes and with different rates of rainfall. Numerous formulas for estimating maximum flood discharges have been evolved, but it does not seem possible to arrive at either a rational understanding of the causation of floods or the most reliable method of estimating probable maximum flood discharge without taking into account the amount of infiltration occurring during rains.

9. *Temperature*—The most important factor affecting evaporation losses of all kinds is temperature. It is also an important factor in relation to floods as affecting the rate of melting of accumulated snow. Data for air temperature are generally available, but what is needed in relation to evaporation is the temperature of the soil and of water surfaces. Data on these subjects are meager. The obtaining and publishing of additional data of soil-surface and water-surface temperatures, and especially the correlation of such temperatures with air temperature, are matters which will become of increasing importance and value as the

development and use of more rational methods of handling hydrologic problems progress.

10. Run-off—The run-off or yield of a drainage basin is the difference between the precipitation on the drainage basin and the water losses due to evaporation of various kinds. The amount of evaporation from the soil surface is dependent upon the same factors which control evaporation from water surface and, in addition, it is dependent on the degree of saturation of the soil surface. Some experimental data in relation to the evaporation loss from soil surface with different degrees of saturation have been obtained by Samuel Fortier (see *Engineering Record* of Apr. 15, 1905, p. 430).

Additional experimental data along this line would be of the utmost practical and economic value, not only in relation to the ordinary problems of hydrology in estimating stream flow, but also in relation to irrigation, land drainage and agricultural engineering in general. The writer has designated the ratio of the actual evaporation rate from a soil surface at any given time and with any degree of saturation to the evaporation rate from water or a saturated soil surface as the "evaporation opportunity."

It so happens that in long periods of drought, when the evaporation rate from a saturated surface is highest, the evaporation opportunity from the soil surface decreases. It is a natural result of these opposing influences that there is some particular amount and distribution of rainfall in any locality for which the total evaporation loss from the soil is a maximum. Although this is important, the writer does not think that it has ever hitherto been pointed out. Strangely enough, it follows as a simple mathematical deduction from a number of existing formulas for calculating run-off and, furthermore, it is abundantly confirmed by experience, inasmuch as it will be found that if almost any long-term record of rainfall and stream flow is analyzed, and the results are plotted in terms of water losses against precipitation, the resulting water losses will have a maximum for an annual rainfall which generally lies between 45 and 75 in. in England and the Eastern United States.

This calls attention to the fact that the older ideas and methods of expressing run-off as a percentage of rainfall are essentially fallacious, and if engineers are to justify public confidence with regard to their ability to predict safely the available yield of water-supplies, their work must, in the future, be founded upon the use of meteorologic data now often ignored and upon more rational and detailed methods of analyzing and utilizing such data.

Licensing Laws in Oregon and Idaho—Proposed Ohio Bill

Unique Features in Ohio and Idaho Bills—Oregon Law Follows Joint Committee—Iowa's Proposed Law

PROGRESS in the movement to license engineers is seen in the fact that the Association of Ohio Technical Societies has prepared for introduction into the legislature of Ohio a bill which contains many unique features. It is designed to include all classes of professional engineers and architects; also land surveyors, by specific provision. The special features of this bill are here presented, and a short statement follows giving the features in which the bill passed by the Oregon legislature Feb. 26, 1919, differs from the Joint Committee bill, as discussed in *Engineering News-Record* of Feb. 27, 1919, p. 423. A similar bill has just been introduced into the Iowa legislature. The Idaho legislature has just passed a licensing bill, the main features of which are here given.

The Ohio bill provides for a state board to be appointed by the Governor "by and with the consent of the Senate," for the purpose of registration for professional engineers and architects. It is to consist of nine members, not more than five of the same political party, and with one representative each for civil, mining, mechanical, electrical, and chemical engineering, and architecture. The qualifications for membership include a five-year previous residence and 10 years of active practice; the latter may be in teaching the profession, but not more than three members may be appointed who have had such active practice in teaching professional engineering in a reputable college or university. The secretary of the board may or may not be a member, but must have the qualifications of a member, receives a salary to be fixed by the board, and must give a bond. Members of the board receive no compensation except necessary expenses. The board shall meet in Columbus on the last Wednesday of June each year and at other appointed times. Seven members constitute a quorum.

The bill provides that after one year from its passage it shall be unlawful "for any person to practice professional engineering or architecture, as defined in this act, or to hold public office or employment involving the practice of such professions, or to set or disturb boundary monuments in Ohio, unless such person shall have first obtained a certificate entitling him to practice professional engineering or architecture from the board. Such certificate shall state whether the holder thereof is registered as a professional engineer or architect."

Special provisions are made for registering surveyors. No map or plat of any land or mine shall be accepted unless certified by a registered professional engineer or a registered surveyor. The act shall not apply to officers holding office or officers-elect at the time of passage of the act, during the term for which they have been elected, or to engineers or architects in the employ of the United States Government, but the latter shall not do any engineering or architectural work in Ohio except that pertaining to their official position, unless they comply with the act. Registered professional engineers or architects only can qualify to give testimony as engineering or architectural experts.

Definition of Professional Engineering and Architecture—These are defined to include all branches other than military engineering, as follows: "Any person who designs *or makes drawings for* any building, bridge, railroad, harbor, water-works . . . " etc., including a complete list of possible activities for all classes of engineers, not even excepting marine architecture and landscape engineering. It includes a person acting "as resident engineer, department engineer, division engineer, assistant engineer, clerk of works, or other similar title, with authority to exercise discretion, assume responsibility, devise methods, or to perform duties ordinarily delegated to such position . . . "even though employed by or under the di-

rection of a registered professional engineer or architect. However, nothing in the act is to be construed to prevent the employment of assistants of grades below those specified "provided they are under, and report directly to, registered professional engineers or architects or a registered surveyor, who assumes all responsibility for their work." Residents outside of Ohio may be called to testify as witnesses without holding certificates.

Qualifications for Certificates—A certificate may be issued to any applicant holding lawfully a diploma in any branch of engineering or architecture, except surveying, from a college or university approved by the board, together with evidence that he has had at least two years' practical experience; or to any member in good standing in the six great national engineering societies (including the Chemical Engineers and Architects) or other national engineering organizations having similar requirements for membership; or who, within one year, submits evidence of five consecutive years' prior practice; or to any applicant who successfully passes an examination before the board, to determine his fitness for such practice. The board may grant a certificate to practice land or mine surveying to any person otherwise eligible under the foregoing requirements, whose practice has been limited to such branch, or who, upon examination, satisfies the board of his fitness to practice the same; but the holder shall not be entitled to practice any other branches except surveying and platting of land or mines.

In providing for nonresident engineers, architects or surveyors, certificates are granted to those from such states as have equal qualifications, provided equal rights are accorded by such states to Ohio registered engineers, architects or surveyors. The fee is the same as that in the state from which the engineer comes; or if there be no such fee, it is made $10.

The board may reject an applicant guilty of fraudulent methods of practice, or revoke a certificate for the same cause. An affirmative vote of not less than six members shall be required to authorize the issue or revocation of a certificate. The fee for consideration of an application is $10, without examination, and for examination the fee shall be $25; for certified copies of certificates, $1 per copy. In no case shall the fee be returned in event of refusal to grant a certificate, but unsuccessful candidates may be examined at any subsequent session within one year. Fraud in obtaining a certificate is made a misdemeanor, punished by a fine not exceeding $1000 nor less than $100, or imprisonment of not more than one year nor less than 30 days, or both. Violation is classed as a misdemeanor, punishable by a fine of not less than $20 nor more than $500, or imprisonment of not less than 30 days nor more than one year, or both. The secretary of the board is charged with the duty of enforcing the act.

Bill Passed by Oregon

The bill just passed by the Oregon legislature is almost exactly like that of the Joint Committee proposed in 1915, but with modifications stated below. It takes effect on July 1, 1919, when the term of office of the Board of Examiners also begins. It prescribes Jan. 1, 1920, as the date after which certificates must be obtained to allow practice.

The prohibition against permission to testify is omitted; the salary of the secretary of the board is specified at $1200 per annum; his bond is to be fixed by the board; the fees are to be paid into a special fund, the "Engineers' Registration Fund"; the fee for admission to examination is $10, the additional fee for certificate is $5; and $15 is required for a certificate without examination for which six years, instead of ten years, of practice are required, not necessarily immediately preceding the date of application; penalties for violation are provided by a fine of from $25 to $500, or imprisonment not to exceed six months.

The act does not apply to "any architect practicing architecture," and the time limit for engineers from without the state is placed at three months before application for examination must be made, and the following clause is added, "The service of professional engineers in the United States military service shall be considered as the practice of professional engineering, and provided further that such Army engineers may be registered without examination . . . within a period of one year from the date of their discharge." No provision is made by appropriation of money for the use of the board, although the original form of the bill proposed the sum of $3000.

Proposed Iowa Bill

The Iowa bill is also largely a copy of the Joint Committee bill, but provides for separate certificates to land surveyors. The board of examiners is composed of five, instead of nine, members, no two of whom shall be from the same branch of the profession; their compensation is at the rate of $10 per day. Each year in a recognized engineering school, if successfully completed, is allowed as equivalent to engineering practice in the six-year requirement. The fee for examination is $15, and for certificate $10 additional. For six months after the passage of the bill, certificates may be issued for $25 fee, to professional engineers or land surveyors of two years' practice immediately preceding the date of passage. Violation is a misdemeanor punishable by fine of $100 to $500, or by imprisonment for three months, or both.

Application of this act does not include full-time employees of corporations unless the latter offer their services to the public as professional engineers or land surveyors; if so, all principal designing or constructing engineers must register. Assistants to registered engineers or land surveyors are also exempt.

Idaho Legislature Passes Licensing Bill

The Idaho legislature, which recently adjourned, passed a bill providing for the licensing of civil engineers. Civil engineering is defined as "the practice of any branch of the profession of engineering other than mining, metallurgical and military."

The department of law enforcement of the state Government is empowered to conduct examinations, to pass upon the fitness of applicants for reciprocal registration from other states, to prescribe rules for holding examinations, to determine what shall constitute a school, college or department of a university for civil engineers and the reputability and good standing of such schools (the requirements of the University of Idaho for the degree of civil engineering are adopted as the standard), and to conduct hearing on proceedings to revoke certificates.

Seven persons, each a registered civil engineer of

recognized standing and having had ten years' active practice, and a resident of the state for at least one year, are to be appointed to hold the examinations. Appointments are to be made after giving due consideration to recommendations by members of the civil engineering profession and organizations. The members of this board are to receive per diem allowance of $5 and mileage.

The fee for residents of the state is to be $10 and for applicants from outside $25. Applicants shall be of good character, more than 21 years of age, have been in active civil engineering work as assistant or otherwise for at least six years, or shall be graduates of a recognized school. To any person having these qualifications and having been actively engaged in the practice of the profession for one year will be granted a certificate on payment of the fee and taking of an oath, without having to pass an examination. A person registered in any other state having a minimum requirement not less than that of Idaho may be registered without examination, in the discretion of the department. Certificates may be revoked for any of the following grounds: 1, Fraud or deception in procuring certificate of registration; 2, fraud or deception in practice, or 3, conviction of a felony.

The act does not apply to engineers in the employ of the United States Government; nor to engineers employed as assistants to registered engineers, nor to non-resident engineers coming into the state for consultation, to collect information or to give expert testimony in court.

Tests Determine Effect of Air in Centrifugal Pump

By A. P. Blackstead
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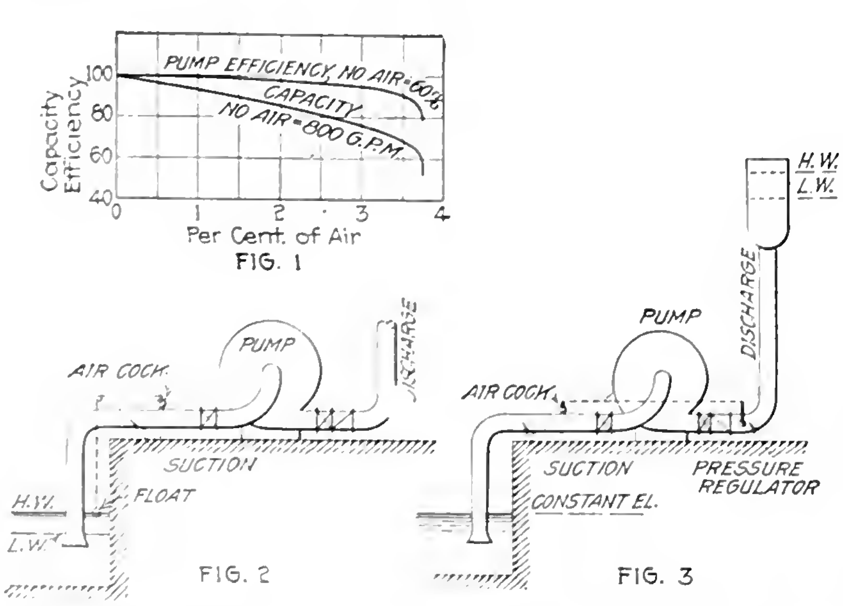
Some time ago the writer conducted a series of tests in order to determine the effect of air let in on the suction side of a centrifugal pump.

The pump had 5-in. suction and discharge nozzles and was direct-connected to a constant-speed electric motor. The power input was measured with standard, calibrated instruments. The water pumped was weighed on standard scales, the suction and discharge heads being measured by mercury columns. A small gas meter, with inlet open to the atmosphere and outlet connected to the suction pipe, was used to determine the amount of air let in. The valve in this line controlled the amount of air. By throttling the gate valve in the main suction line a constant vacuum of 20-in. mercury was obtained simply by regulating the discharge gates where a constant total head of 60 ft. was obtained.



ARRANGEMENT TO MEASURE EFFECT OF AIR ON PUMP

The test was repeated several times, each time giving substantially the same results, which are graphically shown on Fig. 1. It will be noted that whereas the capacity took a decided drop with the increased percentage of air, the pump efficiency remained virtually constant up to a point where the pump would not handle any more air, 3.75% volumetric, where it dropped the suction. A very small amount of air, 3.12%, reduced the capacity 25 per cent.

This offers an easy method of regulating the capacity of a centrifugal pump which is working under suction. Fig. 2 shows a schematic arrangement for such a control where it is desirable to regulate the pumpage by the fluctuation of the water in a suction well, as is often the case in sewage installations. If, on the other hand, as in water-works service often is the case, the pump capacity is to be regulated by the elevation of the water in the standpipe, a similar arrangement can be made with the air cock controlled by the variation in the water pressure. This is indicated in the illustration, Fig. 3. This control will eliminate a number of objectionable features in connection with the usual automatic regulation of starting and stopping or change of speed.

It will be noted that the cost of this outfit would be very small. The control would work equally well on large and small pumps and could be applied to existing pumps without difficulty.

Winter Concreting on Miami Conservancy Work

Concreting has been carried on through the winter in the dam-construction work of the Miami Conservancy District, Ohio, with only occasional interruptions. As the nature of the enterprise demands that progress be rapid and according to schedule, and as it is important to keep the working organization intact, to avoid losses and delays, it became necessary to plan reducing the interruptions of concreting to a minimum.

Study of the extra costs involved in heating materials and protecting deposited concrete led to the conclusion that the greater part of the extra cost is incurred only at temperatures below 20 deg., and a general rule was therefore made that work through the cold season is to be continued until the thermometer drops below 20 degrees.

Provision for heating aggregates by steam coils built in the bins has been made at all three of the dams where concreting has been going on, Englewood, Germantown and Lockington. Means have also been provided for protecting the surfaces from freezing by tarpaulins and salamanders, or, in some instances, by steam coils (where steam was available because it was used for other purposes).

Care is taken that no fresh concrete is placed on frozen foundations. With a view to reducing the liability of freezing also, the amount of water used in mixing is closely regulated.

At two of the dams most of the concreting has been in footing trenches, and, as this situation protects the concrete from wind, protection from freezing is relatively simple. At Lockington, however, the concrete walls under construction project high above ground and are more difficult to protect; work at Lockington has therefore been held up in cold weather during a greater part of the time than at the other dams

Effect of Cold-Working and Rest on Endurance of Steel

Cold Pressing and Rolling Have Slight Effect on Results of Reverse Stress Tests—No Gain from Rest Periods

ALTERNATE-STRESS tests were applied to the investigation of a new question by Prof. H. F. Moore and W. J. Putnam of the University of Illinois, during the past year. Their results were reported to the American Institute of Mining Engineers last month in a paper entitled "Effect of Cold-Working and Rest on the Resistance of Steel to Fatigue under Reversed Stress." Briefly, they sought to determine whether the improvement in strength and elastic limit of a piece of steel by cold-working, such as rolling, stretching or compressing, is accompanied by improvement in the endurance of the steel under reversal of stress many times repeated. Furthermore, since it is known that the effects of overstrain are diminished by a period of rest (as well as by low heating, such as through immersion in boiling water), it was desired to find whether rest benefits the fatigue strength. Essentially, the results of the many series of tests made to answer these two questions were negative. That is, cold-working does not increase the fatigue strength, although it also does not distinctly decrease it; and no marked benefit through rest could be detected.

Underlying the experiments was the thought that the service of steel is in the last analysis determined by its resistance to repeated stress—in other words, its endurance—and only in less degree by its static qualities, such as tensile strength and elastic limits. If, therefore, the marked raising of elastic limit in steel through cold-working is paralleled by a raising of the fatigue strength, very important practical conclusions would follow.

For some years Professor Moore has studied fatigue tests on the hypothesis of the exponential law as a satisfactory working formula. According to this law, the number of repetitions of stress which a given material will stand is in inverse proportion to some power of the unit stress applied. The hypothesis is convenient because the curve connecting unit stress and number of repetitions becomes a straight line when plotted on logarithmic paper, which greatly facilitates the comparison of experiments made in widely different ranges, though it does not remove the possibility of committing serious error in such extensions from one range to another. Experiments have given a fair degree of support to the exponential hypothesis. It is on the safe side because it calls for a low working stress for very great numbers of repetition.

In the series of tests summarized in the three diagrams of Fig. 1 the Upton-Lewis vibratory testing machine was used. This works on a flat specimen, in this case a strip having a reduced section about ⅝ in. wide and about 2½ in. long, and gives complete reversals of bending stress at the rate of 250 per minute. Other tests, one series of which is summarized in Fig. 2, were made on the White-Souther machine, which uses a cylindrical specimen, in this case ½ in. in diameter and 4½ in. long from edge of support to center of bearing of load.

In Fig. 1 the points representing the individual tests are not marked, but Professor Moore has stated that they are not much more scattering or distant from the lines drawn than the tests shown in Fig. 2. However, many of the tests were to the left of the section of curve drawn; that is, they were above the static elastic limit (as determined under the American Society for Testing Materials' specification, by the sudden increase of rate of stretch of a tension specimen as shown by the extensometer).

Briefly, the comparative endurance of two specimens represented by two different lines on the diagram is to be estimated by the position of the lines above or below each other; the upper line indicates material of greater

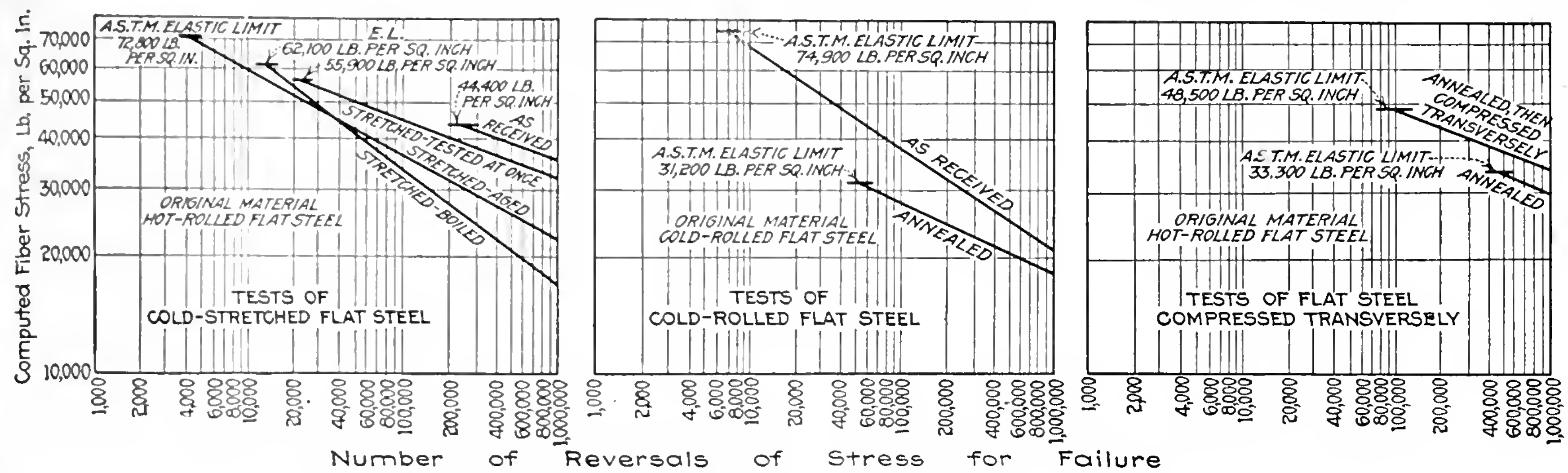


FIG. 1. FATIGUE TESTS WITH UPTON-LEWIS MACHINE TO DETERMINE EFFECTS OF COLD-WORKING ON THE ENDURANCE OF STEEL

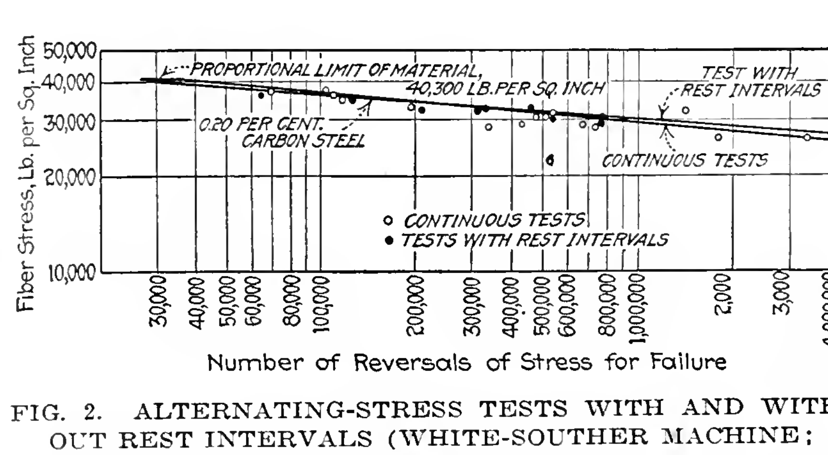


FIG. 2. ALTERNATING-STRESS TESTS WITH AND WITHOUT REST INTERVALS (WHITE-SOUTHER MACHINE; STEEL 0.20% CARBON)

endurance. Judged by this criterion, it will be seen that in the first diagram of Fig. 1 the (hot-rolled) material was of better endurance in its original condition than after cold-working by stretching, or after 60-day aging or 15-minute boiling treatment subsequent to the stretching. In the second diagram of the same figure cold-rolled material showed better endurance in its original condition than after annealing, which effect is the opposite of that indicated by the preceding diagram. The explanation may be that cold-rolling involves a compressive action and for that reason strengthens the material in endurance, while the cold-stretching in the previous diagram weakened the material. The same indication may be gathered from the third diagram of Fig. 1, in which hot-rolled material strained by transverse squeezing showed slightly better endurance than the same material not compressed. In any event, however, the effect of the cold-working on endurance is not great, and the practical conclusion is that cold-working does not have any marked effect on the endurance of the metal, although it modifies very profoundly the elastic limit and other static tensile properties.

Various series of tests to investigate the effect of rest after cold-working are fairly typified by the diagram reproduced as Fig. 2. It is to be concluded from this that the rest intervals (either one or two, of 24 hours each) did not improve or otherwise change the endurance qualities of the material.

In view of the fact that failure in endurance tests has been shown to be due to the slow opening up of separations between the grains of the metal, starting probably from some slight local defect, it is not an unexpected result that rest has no effect in restoring the damage done by the previous repetitions of stress. The starting and gradual growth of this detailed failure in alternating-stress tests has been shown most strikingly by Professor Moore through moving-picture microphotographs that were taken of a small polished and etched spot on the side surface of one of the endurance specimens.

Sanitary Service Rids Construction Camp of Influenza

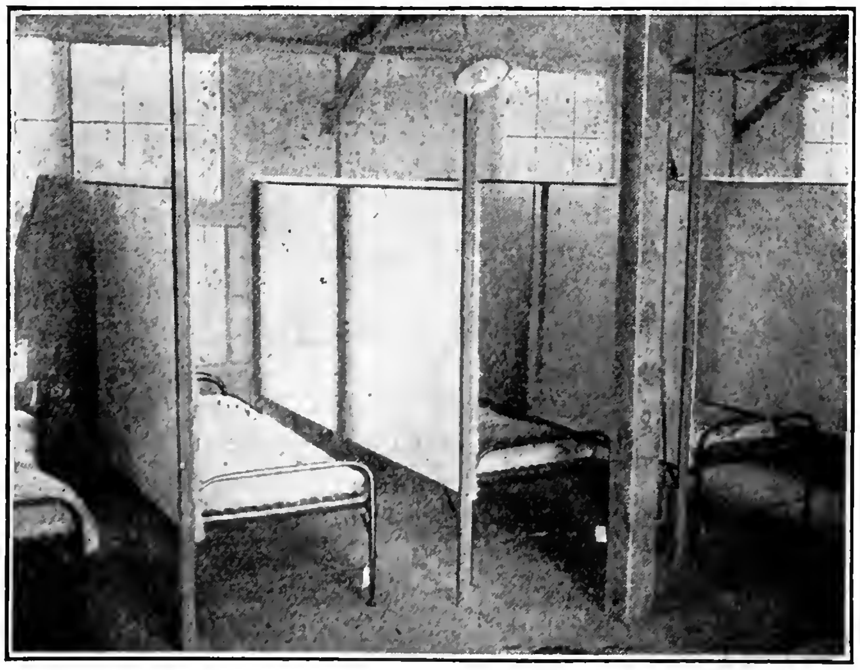
Strict Enforcement of Ordinary Sanitary Precautions Kept Intact Working Force on Camp Custer Extension When Surrounding Communities Were Decimated by Disease

By M. D. Kauffman
Division Engineer in charge of Sanitation, Camp Custer Extension

During the height of the influenza epidemic last autumn the construction force building the extension to Camp Custer suffered no diminution on account of disease. Instead, the superior reputation for healthfulness of the camp led to an increase of 50% in the applications for work. Construction progress was maintained at scheduled speed while on neighboring jobs work lagged because of workmen lost through disease and desertion, and communities all about had closed theaters, schools and churches and were conducting all business under quarantine restrictions. Specifically, from Oct. 6, when the working force was 1281, to Nov. 15, when it was 2572 men, there were four cases of influenza and one case of pneumonia, and altogether only 14 cases of sickness demanding the attention of a physician. By this time 65% of the work was completed. From Nov. 15 to Dec. 31, when the working force fell from 2572 to 1080 men and 95% of the work had been finished, only 10 more cases of sickness occurred. Thorough sanitary service explains these facts.

Success in sanitary service at Camp Custer came from attention to detail. No unusual hygienic or sanitary measure was employed; also, no essential hygienic precaution was neglected, and no carelessness in its execution was permitted which vigilant inspection could prevent. The story to be narrated is, therefore, a story of details and not one of general practices.

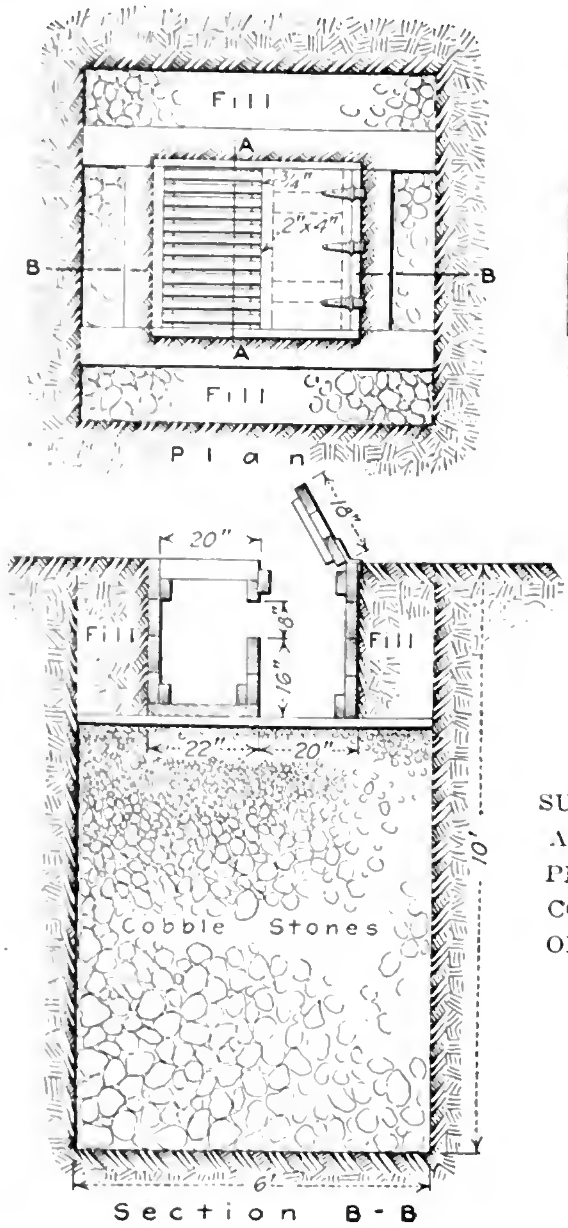
Camp hygiene began with personal cleanliness, and no other single provision counted so high toward the sum of the results obtained. Ample and comfortable facilities for body bathing and for washing clothing were provided. Every workman was required to bathe thoroughly once a week. Men having the handling of food in any way had to bathe twice a week, to brush their teeth daily and to wash their hands frequently. Discharge followed refusal to comply with rules for bathing or refusal to change frequently to clean clothing. Lavatory attendants and bunk-house caretakers kept careful watch to detect lack of cleanliness. If carelessness was observed the man was reported and subjected to such examination as seemed required. If communicable disease was discovered, the workman was isolated and his personal effects were disinfected, or



WALLBOARD SCREENS BETWEEN COTS CONFINED SPRAY FROM SNEEZING

he was handed over to a physician or to the hospital, as the circumstances required. If body vermin were discovered the man was isolated until the trouble was eradicated. Refusal by the workman to submit to these requirements was met by discharge from the camp. All but a very few of the men coöperated cheerfully in maintaining the high standards of personal hygiene.

Bunkhouses accommodated 65 men, and at the height



SURFACE WATER ACCUMULATION PREVENTED BY CONSTRUCTION OF DRAINAGE PITS

of progress 20 of them were occupied by an average of 1200 men. All were furnished with iron cots and straw ticks; cots were set 20 in. apart and were cubicled off by semipartitions of wallboard arranged as illustrated. These partitions reduced the danger of infection from spray from coughing and sneezing and did not interfere with ventilation.

Each bunkhouse had a day caretaker and a night caretaker. After the workmen left the bunkhouse in the morning the day caretaker opened every window full top and bottom and kept it open four hours. All blankets were removed from the beds and hung outside for a period of six hours daily when the weather permitted. Every Monday, cots and ticks were put outside and sunned and aired for four hours. Cots, floors and wall surfaces were sprayed daily with 5% lysol solution. Floors were swept morning and afternoon and scrubbed at least twice a week. Before each sweeping the floor was sprinkled with sawdust saturated with a solution of 5% lysol, 5% formaldehyde and 90% water. A half hour after sweeping all flat surfaces were wiped with a damp cloth or oil duster. All woodwork, including the floors, partition supports, etc., was scrubbed once a week with soap and water, and windows were cleaned and polished once a week.

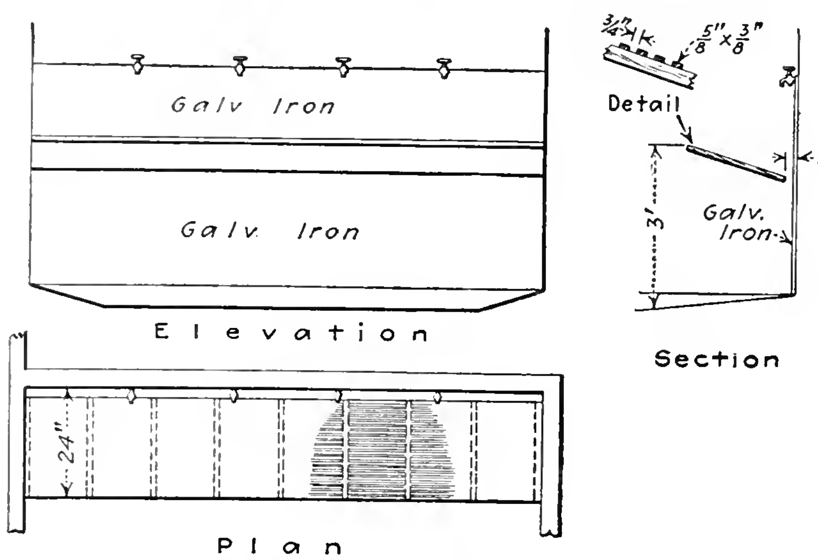
BLANKETS SUNNED AND AIRED FOUR HOURS EVERY DAY

Spitting, except into cuspidors, was prohibited within or adjoining bunkhouses. Six cuspidors were provided for each floor. All were emptied daily and the contents were removed to the dump and buried. The cuspidors were then scrubbed inside and outside with soap and water and refilled with clean sand sprinkled over the top with chlorinated lime.

The spread of vermin was prevented by examination of the clothing of men applying for accommodations; by daily inspection of walls, cots and bedding; by spraying walls, cots and ticks monthly with a solution of two drams of chloride mercuric and 16 oz. of wood alcohol; by prohibiting the keeping of food or of cast-off clothing in the bunkhouses.

Rules for ventilation at night required that eight windows, three in each side and one in each end, be kept full open from 9:30 p.m. to 4:45 a.m. Inspection was made nightly to enforce this regulation.

One attendant was assigned to each compartment containing 24 water closets, 30 ft. of urinal trough, 10 showers and 30 ft. of wash trough. The floors were scrubbed every morning, and swept and mopped every afternoon and evening. Walls, doors and woodwork were scrubbed weekly with soap and water. Cuspidors in the lavatories were emptied and scrubbed twice daily. Water closet bowls were washed with soap and water and scoured inside each day with lye. Incrustations in the bowls were removed with muriatic acid. Water-closet seats and the wood in wash troughs were washed three times a day. Urinal troughs were



FREQUENT LAUNDRY TUBS ELIMINATED EXCUSES FOR DIRTY CLOTHING

scrubbed and treated with kerosene or crude oil every morning and afternoon.

Privies were used only when work had to be done before sewerage was installed. One attendant took care of three privies. Floors and troughs were scrubbed twice a day, and seats were washed with soap and hot water three times a day. Chlorinated lime was used freely in vaults and troughs and the ground under the troughs was kept soaked with crude oil. When a privy was abolished, 6 in. of air-slaked lime was spread over the contents of the vault, and it was then filled to within 6 in. of the surface. The ground for 3 ft. around the vault was then excavated to a depth of 6 in. The excavated and vault area combined were then covered with burlap soaked in crude oil. The area was then filled to the surface with cinders.

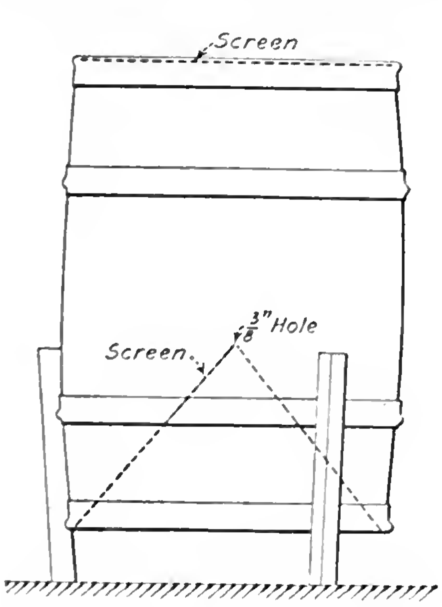
One or two collections of waste were made daily. A morning collection covered the whole camp area and included all waste; an afternoon collection covered the occupied area only and included only garbage and refuse.

Two two-horse teams, each with a driver and two men, did the collecting. Garbage was handled in 40-gal. covered cans, and 15 cans were a wagon load. For ashes and refuse the wagon bodies were divided by movable partitions into a forward compartment for refuse and a rear compartment for ashes. Ashes were used for filling depressions and for drives; refuse and garbage were taken to the dump. At the dump the garbage was burned and the cans were washed for return to the mess halls. Refuse was first sorted for materials having a salvage value, then the remaining combustible materials was burned and the incombustible material was piled. Three men at the dump assisted by the men on the wagons sorted and salvaged the refuse, buried the garbage and burned or piled the waste. A record of salvage kept for eight days, for roofing paper, lumber, cement sacks, nail kegs and tools, showed enough value recovered to meet the cost of 15 men and four teams required for street cleaning, refuse removal, dump service and the filling of the water barrels.

Manure from the stables accommodating 200 horses was handled separately. There was an attendant for each 20 stalls. Each morning and noon the stalls were cleaned and sprinkled with crude oil or quicklime. Manure was collected in piles outside the stables and removed daily to adjacent farms and spread on the land. After removal, the ground where the piles had been was sprinkled with quicklime. If delayed removal permitted fly larvæ to develop, the piles were sprinkled with a solution of 1 lb. of powdered hellebore and 25 gal. of water.

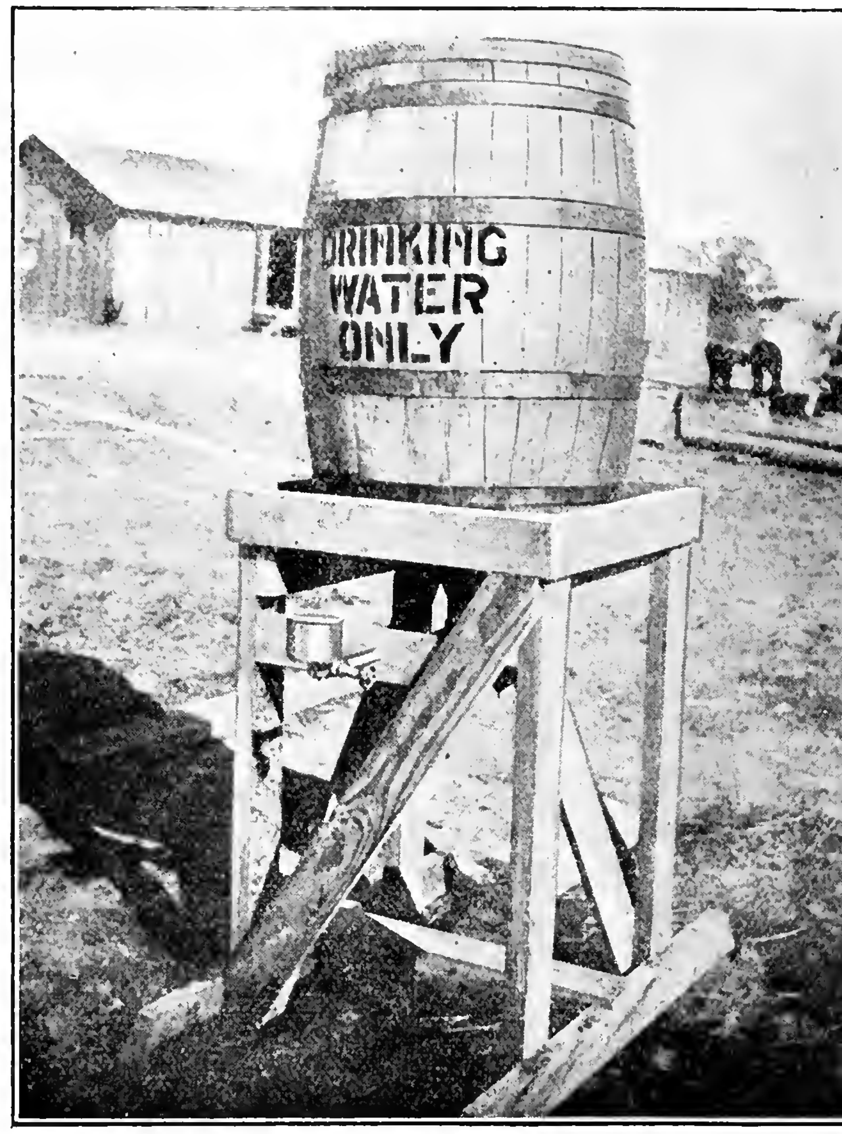
Rubbish, garbage, manure and all other forms of decomposed matter that could attract flies were protected until disposed of. Garbage platforms were scrubbed and disinfected daily. All rooms were screened and provided with fly paper. Fly traps baited with vinegar and sugar, stale meat and banana skins were placed in all locations where flies were observed to congregate.

To eliminate mosquitoes all small pools were filled, and every place in which water could accumulate was eliminated. Filled fire barrels were filmed with oil.



BARREL TRAPS REDUCE FLY PEST

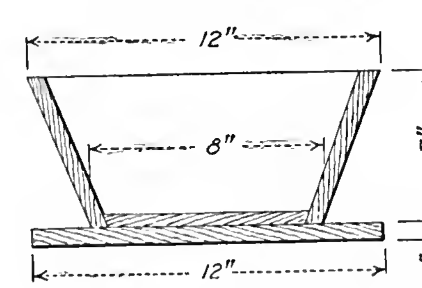
Water supplied from Camp Custer was of established purity, and the only precaution necessary was to keep it uncontaminated. For drinking purposes, improvised bubbling fountains were located at convenient places about the work. On isolated jobs, where the installation of fountains was not warranted, paper drinking cups were issued to the men and water was carried to them in covered pails. Common drinking cups



BUBBLE FOUNTAIN IMPROVISED FROM WATER BARREL AND TIN CUP

were absolutely prohibited. As an inducement to the workmen to keep their quarters clean and orderly, as well as to provide an essential item in complete sanitary service, the streets and grounds were kept clean. A force of one foreman and four laborers was provided. The streets and roadways were cleaned daily, and the grounds were raked every morning and policed all day to remove stray accumulations. Besides doing routine cleaning, the force filled in damp hollows, dug small drains, banked around buildings, repaired walks, and did other necessary work.

Not including mess-hall sanitation, which will be described in an article to be published later, the sanitary squad during the week of Nov. 8-14, when operations were most active, comprised 80 men, of whom 23 were on night duty. During this week the average daily working force was 2421 men, and an average of 1175 men was housed daily in the bunkhouses.



CUSPIDORS PLENTIFULLY PROVIDED

The construction of the extension to Camp Custer was under the direction of Maj. T. A. Leisen, constructing quartermaster. Samuel A. Greeley of Chicago was supervising engineer. The W. E. Wood Co., of Detroit, Mich., was general contractor. The writer, M. D. Kauffman, of Chicago, was division engineer in charge of sanitation. Valuable supervision and inspection work was also done by Lieut. G. W. Long, United States Army.

Ditch and Road Work Combined on Drainage Project

Spoil from Drag-Line and Wheel Excavators Builds Roads—Engineer Uses Tractor Plows to Break Heavy Surface Mat

TO OPEN up for settlement an area of 40,000 acres of swamp land the Virginia-Carolina Farms Co., Beaufort, N. C., is constructing a system of drainage ditches, and is utilizing the excavated material for roads along the section lines. The land lies north of Beaufort, between the Neuse River and Gore Sound, and is 12 to 16 ft. above sea-level, with a slight slope toward both waterfronts. It has about 4 ft. of wet muck over a clay stratum. The nearest railway is 12 miles distant, and a wharf will be built on the Neuse River waterfront to accommodate river craft.

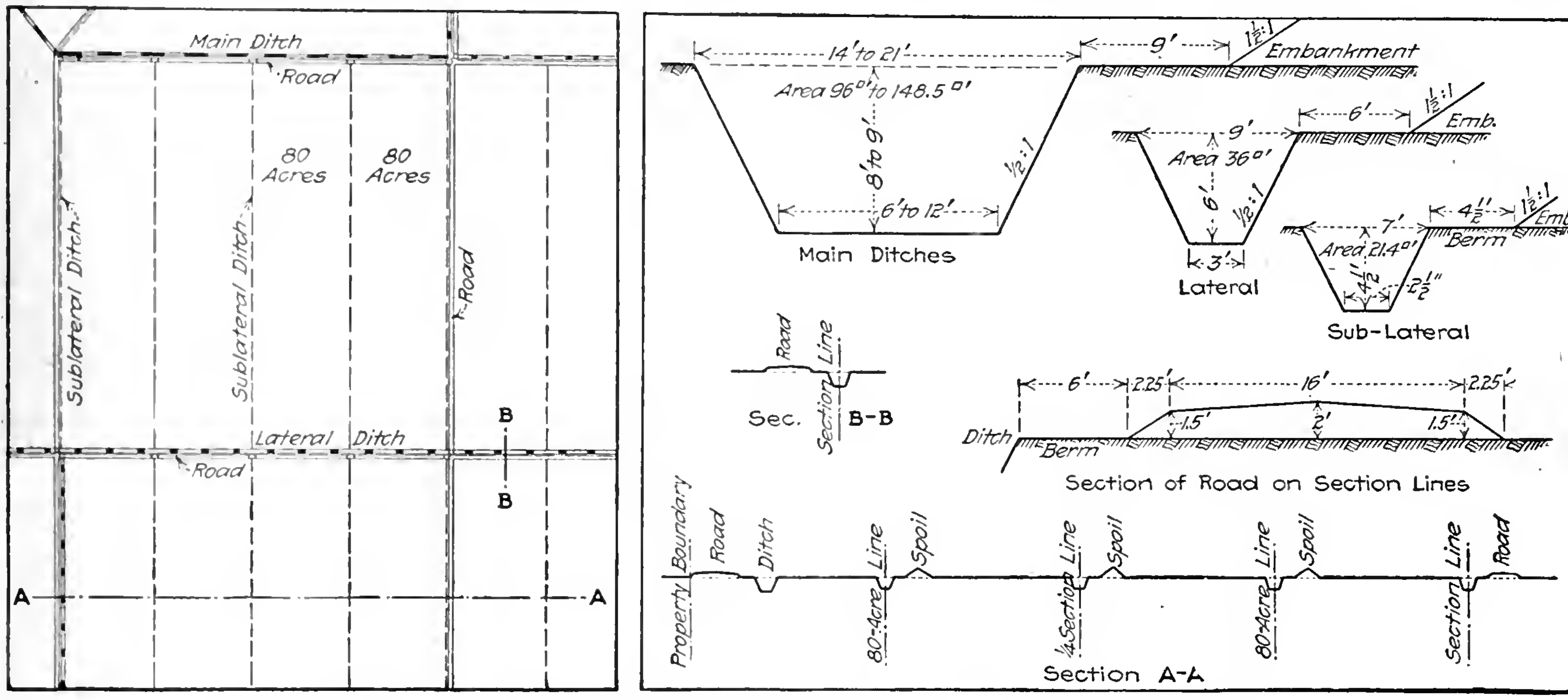
Land in that part of the country is not laid out on the ordinary rectangular section system, but is in irregular tracts described by metes and bounds. As most of the trees and other marks used as the original survey points disappeared long ago, and as the creeks whose center lines were recorded as boundaries have shifted their positions, it was no easy matter to determine the boundaries of the area to be improved. It is of irregular shape, but the topographic conditions were favorable to a rectangular subdivision, with main and lateral ditches following the section and lot lines, and roads paralleling the section-line ditches.

Shrinkage of the soil due to drainage is expected to cause an average settlement of 10% in the depth of the muck stratum, but as all the ditches are bottomed in the stiff clay substratum this settlement will not affect the drainage works. The main ditches slope in two directions, to the two waterways mentioned.

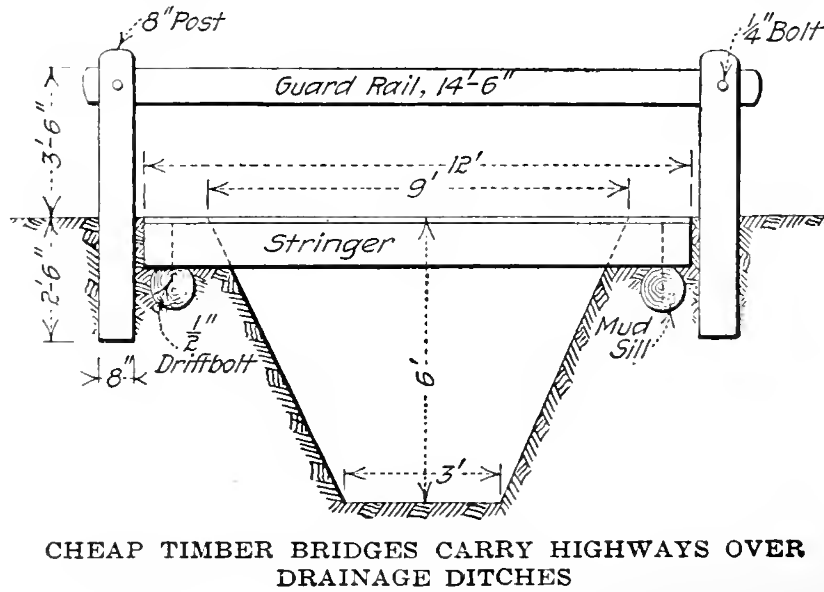
There is little timber on the drained area, but some timber land is adjacent. The surface growth is largely gallberry-fetter bushes and also bay bushes and vines, whose roots cause a dense mat about 9 in. thick. Handling this mat is a difficult problem, as it will not burn, even when the growth is cut and burned. Experiments made by the engineer indicated successful treatment by deep plowing and rolling. A 6-ton caterpillar tractor developing 3000 lb. drawbar pull hauled a plow with two 18-in. bottoms which cut through the mat and threw it in furrows. The plow would not turn the furrows so as to bury the mat, but the plowed surface was spread and leveled by running over it with the tractor in such a way as to press the former top of the mat down into the muck. The soil is so sour that it must be treated with lime and left for about a year before it can be used for crops.

Main ditches have a bottom width of 6 to 12 ft., with slopes of ½ on 1 and a depth of 8 to 9 ft. Laterals have a minimum bottom width of 3 ft., with 6 ft. depth; and sublaterals a 2½-ft. width with 4½-ft. depth. In all cases, the berm width is equal to the depth of the ditch. For the roads, the spoil bank is leveled down and topped with the clay, forming a fill of the section shown. Numerous bridges are required. These are of very simple construction, consisting of stringers drift-bolted to mudsills placed about 18 in. back from the edge of ditch and carrying two layers of 2 x 12-in. planks, 14 ft. long. Posts set in the banks carry guard rails, as shown.

Excavation was done by a dragline machine of the walking type and a wheel-type machine mounted on



DITCH AND ROAD LAYOUT PROVIDES FOR RECLAMATION OF WET LAND



CHEAP TIMBER BRIDGES CARRY HIGHWAYS OVER DRAINAGE DITCHES

caterpillars. The former had a 1-yd. bucket. The latter, with buckets on the rim of the wheel and inclined side-arms to cut the slopes, could excavate a finished ditch at the rate of 8 ft. per minute.

There was considerable trouble in obtaining and keeping a labor supply, the men available being independent and their work poor in proportion to the wages paid. The labor force averaged 80 men. Work was commenced in January, 1917. W. H. Rosecrans, Chicago, is engineer for the company, with W. H. Winsett as resident engineer. The contractors are William H. Esson and Roberts Brothers, Chicago.

Indianapolis Garbage-Reduction Profits

NET profits of nearly $15,000 are reported from the operation of the garbage-reduction works of Indianapolis from May 26 to Dec. 31, 1918. On the former date the works were taken over for $175,000 by the Board of Sanitary Commissioners of the Indianapolis Sanitary District, which has since operated the plant. During the approximately seven months of public operation 12,187 tons of garbage and related material were treated, at a total cost of $72,550 or $5.95 per ton, including capital charges. In more detail the figures were:

		Per Ton
Operating revenue:		
Grease	$63,666	$5.22
Tankage	19,502	1.60
Hides	4,259	....
Total	$87,427	
Operating expenses:		
Plant department	$36,371	$1.21
Transportation	7,090	.58
Purchase of dead animals	5,511	....
Purchase of meat and grease	1,355	....
Total	$50,327	
Capital charges:		
Depreciation	$17,500	$1 43
Interest on bonds	4,703	.38
Total	$22,203	$1.81
Total annual revenue	$87,427	....
Total operating and capital charges	72,530	....
Net income	$14,897	$1 22

Attention is called to the income of $37,100, which is the difference between the total income and the operating expense. Out of this amount the sum of $17,500 has been laid aside for depreciation. This is for a seven-month period and is at the rate of $30,000 per year. At this rate, Jay A. Craven, member and secretary of the commission says, the plant will more than pay for itself in a five-year period, as at the end of that time the plant will be in in an operating condition and worth considerable money even as scrap value. In addition to depreciation, the interest on bonds, $4703, has also been allowed for the seven-month period. After deducting these two items, Mr. Craven states, a net profit of $14,897 remains, which represents a return of 8½% on the investment of $175,000.

In addition to a favorable return on the garbage plant, says Mr. Craven, a considerable saving not shown in the figures above, is being made in the collection end. In the seven-month period during which the city did the collecting in 1918, the total cost was $29,766. This covers the summer months, when the costs are heaviest. On this basis, however, the costs for the year would be $51,000, approximately $2000 more than the old contract price with the former reduction company, and $36,900 less than the new price of $87,900, the amount of a bid received for the collection and reduction of garbage for a year.

Mr. Craven sums up by saying that by taking over garbage collection and disposal the city has saved at the rate of $37,000 a year to the taxpayers, neglecting altogether the net profit of practically $15,000 for a seven-month operation of the garbage-reduction plant.

Auxiliary Outlet Gate Relieves Main Gates of Dam

Drillers on Suspended Platform Cut Opening in Gate Well to Avoid Operating Main Gates Under High Head

By R. C. E. Weber,

Assistant Engineer, United States Reclamation Service, Orland, Calif.

OPERATION of the original service gates at the East Park Dam of the Orland, Calif., project of the United States Reclamation Service has always been somewhat difficult under high heads. The gates are 48 x 60 in. When operated under the full head of 65 ft. for the first time in 1911, scoring of the bronze bearings resulted. New bearings were substituted in 1911 and 1912 on both gates, which resulted in improvement in that the new bearings did not score, but still under full head the gates were operated with considerable difficulty.

To eliminate the necessity of operating them under high head it was determined to install an auxiliary gate at a higher level which would furnish sufficient discharge till the water surface in the reservoir reached an elevation that would permit of operating the lower

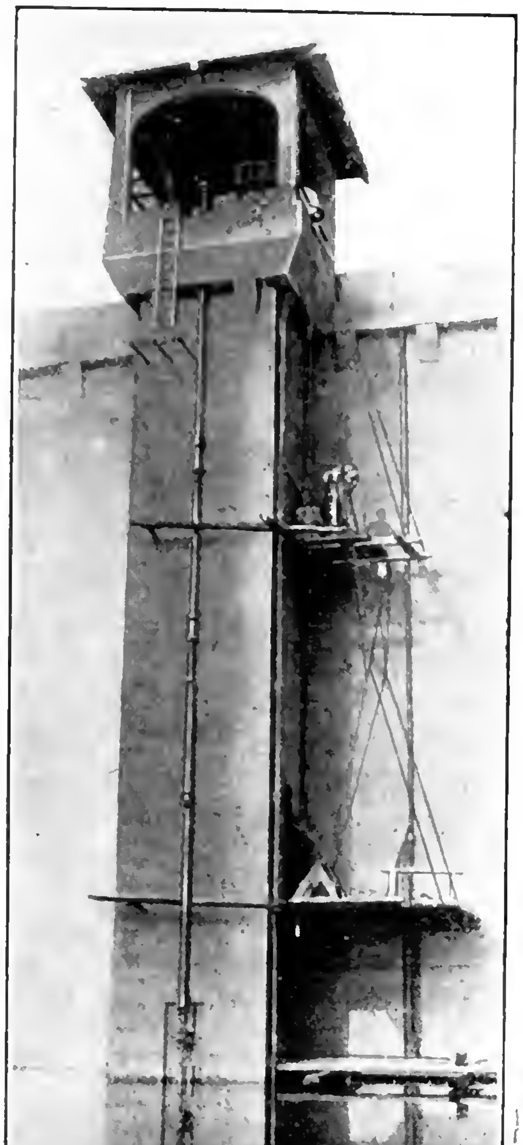
PUTTING ADDITIONAL GATE IN GATE WELL AT DAM

gates with less difficulty. Accordingly a 36 x 36-in. gate was designed, to be located in the north side of the gate well, with its sill at El. 152. Full reservoir level is at El. 188. The gate was designed by the Denver office of the United States Reclamation Service.

The work of installing the gate was commenced on Oct. 12 and completed Nov. 5, 1916, with a force con-

sisting of the writer in charge and two experienced drillers. With the exception of the help of an additional man at the time of raising the gate stem into position, this force performed all the work of installation. The water in the reservoir stood at El. 143, or 43 ft. above stream-bed level at the dam, which precluded the use of scaffolding.

A platform 8 x 12 ft. was suspended from the top of the gate well by means of wire ropes and was secured with its floor 18 in. below the sill of the new gate. The 36 x 36-in. hole through the tower wall, 21 to 24 in. thick, was driven by first drilling a 1½-in. hole and then removing the concrete with steel gads and sledgehammers. The opening was completed in 1½ days by the two drillers. No reinforcing was encountered, the walls of the gate well being plain concrete. The 12 horizontal holes for the bolts securing the gate frame were drilled with ⅞-in. drill steel fitted with a 1½-in. bit. In drilling the vertical hole through the 4-ft. tower coping, for the 2 11/16-in. gate stem, a 1-in. core hole was first drilled and followed by a 4-in. drill. The smaller hole was made to avoid cleaning while working the 4-in. drill and also to serve as a guide for the latter. Numerous large stones were encountered by the larger drill and the resulting hole was irregular in section. It was rounded out by means of smaller drills and chisel-pointed steel. The rocks encountered were boulders, and very hard to drill and break.



LOWER PLATFORM IS FOR WORK AT GATE AND GATE OPENING. UPPER PLATFORM IS FOR PLACING THE GUIDES OF GATE STEM

For drilling the four horizontal holes for each of the three stem guides, a smaller platform with floor 4 x 6 ft. was swung from the top of the gate well. This platform was of such weight that it could be raised and lowered readily to the different elevations of the stem guides. The holes for the stem guide bolts were drilled after the gate frame, leaf, stem and stand had been properly adjusted.

The gate stand was taken to its position on the top of the gate well by means of the steps leading to the top of the dam. Block and tackle were used in raising and lowering it over the steps. The gate frame, stem and leaf were floated to the dam on a raft and hoisted into position by means of a 4-part line of 1¼-in. manila rope and double blocks. A lead gasket 1½ in. thick was placed between the concrete and the gate frame. This was calked after the frame was secured to the wall by anchor bolts, thus securing an even bearing for the frame as well as a watertight junction between wall and frame. All anchor bolts for the gate frame and the stem guides were grouted into place with a rich mixture of sand and cement. Holes for the anchor bolts for the gate stand were drilled after final adjustment of the stem and stand. These bolts were secured to the floor of the gate well by babbitt. The total weight of the gate complete was 3017 pounds.

Engineer Arbitrators Fix Value of Water-Company Property

Time and Money Saved by Engineers on Ground After Their Representatives Had Made An Inventory

BY FARLEY GANNETT
Consulting Engineer, Harrisburg, Penn.

ONCE more a board of engineers has satisfactorily and promptly valued a water-works plant for purchase by a municipality. On July 1, 1918, the Borough of Huntingdon, Penn., purchased the plant of the Huntingdon Water-Supply Co., after years of controversy in the courts. The purchase followed the award of a board of arbitrators consisting of five engineers. The price set by the board was $157,684.

When the plant was built in 1885 a clause was inserted in the franchise providing for the right of purchase by the borough at the end of each ten-year period, the value to be set by a board of five engineers from which there was to be no appeal. The borough had the right by the contract with the company to refuse to buy the plant after the price was set by the arbitrators, but the sale took place and the borough is now operating the property. The company, according to the terms of the contract, had to sell if the borough decided to buy at the price set by the board, and although the price was less than that for which the stockholders were previously willing to sell the property, based perhaps on the earnings, it was not so much lower as to cause a great sacrifice. The company carried the plant value in its books at approximately $220,000, and the county court had, a few years previous to the award of the arbitrators, set the value, for ratemaking, of approximately $135,000.

In 1915, one period of 10 years having elapsed, the borough started proceedings, but these were objected to by the company, and after more than two years of struggle in the courts the arbitrators were finally appointed in the summer of 1917. The board consisted of Frederick P. Stearns, Boston; John M. Rice, Pittsburgh; E. W. Hess, Clearfield, Penn.; Fred C. Dunlap, Philadelphia, and Farley Gannett, Harrisburg. A detailed inventory was made by representatives of Mr. Rice and Mr. Gannett, working in the field together, and this was presented to the board sitting in Huntingdon, when unit prices were applied after inspection of the plant and the taking of some testimony.

The plant consists of a timber intake dam and brick pumping station, a reservoir and a filter plant, with the normal pipe lines, valves, hydrants, etc., for a town of 7500 population.

Extracts from Valuation Decision

The board was in session only 10 days, and handed down its decision on Jan. 28, 1918.

The following extracts are from the report of the board:

The schedule upon which the above valuation was based includes the real estate, buildings and other improvements, water rights, dam, intake basins, old pumping station and equipment, reservoir, filter plant, tanks, piping system, services, meters, fire hydrants, tools, supplies, equipment, office furniture and new filter-plant drawings. This schedule represents the property as of Sept. 1, 1917.

The schedule does not include the electric pumping station and its equipment, which are not included in the valuation, as the evidence presented to the board of arbitrators, including the contract between said water company and the electric company, dated July 20, 1907, indicates that this pumping station and its equipment are not owned by the Huntingdon Water Supply Company.

Guided Largely by Reproduction Cost

The board of arbitrators, in its determination of the value of the different parts of the water-works, has been guided largely by the cost of reproducing such parts, using as the unit prices for property, labor and materials the normal prices of recent years and not the abnormal prices which now prevail as a result of war conditions. No records could be found from which the original cost of the various property units constructed prior to 1900 could be ascertained, but for subsequent years records were available, and these have been used in many cases either to determine the cost or to aid in determining the reproduction cost of parts of the property added during and after 1900.

After determining the cost of the various parts of the property in active use as if they were new, a deduction has been made to cover the depreciation in value of each part, the intention being to make the amount of depreciation represent as nearly as practicable the actual loss of worth of the particular part resulting from the expiration of a part of its serviceable life, including the effects of wear and physical decay.

For parts of the property not in active use and no longer serviceable for future use, the salvage or scrap value has been allowed.

In determining in the first instance the cost of reproduction of the various property units, no allowance was made for contingencies or for omissions from the schedule, or for the overhead costs of promotion, organization, financing, administration and legal and engineering services. To cover these and other similar costs, a sum has been added to the previously determined cost of the real estate and plant.

In order to cover the additional cost incidental to the necessary use of money during the period when the works were under construction up to the beginning of their regular operation, a further sum has been added for interest during construction.

The total amount determined in the manner indicated has been adopted as representing the value of the water-works as a completed property ready for operation. A property of this sort requires still further expenditure in order to develop the business to the point where an adequate return is secured. Therefore, to the above total amount, a sum has been added to represent the increased value of the property as a going concern with a developed business and established earnings.

Several interesting points came up in the appraisal and are discussed briefly below:

Real Estate—The company owned a large tract of land, on a hill behind the town and extremely well situated for a reservoir. On a small part of this tract the distributing reservoir was built. The testimony showed that to have bought only so much of this land as was needed for the reservoir would have cost almost as much as the whole tract cost. Three real-estate dealers were engaged to value the real estate for the board of arbitrators, giving their opinion of the value of the property without regard to its value for water purposes, and to this value the board added what it deemed the proper amount for this use.

Filter Plant—A filter, built in 1900, but now seldom used, was treated as nearly obsolete but having some value by reason of the sale value of the machinery and equipment. Plans had been drawn covering a new mechanical filter plant, and allowance was made in the valuation for the cost of these plans.

Pumping Station—A steam pumping station and equipment of boilers and pumps were constructed at the time when the plant was built, but for several years had not been used, as the pumping was being done by electric pumping equipment. The new station and its electrical equipment were built by an electric company from which power was purchased. This contract provided that at the end of 10 years the pump station and equipment would become the property of the water company. This station was not included in the inventory or valuation, and the old steam station was included at a considerably depreciated value.

Going Value—A separate sum was added to the physical value to cover the "increased value of the property as a going concern with a developed business and established earnings." In this case the business was profitable, but had undoubtedly gone through a period in its early history during which for a few years the profits did not cover outlay and interest. As this plant was being purchased by a municipality, its value would not be subject to state regulation.

Speed and Cost of Proceedings

The arbitrators took their oaths of office July 24, 1917. The detail inventory was then made, the report was filed with the board of arbitration two months later, and by the end of January the value had been set. Compare this with the time consumed by the average rate-valuation case before a court or a public service commission. The writer has not been connected with a rate case before such a body which has taken less than 18 months for a decision to be reached, and then there often have followed appeals to superior and supreme courts.

The cost of the arbitration proceedings, exclusive of lawyers' fees to both sides, was only about 2½% of the value of the plant. This cost was charged equally to the borough and the water company in accordance with the terms of the contract, which also provided that if the borough had refused to buy the plant it would have had to pay the whole cost of the arbitration.

If, before throwing matters concerning water rates or valuation for purchase into courts and before public service commissions many of which are overloaded with work, the utilities and municipalities would agree to put these matters up to boards of arbitration composed of engineers they would, as a rule, get much quicker results, and I believe just as impartial results, and

at less cost. It is not the thought of the writer that boards of arbitration should replace courts and commissions in handling all such work, but it is a fact that, as more and more such work is disposed of thus, the strain on the judiciary and public service commissions will be lessened and prompter results obtained. Of course, where grave legal questions are involved, such matters would have to be solved by a legal body, but where simple matters of value only are involved the cumbersome machinery of courts or commissions is not essential, and results based on fairness and justice can be obtained by boards of arbitration promptly and inexpensively.

Another advantage of arbitration is that the decision is reached by men who are, usually, entirely familiar with the plant, meetings are held on the ground, and disputed questions can be settled by inspection of the article in dispute. A great deal of information and data can thus be obtained first-hand by the board or its members, and it does not become necessary to rely entirely upon often conflicting and prejudiced testimony.

An instance in point arose at Huntingdon. It was stated that a considerable amount of the pipe was laid in rock cut, and the board examined in a body certain sewer trenches then in process of excavation, as well as numerous test pits dug at selected points over the town, and made up its own mind concerning both the amount of rock excavation and the nature of it.

At another time, in order to settle certain questions relative to the class of cast-iron pipe used and its condition, a section of pipe which has been in use about 30 years was opened up and a section of it was cut, examined, weighed and measured by the arbitrators.

The practice of the Pennsylvania Public Service Commission is to order engineering conferences to be held between engineers representing the commission, the complainant and the respondent company. At these conferences the inventory is usually agreed upon, and often the complete reproduction value, less depreciation, and sometimes the historic cost. This conference of engineers reports its findings to the commission, and testimony is taken only on points not agreed to by the engineers. Often the operating expenses and rate of return have been agreed to at these conferences, as well as the segregation of the property between domestic and fire service. This is going a long step in the direction of decision by arbitration, but the trouble with this practice is that the commission's engineers cannot hand down decisions and must turn their results over to the commission, to await the long and tedious routine of procedure of testimony, argument and filing of briefs by attorneys.

Devastation Wrought by the Great War in Belgium, Serbia and Italy

By Major Daniel T. Pierce
American Red Cross, Paris, France

For the benefit of those contemplating professional work or business undertakings in the three countries named, concise reviews of the damage done and some of the general conditions prevailing have been prepared for "Engineering News-Record" by Mr. Pierce.—EDITOR.

Belgium: A Huge Total of Destruction

BELGIUM'S bill against Germany for damages has now been presented, at least in part. It does not include personal losses, which at the present time are being determined by tribunals throughout the country. These tribunals are open to the poorest householder, shopkeeper or farmer, and are making a record of every loss for which compensation is claimed, from a farm to a chicken. The statement is made on good authority, but not officially, that the personal losses, which include private structures of all kinds, the equipment of factories, etc., will equal the "state losses," the total of which, as submitted to the Reparations Committee of the Peace Conference, is \$3,000,000,000.

The total just mentioned includes an item of \$750,000,000 for damages and destruction of railways, posts and telegraphs. The other important items do not cover damage or devastation but refer to war expenditures (\$600,000,000), war taxes paid to Germany (\$500,000,000), the relief of the Belgian population (\$100,000,000), etc. Taking the situation as a whole, west of Brussels the Belgian railways may be described as in a state of chaos. At regular intervals there are deep holes in the right-of-way, with the rails twisted and standing upright in the air. Innumerable bridges and conduits have been blown up, and all sorts of structures, such as tanks, towers and stations, have been demolished. One of my informants, who asserts that he was an eye-witness, says that as the Germans retired they mounted a heavy gun with a deflected muzzle on a flat-car and this gun, as it was drawn over the lines, was fired into the receding track. I should say that this was merely a novelty in the general program, for it is evident that the greater number of the culverts and other vulnerable spots along the line were blown up from below. I am told that conferences are already under way between the Belgian Government and American firms with a view to arrangements for the reconstruction of the Belgian roads. An enormous amount of material and labor will be required to put them into operating condition.

Not only the railways but the roadways were in many places systematically destroyed, the most effective damage being done, of course, by demolishing bridges, but here and there it is evident that mines were exploded under the solid roadbed.

On the Belgian state railways, out of a total of 4150 km. of track, 1100 km. have been completely destroyed and 410 km. "rendered useless." Destruction is especially severe in the Borinage coal valley, in and around Tournai; in the vicinity of Bruges, Ghent, Courtrai and Ostend. The whole railroad system of west and east Flanders is classed as practically destroyed.

The great bridges over the Meuse at Liège, Namur,

Dinant and Anseremme, as well as the bridges leading in and out of Ostend and Bruges, are classified as a total loss. On the Ghent-Terneuzen canal eight bridges were destroyed, notably the two important structures at Selzeate near the Dutch frontier which weighed 3,000,000 lb. each. The total destruction in weight of bridges in Belgium totals approximately 100,000,000 pounds.

The block-signal system of the Belgian Government railways was entirely removed and replaced by a German signal system which is now useless, since the Belgian locomotive drivers cannot read the signals. Telegraph lines, telephone wires and all portable stores and materials were likewise removed or destroyed.

The Germans appropriated 2614 locomotives out of a total of 4593, or 57%. They also removed 9062 passenger coaches out of a total of 10,812, and made way with 80,568 freight cars out of a total of 94,737 owned by the Belgian railways at the time of the outbreak of the war. The actual value of material, cars and locomotives taken away, plus the damages to the Belgian railroads, is placed at $1,000,000,000. This does not include damages to interurban steam railroads owned by private companies which have not yet put in estimates of their losses.

A Huge Total of Destruction

The number of dwellings and other buildings destroyed in Belgium is officially stated to be 45,000. Of these 20,000 were wiped out in 1914 and the remaining 25,000 destroyed in the following years of the war. If, however, one considers only the buildings ruined, he will get a very misleading idea of what Belgian cities and innumerable small villages have suffered. Louvain, Dinant, Dixmude, Ypres, Termonde, Roulers—to name only a few of the larger places—together make up a huge total of destruction, while Bruges, for example, would add only a few to the list of ruined buildings. But more than 60 of the 83 famous bridges of Bruges were blown up in the last days of the war, and their destruction is a far more serious matter than the demolition of an equal number of houses.

There is also a vast although invisible loss in the deterioration of all public improvements, on which little or no maintenance work was done for more than four years. This is likewise the source of very serious damage to canals. The locks and sluices have been neglected and allowed to rot. Channels have filled up and, owing to continued neglect, it will take a long time to restore them to operating condition. This is also true of the Antwerp port facilities. At the present time this port is in shape to handle only about 60% of the pre-war tonnage. The lack of oil and of cable has led to serious deterioration of all hoisting machinery. Wood, on the other hand, seems to have been relatively plentiful. The Germans brought in quantities of lumber, and among other things that they did not have time to take away with them were several million feet of timber, about 10 x 10 in. in size, now stored in great piles near Bruges.

According to the Belgians, the Germans acknowledged that the value of raw materials and machinery moved from the country up to January, 1915, was $400,000,000, and according to a semi-official statement made by a Belgian official to a representative of the London *Times* the value of material and other equipment carried away by the Germans since that day would greatly exceed the sum stated. Not only were whole establishments robbed of every scrap of equipment, but the country was systematically looted of brass and bronze, even the smallest ornamental metal work being removed. In some hotels the brass door knobs and bolts were carried away, as was reported during the war. In the neighborhood of Liège, where there were a number of steel plants, the blast furnaces, mills and construction plants have been totally denuded of all heavy tools and equipment; even the bellows were taken.

In the mines the damage is not nearly so great as was expected, perhaps because, as is certainly true in some cases, the Germans were deterred from destruction by President Wilson's threat of reprisal if such destruction were attempted. Throughout the war the coal mines were systematically worked, but only to about 50% of their capacity. Apparently, only electric motors and cables were removed. The lifts and galleries of the mines are in good shape, but because of lack of oil and misuse of tools it will be necessary to replace about half of the machinery. The coal mine at Limbourg is the only one reported ruined by the admission of water. The cement industry, which was making good progress, has suffered very little. An expert who has made a survey of this industry states that all it needs to go ahead is belts and bags, which at the present time are unobtainable.

In the glass industry, where the production was important and profitable before the war, the plants have been reduced to about 50% capacity, and important repairs must be made before the industry can resume. The cutting tables were the only equipment carried away, for some reason. Considerable stocks of sheet glass were left, but no bottles.

The textile industry is another one that has not suffered severely by destruction or the removal of machinery. Very few weaving frames were taken, and Belgium's wool, cotton, hemp and flax plants could resume at present on a basis equivalent to 70% of the pre-war output—if raw materials were obtainable.

Agriculturally, Belgium has not suffered nearly so severely as France. Except for a comparatively limited area in the fighting zone, all of the lands heretofore devoted to farming could be put back under cultivation immediately. Here again there is the possibility of the resumption of normal industry defeated by lack of tractors, tools and transportation.

Almost No Horses Left in Belgium

There are practically no horses left in Belgium, which for centuries has produced the most valuable heavy draught horses in the world. These were systematically collected and carried away by the Germans. At a small town near Poperinghe last year I found a patriotic old Belgian doctor who had, by purchase in France, got together an Andennes stallion and six mares which were, he told me, all that were left of this famous breed. This, of course, was merely the exaggeration of despair, but, so far as being available for work purposes is concerned, the famous Belgian draught horse has, in fact, disappeared from the country. The Government has arranged to buy 25,000 Canadian horses and is endeavoring to buy 100,000 horses from England, presumably those that have been used for military transport. Of farm animals, cows and pigs, hardly a trace remains, and eggs even at the present time (February) are almost a curiosity in Brussels.

It would be more satisfying if it were possible to give an official estimate of actual destruction in Bel-

gium, but this, as in other countries, is impossible, because such figures as have been used in making up Belgium's bill for damages include enormous items for losses other than those that can be called damage to property. They even include losses due to the fact that the industries of the Belgian Congo have had to be abandoned. But after even a motor-made inspection of the destruction of towns, villages and isolated houses, factories, mines and plants, it is easy enough to believe the statement already mentioned that those Belgian losses classified as personal will equal, at least, the state loss of $3,000,000,000.

Wherever figures in dollars have been stated here they have been arrived at by counting five Belgian francs to the dollar.

Serbia: Transportation System Nearly Wiped Out

ALTHOUGH physical devastation in Serbia is bad enough, it is not so bad as the social devastation resulting from the movement back and forth over the country of three hostile armies during a period of more than four years. The population of about 5,000,000 has been reduced by more than 1,125,000, and, worse than this, the loss is mainly among the younger and more virile part of the population. This has an important bearing upon the subject of reconstruction, for with all men between 20 and 50 mobilized and those who have not been killed still in the army and most of them out of the country, no supply of labor worth considering is available. Furthermore, Serbia was not a land of artisans but of farmers, 85% of the population being engaged in agriculture.

Serbia is now reaching out for the aid of the United States in rebuilding the country, and it is for this reason that some facts in regard to conditions that prevail both in old and new Serbia are included here, although they do not relate strictly to devastation. One of the ministers of the new "Government of the Serbs, Croats and Slovenes" (which is the name by which the Government of Serbia prefers to be known), who was in Paris in February, was asked what America could do; what America could supply. His answer was, "Everything." The country is literally denuded of finished products, such as clothes, furniture, hardware, prepared woods, metals and glass.

And, to make matters worse, the finishing blow to the country's ruin was struck in October and November of last year, when its transportation system was almost completely wiped out. The main line of railway traverses the country from north to south, extending from Salonika on the Aegean Sea to Nish and Belgrade, with a branch line to Semendria. A through highway, poorly constructed, with many steep grades, parallels the railway. The main line of the railway from Belgrade to Nish continues through Pirot and on to Sofia in Bulgaria, forming a part of the "Berlin-Bagdad Railway."

This main line, as well as many of the branch lines, was destroyed by the Germans, Austrians and Bulgarians as they retreated through Serbia in the last weeks of the war. Bridges, large and small, and almost innumerable culverts were blown up. As the road parallels the Vardar and Morava rivers, it was carried over many smaller streams emptying into these rivers. These multiplied the number of bridges to hundreds, and all are destroyed. There were only three tunnels, but these also were destroyed. The roadbed itself was not disturbed except near Belgrade, where mines were systematically exploded every 1000 meters.

The main highway was just as systematically attacked, all bridges being mined. Originally, there appears to have been a stone base in the road, but this is now covered with a deep layer of mud in which the ruts are so deep that heavy camions find it almost impassable. On the highway, by Dec. 31 the bridges between Skoplie (Uskub) and Semendria had been temporarily repaired. A surveying party which made the trip between these two cities by camion was 11 days on the road. The only effort then being made to fill the holes and ruts was the employment in a desultory way of a few Bulgarian prisoners.

Thus, the two main arteries of Serbia's transportation system are virtually out of existence so far as supplying the needs of the country is concerned. The railroad has been repaired as far as Skoplie, and late in December a temporary bridge over the Vardar at Strumitza was opened. Two weeks later it was reported that trains were running to Kumanovo, and it was promised that by the end of February trains would run as far as Vranja, but as this would mean the rebuilding of a number of important bridges it hardly seems possible of accomplishment. From Kumanovo to Semendria and Belgrade not a wheel is moving on the railway except for about 12 miles south of Nish where the road had not only escaped destruction but where a locomotive in operating condition had been left. By January the Nish-Sofia line had been repaired from the Bulgarian frontier as far as Pirot, but no effort was being made to open it between Pirot and Nish. Efforts of the French and English to operate camion service between some of the important towns are defeated by the fact that the trucks cannot negotiate the roads. The camions used were chain-drive, and most of the time was spent in replacing chains. Trucks must be very lightly loaded and must carry their own gasoline, as no gasoline is to be had in Serbia north of Uskub. To complicate the transportation problem, especially in regions off the main line of highway, practically no horses or mules remain. Their skeletons are scattered by the roadside for almost the entire stretch of highway from north to south. Oxen are a little more plentiful in the north.

So desperate is Serbia's need that she has made an urgent appeal for details of the United States Army to take charge of the reconstruction of the main line of the Serbian railway.

Property and Population Records Destroyed

As for records, national or local, there are none. The Serbian officials who have returned to their posts find that the Austrians and Bulgars who assumed charge of the local governments destroyed or carried away everything, and when the Serbian prefects came back to their posts they found only empty buildings. There are no records of either property or population except fragmentary reports prepared by the Austrians for the purpose of rationing the country.

When the fortunes of the war changed last year it seemed to have been a surprise to the hostile armies occupying Serbia. They had sent home great quantities of food and furniture when the shortage in Austria and Germany became acute. Now they pillaged the country of everything that remained. Into Austria and Germany were transported carload after carload of

furniture, bedding and clothing, so that at the present time even those who were comparatively well off before the war have nothing but the clothes in which they were standing when the enemy departed. In this sense Serbia is devastated throughout.

But in the sense of physical destruction the devastation is confined to areas extending in strips along the northern and southern borders. In the north, along the Danube, the cities have suffered severely. About half the buildings of Belgrade are damaged, and of this proportion about 20% may be classified as destroyed. Important parts of Belgrade, the capital, were destroyed when it was originally captured by the Austrians in November, 1914, and again when it was captured by the Germans in November, 1915. Additional injury was inflicted when the Austrians and Germans departed in November, 1918. The industrial portions of the city suffered more than others. The largest tobacco factory is now only a crumbling ruin. Of the two largest hotels one is completely destroyed, and the other is in such bad shape as to require complete interior reconstruction. The royal palace is not habitable, and the University of Belgrade is seriously damaged. All over the city are buildings which, while they appear from the outside to be intact, are found, on closer inspection, to be gutted. Semendria, about 30 miles east of Belgrade on the Danube, is in much the same condition as the capital. Shabatz, 30 miles west of Belgrade on the Save, is in even worse condition.

Along the southern boundary of Serbia, which was the battlefront during the period of occupancy, there was, of course, serious destruction. Monastir, the second city in size in Serbia, was badly injured by shellfire. Officials estimate that 35% of all the buildings in Monastir have been so badly damaged as not to be repairable. A great many small villages in this area may be classed as wholly destroyed so far as providing human habitation is concerned.

Innumerable Buildings Blown Up

In addition to the destruction in the extreme northern and southern zones, there is sporadic destruction all over Serbia. The worst of this is found in the region on the line of retreat of the hostile armies. Innumerable buildings were blown up. The railroad station at Leskovatz, in central Serbia, a large structure, is now a mass of ruins. In other towns one is struck by the evidences of a practice of blowing out the windows and doors of the buildings facing on the principal streets, and those who have recently made a journey of 320 miles through Serbia by camion say that their most vivid impression is that of an avenue of doorless and windowless houses. No glass is obtainable in Serbia, and the practice has already been adopted of bricking up wall openings to within 6 or 8 in. of the top, depending only on such light and ventilation as may come through the door when left open or from the apertures at the top of what formerly were windows. Besides actual physical injury, hundreds of buildings have been rendered useless for a long time by indiscriminate disposal of filth and the use of structures of all kinds for stables.

The coal mines in Serbia, never a very important factor, are not operating now. There is wood, but no way of utilizing it. The fuel problem is therefore very serious, and the street railway in Belgrade in December and January repeatedly suspended operation for lack of fuel. The lighting plant was operated only for a few hours in the evening. Here again we have emphasized the fact that the key to Serbia's rehabilitation and the thing that must precede all efforts at reconstruction is the repair of her transportation system.

Most of the foregoing facts were taken from the report of the survey completed in January by Homer Folks, chief of the mission sent by the American Red Cross to inquire into post-war effects in the countries of southeastern Europe.

Italy: Physical Harm Unexpectedly Small

Unlike France, Italy has failed to keep systematic records of the destruction of public and private property by the enemy. It is impossible, therefore, in the case of Italy to present even the approximate figures that are available for France. Upon inquiry of representatives of the Italian Government attending the peace conference in Paris, it could be learned only that certain figures showing damage to Italian towns would be presented, but at the same time it was stated that these figures included consequential damages, loss of use, etc., making them valueless for the purpose of arriving at a determination of the actual damage to property suffered by the towns within the war area. But from several surveys that have been made it is possible to give a rather definite idea of the damage.

The actual destruction of buildings and other physical properties in Italy, while sufficient to give rise to a great social problem, is less than one would expect. The greater part of the fighting between the Austrian and Italian armies was in Austrian territory. It is to be considered, however, that this territory is now in the hands of the Italians and will presumably remain in their hands, so that whatever reconstruction problem exists will be one with which the Italian Government will have to deal. The area in which destruction was suffered is limited by the fact that in the invasion by the Austrian army of northeastern Italy, the Italian army opposed so slight a resistance until the Piave was reached that there was not much destruction by shellfire, and in the Austrian retirement there was likewise little resistance after the enemy had been driven from the river.

Physical destruction is, therefore, to be found almost wholly in three regions: Along the Piave, where the Austrian invasion was stopped and at which point occurred the heavy fighting in the final great invasion; in the Val Sugana above Bassano, and in Val Lagarina near the frontier. The Piave runs through one of the fertile and populous districts of northern Italy. Val Sugana and Val Lagarina are in the mountainous regions on the northwestern frontier of the province of Veneto.

While modern artillery carries for great distances, it appears that the area in which anything approaching total destruction of buildings occurs is limited to a very few miles. On the Piave, for instance, where the heaviest fighting occurred over a period of a year, there are many buildings standing yet, intact or only slightly damaged, up to within 5 km. of the river. But within this area of 5 km. on both sides of the river the greater number of the buildings are either destroyed or more or less damaged. Further away from the river this destruction is the exception, not the rule, although in certain cities more or less serious damage to buildings is found, especially where large numbers of troops were quartered, and those in which some

effort at resistance was made during the Austrian retreat. A notable instance of this latter condition is the town of Sacile, a village of a few thousand population about 25 km. from the Piave. In this town practically every house was damaged and a great many were destroyed. The Austrians made a stand here and also had used the village more or less as a headquarters for some time, in consequence of which it had suffered seriously from air raids as well as from bombardment.

At Pardenone, a city of 16,000 inhabitants, 10 km. further east, only a few destroyed buildings were found, but there were many of which only the walls and roofs remained, the doors and windows having been removed and in some instances even the partitions and floors torn out to provide fuel. The buildings occupied by the poor were much less damaged than the finer structures.

There are no large cities on the Piave, but there are numerous small towns ranging in population from 13,000 downward. Treviso, a city of 40,000, is some 15 miles west of the Piave, and was not injured by shellfire, though a good deal of damage was done in some quarters by bombing. It is officially estimated that 16% of the buildings are in some measure damaged.

As a whole, the province of Veneto may be classified as agricultural. A belt including the territory 5 km. on either side of the river would embrace a population of about 175,000. Within this area the destruction is not in all instances complete, but it is officially estimated that there are 200,000 persons in this belt and adjoining it whose homes were entirely destroyed. In addition to these, there are undoubtedly an equal number whose homes were considerably damaged, but not beyond repair. The homes of still others were looted of all furnishings, but the buildings remain intact.

No Comparison Between Italy and France

It would be a mistake to draw any comparison between Italy and the devastated agricultural regions of France. The region in which the land in Italy has been seriously injured from an agricultural standpoint by shellfire and trench operations has been very limited. Except along the lower Piave there are few shell holes in the fields or along the main roads, and a great majority of the trees along the road which crosses the Piave at Nevassa are still standing practically uninjured. The general appearance of this region is in marked contrast to such a region as the valley of the Somme, which was fought over repeatedly and in which all vestiges of permanent construction have disappeared. The land in the Somme is pitted in every direction, as far as the eye can see, with shell holes, and crossed by an interminable tangle of trenches and barbed wire. There is little vegetation. The difference is partly due to the fact that the Piave formed a natural barrier and the fighting was across that river, while it was along the Somme.

Very few refugees have returned to the devastated regions of Italy; this is due partly, no doubt, to the opposition of the military authorities. This opposition is very effective, because the Government controls all means of transport and there are only a few temporary bridges across the Piave. One judges from conversation with Italian authorities that the return of the refugees is not thought to be immediately desirable or necessary, and no program has been worked out, as in France, for even a gradual return of the former inhabitants. The Italian Government has considerable hesitation about entering upon temporary housing on a large scale. Its attitude in this respect is due to the rather curious fact that the temporary houses in southern Italy provided after the earthquake still remain in use, and no steps have been taken there for permanent construction. Meanwhile, the temporary housing has become extremely dilapidated and unsanitary. The people of the north are undoubtedly more progressive, but the Italian Government is evidently desirous of avoiding temporary housing if possible.

The occupied territory covering all of northeastern Italy, going west as far as the Piave River, inclusive of the Asiago plateau, forms about 5% of the total area of Italy and provided homes for 4% of the population. Almost 1,000,000 persons remained in the occupied territory, and their care at this time constitutes a much more urgent problem than does the rehabilitation of the devastated region. It is a problem complicated by the destruction of the railways, the damage to the roads, and the blowing up of all the bridges across the Piave River.

As in the case of all the regions devastated by war operations, in all countries, it is well to remember that the problem of physical reconstruction of buildings, while perhaps the most engaging, is also the most remote. The disturbance of soils and the wrecking of such water and sewerage systems as existed have the most serious results, as would be expected, and it is the dangers from such sources that must be first met. For example, the typhoid fever death rate in northern Italy, which had fallen from 27 per 1000 of population in 1911 to 19 in 1914, is now, on the basis of very imperfect statistics, placed at 26 and is probably much greater.

Decay of Timber in Mexican Low Coastal Plains

Inspection of Line of Southern Pacific Railroad in Mexico Showed Badly Decayed Condition of Untreated Pine

By J. D. Mathews

Engineer Maintenance of Way, Southern Pacific Railroad of Mexico, Empalme, Mexico

SAGGING trestles and rotted ties were found during the inspection of untreated pine construction on the Southern Pacific R.R. of Mexico, while redwood ties and cedar piling well withstood the same conditions of dampness in warm, moist coast lowlands. Six years is the probable life limit of untreated pine trestle timbering in this climate of the lowlands of Mexico, and redwood would be an immediate economy, as the replacement of pine ties and timbering would have to begin in two years after installation.

In December, 1918, the writer made a trip of inspection to investigate the physical condition of the unoperated portion of the Southern Pacific R.R. of Mexico lying south of the town of Acaponeta, in the state of Nayarit—a distance of about 103 miles. The operation of trains over this portion of the line had been discontinued by the railroad company in 1913 owing to the revolutionary disturbances, but the continuance of operation was attempted by the military authorities, until some time in 1913; since that time the line has been idle, with no attempt at operation.

This portion of the line was constructed between 1909 and 1912, reaching the City of Tepic with the close of December, 1911. The timbers in use in the

track and trestles are still those of the construction, and have had a service of from 7 to 9½ years. Portions of this line saw but a few months' operation, and none of it saw more than two years', with occasional use by the military authorities during the third. The present condition of the timber, then, represents one of decay only, destruction under traffic or mechanical wear not being a factor.

Pine timbers and, generally, sapwood of all timbers, decay very rapidly in the coastal plains of continental Mexico, bordering the Gulf of California, and particularly so south of Culiacan, the capital of the State of Sinaloa. Thirty or 40 in. of rainfall per annum causes the soils to remain damp a considerable portion of the year. This, coupled with a warm, moist atmosphere and associated with a jungle growth of grasses, underbrush and trees, and the whole soil covered with a tangle of vines, produces a condition that causes rapid destruction of those woods that do not contain, either naturally or artificially, a decay-resisting agent.

Untreated Pine Susceptible to Decay

Untreated pine is particularly susceptible to this decay, and more so when sawed as stringers, caps, ties and guardrail Creosoted pine, used in bulkheads, has suffered but little in the nine years since construction. Untreated pine, however, has rotted in various structures until trestles are sagging from their own weight, as they have not carried the weight of traffic for nearly five years. Thus, in the space of nine years, and absolutely uninfluenced by traffic loads for the past five years, a number of these trestles have rotted to destruction.

Decay attacks most readily the exposed end fibers, and traverses them longitudinally under a sun-baked shell of frequently respectable appearance. Ties that will crush under foot not infrequently present an almost perfect appearance, externally. Entering the end of the sticks, decay penetrates caps and stringers, sometimes but a few inches, but often for several feet, and, in cases, the entire piece is affected. Points of contact, also, are locations of proneness to decay. Stringers decayed at the ends and over the center caps are useless as such, although the major portion of the stick may be sound. Decay of stringers over the cap produces decay in the cap, if of untreated pine. If of redwood, however, the caps will be practically unaffected.

End panels of trestles have suffered more than the centers, but the centers have been far from immune. This is undoubtedly due to the fact that the end panels are in a more continuous state of dampness, being closer to the steaming earth, and also are more continually immersed in the shadows of the adjacent trees. The center panels are frequently over the tops of the trees and face the direct rays of the sun—always an enemy to the destroying microbe.

Nevertheless, while the timber in the center panels of the higher trestles will, undoubtedly, give the longest period of service, yet, in these lowlands the maximum length of life of untreated pine, under the best conditions, will probably not exceed 10 years, while by far the greater percentage will have disappeared in much less time. Such timber is seldom placed under more favorable operating conditions than as decking for our steel bridges, many of them on this line being 50 ft. or more above the water. Few of these structures have been in place more than eight years, and, with this length of service, under the best of conditions a heavy percentage of their ties and guardrail is completely gone.

Pine cross-ties have suffered most severely of all. Panel after panel of these ties is completely gone. This does not simply mean "have become unserviceable to the point of removal," but they have gone till the rails, over which no traffic has passed in five years, are crushing them down, or the tie has completely disintegrated—its place being marked by a mass of shapeless rot.

The lesson of the experiences is that untreated pine, in these warm, moist coast lowlands, will give but a few years of service. The pine cross-ties ceased presenting a condition for service an unknown period of time ago, as, long before they reached their present condition, they would have been unsuitable for operation. It is probable that three or four years under traffic would have been their average life. Likewise, trestle timbers had for the most part long since decayed beyond the point that would have sustained operation. As with the pine cross-ties, we have to look backward for the limit of time to which these trestles could have been operated in safety. Many of them passed this limit not less than two or three years ago, some of them more. It thus follows that six years will be the limit of life for much of this trestle timbering of pine, while but little of it will see a life of 10 years.

Redwood and Cedar Well Preserved

On the other hand, cedar piling, redwood caps and posts and redwood cross-ties stand out in strong contrast to the destruction of the pine. For the most part, cedar piling is only now approaching the point when renewals must begin. Redwood ties, in a number of actual counts of ties in track, when tested by picking and hammering with prospecting picks, showed up not more than 5 to 10% more or less doubtful cases of renewals required to the rail, under precisely the same conditions that caused such excessive decay in the pine.

It thus follows that redwood, displacing pine for cross-ties and trestle timbering in everything but stringers, will be not an ultimate economy but an immediate one, as renewals will begin in all replacements in pine in two years, and be continuous until the last stick will have been removed inside of eight years, while, with redwood, the evidence demonstrates a minimum of service of eight years, with an average and a maximum yet undetermined, but it is safe prophecy to state that it will be several years over the demonstrated minimum.

While the foregoing discussion is confined to the territory south of Acaponeta, yet the same conditions obtain on the operated line, with practically undiminished force, in the vicinity of the City of Culiacan. Further northward there is a noticeable reduction in this excessive decay, until north of the Fuerte River the decay approaches normal. This establishes the limits of the territory in which it will be an operating economy to substitute redwood for pine wherever mechanically possible as the State of Sinaloa and the lowlands of Nayarit. As we leave the lowlands and the elevation increases, approaching the City of Tepic, decay again begins to become normal. Just where the southern limit of excessive decay lies is yet to be determined.

High Relative Temperatures of Pavement Surfaces

Thermometer Readings Taken on Surfacings and on the Adjacent Lawns Show a Variation of from 9 to 22 Degrees

By G. S. Eaton

Assistant Division Engineer, Universal Portland Cement Company, Chicago, Ill.

Maximum temperatures of 124, 118 and 114° F. which were attained respectively by asphalt, brick and concrete pavement surfaces, according to observations made by engineers of the Universal Portland Cement Co., Aug. 6 and 7, 1918, were relatively high with respect to adjacent locations. From 11 a.m. to 6:30 p.m. the average readings for the three types of surfaces in the order named were 118, 113 and 108°. What the effect of such temperatures on rubber tires, horses' hoofs and shoe leather might be is questionable. It is well known that a great deal of tire trouble is experienced in hot weather because of the expansion of the air in pneumatic tires. Pavement surfaces at high temperatures would undoubtedly aggravate this condition.

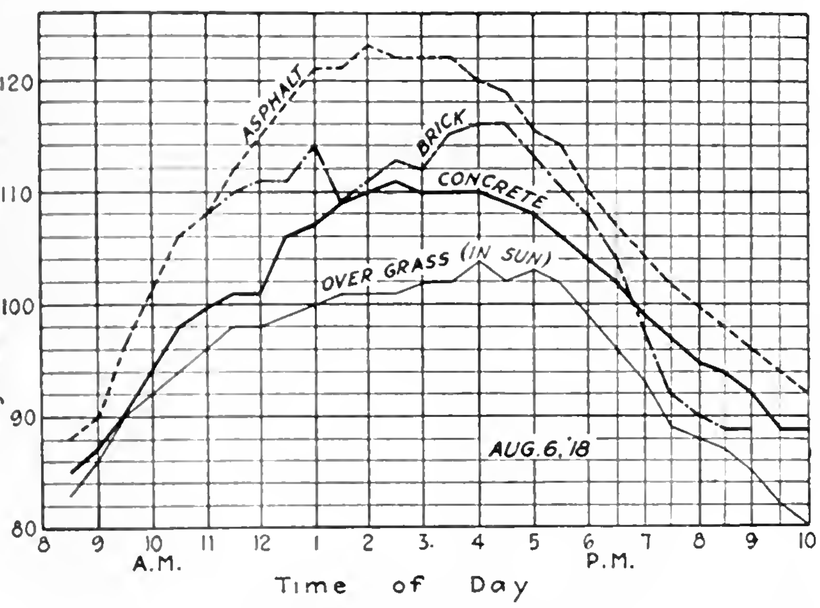


FIG. 1. SURFACE TEMPERATURES FOR VARIOUS TYPES OF SURFACING

During the middle of the day the effect of the pavements in heating the air above them was noticeable, as thermometers 1 ft. and 4 ft. above the roadways read from $3\frac{1}{2}$ to $4\frac{1}{2}$° higher than over a lawn in the sun. Temperatures above the pavements were found to be much the same, however, regardless of the type of surface. Over the asphalt, the readings averaged 1° higher than above the concrete, and $\frac{1}{2}$° higher than above the brick. After 7:30 p.m. the temperatures above the surfaces were practically the same as those of the surrounding air. The presence of large lawns and shade trees probably hastened the cooling and somewhat different results might be expected in the closely built-up sections of a city. Temperatures in the shade, 30 ft. away, were not influenced by the pavements.

The tests were made at Riverside, Ill., about 20 miles from Chicago. This place was far enough inland to escape the effect of lake breezes, and the three types of surfacing lay within a few hundred feet of one another. Absence of tall buildings and industrial plants with their accompanying smoke was another factor in the choice of location.

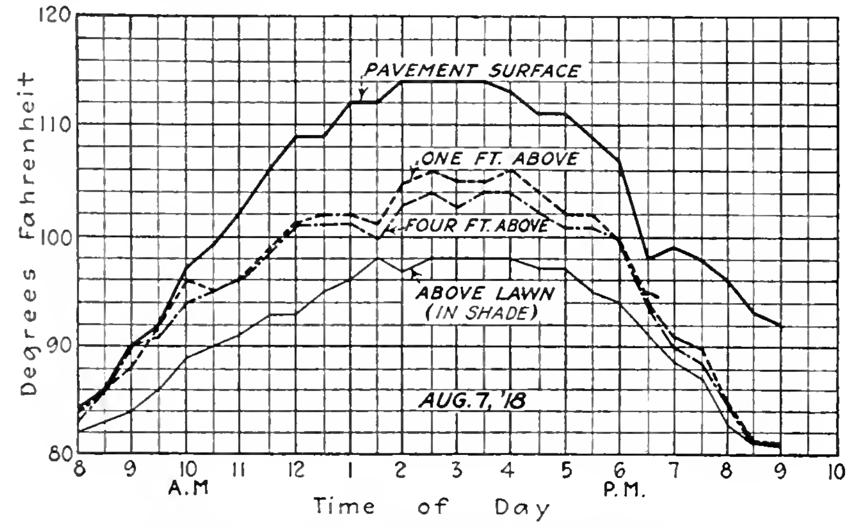


FIG. 2. VARIATION BETWEEN CONCRETE SURFACES AND VARIOUS ADJACENT LOCATIONS

Weather conditions were ideal during the period. The sky was almost entirely clear, and the maximum temperatures recorded for the two days by the Weather Bureau at Chicago were 102 and 101°—the highest of the summer.

For each pavement, readings were taken at the surface, 1 ft. and 4 ft. above, and 30 ft. to one side of the roadway in the shade above a lawn. An additional set of readings was taken 4 ft. over grass in the sun. Thirteen standard 25-cm. Fahrenheit thermometers were used, each protected from direct sunlight by a white paper or pasteboard cover. Readings were taken every half hour from 8 a.m. to 10 p.m.

At the pavement surface the thermometer bulb was placed in a small groove about 1 in. long, $\frac{3}{8}$ in. wide and $\frac{3}{8}$ in. deep. The groove was then filled with mercury to facilitate the transmission of heat between the pavement surface and the thermometer.

Figs. 1, 2 and 3 show graphically typical sets of readings plotted between temperatures as ordinates, and time of day as abscissas. Fig. 1 shows the difference between the various pavement surface temperatures and also the readings over a lawn in the sun. The drop in the brick temperature curve at 1:30 p.m. was due to the moving of the observation station on the brick pavement on account of the encroachment of shade. No point could be found on the brick surface that was in the sun for the entire day. The rapid drop in the same curve between 6:00 and 8:00 p.m.

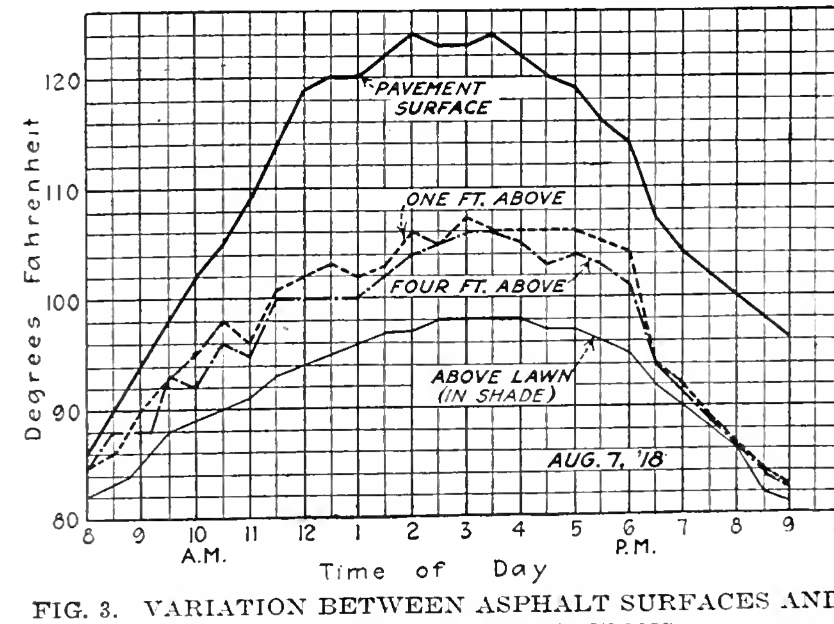


FIG. 3. VARIATION BETWEEN ASPHALT SURFACES AND VARIOUS ADJACENT LOCATIONS

was probably due to the proximity of the Des Plaines River, as air temperatures taken near by showed a similar drop.

Fig. 2 shows the relation, for a concrete pavement, between temperatures at the surafce, 1 ft. above, 4 ft. above and in the shade 30 ft. to one side of the roadway. Fig. 3 shows the same relations for the asphalt pavement.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Navy and Fleet Corporation Unfair to Their Own Draftsmen

Sir—In *Engineering News-Record*, Feb. 6, 1919, p. 298, I noticed a letter from Lloyd W. Weed commenting upon the wage award granted engineers in the Navy Department and the shipbuilding trades. He has quoted the War Labor Board's ruling of Oct. 1, 1918, effective immediately thereafter.

This explanation of what the Navy Department has done for engineers in general is absolutely wrong. The War Labor Board's awards were put into effect by the Emergency Fleet Corporation, and certain steel firms were forced to put in the rates under threats of cancellation of their contracts by the Secretary of the Navy.

The War Labor Board's rating was not put into effect in the Bureau of Yards and Docks and the different navy yards of the country. On Jan. 31 the Secretary of the Navy refused to make the awards retroactive to Oct. 1, 1918, and, also, the men of classes A, B and C, etc., were put in lower classes than their education and experience, of which an oath was taken, called for by the War Labor Board's ratings. This condition exists in general in the Bureau of Yards and Docks and the different navy yards. In addition to this, these increases in salary were made effective in the Bureau of Yards and Docks and in the navy yards about Feb. 5, 1919.

WILLIAM F. FOX.

Lawrence, Kan.

[Following the receipt of this letter and many others of the same purport, this journal addressed a letter to the Secretary of the Navy, asking for an official statement in the matter. The letter printed below was received in reply. From that and from information received from other sources, we are convinced that both the Navy Department and the Emergency Fleet Corporation have not followed the spirit of the Macy award with their own employees, but have applied it only to their contractors' employees. There seems to be no doubt, furthermore, that the Navy Department has resorted to the subterfuge of a reclassification to avoid the raising of wages among Navy draftsmen. Secretary Daniels' letter, dated Feb. 25, follows:—EDITOR.]

Sir—Referring to your letter of Feb. 19, 1919: Upon receipt of the award of the Shipbuilding Labor Adjustment Board (Macy board) on Oct. 29, 1918, the department, under date of Nov. 12, issued instructions to the navy yard service to submit recommendations for a readjustment in the pay of the drafting force, based on the above-mentioned award. Upon receipt of the recommendations, they were turned over to a board appointed within the department to analyze, reclassify if necessary, and submit final recommendation in each individual case. This board submitted its report to the department Jan. 17, 1919, and under date of Feb. 4, 1919, the department issued instructions to the several bureaus in the department concerned, and to the navy yard service, to make certain revisions in their original recommendations as to the readjustment in the pay of the drafting force recommended by said board, and to then immediately put into effect the increases.

It is believed at this time that the readjustment under the Shipbuilding Labor Adjustment Board award has been effected throughout the service.

JOSEPHUS DANIELS.
Secretary of the Navy.

Washington, D. C.

Letting Road Contracts in Long Stretches

Sir—I desire to express my approval of your editorial of Mar. 13, 1919, entitled "Letting Road Contracts in Long Stretches." The thoughts expressed bear out the conclusions I have drawn from a three-year intensive study of the methods of highway construction. The argument as it has come home to me runs about as follows:

The road building ahead of us is probably the biggest construction job that this country has ever had. The roads must be produced, not only in quantity, but quickly; and they must be built better than ever before. They must be *manufactured* as a standard product, as other commodities are manufactured.

Road building, from now on, must be considered an industry and, as such, will require large capital, large plants, large organizations and able men. The writer believes that the organizations, the capital and the men all will be forthcoming just as soon as the various states, counties and the Federal Government realize that the contracting must be done in a much bigger way than heretofore.

Contractors, in assembling their plants, have heretofore purchased individual *machines* instead of a coordinated group of machines that might be assembled into what we may call a *road-manufacturing* plant, where each machine is designed or selected as an integral part of the plant instead of an independent piece of apparatus. In the past one of the chief errors has been an unbalancing as among the capacities of the various elements of the plant. A mixer of large capacity, for example, has been idle for lack of material, due either to inadequate transportation facilities or to inadequate handling devices or storage at the receiving point. In other words, the plant has been unbalanced —uncoördinated.

It is a simple matter to lay out a plant that will enable the contractor to work his concrete mixers to capacity and to keep every one of the machines working efficiently, but that requires an investment of from $100,000 to $150,000. Such a plant will have a capacity of 15 to 20 miles per season. A road job five miles long, to be efficiently handled, however—handled so that each machine element works continuously at full capacity—will require the same amount of equipment.

The contractor should charge off at least 33⅓% of his investment per annum, to take care of depreciation, interest and repairs. In other words, a fully equipped contractor has a plant overhead to carry of $35,000 to $50,000 per annum. It is not reasonable to charge this against a few miles of road. It should be charged against just as many miles as it is possible for that plant to turn out in a full season's work. With a contract for only five miles of road, however, the contractor needs to procure at least two, and perhaps three, more contracts during a season in order to be successful. But if he were given one contract for 15 or 20 miles of continuous road, he would not suffer the delay of moving the plant from one job to another, nor delays in procuring additional contracts. His entire thought and energy would be concentrated on one job.

Contractors, in an endeavor to hold down their investments, instead of purchasing a complete plant, often sublet parts of the work. But the investment in equipment is there just the same, and *somebody must pay for it.*

Another element favoring the large, coördinated plant lies in the fact that there is no branch of construction work that can be so nearly standardized as road building. The building of one mile of road of any kind cannot differ much from the building of any other mile of the same kind of road. The plant is a standard one; no fear that it must be disposed of when one job is finished, for it can be used just as economically on the next job. In this, road plants differ from the plants required for the construction of buildings, bridges, dams and other classes of work which must be planned differently each time to meet special conditions.

Again, a desirable class of workers soon to be available may best be employed in handling plant, rather than in doing manual work. It has been urged that road building should immediately go forward to give employment to the men of our returning armies. It is submitted, however, that our boys are not coming home with any idea of doing pick-and-shovel or wheelbarrow work. The days of hod carrying are over. These men have been highly trained in organization and coöperation. The war has been won largely by machinery, and our armies have been trained to handle and to care for that machinery.

Even if a soldier were a common laborer before he went away, he is coming home with a broader vision of things, with more ambition, a better education and a desire—even a demand—for a better class of employment than he left behind. In short, the men returning from abroad will be exactly the sort of men that we shall need in a large contracting organization, handling large machinery installations.

Furthermore, common labor is becoming ever scarcer and more uncertain. Fortunately, well designed plants require comparatively few men, and may be expected to go far toward stabilizing the road-building industry by improving the class of labor employed and reducing the labor turnover.

On the other hand, because it is impossible to use properly coördinated plants on the short sections in which the work has been let in the past, the present price of hard-paved roads undoubtedly is higher than it should be. Ultimately, the use of proper plants will reduce the cost of the roads, just as large factories, running on quantity production, reduce the cost of any other commodity.

When engineers and contractors come to realize the possibilities of well coördinated plants, they undoubtedly will plan their work accordingly. Contracts will be let earlier, so that construction may start as soon as the frost is out of the ground in the spring. Contracts will be for longer stretches of road, so that the plant will continue in operation until stopped by bad weather in the fall.

Road building on a large scale is undoubtedly a business to engage the attention of large capital and capable organizations. Let those engineers who have a large mileage of roads to build award the contracts for a few large sections, rather than for a number of short sections as in the past, and there is no doubt that more of the contractors who have been engaged in big work along other lines will be attracted to the new field.

WILLIAM ORD,
Manager, Paving Department, Lakewood Engineering Company.
Cleveland, Ohio.

Would Use French as International Language for Engineers

Sir—I have read with much interest the letter in your issue of Feb. 27, p. 442 entitled "International Language for Modern Engineers," as well as certain other articles on technical publicity. Either of these subjects alone is of the greatest importance to the modern engineer and the engineering profession, but they are at bottom really closely inter-related, as the latter can be realized or obtained in its most comprehensive and broadest scope only through the former.

The writer of the article referred to seems to possess a full realization of the importance of an international language for modern engineers, but, as he says, is probably too prejudiced, on account of his position as chairman of the propaganda committee of the Esperanto Association of North America.

The necessity of technical publicity is being more and more fully realized every day. As a result we have the recent remarkable advance in the growth and activities of local societies. Also, as noted in your issue of Feb. 27, p. 439, a leading consulting civil engineer, L. P. Wolff, proposed that the American Society should set aside $10,000 annually for publicity work; $50,000 to be paid to five writers to furnish engineering articles for the daily and Sunday papers, the balance for expenses of inaugurating and maintaining the work.

Why not adopt French as the international language? It seems the logical one. Already it is the international diplomatic tongue—why not the international engineering tongue? Not only is it the easiest to learn, but, in addition, the majority of engineers already have a good foundation in French or in Latin—which is very similar to French—or perhaps in both, as both these languages are in the curricula of most high and preparatory schools and engineering courses of most technical institutions and universities. To cite my own case as a typical example—in private school it was ordained that I study both French and Latin as a necessary preparation for whatever might follow; in high school both were in the curriculum and had to be pursued; at college it was a choice among French, Spanish and German in the department of civil engineering, French

being by far the choice of the largest number; and, lastly, at the Military Academy at West Point French was compulsory.

One requisite in obtaining publicity is very aptly expressed in an editorial in the issue referred to above (Feb. 27), p. 407, entitled, "How to Get Local Publicity." It is this: "In the last analysis actual flesh-and-blood contact must be made. The more human it is the better the result." This is a true premise, and the logical deduction is that the best way to get widespread or international publicity is through the French language, the language of the country which is the very soul of the "flesh-and-blood contact" of nations today. France exerts a powerful influence over the minds and lives of millions of men of many different nations who have fought on her soil. The French language already has a big impetus in other countries through the words and phrases of everyday life brought back by returning soldiers and perpetuated in songs and poems both on and off the stage.

Furthermore, tendencies seem to indicate a further growth in the study and teaching of the French language in the future. I hope that every one interested in the use or adoption of an international language for engineers will seriously consider the advantages and merits of the French language.

WILLIAM A. CALLAWAY,
Second Lieutenant, Corps of Engineers, United States Army.
Camp A. A. Humphreys, Virginia.

Defines Right-Hand Door and Comments on Concrete Floor Finish

Sir—I read Mr. Conrad's letter in your issue of Jan. 23, 1919, p. 201, on how to determine the hand of a door, and thought that it would be answered quickly and in a practical manner. However, there has been so much delay in answering the question, and the one given in your issue of Mar. 6, p. 485, is so unsatisfactory, that I am going to give my definition of a right- and left-hand door. I hesitate somewhat to write to your paper, inasmuch as I am a member of the B. M. & P. I. U., and also because I read in a recent issue of your paper that the "outstanding characteristic of union labor is selfishness"—which goes rather against the grain.

Place yourself squarely in front of the door of the room you are about to enter. If the door swings around to the left and away from you it is a left-hand door. If the door swings around to the right away from you it is a right-hand door. If the door opens toward you and then swings to the left it is a left-hand reverse; if the door opens toward you and swings to the right it is a right-hand reverse. A left-hand door and a right-hand reverse door describe the same thing.

The writer has had charge of several structures and at no time has he failed to compare correctly in respect to the hand of doors when listing hardware for the interior trim of a building. I trust this explanation will be sufficiently lucid to aid Mr. Conrad in his perplexity.

The article by William McGinnis in the issue of Mar. 6, p. 477, was hardly a finished treatise on cement finish. I refer to the article as a whole, but in particular to the indefiniteness of the treatment of the concrete with acid. No mention was made of the thorough removal of this necessary before the application of grout and cement—or was it taken for granted? One of the most difficult things to do in concrete work is to apply cement finish on a concrete sub-base that has been placed for some days. I do not take exception to the method of screeding described, but do believe the proper amount of detail was omitted.

THOMAS P. MORRISSEY.
Springfield, Mass.

Some Additional Approximate Formulas for Structural Work

Sir—In your issue of Mar. 13, 1919, p. 534, you published an interesting article entitled "Approximate Formulas Useful in Structural Design," by R. Fleming. The following formulas, similar in character to those in Mr. Fleming's article, have been very useful and I send them to you in the hope that they may prove helpful to other engineers.

Approximate Weight of Angles—Multiply the sum of the widths of the legs in inches by the thickness in thirty-seconds of an inch. Divide the result by 10. Thus, for a 4 x 3 x $\frac{3}{8}$-in. angle, $(4 + 3)\ 12 = 84$. The weight in pounds per foot is 8.4.

Approximate Strength of Crane Chain, Safety Factor 4—Square the size of chain in eighths of an inch. Divide the result by 10. The answer will be in tons. For example, a three-quarter chain is six-eighths thick, and $6 \times 6 = 36$. The chain is capable of carrying 3.6 tons.

Resisting Moment of a Row of Rivets About Its Center of Gravity—Number each rivet consecutively, beginning with 1. Add these numbers together and multiply by the stress S on the outermost rivet. If the spacing of rivets is 3 in., the product will give accurately the moment of the row. For any other uniform spacing, divide by 3 and multiply by the given spacing. Thus, for a row of five rivets, spaced 4 in. on centers, and having the outer rivet stressed to 2000 lb., the moment in inch-pounds is

$$(1 + 2 + 3 + 4 + 5) \times \frac{4}{3} \times 2000 =$$

40,000 inch-pounds.

HARRY K. ELLIS,
Assistant Engineer, Bureau of Highways.
Philadelphia, Penn.

Wages Small Part of Ship-Operating Cost

According to J. H. Rosseter, director of operations, United States Shipping Board, there is an entirely wrong impression abroad regarding the effect of high wages for seamen on the cost of operating American ships. As is well known, United States laws require a higher wage scale on ships under American registry than do the laws of any other country. Mr. Rosseter, however, points out that under conditions now prevailing wages constitute only 7% of all ship-operating costs, so that a large percentage of increase in wages will have only a small effect on total operations. He stated that at present it costs $500,000 more to construct a 10,000-ton cargo carrier on this side of the Atlantic than on the other side. In this case, the American-built steamer has a capital charge of $6500 per month more than the European-built vessel, whereas the total wage cost of operating the boat is only $4000 a month.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Concrete Under External Hydrostatic Pressure Made Water-Tight

IN BUILDING a sump and pump chamber in the subway tunnel under the East River in New York, a successful method of making water-tight the concrete walls, that were under an external hydrostatic pressure, was used. It was necessary to construct the sump outside the cast-iron tube, and air had to be used. The concrete was placed under a pressure of about 11 lb., and when the air was taken off it was found that the pressure had made the concrete so porous that under atmospheric pressure the water in places came through in fine needle streams. After discussing several methods of waterproofing, it was decided to try out a simple expedient at first. If this had not been successful a more elaborate process would have been necessary. The chamber was again put under air pressure. The walls of the chamber were then liberally swabbed or painted with a thick grout mixed of the consistency of about one bag of cement to half a bucket of water. The air pressure forced the grout into the holes and closed them up. The air was again reduced to normal and places were noted through which the water still leaked. These were marked and later the pressure was again put on, the holes being fed with the grout until they were completely stopped up. When the pressure was again reduced to normal it was found that the process was entirely successful and the chamber was as dry as a bone.

Other Articles in This Issue of Interest to Contractors

Tests of Frozen Rope Indicate Slight Loss of Strength

A RECENT test indicates that being frozen does not, as has been generally believed, greatly lessen the breaking strength of fiber rope. Four specimens were cut from a 3-in. manila rope. All were spliced at each end with an 8-in. splice. The length between the splices was 6 ft. Two specimens were soaked in water for 45 min., then exposed to an 18° temperature from 5:30 p.m. to 9:30 a.m. Both were stiff with frost when tested. The other two specimens were kept unfrozen. Elongation, at 50%, 1¾ in., and at 80%, 2 in., was the same in all specimens. The breaking strains were, for the frozen rope 10,000 lb. and 10,900 lb., and for the unfrozen rope 11,000 lb., and 11,300 pounds.

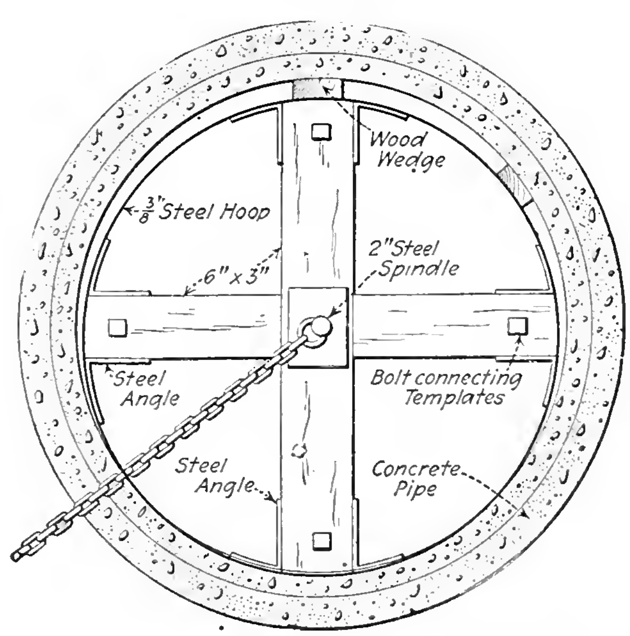
This experiment was conducted by Fred A. Jenks, Plymouth Cordage Co., Plymouth, Mass., to answer an inquiry by the editor. Mr. Jenks comments as follows:

"The results were rather surprising. It was expected that the unfrozen rope would show a much larger breaking strain, comparatively. As soon, however, as pull began to be exerted on the frozen rope the frost particles began to break up. After the rope had broken, the portion under stress was absolutely clear of frost, although in the splices, where the strain was on the double, the rope was still somewhat stiff from frost, and the ends of the tucks were completely frozen. Between pulling centers there was practically only a damp rope at the time of rupture. The pull had not only broken the frost crystals, but the heat generated by the friction in the strain and breaking of the rope had melted the frost. However, despite the showing made by the tests, everyone who has handled frozen rope knows that it cannot be as easily handled or run as freely over sheaves or used as well over capstans, and that it is much more difficult to secure. These facts alone constitute good reasons for protecting rope from frost."

Concrete Sewer Pipe Transported by Rolling to Place

By L. McLaren Hunter
Ottawa, Canada

IN THE construction of the Rideau Interceptor, the work of conveying the concrete pipe from the point where the pipe contractors had dumped them caused



ROLLING SOLVED PROBLEM OF TRANSPORTING PIPE

delays and entailed great expense. At first a track was built and a light carriage made. This was drawn by a horse to the derrick, but the lifting and laying of track always delayed the work of pipe laying for several days.

The difficulty was overcome by providing two templets, as shown by sketch, which were inserted in the pipe, each section of which averaged 3700 lb., and tightened by wooden wedges. Through the center was a 2-in. steel spindle which protruded about 9 in. at each end.

A team was hitched to this and the pipe was drawn to the job like a large roller. With this device there were no delays in pipe laying.

Care was taken to see that the pipe met no obstructions on the path, and apparently they suffered no damage by the operation.

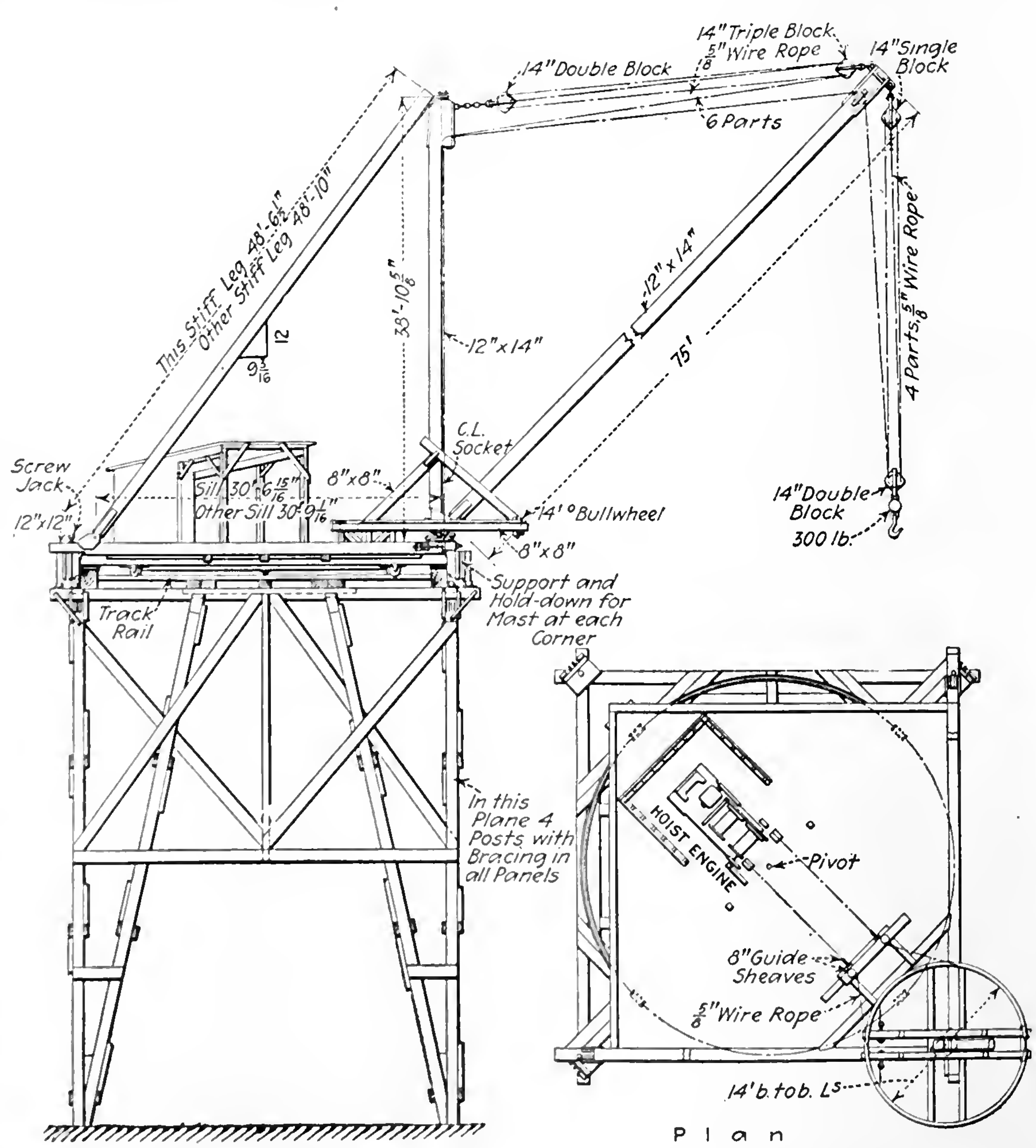
Turntable Mounting Extends Reach of Stiffleg Derricks

TOWER derricks used by the Foundation Co. in its New Orleans shipyard have an ingenious turntable mounting, by which a derrick of given length of boom commands a larger area. It is shown by the drawing.

The derricks themselves are standard machines made by the Edward F. Terry Mfg. Co. They are set on wooden towers 32 ft. square, ranging from 35 to 48 ft. in height, in order to bring the derrick step above the deck level of the ship; the 48-ft. towers are near the head of the ways where the ship is highest above ground. The derricks have a capacity of five tons at 75-ft. radius, or 15 tons at 45- ft. radius. A timber base frame carries mast, stifflegs and engine. This frame bears through four wheels on a circular track rail resting on the tower top, and the derrick can thus be turned to face in any direction. The mast of the derrick centers over any one of the corner posts of the tower, when the frame is swung to proper position. On top of each of the four posts is a heavy bearing block, steel shod, and the mast can be brought to bear on this block by means of a screw jack fastened in the derrick base frame. Two other screw jacks at the rear ends of the sills transmit any uplift to the tower posts. A steel hook-shaped fitting attached to each bearing block projects inward over the the turntable and prevents its lifting.

By turning down the screw jack into a socket in the top of the bearing block, the mast is given firm support and the turntable locked in position.

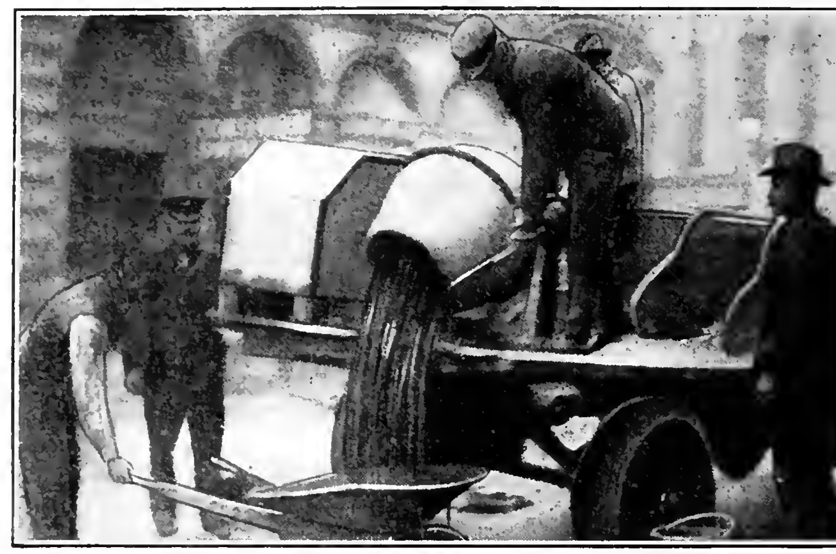
The derricks at the New Orleans yard have 75-ft. booms, but through the arrangement described they are enabled to command an area of about 100 ft. in radius.



TOWER DERRICK WITH TURNTABLE MOUNTING HAS 100-FOOT EFFECTIVE REACH WITH 75-FOOT BOOM

Mixer Mounted on Street Repair Truck

TO HANDLE the concrete work of small street-repair jobs, the City of New Orleans had a 1½-ft. mixer mounted on a 3-ton truck on which material bins of 1-yd. total capacity are also built. This leaves space enough to carry the necessary cement, which is



USING NEW ORLEANS' TRUCK-MOUNTED MIXER

often piled against the open end of the bins to increase their capacity. One man standing on the truck places the stone, sand, cement, and the water in the mixer, which he dumps over the end of the truck as each batch is mixed. The outfit is owned by the Department of Public Property.

NEWS OF THE WEEK

New York, March 27, 1919

American Society Convention to Be Held June 17-20

The annual convention of the American Society of Civil Engineers will be held this year in St. Paul-Minneapolis June 17-20, according to decision by the Board of Direction. The last June convention was held in Pittsburgh in 1916, the St. Paul-Minneapolis meeting scheduled for June 12-15, 1917, having been indefinitely postponed on account of war conditions.

The committee of the board in charge of arrangements consists of W. L. Darling, E. E. Wall and Charles Warren Hunt. The local convention committee consists of the following members: W. C. Armstrong, Frederic H. Bass, R. B. C. Bement, F. W. Cappelen, Oscar Claussen, William de la Barre, F. E. House, W. H. Hoyt, W. N. Jones, F. C. Shenehon, Horace E. Stevens, Howard E. Stevens, P. E. Thian, W. T. Walker, George L. Wilson, L. P. Wolff, R. D. Thomas.

Railroad Construction Work Stopped

By order of the Railroad Administration, all new railroad work in the way of betterments, additions or new lines will be held up, owing to the failure of Congress to provide the necessary funds. Only such construction is to go ahead as is necessary to insure safety or to protect contracts already entered into.

National Chamber Urges Private Aid to Employment Work

In connection with the recent appeal of the United States Employment Service, that communities and business interests carry on the work, as far as possible, until such time as adequate funds may be provided by Congress, the National Chamber of Commerce of the United States has issued a call to commercial organizations of the country, urging them to assist in every way possible in placing returning soldiers and sailors in employment.

War Department Will Receive Bids on Cantonments April 15

Bids will be received Apr. 15 for Army camp material, including buildings, railroad tracks and sewerage systems, to be abandoned by the War Department. The plan is to sell entire camps for lump sums, and big industrial concerns are regarded as the most likely purchasers. In some cases, state governments are expected to bid for the camps for use as National Guard training centers. Such bids will have preference.

Thirteen camps to be sold on Apr. 15 include all the War Department has definitely decided to dispose of. Others may be sold later. The 13 are: Camp Beauregard, Louisiana; Bowie, Texas; Colt, Pennsylvania; Hancock, Georgia; Kendrick, New Jersey; Logan, Texas; Polk, North Carolina; Sevier, South Carolina; North Camp Jackson, South Carolina; Shelby, Mississippi; Sheridan, Alabama; Wadsworth, South Carolina, and Wheeler, Georgia.

Division storehouses and the utilities serving the storehouse area are excepted from sale.

Tentative bids have been received from the State of Louisiana for Camp Beauregard and from Alabama for Camp Sheridan, the expressed intention in each case being to utilize the sites for the mobilization of state troops in case of emergency.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

In the general cut in the United States Employment Service it has been found necessary, officially, to abolish the offices of the Professional and Special Section, but it is hoped that this work may be continued by local interests. As mentioned in these pages last week, the Military Training Camps Association at Chicago has already taken over the work of the Professional and Special Section office in that city.

Engineers Discuss Plans for Vehicular Tunnel

Size and Design of Proposed Hudson River Tube are Unprecedented and Suggest Many Difficulties

Plans for the proposed vehicular tunnel under the Hudson River at New York City were discussed at a meeting of the American Society of Civil Engineers Mar. 19. The society has seldom held a session at which greater interest was manifested. While several different designs were described, the main interest centered around the one adopted over a year ago by the New York and New Jersey Bridge and Tunnel Commission. Arguments both for and against this design were advanced, and the great number of uncertain conditions to be met, due to the unprecedented size of the tube and of the shield to be used, were brought out by expert tunnel men. The state Reconstruction Commission, to which Governor Smith of New York is referring such projects, assisted by an advisory committee of engineers nominated by the Engineering Council, had held a public hearing on the project Mar. 12 and several of the engineer committee were present at the meeting of the society Mar. 19.

The plans, which were adopted by the tunnel commission, are for a tunnel 42 ft. in diameter, to be built according to novel methods originated and patented by John F. O'Rourke. As described by Mr. O'Rourke in *Engineering News-Record* of Mar. 21, 1918, p. 563, the tunnel is to be driven with a shield having its face divided by horizontal partitions into separate compartments in which different pressures of compressed air are carried, according to the hydrostatic pressure in the earth penetrated. The tunnel is to be lined with precast concrete blocks instead of cast-iron segments, and is to have the space back of the shield filled with gravel blown in by compressed air, instead of the usual grout filling. The O'Rourke plans have been approved by Gen. George W. Goethals, consulting engineer to the New York and New Jersey Bridge and Tunnel Commission.

Some of the questions which must be settled before the practicability of the large-diameter tunnel can be affirmed were stated by Paul G. Brown in his remarks at the Civil Engineers' meeting as follows:

Can a tunnel such as this proposed be ventilated?

Can a shield 43 ft. in diameter be constructed of sufficient strength without prohibitive weight and expense?

Would premolded concrete blocks

have sufficient strength to withstand the thrust of such a shield?

Could premolded concrete blocks of the design suggested be made water-tight?

Would premolded blocks of the design suggested have sufficient strength to support the tunnel structure?

Is it possible to maintain compressed air of several stages of pressure in the face of a shield?

Can a shield of such size and length be kept to line and grade?

It is a well known fact that a shield, if it cannot move ahead, will move downward, and if such a shield did settle, could it ever be brought up to grade again with the projection of the lower part acting as a cantilever?

This shield is 93 ft. below mean low tide or 20 ft. lower than would be necessary with a smaller tunnel with correspondingly lower air pressure. In the bottom chamber through the rock section the "sand hogs" would only work short hours. The shield could move no faster than the bottom chamber. Would this make the progress so slow that the cost would be prohibitive?

Can any system of concrete blocks be designed for the North River that would be a proper substitute for the usual cast-iron lining?

Would the congestion of traffic at the terminals due to the concentration into one tube prohibit that type of construction?

Would two single tubes, if carrying two lines of traffic in each direction, be sufficient for the present traffic needs?

What units of cost are used in making the estimate of $11,500,000 for this tunnel?

The discussion was notable for the number of well known engineers experienced in soft-ground tunnels who participated, including J. Vipond Davies, James Forgie, W. C. Parmley, A. F. Byrne and Fred Lavis. Replies to various criticisms of the tunnel design were made by John F. O'Rourke.

The engineers advising the Governor's reconstruction commission have recommended that the whole matter of the designs and estimates for the Hudson River vehicle tunnel should be referred to a board of engineers to investigate and report as to the best plan.

Kansas City Cannot Make Ice

A proposed $400,000 bond issue to provide money for a municipal ice plant for Kansas City, Mo., has been declared unconstitutional by the Supreme Court of the state on the ground that ice-making is a private enterprise and the city cannot engage in private enterprises. The decision was six to one. The dissenting judge held that ice is a prime necessity in cities and its manufacture for the protection of the health of the people is an exercise of the police power. There is said to be talk of an application for a rehearing. E. M. Harber is city counselor of Kansas City.

New President of American Railway Engineering Association

Earl Stimson, elected president of the American Railway Engineering Association at the annual meeting last week in Chicago, was appointed, in August last year, general superintendent maintenance of way and structures of lines under the jurisdiction of the Federal manager of the Baltimore & Ohio R.R. Lines East. He received his technical training at the University of

EARL STIMSON

Cincinnati and at Cornell University. In 1895 he entered the service of the Baltimore & Ohio R.R. as a rodman. His service has been with the Baltimore & Ohio and affiliated lines ever since.

In 1898 he was made assistant division engineer at Chillicothe, Ohio, and in 1901 division engineer at Flora, Ill. Four years later he was appointed engineer maintenance of way of the Baltimore & Ohio Southwestern R.R., with headquarters in Cincinnati. In 1910 he went to Baltimore as chief engineer maintenance of way of the Baltimore and Ohio R.R., succeeding A. W. Thompson, who became chief engineer and who lately resigned as Federal manager of the Baltimore & Ohio and associated lines to become president of the Philadelphia Co., Pittsburgh. On Aug. 1, 1918, Mr. Stimson was appointed general superintendent maintenance of way and structures of the Baltimore & Ohio Lines East.

Canadian Budget Provides For Public Work

The estimates for the financial year 1919-20 were presented to the Canadian House of Commons last week. They included unusually large appropriations for railways and public works. Estimated expenditure on capital account by the Department of Railways and Canals was $50,896,681, including the following items: Construction of and betterments to the Canadian Government Railways, $11,121,681; railway equipment and materials, $35,000,000; Port Nelson terminals of Hudson Bay Ry., $100,000; construction of Welland Ship Canal, $3,500,000; and construction and betterments of the Trent Canal, $1,000,000. There are also appropriations of $30,000,000 for the Government's shipbuilding program, and $348,930 for harbors and rivers in Ontario. A grant of $10,000 is made to the Canadian Engineering Standards Association for the promotion of uniformity of standards in metals and their products.

Hurley Reports Shipping Statistics

Chairman E. N. Hurley of the United States Shipping Board has released his report on a three months' visit which he has just completed in Europe, investigating the present conditions in the shipping industry of the world. It contains few facts or promises for the future of the American shipbuilding industry. Largely, it is devoted to statistics of shipping today, specifically outlining the prospects in the various maritime countries. It finally urges the necessity of the United States having a gross tonnage of 7,500,000 to take care of its prospective foreign trade, but the report gives no indication of what the policy of the Government will be with regard to future shipbuilding and ship ownership. A suggested policy will probably be made public by Mr. Hurley in a speech in New York Mar. 27.

Mr. Hurley says that there is a false impression in this country regarding the importance on a prospective merchant marine of the high wages required to be paid to seamen under United States laws. He says that not only do the leading shipping nations in the world pay just as high wages, but that wages are so small a proportion of the cost of operating a ship as to make them of small effect on total costs.

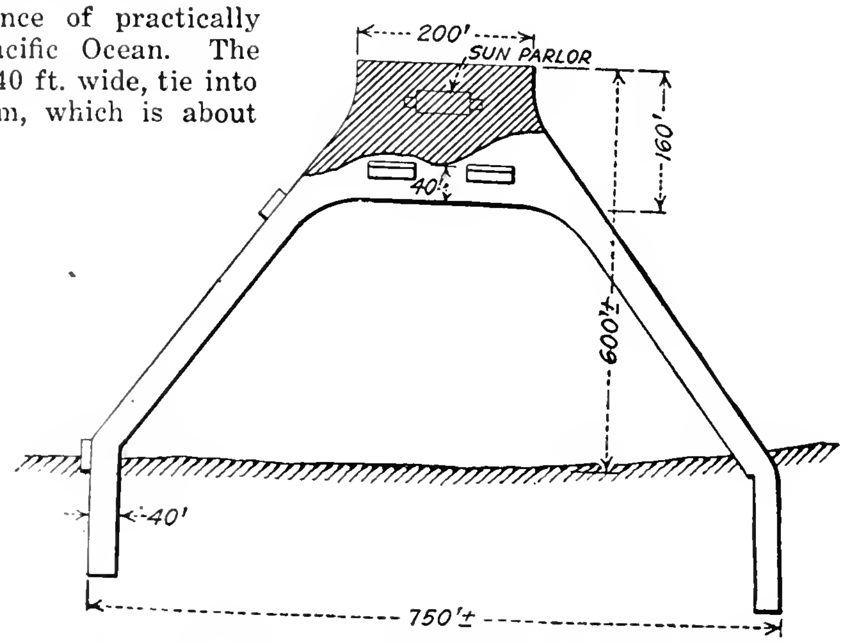
The statistics on present ship tonnage show that the total oceangoing tonnage of the world in 1914 was 41,295,000 gross tons. Today similar figures are 37,100,000 gross tons, the net loss of over 4,000,000 being due to the destruction of much more than that plus the increase due to production of ships during the four years of war. The falling off of normal increase by new construction which would have continued had the pre-war rate stood would amount to about 12,000,000 gross tons, so that there is today a shortage of 16,000,000 gross tons. In August, 1914, the United States seagoing merchant marine, 500 gross tons and over, included 624 steamers of 1,758,465 gross tons and 837 sailing vessels and schooner barges of 947,852 gross tons, making the grand total of 1490 seagoing merchant vessels of 2,706,317 gross tons. In November, 1918, the steam merchant marine had increased to 1366 vessels of 4,685,253 gross tons and the sailing vessels and schooner barges had decreased to 747 vessels of 829,917 gross tons, mak-

ing the grand total 2113 seagoing vessels of 5,515,180 gross tons. This does not include the seized enemy vessels, which at the end of the war averaged 88 vessels of 562,005 gross tons, of which number 81 are of 546,210 gross ton, steamers, and seven of 15,795 gross tons were sailing vessels. The total construction in the United States added to the merchant marine during the war amounted to 875 vessels of 2,941,845 gross tons.

Ocean Undermines Concrete Pier at Redondo Beach, California

The outer portion of the concrete pleasure pier at Redondo Beach, California, collapsed during a heavy windstorm on the night of Mar. 6. This pier, which was fully described in *Engineering News* of Sept. 14, 1916, p. 518, is in the form of a triangle extending out a distance of practically 600 ft. into the Pacific Ocean. The two legs, each about 40 ft. wide, tie into the outshore platform, which is about 160 x 200 ft. in plan. The structure was of reinforced-concrete girder and slab construction supported on reinforced-concrete piles which were jetted into place. It carried a sun parlor, an observation tower and other appurtenances.

DAMAGED OUTER END OF REDONDO BEACH PIER SHOWING COLLAPSED FLOOR WHERE PILING WAS WASHED OUT



PLAN SHOWS PART OF PIER WHICH FAILED

As shown on the diagram herewith, a large part of the outer section was washed away. At the present time, the failure of the pier is attributed to an unusual undertow washing the sand away from the piling. The end of the pier terminates at the head of a submarine cañon whose side and bottom slopes are very deep compared with the gradient of the surrounding ocean floor. There was a terrific undertow following the storm, and it is thought that possibly the cañon banks were affected by this action. The reinforced-concrete piles varied from 20 to 85 ft. in length; it is not known just how deep was their penetration, although it is thought that at the outer edge it was about 25 feet.

The City of Redondo is planning to repair the pier and has employed W. K. Barnard of Los Angeles to investigate the extent and cause of the damage.

Railroads Now Can Coöperate in Local Improvements

Although issued Dec. 30, 1918, the Railroad Administration order permitting the railroads to coöperate in local improvements does not seem to have had wide circulation, because a number of municipal authorities have recently written to Washington saying that local municipal projects were being held up because the railroads refused to assume their proportion of the cost. Circular No. 44, issued by the United States Railroad Administration July 29, 1918, permitted the railroads to refrain from coöperating in local improvements other than those of imperative necessity. This order has now been set aside, and such joint action on improvements should now be taken up by local municipal authorities in coöperation with the railroads, just as they were before the war.

No Freight Rate Reduction on Building Material

Freight rates on building material will not be reduced, according to an official statement of the Railroad Administration which reads as follows:

"Various inquiries have been received as to whether the Railroad Administration contemplates a reduction in freight rates on materials used in construction of buildings, and therefore it becomes important to make it clear that no such reductions are in contemplation. The Railroad Administration is, however, giving consideration to the question of making reduced rates on crushed rock, stone, sand, and gravel for road construction when consigned to and the freight thereon is paid by a Federal, State, county, parish, or township government. Before the matter can or will be definitely determined it is intended to ascertain what, if any, reduction necessary to establish a stable price will be made in the price by those producing and supplying the materials."

Highway Bond Issue for $30,000,000 Vetoed in Arizona

A bill clearing the way for a $30,000,000 bond issue for constructing roads in Arizona has been vetoed by the Governor. The bill provided for a highway commission of five members, and the objection of the Governor to this form of supervision is given as the reason for the veto.

Oregon Passes Highway Bond Issue for Ten Million Dollars

By utilizing an emergency provision, the legislature of Oregon, with the approval of the governor, has eliminated the necessity of putting to the vote of the people the measure providing for a bond issue of $10,000,000 for highway purposes.

This amount of money, which is thus made immediately available, when combined with the Federal aid to be received in the next two years and a portion of the $5,000,000 bond issue now being planned by the reconstruction committee of the legislature, will provide a large amount of money for highway work in the state during the coming year.

Exhibit of Army Personnel Work To Be Shown

Methods developed by the Committee on Classification of Personnel in the United States Army will be shown at an exhibit at the Engineering Societies Bldg., 29 West 39th St., New York City, Apr. 1-12, under the auspices of the National Association of Corporation Schools, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

The exhibit consists of a collection of wall charts, forms, photographs and models showing how the Army finds out what men can do best and how it uses that information; how soldiers are trade tested, and how officers are rated and fitted into place; how the work is checked and supervised, and its results in the war. The exhibit was shown for several weeks at Washington, where it excited so much interest that, in response to many requests, the Adjutant General consented to its display in other cities. Two commissioned officers accompany the exhibit to explain its features.

Los Angeles Wants To Sell Cement Mill

The first and only municipal portland cement mill is now being offered for sale, as has been noted in several of the advertising pages of this journal. This is the Monolith mill built in 1908 by the City of Los Angeles, Calif., for the manufacture of cement to be used in the mammoth Los Angeles aqueduct. The plant is situated 117 miles north of Los Angeles, and includes contiguous and almost inexhaustible deposits of clay and limestone. The city has been in doubt for some time as to its disposition, but finally has decided that it cannot enter into commercial competition in the production of cement and that the mill is much too large for the needs of its own construction.

The mill is notable because it was utilized in the production of a tufa cement, using a volcanic deposit in close proximity to the mill. This blended cement required additions to the mill, so that today it has a capacity for a blended cement of about 1500 barrels.

Urges United Port of New York

In a paper read before the Society of Terminal Engineers Mar. 18, A. T. Skougor, engineer of the Chile Exploration Co. of New York, proposed a plan for a united port of New York and New Jersey which contained some features not hitherto included in similar projects. Mr. Skougor's preliminary contention is that a new state should be formed out of the districts immediately contributing to the port of New York, with the idea of furnishing one government and unified aims for the development of the port. He asserts that joint action will never amount to much. He urges that after such a state has been formed some engineer of national reputation be selected to plan, design and construct the port, having a free hand to select his staff, and that the port once having been developed, a Governor be appointed who will have full control of its administration.

In the design of this new port all efforts should be concentrated to divert from Manhattan Island all of the freight not essential to Manhattan, and that Manhattan shore should be used mainly as a passenger steamship port.

Engineers Will Discuss Federal Public Works Department

The Engineering Council through its National Service Committee has sent out invitations to 152 representative engineering societies of the United States, requesting the selection of delegates to attend a national conference on the establishment of a Federal department of public works. The conference is to be held in Chicago, Apr. 23-25.

With the invitation there has been sent to each society a general plan of organization for the conference and a statement of some of the principal questions which the conference will have to consider. It is requested that the societies take up these questions and, if they so desire, vote upon them, prior to the conference.

The calling of this conference follows close on the action of the Engineering Council on Feb. 20, 1919, advocating the establishment by Congress of a department of public works and urging engineers in all branches of the profession to use their influence to arouse public opinion so that the importance to the national welfare of such a department may be understood.

State Utilities Commission the Proper Agent

The State Supreme Court of Kansas has ruled that the Public Utilities Commission of the state is the proper means of compelling a utility company to give sufficient and efficient service. The decision was rendered in a suit brought by the City of Parsons against the Parsons Water-Supply & Power Co. to obtain the appointment of a receiver on the plea that the company had violated its franchise by not furnishing water in sufficient quantity and with sufficient pressure. The Supreme Court denied the application for a receiver and held that the courts will not decree specific performance so long as the proper remedy is offered through appeal to the Public Utilities Commission.

News Item on Appropriation for Federal Aid Corrected

Through an error, a news item announcing the passage of the Federal-aid highway appropriation for $200,000,000, which was published in *Engineering News-Record* Feb. 27, p. 446, was reprinted in the issue of Mar. 20, p. 592.

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States. — Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agriculture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3500 per year. File application before Apr. 1.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Mar. 26-27 and Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City.

The Albany Society of Civil Engineers will hold a meeting Mar. 27 at which R. E. Brooks, district manager for the Koehring Machine Co., will speak on "Modern Methods of Handling Material," with special reference to economy. The lecture will be illustrated by motion pictures.

The Engineers' Society of Milwaukee held its regular monthly meeting Mar. 19 under the auspices of the Milwaukee Section of the American Society of Refrigerating Engineers. J. R. Watson, of Chicago, spoke on "The Use of Synchronous Motors with Ammonia Compressors." Duncan Watson, M. I. E. E., alderman of London, England, and chairman of the Joint Conference on Electrical Undertakings of Greater London, addressed the meeting.

The Engineers' Club of St. Louis held a joint meeting Mar. 19 under the auspices of the St. Louis Association of Members of the American Society of Civil Engineers, at which Lieut. Col. F. G. Jonah, Engineers, U. S. A., previously chief engineer of the Department of Light Railways, American Expeditionary Forces, and now chief engineer of the St. Louis-San Francisco and the Missouri, Kansas & Texas Rys., spoke on the "Construction of Light Railways in France."

The Utah Society of Engineers held its monthly meeting Mar. 19. The following papers were presented: "Recent Improvements in Steam Prime Movers," by Prof. E. H. Beckstrand; "Modern Internal Combustion Engines," by Prof. A. L. Taylor; and "Water-Wheel Development," by L. M. Pharis, hydraulic engineer, Utah Power and Light Co. Calvin W. Rice, secretary of the American Society of Mechanical Engineers, will address the society Apr. 7.

The Engineers' Club of Philadelphia will hold an informal meeting Apr. 9 at which Roland L. Cummins, of the Packard Motor Car Co., will give a demonstration of the Liberty motor. The method of manufacturing Liberty motors will be illustrated by motion pictures. The regular monthly meeting will be held Apr. 15 and will be addressed by S. M. Swaab on "Main Interchange Station Under the City Hall, Philadelphia Subway System"; the address will deal with unique construction methods made necessary by conditions imposing exceptional difficulties. A special meeting will be held Apr. 23 at which Arthur J. Baldwin, vice-president of the McGraw-Hill Co., Inc., will present an illustrated paper entitled "The Devastated Area and Its Reconstruction." Mr. Baldwin was a member of a party of technical and business paper editors and publishers who were invited by the British Ministry of Information, as its guests, to visit Europe.

The American Water-Works Association's nomination committee has made the following nominations for office, which are now being voted on by mail: President, Carleton E. Davis, chief of the Bureau of Water, Philadelphia; vice-president, Capt. M. L. Worrell, Q. M. C., U. S. A., in charge of utilities at Camp Hancock, Georgia; treasurer, James M. Caird. W. H. Randall, superintendent of maintenance of the Water Department of Toronto, Ont., and F. C. Jordan, secretary of the Water Co. of Indianapolis, Ind., are the nominees for trustees.

The Vermont Society of Engineers was addressed by Maj. Gen. Clarence R. Edwards, commander of the Northeastern Department, U. S. A., at the annual meeting held at Burlington Mar. 12. John K. Hooper, meteorologist of the United States Weather Bureau station at Burlington, read a paper on "Rainfall in Vermont in 1918" and Charles H. Pierce, district engineer, United States Geological Survey, Boston, read an illustrated paper on "Stream Gaging in Vermont." Officers were elected for the ensuing year as follows: President, C. F. Purinton, Burlington; vice-president, F. D. Denison, St. Albans; secretary, G. A. Read, Montpelier.

The Indiana Society of Sanitary Engineers elected the following officers at the annual meeting in Terre Haute, Mar. 12: President, William J. Woolley; vice-president, E. Kanney; secretary-treasurer, Claude McElwaine.

The Ann Arbor Engineers' Club elected the following officers at the regular meeting Mar. 13: President, George H. Sandenburgh; vice-president, Robert Norris; secretary-treasurer, F. Leslie Feiner.

The Rochester Engineering Society was addressed Mar. 14 by Le Grand Brown, who delivered an illustrated lecture on "California." Miss Kate Gleason was the speaker at the luncheon Mar. 17. Leon R. Brown, New York State Railways, addressed the meeting Mar. 21 on "Taking Soundings in the Niagara River." The meeting Mar. 28 will be addressed by H. A. Winne, of the General Electric Co., on "Electric Furnaces."

Personal Notes

A. A. MATTHEWS, formerly chief engineer of the St. Louis Southwestern R.R. of Texas, has been appointed chief engineer of the group of railroads in the Southwestern region comprising the St. Louis Southwestern R.R., the St. Louis Southwestern R.R. of Texas, the Eastern Texas R.R., the Dallas Terminal Railroad and Union Depot, the Southern Illinois and Missouri Bridge and Louisiana and Arkansas Railroad.

GEORGE C. D. LENTH, for the past eight months general superintendent for the M. J. Corboy Co., on the construction of a sewer system and water-supply at Camp Henry Knox, Kentucky, has returned to his former position as assistant chief engineer of the Board of Local Improvements, Chicago.

LIEUT. F. E. SCHNEPFE, Construction Division, U. S. A., has received his discharge from the service and is now associated with the Lime Association as district engineer of the Southeastern District, with headquarters in Washington, D. C.

A. M. KRAMER, field engineer, Portland Cement Association, for western New York, has resigned to become affiliated with the Universal Portland Cement Co., with office in Pittsburgh.

LIEUT ADOLF HINRICHS, Engineers, U. S. A., has received his discharge from the service and has become secretary of the Woodbury Service, Inc., appraisal and production engineers, New York City.

FREDERICK WILLIAMS, junior engineer, Wilmington, N. C., has been transferred to the United States Engineer Office, Third District, New York City.

COL. SIDNEY B. WILLIAMSON, 55th Engineers, U. S. A., returned to this country Mar. 20 and has received his discharge from the service. He will resume his work as consulting construction engineer for Guggenheim Brothers.

CAPT. JOHN K. FLICK, Engineers, U. S. A., assistant to the Constructing Quartermaster, Curtis Bay Ordnance Depot, has been discharged and has become associated with Arthur Farmer, under the firm name of Farmer & Flick, engineers and contractors, 15 East Fayette St., Baltimore.

EDWIN B. BURCHARD, Office of United States Geological Survey, in Albany, has been transferred to the station at Ames, Iowa, where he will work in coöperation with the Iowa State Highway Department and the State Agricultural College.

P. H. WITHINGTON, A. B. ROBERTS and G. OTIS WRIGHT have become associated under the firm name of the Withington-Roberts-Wright Co., engineers, with main offices in the Swetland Building, Cleveland. Branch offices are located in Boston, New York, Baltimore and Chicago.

WILLIAM H. CUSHMAN has left the service of the Hydraulic Construction Co., Watertown, N. Y., and has opened offices in the Flower Building, as a consulting hydraulic engineer.

LIEUT. COL. WILLIAM C. SHERMAN, Corps of Engineers, U. S. A., who is an aviator and has been connected with the air service for some time, has been detailed as chief of Air Service Training, which will include heavier-than-air training at the ground schools and flying fields under Brig. Gen. William Mitchell.

LIEUT. W. G. SLOAN, 49th Engineers, U. S. A., stationed at general headquarters in France, has received his discharge from the service and has returned to his position as representative of the Irrigation Division, Bureau of Public Roads, United States Department of Agriculture, for Idaho and Eastern Oregon, with headquarters at Boise.

J. WENDELL MOULTON, Office of United States Geological Survey in Boston, has been transferred to the office in Albany, N. Y., replacing Edwin B. Burchard, transferred to Ames, Iowa, as noted elsewhere.

WARREN G. SWENSON, consulting engineer, of Pocatello, Idaho, has been appointed State Engineer of Idaho. After his graduation in civil engineering from the Utah Agricultural College in 1903, he entered the

service of the Utah Experiment Station, in charge of field operations and irrigation experiments. Later he became connected with the United States Reclamation Survey and afterwards served as engineer of the Telluride Power Co. In 1907 he became associated with the Beaver River Power Co. in charge of hydraulic engineering and construction, afterwards engaging in private practice, during which he has specialized in water-power and irrigation work.

CAPT. C. E. HICKOK, Engineers, U. S. A., who received his discharge from the service Jan. 1 and is now city engineer of Alameda, Calif., has been appointed major in the Engineers' Reserve Corps.

T. N. JACOB, civil engineer and specialist in land drainage and flood-prevention work, East St. Louis, Ill., has taken offices in the Boatmen's Bank Building, St. Louis, Mo.

GEORGE MOAGE, Wauseon, Ohio, has been appointed city engineer of Grand Haven, Mich.

W. S. MOORE, formerly city engineer of Grand Rapids, Mich., has become associated with the Simplex Mfg. Co., of Bethlehem, Penn.

MAJ. K. C. GRANT, Construction Division, U. S. A., has received his discharge and has returned to Dayton, Ohio, where he has become a member of the firm of Frank Hill Smith, Inc., engineers. Before entering the Army, in April, 1917, as a captain of engineers, he was division engineer for the Miami Conservancy District, with headquarters in Dayton.

MAJ. F. I. WHEELER, Corps of Engineers, U. S. A., has been discharged from military service and has returned to Cleveland to resume his duties as assistant engineer with Col. D. W. Lockwood, Corps of Engineers, in charge of the river and harbor district, embracing the lake shore of Ohio from Toledo to Conneaut. During the past year and a half Major Wheeler has been constructing quartermaster at Camp Johnston, Florida, and Camp Shelby, Mississippi, previous to which he was in charge of the construction of roads at Camp Sheridan, Alabama.

J. K. WILSON, of Grand Rapids, Mich., has become field engineer, Universal Portland Cement Co., with headquarters in Chicago.

CAPT. A. C. NELL, Construction Division, U. S. A., in charge of the purchase of power and mechanical equipment in the Construction Division, has received his discharge from the service and has been appointed Chicago district manager for the Lea-Courtenay Co. and the Schutte & Koerting Co. Captain Nell was formerly connected with the Allis-Chalmers Manufacturing Company.

IRA W. MCCONNELL, formerly works manager and assistant general manager, American International Shipbuilding Corporation at the Hog Island shipyard, has become vice-president of the Dwight P. Robinson & Co., Inc., constructing and consulting engineers, of New York City. After his graduation from Cornell University, in civil engineering, in 1897 he served two years as instructor and was afterward professor of civil engineering at the Missouri School of Mines. He later became connected with the United States Reclamation Service in charge of work on several projects, including the Uncompahgre project and the Gunnison tunnel. In 1909 he became chief irrigation engineer for J. G. White & Co., Inc., New York City, and was later appointed vice-president and general manager of the Idaho Irrigation Co. at Richfield, Idaho. In 1912 he became associated with Stone & Webster as a consultant.

WALTER RENTON INGALLS, for 14 years editor of the *Engineering and Mining Journal*, McGraw-Hill Co., Inc., has retired to reënter professional practice as a consulting engineer, with offices in New York City. However, he will not sever his connection with the *Journal*, but will continue to act as consulting editor and will remain in full charge of recording the weekly metal markets, making the quotations as heretofore. H. C. PARMELEE becomes acting editor without relinquishing the editorship of *Chemical and Metallurgical Engineering*, McGraw-Hill Co., Inc.

JAMES W. ROUTH, engineer, Rochester Bureau of Municipal Research, has been appointed director of the bureau, succeeding Le Roy E. Snyder, resigned. Mr. Routh has been associated with the bureau since its establishment four years ago, having previously been the principal worker in the preliminary survey of the local government. He had also been associated with the New York Bureau of Municipal Research. He is a graduate in engineering from the University of Minnesota and Cornell University.

D. T. BLACK, for eight years city engineer of Welland, Ont., has been appointed city engineer of Niagara Falls, Ont., succeeding Frederick Anderson, killed in action in France.

D. H. FLEMING, assistant city engineer of St. Catharines, Ont., has been appointed town engineer of Owen Sound, Ont.

W. L. STEVENSON, who from April, 1918, to the signing of the armistice, was sanitary engineer and assistant director of the Department of Health and Sanitation of the United States Shipping Board, and since then has been engaged in special work for the Emergency Fleet Corporation, has been appointed assistant chief engineer of the Pennsylvania Department of Health, with office at Harrisburg. He was previously assistant engineer in charge of investigations, reports, design and construction of intercepting sewers and sewage-treatment works of Philadelphia.

J. E. FERGUSON has opened offices in the Spitzer Building, Toledo, as a consulting and contracting engineer. Mr. Ferguson was formerly general manager of operation of the American Steel Co. of Cuba, previous to which he was general superintendent of the Toledo Bridge & Crane Co. of Toledo, Ohio.

CAPT. C. F. WAGNER, Engineers, U. S. A., has received his discharge from the service and has become chief engineer for the J. B. McCrary Co., Atlanta. Captain Wagner was supervising constructing quartermaster of coast defenses and later was officer in charge of construction, Camp Eustis, Virginia.

G. H. BISHOP, of Atlanta, has resigned as assistant sanitary engineer of the United States Public Health Service.

MAJ. RICHARD MESSER, Construction Division, Maintenance and Repair Branch, U. S. A., has received his discharge from the service and has returned to Virginia as chief engineer for the State Board of Health. He had charge of the section having general supervision over the operation of water-supplies, sewerage systems and treatment plants at cantonments, camps and other Army posts.

OBITUARY

E. K. LOVELACE, Cadillac, Mich., district engineer on the staff of the State Highway Engineer, died at Ann Arbor Mar. 6. He was at Ann Arbor in attendance at the university short course in highway engineering.

JESSE T. VOGDES, chief engineer and superintendent of Fairmount Park, Philadelphia, for 21 years, died in that city Mar. 18, at the age of 61. He entered engineering work in 1880 and became assistant engineer to General Thayer, who was chief engineer of Fairmount Park. The improvement of 34th St. in front of the Zoölogical Gardens, where the land was formerly a swamp, was begun and finished under his direction. He also superintended the construction of the East River drive from Lincoln Monument to the Wissahickon.

HARVEY M. GEER, consulting engineer, Ballston Spa, New York, died in Troy March 18. He was graduated from Rensselaer Polytechnic Institute in 1872, after which he entered engineering work and later became engaged in contracting. In 1876 he became assistant engineer on surveys for the water commissioner of Troy, and continued in municipal work. He had charge of the construction of water-supply systems in Johnstown, N. Y., Amsterdam, N. Y., Macon, Ga., and Westboro, Mass.

Price of Steel Lowered

Steel both in mill and warehouse has been reduced in price as a result of a joint meeting of representatives of the Iron and Steel Institute and the Industrial Board of the Department of Commerce, Mar. 20. The price of pig iron was lowered $4.25 per ton; steel, $7, at mill. The price of iron ore, $5.50 a ton, will remain the same. The object of the decrease is partially to restore business and industry to a peace basis.

The effect of this drop is already reflected by dealers. Beams and channels of 3 to 15 in., angles of 3 to 6 in., and 3-in. tees have declined from $4.07 in New York and Chicago to $3.47; plates, from $4.27 to $3.67.

At the conclusion of the conference, when the new schedule had been made public, Judge Gary said, "It is expected that prices for 1919 will not be any lower." This means that prospective buyers may go ahead with their projects, practically secure in the knowledge that iron and steel prices have been definitely fixed for this season.

Government Will Sell Accumulated Stock of Copper

Arrangements have been made by the War Department to sell a stock of approximately 100,000,000 lb. of copper, which it controls, at market prices, during the next 15 months. This is the result of an agreement with copper producers. The United Metal Selling Company, organized for the purpose by the producers, will handle the transaction.

For the first 10 months 5,000,000 lb. per month will be sold, and thereafter 10,000,000 lb. per month, until the stock is disposed of. The basis of the agreement is a stipulation that the producers shall absorb the stock at a rate equal to 10% of their sales. A small amount to cover the expense of sales is paid to the producers, and if market conditions improve the sales per month will be increased.

Plans for Utilizing Waste Explosives

When the munitions and shell-loading plants are finally closed, the Government will have on its hands hundreds of thousands of pounds of explosives consisting of scrapped TNT, amatol, ammonium nitrate, etc. Timothy D. Gleeson of New York, president of the Association of Practical Inventors of America, and formerly connected with the United States Ordnance Department as supervisor of plant safety and supervisor of amatol, has suggested several plans by which these explosives could be disposed of, and make unnecessary the plan some are advocating—that they be carried out to sea and dumped into the ocean. Instead of this wasteful procedure, he suggests that they should be utilized so that contractors, engineers, and farmers would obtain immediate benefit.

For example, farm acreage in meadows might be measured by blasting out stumps and undergrowth; new roads might be made in rocky regions; streams with soft mud bottoms might be deepened by scientifically exploding moderate charges at proper points. Along railroads, where slides of loose rock or earth occur, these menaces could be cheaply removed by these explosives, obtained at little or no cost. In many rivers and harbors are projecting reefs and movable sandbars that endanger navigation. These could be blasted out and removed.

Argentine-American Chamber of Commerce Formed

Formation of an Argentine-American Chamber of Commerce in New York City, under the auspices of the Chamber of Commerce of Buenos Aires, has been announced by Enrique Gil, secretary of the organization. Its purpose is to foster trade relations between the two countries, to encourage investment of American money in Argentina, and to serve as a clearing house for all business. The membership will include citizens of both countries.

Business Notes

Amplex, Inc., New York and Tokio, announce that they will remove their New York office Apr. 1, to the 17th floor of 6-8 West 32d St. This firm acts as representative of American manufacturers in Japan and China.

W. J. Austin, general manager of the Austin Co., industrial engineers and builders, Cleveland, Ohio, has just returned after spending three months in France, Belgium and England. While in Europe, Mr. Austin and his party were guests of the British Government for a considerable time, visiting many sections and interviewing leaders of industry in foreign countries, and he believes that friendly conditions which have resulted on account of the war have already given American manufacturers a good start toward winning new markets in Europe. In the party were J. K. Gannett, export sales manager of the Austin Co., and Alvan T. Fuller, member of the House of Representatives from Massachusetts.

The Chicago Pneumatic Tool Co. announces the following changes in office locations and personnel: The Detroit office has been removed from 236 Hancock Ave. to 502 Farwell Bldg.; the Boston office has removed to 182 High St., and is in charge of F. S. Eggleston; offices have been opened with warehouses at Tulsa, Okla., and El Dorado, Kan.; J. I. Edwards has been appointed manager of rock drill sales, succeeding E. Eklund, recently appointed foreign representative; Fred H. Waldron, formerly stationed at Minneapolis, has been appointed manager of pneumatic tool sales, with headquarters in Chicago, succeeding J. G. Osgood, resigned; Nelson B. Gatch has been appointed manager of sales at the Minneapolis office, 301 Metropolitan Bank Bldg., and J. K. Haigh has been appointed assistant district manager of sales at 175 First St., San Francisco.

An organization, known as the Eastern Paving-Brick Manufacturers' Association, to advance the interests of paving-brick manufacturers of New York, Pennsylvania, Ohio and West Virginia, was perfected as a result of a meeting held recently at Harrisburg, Penn.

The Associated Metal Lath Manufacturers, who formerly had their offices in the Swetland Bldg., Cleveland, Ohio, have decided to move them to Chicago, Ill., the former home of Wharton Clay, who has been elected commissioner of the organization.

Trade Publications

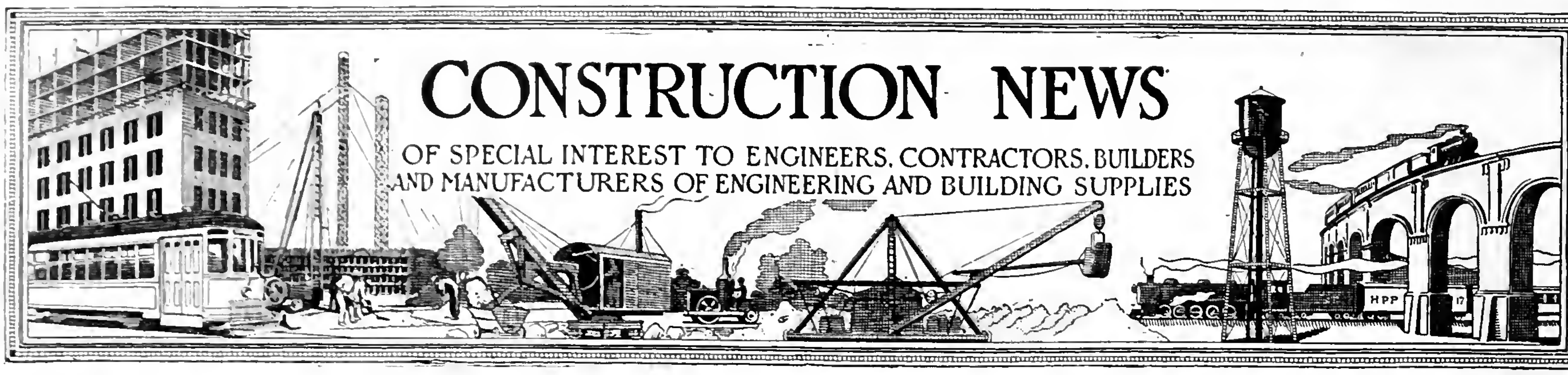
"Tarvia Road Book" is the title of a handbook just issued by the Barrett Co. for the use of engineers who are applying tarvia to their roads. It contains 70 pages, is 3½ x 6 in. in size, is neatly bound in leather and consists of tables useful to road engineers, together with specifications for applying tarvia. Among the tables are: The quantity of tarvia per mile; distance covered by various tank capacities; weight per cubic yard of various substances; spacing for covering material in half-ton piles; costs per mile at price per square yard, and many others. The book will be sent, on request, from any of the Barrett Co.'s offices.

"Pointers to Profits" is the title of a 7 x 10-in. catalog of 64 pp. just issued by the Acme Motor Truck Co. of Cadillac, Mich. Descriptions and illustrations of the operation of motor trucks, with specifications for sizes from one to five-ton capacities, are given.

Collapsible steel forms for concrete culverts from 13 to 15 in. to 36 x 46 in. in section are described in detail in a 24-p. pamphlet, 9 x 6 in., issued by the Illinois Culvert Form Co., Marseilles, Ill.

The Union Iron Products Co., of East Chicago, Ind., has issued a 3½ x 8½ in., 11-p. catalog illustrating "Wearproof" traffic direction signs, warning signs, metal highway markers and street nameplates. These signs are shown in colors and the accompanying descriptions give prices.

Cutting and breaking asphalt pavement and loosening frozen coal are two emergency uses for tie tampers described in the new Ingersoll-Rand tamping outfit catalog, which covers the company's outfits for track work.



PROPOSALS

For Proposals Advertised See Pages 64-70 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 31	Bakerton, Pa.	Mar. 27
	Adv. Mar. 20 and 27.	
Apr. 1	Duncan, Okla.	Mar. 27
Apr. 1	Scottsbluff, Neb.	Mar. 27
Apr. 1	New York, N. Y.	Mar. 27
Apr. 9	Kansas City, Mo.	Mar. 27
	Adv. Mar. 20 and Mar. 27.	
Apr. 15	Duluth, Minn.	Mar. 13
Apr. 15	Freeport, O.	Mar. 27
Apr. 18	Akron, O.	Mar. 27
	Adv. Mar. 20 and Mar. 27.	

SEWERS

Bids Close		See Eng. News-Record
Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Apr. 1	Great Falls, Mont.	Mar. 20
Apr. 1	Harrison, N. J.	Mar. 6
Apr. 1	Newark, N. J.	Mar. 6
Apr. 1	Nutley, N. J.	Mar. 27
Apr. 2	MasonCity, Ia.	Mar. 27
Apr. 2	Brooklyn, N. Y.	Mar. 27
Apr. 2	Hamilton, Ont.	Mar. 13
Apr. 4	Trenton, N. J.	Mar. 27
Apr. 4	San Bernardino, Cal.	Mar. 27
Apr. 8	Hagerstown, Md.	Mar. 20
	Adv. Mar. 20 and 27.	
Apr. 17	Pawtucket, R. I.	Mar. 27
Apr. 22	Cleveland, O.	Mar. 27

BRIDGES

Bids Close		See Eng. News-Record
Apr. 1	Peterborough, Ont.	Mar. 13
Apr. 1	Ft. Dodge, Ia.	Mar. 20
Apr. 1	Kansas City, Mo.	Mar. 27
Apr. 2	Toronto, Ont.	Mar. 27
Apr. 4	Ottawa, Ill.	Mar. 27
Apr. 7	Adna, Wash.	Mar. 20
Apr. 7	Rawlins, Va.	Mar. 20
Apr. 7	Stella, Va.	Mar. 20
Apr. 8	Lewisburg, W. Va.	Mar. 20
	Adv. Mar. 13 t o 27.	
Apr. 8	Hillsboro, N. D.	Mar. 27
Apr. 9	Jellicoe, Ont.	Mar. 27
Apr. 10	Clarksville, Pa.	Mar. 20
Apr. 11	Holyoke, Mass.	Mar. 13
	Adv. Mar. 13 and 20.	
Apr. 15	Copper Valley, Va.	Mar. 20
Apr. 16	Ottawa, Ont.	Feb. 20
Apr. 22	Kingston, N. Y.	Mar. 20
	Adv. Mar. 20.	
Apr. 22	Toledo, O.	Mar. 27

STREETS AND ROADS

Bids Close		See Eng. News-Record
Mar. 28	Pennsylvania	Mar. 6
	Adv. Mar. 6 to Mar. 20.	
Mar. 31	Lockport, N. Y.	Feb. 6
Mar. 31	Ottawa, Ont.	Feb. 27
Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Mar. 31	Youngstown, O.	Mar. 20
Mar. 31	Maryland	Mar. 27
Mar. 31	Port Washington, Wis.	Mar. 27
Mar. 31	Elkhorn, Wis.	Mar. 27
Mar. 31	Wisconsin	Mar. 27
Mar. 31	Camden, N. J.	Mar. 27
Mar. 31	St. Paul, Minn.	Mar. 27
Apr. 1	Dodgeville, Wis.	Mar. 27
Apr. 1	Richland Center, Wis.	Mar. 27
Apr. 1	Lancester, Wis.	Mar. 27
Apr. 1	Perrysburg, O.	Mar. 27
Apr. 1	Newark, N. J.	Mar. 27
Apr. 1	Frankfort, Ky.	Mar. 27
Apr. 1	North Hatley, Que.	Mar. 27
Apr. 1	Raleigh, N. C	Mar. 20
Apr. 1	Salt Lake City, Utah	Mar. 20
Apr. 1	Billings, Mont.	Mar. 20
Apr. 1	Kansas City, Mo.	Mar. 20
Apr. 2	Rhode Island	Mar. 27
	Adv. Mar. 20 and 27.	
Apr. 2	Fond du lac, Wis.	Mar. 27
Apr. 2	Mason City, Ia.	Mar. 2
Apr. 2	Michigan	Mar. 27
Apr. 2	Harrisburg, Ark.	Mar. 27
Apr. 2	Long Island City, N. Y.	Mar. 27
Apr. 2	Gold Beach, Ore.	Mar. 13
Apr. 2	Michigan	Mar. 13
Apr. 2	Santa Ana, Cal.	Mar. 13
Apr. 2	Boston, Mass.	Mar. 20
Apr. 2	Durham, N. C.	Mar. 20
	Adv. Mar. 20 and 27.	
Apr. 2	Bamberg, S. C.	Mar. 20
Apr. 3	Flemington, N. J.	Mar. 13
	Arv. Mar. 13 to 27.	
Apr. 3	New York	Mar. 20
Apr. 3	Pennsylvania	Mar. 27
Apr. 3	Lambertville, N. J.	Mar. 27
Apr. 3	Jonesboro, Ark.	Mar. 27
Apr. 4	New York	Mar. 20
Apr. 4	New Hampshire	Mar. 27
Apr. 4	North Platte, Neb.	Mar. 27
Apr. 5	South Dakota	Mar. 20
Apr. 5	Tylertown, Miss.	Mar. 20
Apr. 7	Moulton, Ala.	Feb. 20
Apr. 7	Salem, N. J.	Mar. 13
	Adv. Mar. 20 and 27.	
Apr. 7	San Jose, Cal.	Mar. 20
Apr. 7	Waukesha, Wis.	Mar. 27
Apr. 7	Camden, N. J.	Mar. 27
Apr. 7	Albany, N. Y.	Mar. 27
Apr. 7	Dothan, Ala.	Mar. 27
Apr. 7	Breckenridge, Minn.	Mar. 27
Apr. 7	Wahpeton, N. D.	Mar. 27
Apr. 7	Colorado	Mar. 27
	Adv. Mar. 20 and Mar. 27.	
Apr. 8	Mt. Vernon, Wash.	Mar. 20
Apr. 8	Indiana	Mar. 20
Apr. 8	Davenport, Wash.	Mar. 27
Apr. 8	Harlowton, Mont.	Mar. 27
Apr. 8	Pittsburgh, Pa.	Mar. 27
Apr. 9	Hackensack, N. J.	Mar. 13
	Adv. Mar. 13 to 27.	
Apr. 9	New Jersey	Mar. 20
	Adv. Mar. 13 to 27.	
Apr. 9	Center, N. D.	Mar. 20
Apr. 9	Providence, R. I.	Mar. 27
	Adv. Mar. 20 and 27.	
Apr. 9	Ithaca, N. Y.	Mar. 27
Apr. 10	Indiana	Mar. 20
Apr. 10	Middlebourne, W. Va.	Mar. 20
Apr. 10	Nevada	Mar. 27
Apr. 11	Jamestown, N. D.	Mar. 20
Apr. 11	Pennsylvania	Mar. 27
	Adv. Mar. 20 and Mar. 27.	
Apr. 11	Ebro, Minn.	Mar. 27
Apr. 12	La Moure, N. D.	Mar. 27
Apr. 14	Johnson City, Tenn.	Mar. 20
Apr. 14	Tunica, Miss.	Mar. 20
Apr. 14	Minneapolis, Minn.	Mar. 27
Apr. 14	Lincoln, Neb.	Mar. 27
Apr. 15	Billings, Mont.	Mar. 20
Apr. 15	Greenville, Miss.	Mar. 13
	Adv. Mar. 20 and 27.	
Apr. 15	St. Louis, Mo.	Mar. 20
Apr. 15	Columbus, Neb.	Mar. 27
Apr. 15	Keyser, W. Va.	Mar. 27
Apr. 15	Pawtucket, R. I.	Mar. 27
Apr. 16	Wayne, Neb.	Mar. 27
Apr. 19	Gandy, Neb.	Mar. 27
Apr. 22	Spencer, W. Va.	Mar. 13

RAILWAYS

Bids Close		See Eng. News-Record
Apr. 8	Pennsylvania	Mar. 27
	Adv. Mar. 20 and 27.	

EXCAVATION AND DREDGING

Bids Close		See Eng. News-Record
Mar. 31	Cleveland, O.	Mar. 20
Apr. 4	Whiteside, Ill.	Mar. 6
	Adv. Mar. 6 to 27.	
Apr. 8	Hollandale, Miss.	Feb. 13
Apr. 10	Newport, Ark.	Mar. 13
Apr. 15	Trenton, N. J.	Mar. 27
	Adv. Mar. 27.	

INDUSTRIAL WORKS

Bids Close		See Eng. News-Record
Apr. 1	Quebec, Que.	Mar. 13
Apr. 1	Sioux City, Ia.	Jan. 16
Apr. 1	Boonville, Mo.	Mar. 20
Apr. 1	Astoria, Ore.	Mar. 20
Apr. 5	Richmond, Va.	Mar. 27
Apr. 7	Hartford, Conn.	Mar. 27
Apr. 7	Brooklyn, N. Y.	Mar. 27
Apr. 10	Vancouver, Va.	Mar. 27
Apr. 14	Brooklyn, N. Y.	Mar. 27
Apr. 16	Winnipeg, Man.	Mar. 27
Apr. 16	Bellair, Ohio	Mar. 27
Apr. 18	Sheboygan, Wis.	Mar. 20
May 1	Brainerd, Minn.	Mar. 27

BUILDINGS

Bids Close		See Eng. News-Record
Mar. 31	Ottawa, Ont.	Mar. 6
Mar. 31	Mento, Ia.	Mar. 27
Mar. 31	Edgard, La.	Mar. 13
Mar. 31	Charlotte, N. C.	Mar. 20
Mar. 31	Chicago, Ill.	Mar. 20
Apr. 2	Fairfield, Cal.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 6
Apr. 2	New York, N. Y.	Jan. 23
Apr. 2	Duluth, Minn.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 20
Apr. 2	Chicago, Ill.	Mar. 27
Apr. 4	Seattle, Wash.	Mar. 13
Apr. 4	Compton, Cal.	Mar. 27
Apr. 4	Brooklyn, N. Y.	Mar. 27
Apr. 7	Ordway, Colo.	Mar. 20
Apr. 9	Jefferson, Ia.	Mar. 27
Apr. 10	Newaygo Mich.	Feb. 6
Apr. 10	Rome, N. Y.	Mar. 27
Apr. 10	Scottsville, Ky.	Mar. 27
Apr. 14	Superior, Wis.	Mar. 27
Apr. 15	Newark, N. J.	Feb. 6
Apr. 15	Chisholm, Minn.	Mar. 27
Apr. 15	Buhl, Minn.	Mar. 27
Apr. 21	Albany, N. Y.	Mar. 27
Apr. 22	Bovey, Minn.	Mar. 20
May 1	Wakefield, Minn.	Mar. 20
May 1	Virginia, Minn.	Mar. 27

FEDERAL GOVERNMENT WORK

Bids Close		See Eng. News-Record
Mar. 31	Wall and Dock—Spec. 3726—Coddington Point, R. I.	Mar. 27
Mar. 31	Coal—Memphis, Tenn.	Feb. 27
	Adv. Mar. 6 to Mar. 20.	
Mar. 31	Dredging—Wilmington, Del.	Mar. 6
	Adv. Mar. 6 to 27.	
Mar. 31	Power Plant Improvements—Spec. 3389—Pensacola, Fla.	Mar. 13
	Adv. Mar. 13.	
Mar. 31	Boathouse—Spec. 3786—Newport, R. I.	Mar. 20
Mar. 31	Dredging—Spec. 3597—Ft. Lafayette, N. Y.	Mar. 20
Mar. 31	Quay Wall, etc. — Spec. 3726—Newport, R. I.	Mar. 20
Mar. 31	Cranes — Spec. 3794 — Alexandria, Va.	Mar. 20
Apr. 1	Cement—Conneaut Harbor, O.	Mar. 13
Apr. 2	Post Office—Honey Grove, Tex.	Mar. 6
Apr. 2	Sewer and Water Supply—Stapleton, N. Y.	Mar. 13
Apr. 4	Post Office—Eldorado, Kan.	Mar. 6
Apr. 4	Bear Trap Leaves—Cincinnati, O.	Mar. 6
	Adv. Mar. 6 to 27.	
Apr. 4	Rip-Rap—Block Island, R. I.	Mar. 27

A Consolidation of Engineering News and Engineering Record   McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82   NEW YORK, THURSDAY, APRIL 3, 1919   Number 14

Real Military Engineers Were Needed at the Front

MOST of the engineers in the great war found service somewhere behind the lines. The proportion so engaged, which has been variously estimated up to as high as 95%, reached all the way from the immediate Service of Supply in France back to the ports in this country and to the camps and factories which contributed the men and material for the fighting front. So large was this proportion and so important was the work they did, that the more spectacular services of the fighting engineers have been lost sight of in the current engineering stories of the war. But no American engineer should forget that throughout the months that we were in action, up under fire of the German guns there were always thousands of brave, indomitable, resourceful men, with the castle of their corps on their collars, pushing forward with and at times ahead of the infantry spearhead which broke the German line. This was military engineering pure and simple. All else that the engineer did was civilian engineering necessary to the conduct of a war. It required little of military intelligence, little of military experience. The divisional engineers, a glimpse of whose work Captain De Leuw gives in his article on another page, were the real fighting engineers. Their work, or at least the direction of their work, requires military-engineering training. The men who carry it out must be, above all, soldiers, and the major part of their experience certainly should be that of a soldier.

Morale as a Disregarded Asset

A FURTHER blow has been given to the strength of the engineering organization engaged in subway construction in New York City. The city authorities delayed until Mar. 28, three days before the end of the quarter, the money appropriation necessary for continuing the engineering staff in service after Apr. 1. Last December the same proceeding was carried considerably farther; the appropriation was delayed until a month overdue, leaving the subway construction work substantially without an engineering organization for a full month. When the organization was reassembled, the damage done by the delay became quickly apparent. Some men did not return to the service. Others, perhaps most of the remainder, had had their allegiance to the commission's work profoundly shaken, and as a sequel a distinct loss of the spirit of loyal service and coöperation necessary in every great enterprise became apparent. No member of the organization knew whether his activities would continue after the last day of March. Even more after last week's performance, the commission's engineers have no certainty whatever as to the continuity of the work. The city authorities have seriously injured the morale of the organization.

Detroit Water-Filtration Experiments Fully Justified

ANOTHER experimental water-treatment plant has been justified by the light it has thrown upon the design of proposed works to treat the water-supply of a city, as shown by the brief article on page 662. A full year's tests show that the Detroit supply can be treated at a much higher unit rate than is common to mechanical filtration in the Central West. The tests also indicate that alum will be preferable to lime and sulphate of iron as a coagulant for this water. It is to be hoped that the plant will soon be put under construction. Complete treatment of the water would presumably lower the somewhat high typhoid and general death rates, besides effecting a marked improvement in the appearance of the water. The educational work done in connection with the experimental plant is commendable.

To Direct Federal-Aid Road Work

ALMOST on the day that last week's issue of *Engineering News-Record* went to press announcement was made that Thomas H. MacDonald, chief engineer of the Iowa State Highway Commission, had been appointed engineer in charge of the work under the Federal-aid road act. It will be remembered that last week's issue urged that the new director for the Bureau of Public Roads be appointed as quickly as possible. Mr. MacDonald's appointment is not as director, but as engineer in charge of the Federal-aid road work, this apparently being due to the failure of Congress to vote an adequate salary for the man who is to supervise a $200,000,000 expenditure of Federal money. Mr. MacDonald will eventually succeed to the post of director, but not, we hope, until the Congress of the United States votes a fitting salary. Mr. MacDonald goes to the job with excellent qualifications, both as to personality and experience. As chief engineer of the Iowa State Highway Commission, he has handled a good-roads project almost parallel to that, though on a smaller scale, of the Federal-aid act. In Iowa the state supervises all the county work, though the work is paid for by the counties. Obviously, the directors of such work must proceed with extraordinary tact and with full appreciation of the local problems. The points of view necessary for success in Iowa are exactly those necessary in the larger post to which Mr. MacDonald is now going. The whole highway field has confidence in him and will gladly pledge him hearty and unqualified support.

A Workable Shipping Plan

IN THE plan outlined by Chairman Edward N. Hurley of the Shipping Board for a permanent ship-operating policy and system for the United States, the first workable and well considered proposal to solve the sea transportation problem is laid before the nation. Shipping men, who might well have worked toward a solution of the problem before this, appear to have maintained an attitude which at the best was passive. Their interests, of course, are by no means simple, nor are they identical with those which Chairman Hurley represents, for the habit of foreign control has not yet passed from our shipping industry. Because little has been done toward solving the problem up to now, we must welcome a plan based on Mr. Hurley's steadfastly aggressive championship of a permanent American sea commerce. This stand, and the shrewdness he has displayed in most phases of the Shipping Board's negotiations, give great weight to his plan.

It is a workable plan, we have said. The major difficulties of the sea transportation problem are duly taken care of. Skillfully turning the flank of the seaman labor problem, the plan removes one of the two essential causes for apprehension concerning our merchant-marine future. It deals with the other difficulty, that of excessive capital account, by providing for selling vessels at the current market price, just as has been done in England. The plan suggested is practicable and until something better is presented it is bound to form our working hypothesis of ship administration.

What is important for every citizen, whether he be engineer or not, to remark concerning this plan, is that our great Government merchant fleet will largely be completed before the plan can be adopted, organized and started in operation. Our fleet of ten million or more tons will be at work, soliciting, receiving and carrying freight, before the new machinery can take hold of the service. This will mean that at all events the Government must go into ship operation temporarily, and that its operating organization must be developed and enlarged to care for the increasing duties. With such enlargement the Shipping Board will be able to carry on operations temporarily without any need for hurrying the final shaping of the plan, and at the same time its accumulating experiences may be put to use in perfecting the details of the plan. It is quite important that this condition be clearly seen, as otherwise the country may be led into hasty action with regard to the release and sale of its ships, which may start the disorganization of our merchant marine before even it is created. The great present question is to get the ships going, not how they are to be kept going.

Three phases of the shipping problem and Mr. Hurley's plan are of primary importance, in so far as they have relation to engineering work in addition to ship operation. These phases are the close parallelism between the railroad problem and the shipping problem; the question of foreign terminals; and the question of future shipbuilding.

Precisely the same mixture of public service and private interests is found in our shipping as in our railroad problem—provided we take the same public-interest stand as Mr. Hurley, who frankly bases his argument and his plan on the overshadowing importance of developing the shipping industry for the greatest good of the country. There are, moreover, precisely identical difficulties in the two cases. Both involve capital-account questions that seem to make it inevitable for the Government to take a loss chargeable to war cost. Both require the same adjustment between hitherto customary rates and a higher wage level. Both present the triple question of Government operation or Government control or uncontrolled private operation. Despite many surface dissimilarities, the two subjects, railroad and shipping, become more closely similar the more fully the case is studied.

That Mr. Hurley has provided in his plan for intimate coöperation of Government and private functions is of extreme interest in its bearing on the best solution of the railroad problem. He avoids Government ownership, but instead counts on turning every piece of property over to private owners just as quickly as possible and without any restrictions. He arranges for Government financing, and virtually makes Government credit available by using the difference between Government and commercial interest rates to produce an emergency fund which shall protect the whole system in its operation and equalize individual losses. He arranges for control with respect to essential public interests, so that, for example, ship routes shall be established as our commerce needs them; but beyond this he leaves the business wholly free from regulation. Finally, he arranges for covering certain losses by the emergency fund to be drawn from excess interest payments on the purchase mortgages and from excess of private over Government insurance rates.

In emphatic advocacy of our present seamen's protective laws and in a refutation of the oft-made claim that they put American shipping at a tremendous disadvantage, Mr. Hurley, in his report on his European trip, rendered just before the publication of his plan, has exhibited a resolute determination to take account of the irresistible world drift toward stabilized labor conditions. He shows that the storm which has raged about this subject for quite a time past has not shaken him. At the same time, however, it is evident that his plan, though it makes no express provision for any unbalanced labor cost which might render American operators unable to compete, does, in fact, allow for this difficulty. Through the power of the administrative board and its emergency fund of many millions of dollars, the object can be attained. There is no such word as subsidy in the plan.

It is instructive in relation to the railroad problem to observe how Mr. Hurley avoids not only Government ownership or operation—he asserts that he means in his plan to secure the benefits of private enterprise—but also avoids the public-private corporation, a device much discussed with regard to the railroad problem, but one whose dangers we do not yet know. By avoiding these two evils, as well as that of wholly uncontrolled private operations, he offers a system well worth the attention of those who are formulating or are considering railroad operating plans. Perhaps it may even turn out that the finally successful railroad and shipping plans will both be devised as the result of joint study of the two problems.

As to terminals, it is necessary to observe that no provision whatever has been made by Mr. Hurley for ship terminals abroad. This is a defect, it would seem. He says that he desires to give the small ship operator a chance, since only thus can the industry be developed to size and strength. Yet if the small ship operator is to be put in position to make a fight for business

and hold it, he must in many parts of the world be aided in securing port and terminal facilities. It may be that terminals are a detail which will develop in the working out of the plan. We prefer, however, to regard it as a major question. Involved as it is with the subject of international relations, machinery additional to that which Mr. Hurley has conceived will be needed to take care of it. The need for this machinery may be short-lived, since ultimately the question of terminals should adjust itself; but during this temporary period we conceive that terminals will be vital in the development of our foreign shipping business.

Shipbuilding, finally, is a matter to which Mr. Hurley's plan gives no attention, and the shipyard man is left without encouragement or prospect as to anything beyond the current year. Stability in shipbuilding is closely inter-related with stability in shipping. So far we remain in the stagnation of thought which the Shipping Board created last fall. A plan for future shipbuilding is as important a need as a plan for ship operation, and the two should probably be combined. Full shipyard efficiency can be brought about and maintained only by reasonable assurances concerning the future.

Food for Thought in a New York Engineers' Meeting

LAST week's meeting in New York to discuss the engineer as a citizen offered food for thought, not so much in what was said by the speakers designated to open the discussion as in the thoughts offered in discussion and the ideas to which they naturally give birth. A movement was started to organize a New York local engineering society. There was some plain talk, such as is seldom heard in what the chairman called the "temple of engineering," while it remained for the floor discussion to face clearly the engineer's responsibility as to the most pressing questions in our social unrest. A brief account of the meeting will be found in the news section of this issue.

First, it may be said that there should be no delay in bringing to an early conclusion the purport of the resolution to establish a New York local engineering society. With all our talk about the engineer standing up and having his say on civic matters of an engineering character, the engineers of the country's largest city have remained unorganized and inarticulate. In stringent cases the central administrations of the national societies have bestirred themselves, but they have acted out of their natural sphere when they did so. Moreover, with their primary function one of national service, it is futile to expect them to follow closely and act on all manner of local questions.

As to the opening discussions at the meeting, none of them brought out in any adequate way the chief opportunity and the chief responsibility of the engineer in our present era of dominant industrialism, nor took up and handled conclusively the labor sore spots in our present crisis. Several of the speakers called upon the engineers to withstand the wave of Bolshevism should it break on our shores, but none of them analyzed the cause of Bolshevism nor pointed out the industrial measures that can cure the disease. It remained for one of the audience, Lieutenant Van Gilder, to point out the need for impartial study of this phase of the question.

The responsibility is so obvious that it is all the more remarkable that the subject was not handled fully and convincingly. The present industrial order is the creation of engineering. It is a mechanism by which labor is directed more or less intelligently and efficiently in the creation of things that satisfy human wants. In our conception of industrial economics we recognize two main elements—materials and labor. As to the first, we have left and are leaving nothing undone within the limits of human knowledge to determine all factors that affect their efficient use. In fact, we are constantly pushing out the bounds of human knowledge, by research work, that we may still further increase efficiency in the use of materials.

As to the other factor, labor, we have done relatively little. Taylor, and those who have followed him, have been building up a science of management, but relatively few competent men are engaged in the task. Furthermore, all but two or three set narrow limits to their inquiry and are interested in the efficiency of the worker only while actually at his task or machine. Yet back of that is a host of factors—human factors—that condition his efficiency. These factors—health, housing, the stimuli of sustained interest, the share in the value of what is produced, etc.—all need to be attacked with the clearness of the engineer's vision. They are being attacked, but by long-haired reformers, by rabid leaders, and the results have been far from wholly good.

Scientific principles and mathematical formulæ now in existence may be of no avail for instant application to these human problems, but the elements can be clarified by the impartial examination that is fundamental in engineering inquiries.

Of the plain talking, the most interesting was Mr. Johnson's sharp criticism of the type of men elected to office in our national engineering societies. He described them as men who had won reputations and were afraid of damaging them by starting something new. His analysis may be partly true, but in the general import of his remark—that we elect men to office rather to honor them than to secure for the society services that will really be of value—we heartily concur. "Young men for war, old men for council." The conduct of a worth-while society requires both types. Action is needed, but action tempered by experience. Now, however, the experience is dominant; there is so much counsel that action is inhibited. In business we put the older men in the directorate, but the department heads, who get action, who originate new ideas and methods, are young men. In societies the secretary must be of the action type or have active men under him, and in the board he needs supporters of the active type as well as counsellors of conservatism. Above all, there is needed, every other term, a president selected for the service he is able to render the society rather than for the honor which the society can confer on him.

Mr. Johnson's views are good food for thought for nominating committees.

Finally, a remarkable thing about the make-up of the audience was that it was composed three-fourths of the distinctly younger men. Gray heads and bald heads were in the minority—an indication that the generation coming into power will concern itself more with the engineer's responsibility as a citizen than did the past.

Solving Construction Problems in Canal Street Subway

High Ground-Water Level Complicated Deep Construction Work Under the Old Subway in New York City — Pit and Drift Methods Used

By A. J. Mayell

Assistant Division Engineer, Public Service Commission, New York City

Unusual methods were adopted in the solution of several problems which developed during the construction of the short section of the Canal St. subway in New York City, between Broadway and the Bowery. The primary cause of the adoption of these unusual methods lay in the difficulties due to the high ground-water level, and led to the process adopted, which consisted essentially in digging square pits as deep as the ground-water level would permit, lowering the ground-water level, excavating the cut, extending the pits to lower levels, and concreting them. Under the Centre St. loop, drifts were used in three levels, provision being made to set forms for wall and skew back of the roof arch as the drifts were widened out in 8-ft. sections. Considerable leakage developed at the points where overhead lap joints were made in the waterproofing. This has been reduced by forcing grout under pressure through holes drilled in the concrete.

The street surface of Canal St., from Broadway to Centre St., is only from 10 to 12 ft. above mean high water, and the normal level of ground water is only slightly below mean high water. The first problem involved the lowering of ground water sufficiently to permit building the structure. While normal ground water was only slightly below mean high water, as stated, pumping in the vicinity, by other contractors, had lowered the ground-water level about 15 ft. before the construction of the Canal St. crosstown line, known as Sec. 2, Route 20, was started. The lowering of the water from elevation —15 to —35 was accomplished by continuous pumping from three sumps and two well-points with 3-, 5- and 8-in. centrifugal pumps.

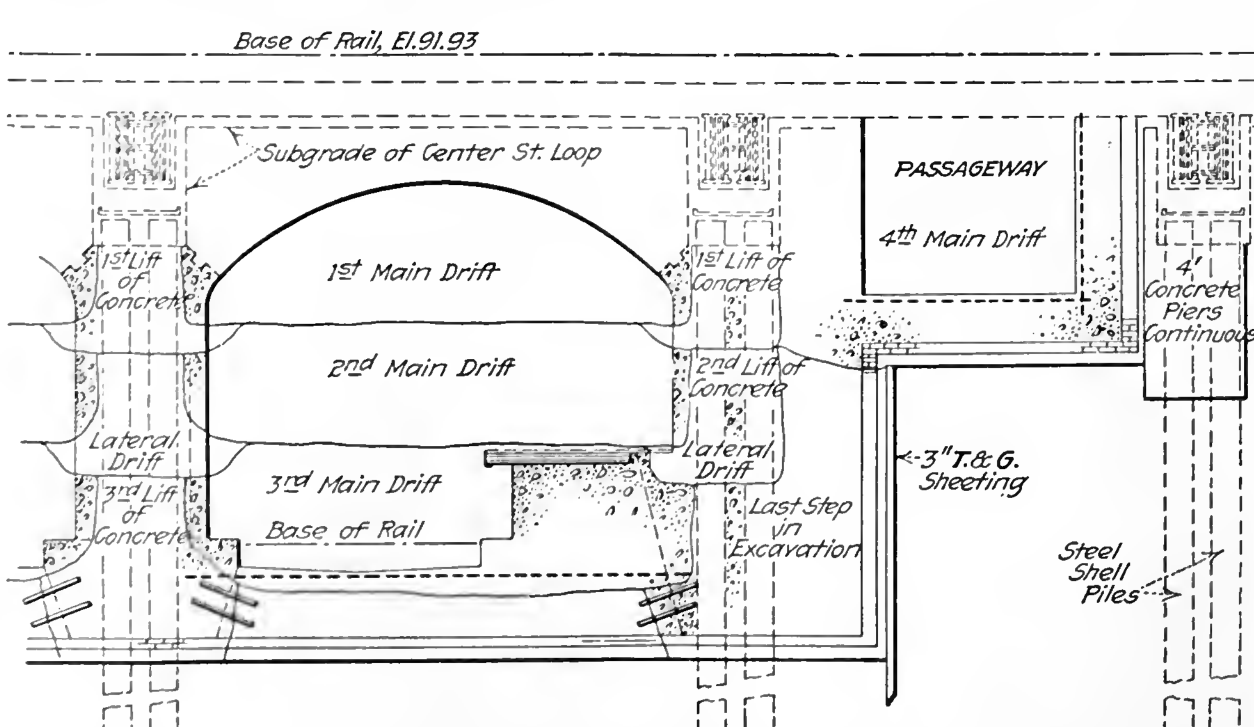
Protection of the buildings along Canal St. from damage due to settlement was accomplished in an unusual manner. Instead of underpinning the buildings, the contractor protected them by means of a continuous concrete wall constructed by the "pit" method, which may be briefly described as follows:

Attacking the work from three shafts, one just east of Broadway, one between Lafayette St. and Centre St., and one at Harry Howard Square, the contractor removed the top lift of the excavation to a depth of about 10 ft. for the full width of the cut. Pits 4 ft. square, spaced 4, 8 or 12 ft. apart were then excavated on the neat lines to such depth as ground water would permit, and filled with concrete. Intermediate pits were then excavated and concreted, until the piers formed a continuous concrete wall 4 ft. thick along each neat line. The needles across the cut supporting the timbering, pipes and street decking either butted against or were recessed into these piers.

In the meantime, pumping from the sumps had been started, and ground water lowered enough to allow excavation to within a few feet of the bottom of the concrete wall, when the process of extending the wall to a lower level was started. This was done by undercutting the wall in 4-ft. sections and excavating these pits to such further depth as the lowered elevation of the ground water permitted. These pits were so spaced that not more than 4 ft. of the wall in every 12 ft. was undermined at one time. After the pits were concreted, the intermediate pits were excavated and concreted, and the process was repeated until the entire wall was extended to this lower level.

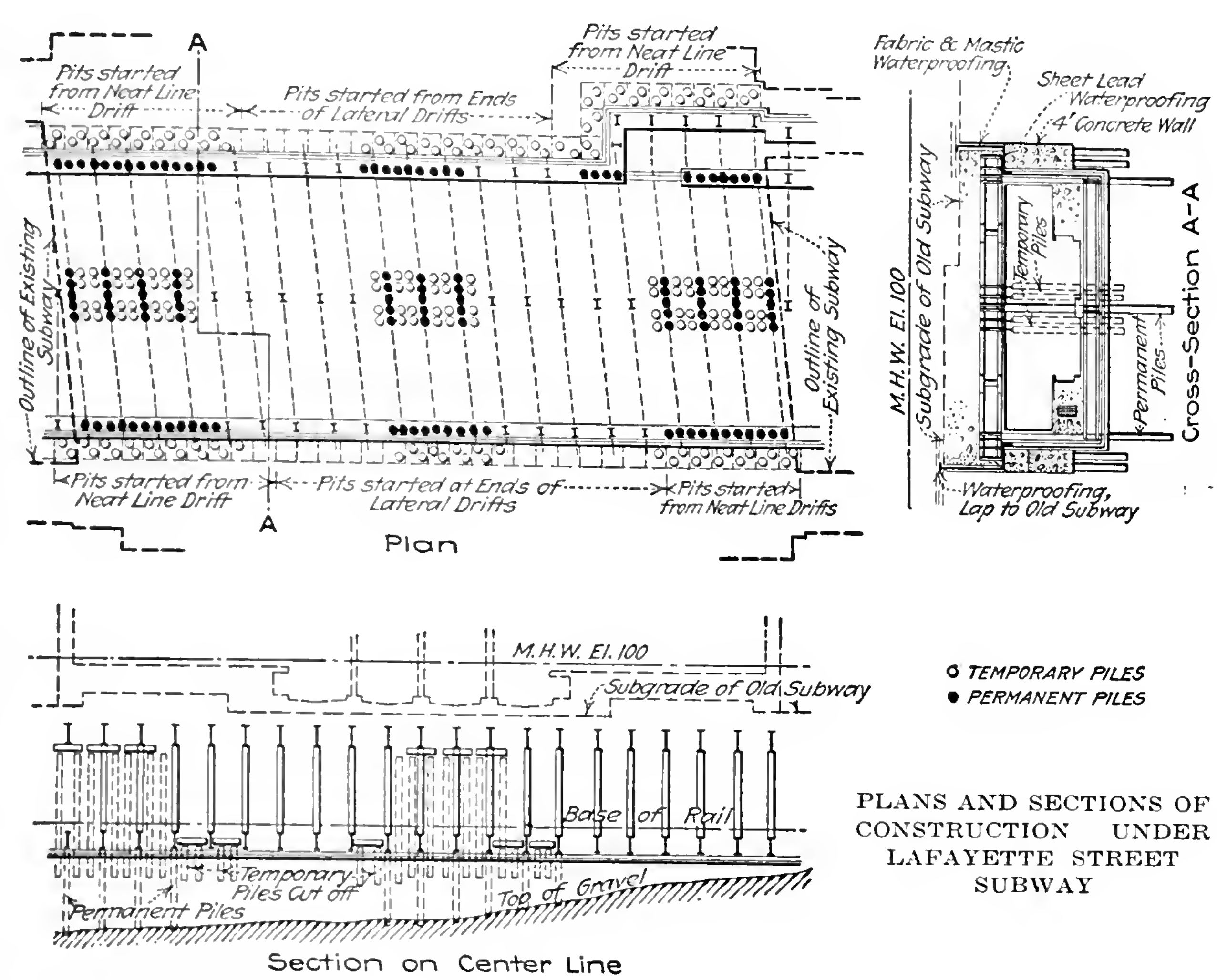
This process of lowering the ground water, excavating the cut, extending the pits to lower level, and concreting them, was repeated until the excavation was within a few feet of subgrade and the cut was protected with a continuous concrete wall on both sides. East of Centre St., where the ground water was lowered below subgrade, the wall was extended a few feet below subgrade, while west of Lafayette St., where lowering the ground water the last few feet was a slow operation and where poor soil conditions were encountered, steel sheet piling was used for the bottom four or five feet.

These concrete walls not only took the place of sheeting but also, with certain additional bracing across the cut, acted as protection for the buildings. As the contractor was entitled to unit-price payment for protecting buildings, and as most of the sand used in the concrete was taken from the cut, the cost of constructing these walls was considerably less than would have been the cost of sheeting the cut and underpinning the buildings.



CONSTRUCTION OF SUBWAY UNDER CENTRE STREET LOOP IN THREE LIFTS

Another problem was the construction of the new subway under the existing subway structures in Centre St. (Centre St. loop) and in Lafayette St. (Interborough subway). When the Centre St. subway was built in 1910-11 the loads were carried to heavy floor girders which, in turn, were supported on steel shell piles driven below the subgrade of the proposed crosstown subway, so that the construction under Centre St. was not a very difficult matter, but the method adopted was somewhat original. The plans called for concrete arch construction over the tracks, and in order to make progress, and still not wait for the ground water to be lowered to subgrade, drifts about 10 ft. deep were excavated along the center line of both tracks of the crosstown line. These drifts were widened out to expose the piles, but the material around the piles was removed in 8-ft. sections at a time.



PLANS AND SECTIONS OF CONSTRUCTION UNDER LAFAYETTE STREET SUBWAY

As each 8-ft. section was uncovered, forms were set for the wall and the skewback of the arch and this section was concreted. This method was continued until the entire center wall with the skewbacks of the arches and the portion of the 8-ft. sidewalls inclosing the piles were concreted to a depth of about 6 ft. The excavation was then deepened in 8-ft. lateral drifts, and the next lower section of the walls was concreted. The top board of the forms was inclined outward and extended above the bottom of the wall already placed so as to permit placing the concrete under a slight head. The horizontal joint between these pourings was grouted after the concrete had set and settlement and shrinkage had taken place.

USE OF 8-FOOT SECTIONS IN CONCRETE CENTER WALL UNDER CENTRE STREET LOOP

Excavation was then continued to the bottom of the wall as placed, and again lateral drifts were excavated, this time to subgrade, and the bottom protection concrete and brick-in-mastic waterproofing were placed. Then forms for the bottom section of wall were placed and concreted. The remainder of the excavation was then removed and the invert placed.

The reason for constructing the walls in 8-ft. sections was to avoid placing entire dependence for the support of the overhead structure on the piles, which would have resulted if the material around the piles had all been removed at the same time.

The method of construction under the old subway in Lafayette St. was more difficult, as no provision had been made when it was built to support it during the construction of the crosstown line. The first operation was to excavate a drift about 8 ft. wide and 8 ft. deep under the old subway along the center line of the crosstown line. This drift was carefully sheeted and braced across with timber struts top and bottom. Under the center line of the Lafayette St. subway a lateral drift was then excavated from the center drift to points about 4 ft. outside the north and south lines of the crosstown line. At the ends of this drift, pits 4 ft. square were sunk, with horizontal sheeting to the ground-water level, and concreted. Two ply of sheet-lead waterproofing were then placed over the top of the concrete piers, and protected with a layer of cement mortar.

The first roof girder was then brought in through the center line drift and placed in the lateral drift in its final location, resting on blocking on the soil, the ends being supported on the concrete piers at the ends of the drift. The roof girders were ordered in three sections so that they could be handled in the drifts, and were spliced after being placed in position.

A 4-in. wall of concrete was then placed at the ends of the drift, a strip of the protection concrete on the bottom of the old subway was removed, and three-ply waterproofing fabric mopped with coal-tar pitch was placed on the protection wall and carefully lapped onto the brick and mastic waterproofing on the bottom of the old subway. The lower end of the fabric was dovetailed with the sheet lead previously placed on top of the concrete pier. About 1½ in. from the fabric a brick wall was erected, and the pocket thus formed was filled with mastic.

Forms were then set 3 ft. each side of the girder, and concrete was placed around the girder about flush with the top of it, keys being left in the concrete and rods being placed to bond it with the adjoining concrete to be placed later. After the concrete was set, posts and caps were placed on top of the girder and wedged up to support the overhead structure.

Another lateral drift was then excavated adjacent to this, and the same operations were repeated; a third drift was excavated on the other side of the girder and this operation was continued, with drifts alternating east and west of the first. The space between the top of the girders and the bottom of the old subway was placed by hand and packed well with rammers. Grout pipes were placed longitudinally with "tees" looking up in each bay for the purpose of grouting during construction, and vertical pipes were placed in each bay for final grouting after the entire roof was placed.

Steel Shell Piles Support Roof

After several roof girders had been placed and concreted, the center line drift was deepened to permit jacking of steel shell piles to support the roof construction while the core of excavation was being removed. Four rows of 12-in. steel shell piles, two rows on each side of the center line, spaced so as to avoid interference with the center line columns and the transverse steel, were jacked in place. These piles were in sections from 5 to 7 ft. long; the material inside the piles was cleaned out as the piles were driven, additional sections being added and held in place by an interior collar. When the piles reached a depth of about 2 ft. below subgrade they were concreted and tested. Jacking was continued until the pile showed no settlement under a test load of 70 tons.

The piles were capped with short pieces of channels, and 15-in. I-beams were placed spanning from a pile on one side of a roof girder to one on the other side, and wedged up with steel plates and wedges under the bottom flange of the girder.

Drifts had in the meantime been started under the concrete wall formed by the piers at the ends of the lateral drifts. Pits 4 ft. square were excavated under the wall, and piles jacked below subgrade, similar to the piles in the center drift; the piles were concreted and tested and the pits concreted and sealed.

The remaining core of excavation was then removed to the base of the rail. On account of the poor bearing power of the soil, it was decided to have additional piles driven directly under the floor girders. Four additional piles were then jacked down to bearing on a stratum of gravel varying from 6 to 12 ft. below subgrade under each floor girder; one pile being directly under the center-line column and two on each side of the center line; under the side walls one pile was driven under each girder and two were driven between each pair of girders.

After these piles were driven the floor girders were placed and brought to bearing on the piles by means of steel plates and wedges. The temporary piles were then cut off, sealed with asphalt and capped with steel plates, and I-beams were placed on top of them between the floor girders, and posted to the roof. The floor was then waterproofed with brick and mastic, and concreted, boxes being placed around the posts on top of the I-beams. After the concrete had set the posts were removed and the boxes concreted.

EXTENDING PITS TO LOWER LEVEL ALONG NEAT LINE OF CUT

The maximum settlement in the overhead structure was 2½ in. in the track columns and 3 in. in the platform columns. About a year after the structure was completed and put in operation and the ground water had returned to its normal level, considerable leakage developed in the new structure. The leakage appeared wherever an overhead lap had been made to the waterproofing of an overhead structure; namely, under the Lafayette St. subway and in certain stairways where connections had been made to the Centre St. loop station. It was thought that a slight settlement had taken place in the mastic waterproofing, and the laps had pulled away enough to permit the entrance of water underhead.

The remedy suggested was to drill holes through the interior concrete in the direction of these laps and force a thin mixture of grout into the holes, under enough pressure to seal the openings. This method has been tried and has proved very effective, the leakage having been reduced from about 150 gal. per minute to less than 5 gal. per minute. The grouting is not yet finished, but it is believed that the leakage can be entirely stopped and the station made absolutely dry in consequence.

The Underpinning and Foundation Co., was the contractor for the construction of this section of the subway.

Effects of Insufficient "Curing" Period in Water Softener

Incrusted filter sand, limed-up meters, coated service mains and persistent troubles with hot-water heating apparatus, all in greater or less proportions, are the result of an insufficient detention period in the settling basins of the Grand Rapids, Mich., water-purification plant.

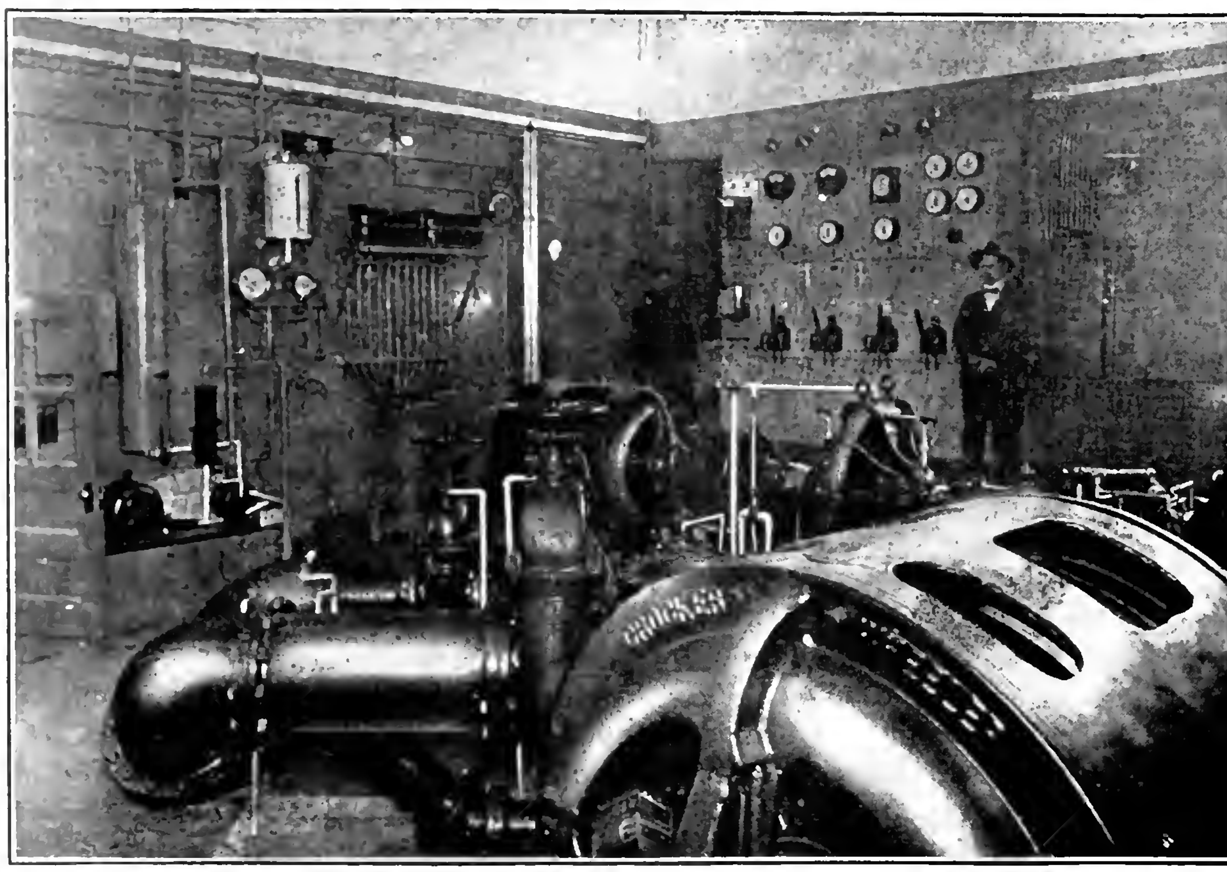
Details were given by W. A. Sperry, chemist of the filter plant, at the recent meeting of the Illinois section of the American Water-Works Association. Comparing the sand as placed in 1912 with analysis made in August, 1918, the effective size had increased from 0.27 to 1.05 mm.; the uniformity coefficient had decreased from 1.61 to 1; the thickness of coating is now 0.255 mm. Intervening increases were given in *Engineering News-Record* of May 10, 1917, p. 304, and Aug. 22, 1918, p. 358. Classifying the troubles found with the 3827 meters, out of a total of 22,000 meters, sent to the shop during the year which ended July 1, 1918, 53.9% were limed-up only; 12.1% had lime and mechanical troubles; 19.3% mechanical troubles only; 8.1% were frozen; 1.5% sand clogged; 0.2% taken out for test; 0.1% found all right, and for 4.8% there was no information.

Design of New Electric-Drive Water-Pumping Station Was Governed by Power Rate

Current Charge for Three Months Depends on Maximum Use in Any Two-Hour Period—Universal Meter System Postponed Because Temporarily Cheaper to Pump More Water, but Expected to Come Later

By Henry W. Taylor
Consulting Engineer, New York City

DEVELOPING a new pumping station for the water-works of Cohoes, N. Y., from 1914 to date, involved unusual conditions as to water consumption, change in power, power rates and changes in design. The chief controlling factor has been the rate for electric power. This has reacted on pump capacity and has caused the temporary postponement of the introduction of a universal meter system. In 1914 the water-works were in charge of a water board under the old city charter. The pumping plant consisted of three reciprocating pumps, driven by two water turbines, and one electric-drive centrifugal pump, which was used during low-water stages of the hydraulic canal. All of the equipment, except the electric-drive pump, was from 20 to 30 years old and was in a condition requiring constant repair and subject to unexpected breakdowns. Mechanically, the equipment needed replacement, in any case, on the basis of safety and economy.



THE TWO LARGER PUMPING UNITS, PRIMING OUTFIT AND SWITCHBOARD OF THE COHOES PUMPING PLANT

In 1914 the Cohoes Co. was still operating the old hydraulic canals which were serving the individual lessees of property along these canals and providing water for power. The old scheme of hydraulic canals resulted in an uneconomical use of the total water power available from the Mohawk River, and the Cohoes Co. was, in 1914, developing a scheme for the installation of a central hydro-electric generating station which would use all the water available from the Mohawk River under a maximum head and with maximum efficiency. The mill owners were to be supplied with electric power which was to supplant the water power previously provided them. Such a reorganization, affecting many different types of mills and a multitude of owners, involved a considerable amount of time, but eventually, special contracts were agreed upon which made a central power station possible. Thus the hydraulic power was eventually supplanted by electric energy.

The city pumping station represented one of the properties which had heretofore used hydraulic power, and the water board must necessarily look forward to a change in its pumping equipment for electric drive. In 1914, the question of contracts was still unsettled, but it was supposed that the best rate which could be obtained in the new arrangement would be about $\frac{3}{8}$c. per kilowatt-hour for night pumping.

The water consumption at Cohoes approximated 225 gal. per capita per day in 1914. Metering was brought to the attention of the board, but was temporarily rejected on the basis of certain peculiar conditions involved in metering the city. Without meters it was found that, at certain times during excessively cold or hot weather, the water consumption frequently ran to from 8,000,000 to 10,000,0000 gal. a day. The normal daily consumption was from 5,500,000 to 6,000,000 gal. Without meters it could not be expected that this rate of consumption would be materially decreased; while, on the other hand, provision must be made for its material increase. The further requirement that pumping must be done on a 12-hour basis to secure the advantage of the better electric-power rate necessitated a pumping station having a capacity twice that of a 24-hour plant. It was therefore decided to abandon the present pumping station and build a new station containing three 10,000,000-gal. units, consisting of centrifugal pumps with direct-connected motors and accessories.

Complete plans were drawn for such a scheme. They involved a new pump house, a new house for the superintendent of the pumping station and a new water intake, suction wells, piping and electrical equipment inside the pumping station, together with a new force main which was required to supplement other force mains to accommodate a pumping rate per 24-hour day of 20,000,000 gal. The three units provided for one reserve unit while the other two units would be run together for a 12-hour shift.

In 1915 the city charter was revised and the office of commissioner of public works was created. The commissioner became the head of the water bureau. The question of metering was thereupon taken up with this official, and a scheme was developed whereby a pumping station could be erected in connection with the installation of meters. This would be much more economical in the end, and for its housing a portion of the existing pumping station could be used. The question of meters was taken up with a citizens' committee, and the whole plan of the combined meter and pump installation was finally accepted as the proper method of development.

Current Charge Based on Two-Hour Maximum

During 1916 and the early part of 1917 efforts were made to close a suitable electric power contract with the Cohoes Co., which would allow adequate credit for leases held by the city for the use of the old hydraulic canal. This contract was closed in the early part of 1917. The main point of interest in this contract, exclusive of local complications, is an electric rate of $20 per kilowatt-year, or about 0.228c. per kilowatt-hour, and the provision that the amount of current charged against any given quarter would be represented by the continuous use for that quarter of the maximum amount of current used during any continuous two-hour period.

In the autumn of 1916 contracts were let for remodelling a section of the present pump house to receive the new electric-drive pumping apparatus and for the first installment of meters, these meters being recommended in size and number to serve the principal industrial and commercial needs of the city. It was hoped that this first installation of meters would reduce the consumption by at least 1,000,000 gal. a day and that the future additional meters would bring the per capita water consumption down to about 135 gal. a day.

A definite electric-power contract having been made, meters purchased and a meter system adopted, it was possible to design a pumping station which would best suit the water-consumption and electric-power requirements in the case. In 1916 the average daily consumption ran to about 9,000,000 gal. a day during continued periods of cold or hot weather. The raw-water reservoir to which the pumps deliver had a storage of about 45,000,000 gal. which could be delivered to the filtration plant. It was assumed that the first installation of meters would be completed before the pumps could be placed and that in the meantime the excessive use of water during hot and cold periods would be materially reduced and the average consumption for the year would approximate about 5,000,000 gal. a day. The electric contract required, for economical operation of the plant, that the water pumped per day be as close as practicable to the consumption, since one day's pumping of an excessive quantity of water would create a power record of over two hours and this day's use of power would be the basis of the charge for the entire quarter irrespective of the reduced power used on subsequent days. The normal consumption of 6,000,000 gal. a day was to be reduced, and, in view of the storage of raw water available, it was considered that a normal maximum capacity of 7,000,000 gal. a day would be ample.

To meet the decreasing use of water due to the use of meters it was important that the units making up the plant should be graded downward, and it was decided to install three pumps, one of 1,000,000-, one of 4,000,000- and one of 6,000,000-gal. capacity. This combination of units made it possible to pump 4, 5, 6 or 7 million gallons per day by various combinations or an average of 4½, 5½ or 6½ million gallons per day.

It was also considered advisable to have the larger pumps of a characteristic curve such that when the 4,000,000- and the 6,000,000-gal. pumps were operating together they would not give their combined capacity but react against each other so as to yield about 7,500,000 gal. per day. In case these two large pumps were used together, inadvisedly, for a period of more than two hours, there would not then be an electric charge for a whole quarter resulting from pumping 10,000,000 gal. for a short period, and with a meter system the pumps designed provided ample capacity and ample reserve for many years to come. Population increase would be balanced by per capita reduction in the use of water, for which there was ample margin.

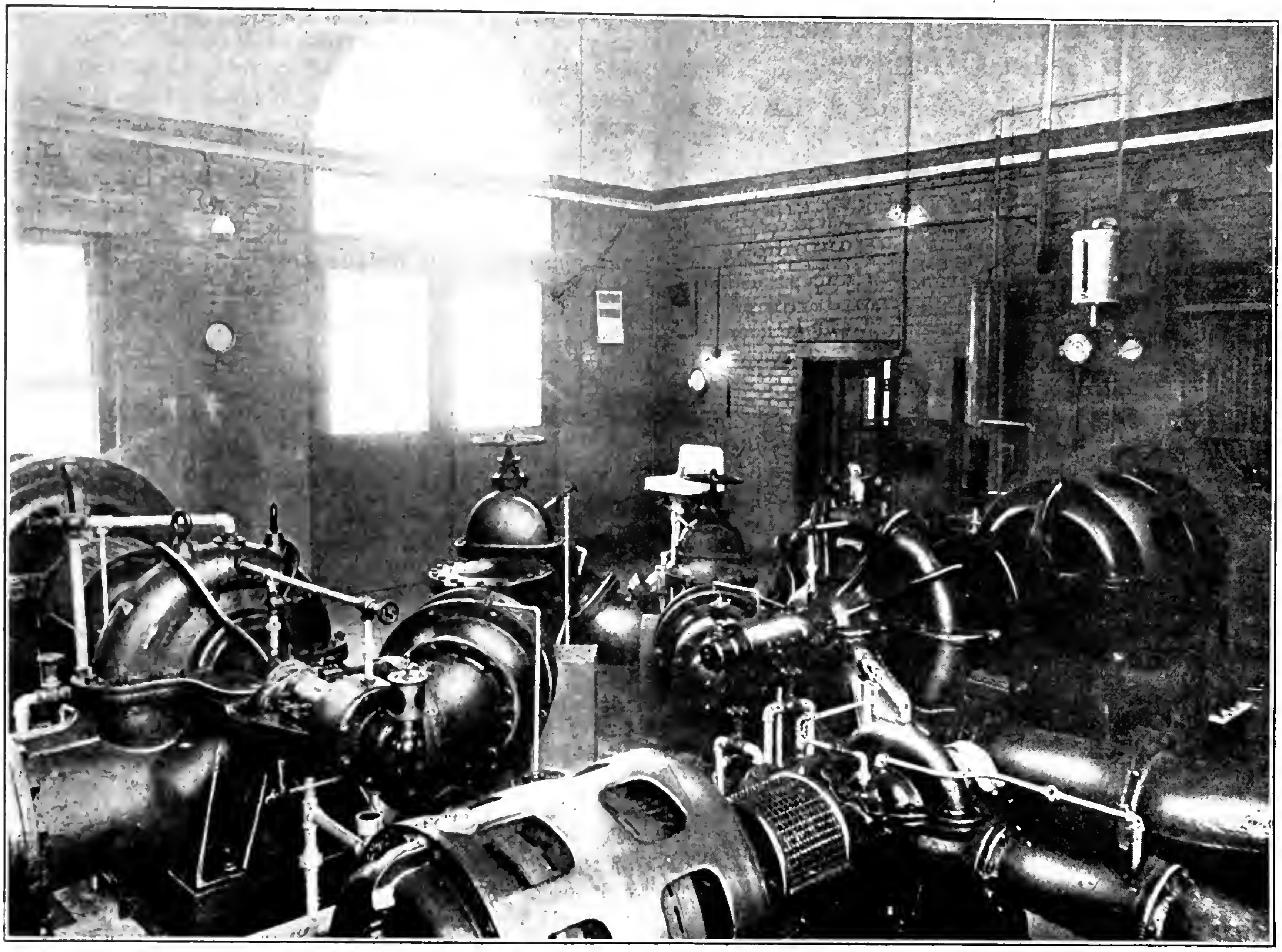
In designing the plant it was necessary to bring the discharge of the pumps to an existing elbow in the floor, which was embedded in a masonry arch and could not be disturbed. In order that the discharges could be separately valved, the parallel layout of the piping shown in the photograph was required with a true 16-in. Y having the inlet flange turned down to a diameter which would be received by the bell of a 20-in. pipe. Flexible joints were installed for the larger pumps, so that no undue strain would be transmitted to the pump castings. There are no gate valves or check valves on the suction lines of the pumps, but the pumps are primed by means of a rotary vacuum pump driven by an electric motor, with long-distance controls at the compensator starters for each pump motor. The air in the suction lines and the pump casings is exhausted by means of this vacuum pump. A small tank with a glass gage indicates to the operator when the suction lines and pumps are full of water. The vacuum pump is then stopped by the pushing of a button, and the motors are started. The motors are slip-ring motors, and a special interlock was installed in the compensator starters which makes it impossible for an operator to throw on the main switch of a motor if the compensator is in the "full-on" position. It is thus impossible to throw the full voltage across the motor in the operation of starting it.

Old Turbine Pit Made Into Suction Well

The suction well sumps consist of an old water turbine pit to which the water passes through float-operated butterfly valves. An electric-alarm float indicator also shows the operator the water level in the suction well and gives the alarm for high and low water.

A wall crane with a 24-ft. reach and containing a trolley and hoist is to be installed for removing the upper half of the pump casings, motor armatures, etc. The station is equipped with a full complement of electrical and hydraulic indicating instruments mounted on the electric switchboard and on the individual unit panels.

The three motors are 2300-volt, two-phase, 40-cycle machines. The two 4,000,000- and 6,000,000-gal. pumps are single-stage, double-suction, operating at 1170 r.p.m. against a total head of from 170 to 195 ft. The 1,000,000-gal. pump is single-stage, double-suction, running at about 2300 r.p.m. against a total head of about 185 ft. at full capacity. The small vacuum pump is operated by



THREE ELECTRIC-DRIVE PUMPING UNITS WORKED IN VARIOUS COMBINATIONS DELIVER WATER TO COHOES
The 1,000,000-gallon unit is in the foreground, the 6,000,000-gallon at the left and the 4,000,000 at the right of the view.

a 2-hp. motor and is capable of developing a 24-in. vacuum. By means of this pump any unit may be brought from rest to full pumping load in about 45 seconds.

The arrangement of the pump may be called radical. The large pumping units have center lines at right angles to each other. This leaves the motor end of the unit in a free space with no electrical apparatus adjacent to it and provides free access to all sides of both machines. Water from the pumps is deflected by a 45-degree fitting to the force main header which runs above the floor on the center lines of the pump discharge openings.

In the process of removing the old apparatus, and, due to lack of water in the hydraulic canal on Sundays, the level in the raw-water reservoir was considerably reduced. At the same time it was apparent that the consumption of water would average at least 7,000,000 gal. instead of 6,000,000 or 5,000,000 and, owing to lack of meters, the average requirements of the pumping station were unexpectedly increased.

The engineer realized that to meet this unexpected demand it would be necessary for the 6,000,000- and 4,000,000-gal. units to operate together to give a total pumping capacity of about 8,500,000 to 9,000,000 gal. A defective runner in the 6,000,000-gal. pump was replaced by a new runner, and in supplying the new runner the manufacturer furnished one with different characteristics, so that 6,000,000 gal. could be pumped against 180-ft. head. From this point backward the characteristic curve would rise as rapidly as possible and deliver as large a quantity of water as might be, against an increasing head, up to 200 ft. This runner was received and was found to operate successfully with the 4,000,000-gal. pump so as to produce a total quantity, against about 195 ft. of 8,500,000 to 9,000,000 gallons.

Lack of meters required this change in the pump design, and increasing consumption placed a load upon the pumping station such that continuous operation during periods from two to four weeks of both the 6,000,000- and 4,000,000-gal. units together would be required. As these facts developed, it was apparent that the reserve in the original design of the pumping station would be seriously impaired, and a reserve unit has been purchased.

The low cost of pumping water produced an unusual condition, affecting the question of metering as against pumping more water. A given number of meters would reduce the consumption of water by 1,000,000 gal. a day but it would cost only $700 per year to pump an additional 1,000,000 gal. Additional pumpage is temporarily cheaper. The metering policy, however, must eventually be adopted in order to prevent the impairment of the capacity of the existing reservoirs, the filtration plant, the force mains and the main conduits delivering filtered water to the city, and of existing pressures. Meters will doubtless be installed after a suitable educational campaign. The writer has been consulting engineer for the Cohoes water-works since 1914.

With the Divisional Engineers in a Great Offensive

What the Fighting Engineer Troops Had to Do When They Went Ahead Day by Day With the Infantry

By Charles E. De Leuw
Gates & De Leuw, Engineers, Chicago
(Late Captain, Engineers, United States Army)

ENGINEERING in the great war was so largely a matter of preparing for the actual fighting, and so great a proportion of the American Army engineers in France was engaged in the splendid work of the Service of Supply, that many in this country have never learned just what was the work of the engineer troops in the zone of advance. Censorship restrictions, too, did not permit those combat units much publicity. The writer was privileged to serve through the last months of the war with the Fourth Engineers, a regiment operating with the Fourth Division, in contact with the Germans, and his experiences there may give some indication of what the divisional engineer had to do, though no one man could have accurate first-hand information of any other than his own regiment.

Each infantry division contains an engineer regiment and an engineer train. The regiment proper consists of six companies, each with 250 men and six officers, and the headquarters detachment of 119 men. The engineer train contains both motor- and horse-drawn vehicles, and, in addition, each company is supposed to have four engineer tool wagons, two motorcycles, eight pack mules, the company supply wagons, rolling kitchen, and mounts for the officers. In service in France, as a rule they had all of these except the pack mules and mounts. The colonel of an engineer regiment is division engineer and adviser to the commanding general on all matters pertaining to engineering or construction work. It is his duty to keep himself constantly informed as to the need for work in the divisional area and to dispose of his unit to take care of that work. Engineers—and, as a matter of fact, all other troops—are auxiliary to the infantry, and in this war they were armed, equipped and trained as infantry, and for such engineering service as they might be called upon to do.

Division Engineers' Part in Trench Fighting

In trench warfare, divisional engineers are charged with the layout and construction of trenches and wire entanglements, the maintenance and drainage of trenches, the construction of dugouts and deep shelters, all mining work, provisions for sanitation and adequate water-supply, and the maintenance of paths and roads leading to the trenches. Immediately after an advance, when a portion of the enemy's trench system has been captured, it devolves upon the engineers to consolidate the new position—in other words, to make such new construction as to render the trench tenable when facing what formerly was the rear. This always includes the immediate erection of wire between the occupied trench and the enemy. If the trenches are to be abandoned, the engineers' job is to demolish all structures which will be of aid to the enemy and to place as many obstacles as possible in the path to obstruct his rapid advance.

In open warfare, or war of movement, the engineers are charged with duties that are somewhat similar, but which are, in the main, less complex. In an advance they repair and build roads, bridges, cut barbed wire and lay out defensive lines; in fact, do anything and everything to facilitate the advance of the infantry and the steady and uninterrupted flow of munitions and supplies to the infantry and the artillery. In a retreat—something, fortunately, in which the American Army had little experience—the engineers' chief mission is to destroy bridges, roads, railroads, and water-works and place as many obstructions as possible in the way of the advancing enemy. In many cases it is necessary to bolster up the line by putting engineer units in as infantry, as was done in the famous repulse of the German advance near Amiens in the spring of 1918.

When Our Engineer Units First Saw Real Fighting In the Open

The campaign having its origin in the great counter-offensive of July 18, 1918, extending from Soissons to Rheims, was the first in which the American Army had a prominent part, and in this action the Fourth Engineers first saw real service. About 10 American divisions participated in this campaign, which was strenuous in every sense of the word. There our engineer units had their first taste of open fighting, and their portion, as well as that of all other troops, was tiring and ceaseless work. Hard fighting took place within the Chateau Thierry salient, but it was of comparatively short duration, and consequently the roads and other structures were not completely destroyed, and in places were practically untouched. The retreat of the Germans out of the salient was so hurried that only occasionally did they have time to destroy roads and bridges, all of which simplified the task of the engineers. Nevertheless, the fighting had torn up the roads and bridges to some extent, and occasionally the Boche engineers had had time to mine a road or a bridge, so our engineer regiments had plenty of work. On roads filled with shell holes there was usually enough stone nearby for backfilling. Where the road had been mined, débris and demolished masonry in the nearest village was hauled to the site, or, if this was impossible, sand bags were used, filled with the best material at hand.

The bridges were all over comparatively small streams, and if it were impossible to repair the structure, a rough bridge which would serve temporarily was thrown up. Time was the only consideration. For foot bridges for use of the infantry, convenient trees were sometimes felled across the streams. In addition to this repair work, the engineers had to outline defensive positions during the advance. It was very necessary to play safe at all times and have a position outlined behind the advanced infantry, so that in case of a strong hostile counterattack the infantry would have a position ready to occupy. In this case outlining a position meant taping out a trench system or its main elements, after a careful reconnoissance. The machine-gun emplacements were dug, and at least one line of wire was strung in front of the position.

The writer knows of no better way to convey an idea of the life and experiences of these engineers than by giving a few extracts from some daily notes, necessarily brief and sometimes abrupt, made in the field during the Chateau Thierry fighting.

July 13—Finished the rifle range for the — Infantry today and moved the company to this town, which is about five miles from the lines. Made a reconnoissance of our new

work this afternoon with the major, most of the time in a pouring rain. Our job is to build lanes and communication trenches from here to the front line for the French. We were pretty close and I saw the German lines for the first time. Our work will not be dangerous, for we will work on the exposed spots at night.

July 16—Knocked out a good day's work on the trench system today, pretty well fagged out tonight. C company had a couple of men wounded today near us, the first in the regiment. Understand the Boche made quite a heavy attack east of here yesterday; we could hear the firing of heavy guns very plainly about 10 p. m.

July 17—Tonight starts our first big adventure; we go over with the infantry.

July 19—We came here with C company yesterday morning under fire, but no casualties. C company has gone up to Hautvesnes to construct a defensive position and we are bivouacked by the side of a sheltered road just east of Vinly, awaiting orders. We are in the counter-offensive from Chateau Thierry to Soissons. Our division and the French have been going splendidly—advanced 9 km. in 30 hours with light losses. The French regiment to which we are attached took 450 prisoners and 70 guns yesterday. The Boche is on the run at this point, the attack being a complete surprise to him. The fighting is open, what trenches there are being a very light type. The night of the 17th-18th was the blackest I have ever seen. There was a hard rain and a thunderstorm lasting half the night. It made the task of moving large bodies of troops up to the line very difficult. The roads were frightfully congested, and in the inky darkness many units had a hard time getting to their positions. They all got there on time as far as I know, and the infantry, our infantry which had never been under any sort of fire before, jumped off on schedule time and waded right through; some of them had hiked 20 km. in that mess of the night before, too.

July 22—Am sitting in an oat field near a small patch of woods. The fields all around are full of shell holes, and small cemeteries are thick. We have moved twice since the 19th, each time toward Germany. Have been doing trench work and road repairs, and D company is certainly going in great style; the company has had only three casualties.

July 24—Our division is going back for a rest and to get replacements, some of the infantry having had heavy losses. Our regiment fared well—only three officers wounded, all of whom will recover, I believe. What casualties we had were all from shell fire. Since the 17th we have moved practically every day, have dug trenches and repaired roads at all hours of the day and night. The most interesting thing I have seen is the short, terrible bombardment, which precedes the artillery attack. We were coming in from work the other night with the artillery back of us, when all at once they cut loose. I happened to be up on a high hill where I could see our shells bursting on the Boche, and it was a great treat. It was 4:30 a. m., and I ran the risk of being caught in an exposed position at daybreak to watch it awhile. It was superb.

Repairing Roads "For a Rest"

July 26—We are taking things easy back here. The billet I am in has been occupied by the Boche. We are repairing roads and building kitchens for the division, coöperating with B company. The other four companies are working on a defensive position. We are doing this for a rest.

July 28—Moved from our billets this morning and are now about nine miles east of there in territory occupied by the Boche within 24 hours. It is interesting to see what pains the Boches have taken to make this woods habitable. They have a profusion of dug-outs, and in every way it looks as though they had intended to stay here all winter. They abandoned an immense quantity of material here, as they have all along the line.

July 29—Moved again this morning, and are now bivouacked in a big woods with the entire division. We are still corps reserve, and I understand we are in an entirely American corps, the first time one has been formed during the war. The regiment is all together for a change.

Aug. 3—The division has been in front for two days. We are again in a large forest, the Fôret de Fère, I believe. Repaired roads and bridges today, covering about 16 km. of roads. Cleaned the débris out of the streets of Fère-en-Tardenois this morning; it was an awful mess. On returning to our bivouac found orders to proceed to the Bois de Dole, about 15 km. north of here. Will have good supper and start.

Aug. 4—Moved up here last night, roads almost impassable in spots due to recent rains. My transport did not get through so I hiked back to locate it; impossible to get anywhere on motorcycle. On roads again today. My company has had no sleep in 60 hours and has hiked that many kilometers.

Aug. 5—Getting a much-needed rest here in the Bois de Dole. Two companies have gone up to put foot bridges over the Vesle River for the doughboys. Another company reported to the — Brigade and is in the line. My company is ready to move on five minutes' notice.

Aug. 6—Made a reconnoissance for an artillery bridge over the Vesle yesterday afternoon with the major. We timed it rather poorly, as the doughboys were just going over and it was pretty hot. The Boche were actually sniping with one-pounders.

Met Machine Guns, Shells and Gas

Aug. 8—Have been assembling material for bridge. It has been hot down there. We are bothered with machine-gun fire in addition to shell fire, and the mustard gas is pretty thick. Our infantry still in the line and going forward slowly; they are holding the road on the other side of the river now. Cannot begin to describe the inferno down in that river valley. The Boche counterattacked this morning; they were supported by a heavy barrage which we had to go through. Their attack fell down when it met our machine-gun fire. The enemy has made a genuine stand here; our advance will soon have to cease, as we are approaching a point where our men are too fatigued to continue the work incidental to an advance.

Aug. 10—We are putting up our bridge. As the infantry have been stopped about 300 yards beyond the river, there is no hurry for an artillery bridge, and we are taking our time. Work at nights and go back about 4 km. to rest during the day.

Aug. 11—Work on bridge called off. Reconnoitered for a defensive position in front of Ville Savoye, just back of the bridge site, this afternoon. Took my platoon commanders along. It is getting hot in the little valley where we are camped. The artillery back there call it Death Valley. Ordinarily it is fairly quiet, but this morning the Boche got our range and I was waked up by some Boche shells. Looked out and saw a frightful slaughter of horses; cannot understand why the artillery keep their animals up here.

Aug. 12—Ordered to resume work on bridge; practically completed job. Working strength of company down to one lieutenant and 65 men.

Aug. 13—Division relieved, for which I am duly thankful. Our casualties were not so heavy, considering what we went through, but they were heavy enough. We all have our eyes burned a bit from the mustard gas in the valley. Joined the regiment today, and are glad to be back where the shells don't drop very often.

Aug. 15—Made a long hike last night and we are again in the Fôret de Fère, well back from the front now. We go back three days' hike and then entrain—do not know where we go. Some damfool at division headquarters has conceived the idea of having the engineers entrain the entire division. I am attached to the — Infantry; will hike back with them, then load them up.

The great campaign on the Meuse-Argonne front saw vastly different conditions and problems to be met. Here "no man's land" had been in the same general locality for four years. The terrific fighting around Verdun in 1915 and 1916 had effaced most of the artificial structures, and had greatly changed the natural features of the topography. Where roads had not com-

pletely disappeared, they were covered with two or three feet of mud. The entire country-side was one mass of churned-up earth, trench material, stone, and débris of all descriptions. On the morning of Sept. 26 the engineers went over thirty minutes after the infantry. Their principal task was to get the roads in such condition that the artillery could be gotten over them and ammunition push up. The infantry drove the enemy back about 10 km. the first two days and left behind them the most desolate looking mess imaginable. Let the imagination go as far as it will, and it cannot exceed the facts in this instance. On one road there were three regiments of engineers filling up the huge holes with sand bags, working with their hands, picks and shovels, using anything and everything to get that road in shape for traffic. The congestion on that road was terrific, and the daily rains served to add to the difficulties. The engineers often turned aside from their road making to put a truck or piece of artillery, which had slid into the ditch, on the road again. All of this was done under a hail of shell fire from the enemy. As everyone knows, these handicaps were overcome, and the campaign was finally pushed to a highly successful conclusion.

Compares Principal Plans for Railroad Policy

Equitable Trust Company Digest Shows Unanimity of Purpose, With Government Ownership Almost Without Support

THE digest and comparison of proposed plans for a future railroad policy, shown on the opposite page, and prepared by the Equitable Trust Co. of New York, indicate that all of the plans advanced "seek, in their final analysis, an adequate transportation system affording first-class service at rates which will not be burdensome but still sufficiently liberal to put railroad credit in the aggregate on a high plane, and which shall make it possible to pay the employees good wages," according to the statement of the company. It is pointed out that Government ownership is found to be entirely without support except from the railroad brotherhoods.

In *Engineering News-Record* of Jan. 2, 1919, p. 18, L. C. Fritch, vice-president and chief engineer of the Chicago, Rock Island and Pacific Railway Co., advanced "fourteen points" which he considered essential to establishing a sound railroad policy. In *Engineering News-Record* of Mar. 13, p. 504, Mr. Fritch suggested a more definite solution of the railroad problem, basing his article on plans which have been presented to Congress.

In commenting on the digest of the various proposals, the Equitable Trust Co. says:

"In the first place, we find that Government ownership is almost altogether without support, except from the railroad brotherhoods as represented by their counsel, Glenn E. Plumb. The predominance of opinion is for private control under restrictions, designed to promote better, more efficient service than was possible under the old system. The extension of Government control to the five-year period proposed by ex-Director General McAdoo likewise meets with little favor. In opposition thereto, it is argued that it would merely postpone the date of determining a problem which must come up for solution sooner or later; that it would tend to make the return of the roads to their owners more difficult; that it would place them in such heavy debt to the Government that liquidation or refunding would be practically impossible, and that there is nothing in the railway problem which cannot be solved in twenty-one months as well as in sixty.

"There is substantial unanimity that mergers should be permitted when in the interest of the public, and that the issuance of securities should be subject to Federal control. The latter subject is closely related to the question of Government guarantee of capital, for if the Government is to undertake the assuring to the roads of a specified minimum return, it is only logical that it should have something to say as to the creation of new securities, and accompanying new capital investment. The plans of the Association of Railway Security Owners, of Paul Warburg, and of Director General Hines, all contain provisions for such guarantee. The railway executives do not suggest anything quite so specific, but insist that rates shall be adequate as well as reasonable.

"The rate question, which is perhaps the most difficult of all to determine, is variously approached. There is a tendency to concentrate the rate-making power in Federal authority without, however, entirely destroying the power of the state commissions. This is in line with the sensible policy of eliminating, so far as possible, the conflicts which are inevitable where there is dual authority, or where the Federal authority may be hampered and its orders nullified, by state action. There is, moreover, a sentiment in favor of an attempt to arrive at some precise figure which will represent equitable compensation to the security holders. Several of the plans contain suggestions for profit sharing with labor, with the Government, or with both, in case profits shall exceed this figure. Here we have the community of interest idea, which has received widespread application in industry, proposed for a new field—transportation. The justice and economic soundness of its adoption will scarcely be questioned, though there will doubtless be conflicting ideas to be reconciled in working out precise details. From the standpoint of the security holders, the important features of a guaranteed minimum return, together with a division of profits above a maximum, means at the same time the elimination of uncertainty as the possibility of reduction of one's income below a certain feature, and the loss of opportunity for very marked appreciation.

"In other words, it would greatly stabilize railway securities and minimize their speculative features.

Suggestions for Financing

"The views in connection with methods of financing the roads are not at all in agreement. Particularly interesting is the novel proposal of Mr. Morawetz, who advocates the refunding of all existing securities by means of a fixed and continuing proportion of debentures and bonds. This would apparently give the debentures a high investment standing, and would still leave the stock sufficient equity, together with the minimum guarantee of $2.50 per share by the Government, to assure it of an investment character only moderately tinged with speculation.

"The successful features of Government operation are not to be lost with the return of the roads to private control, if the ideas of several of the authors of the various railway plans are carried out. The joint use of terminals, the elimination of competitive features which yield no additional public service, such as separate ticket offices, almost identical passenger train schedules, etc., may be eliminated in the interest of economy.

Adjustment of Wages

"Some thought has also been given to methods of settling wage disputes. Three of the plans quoted aim to set up permanent organizations for the handling of these questions. Presumably a regular line of procedure for obtaining hearings and appeals would be instituted. If found workable, this would provide the machinery for proper consideration of, and decisions upon, this very vital matter."

PROPOSED RAILROAD PLANS

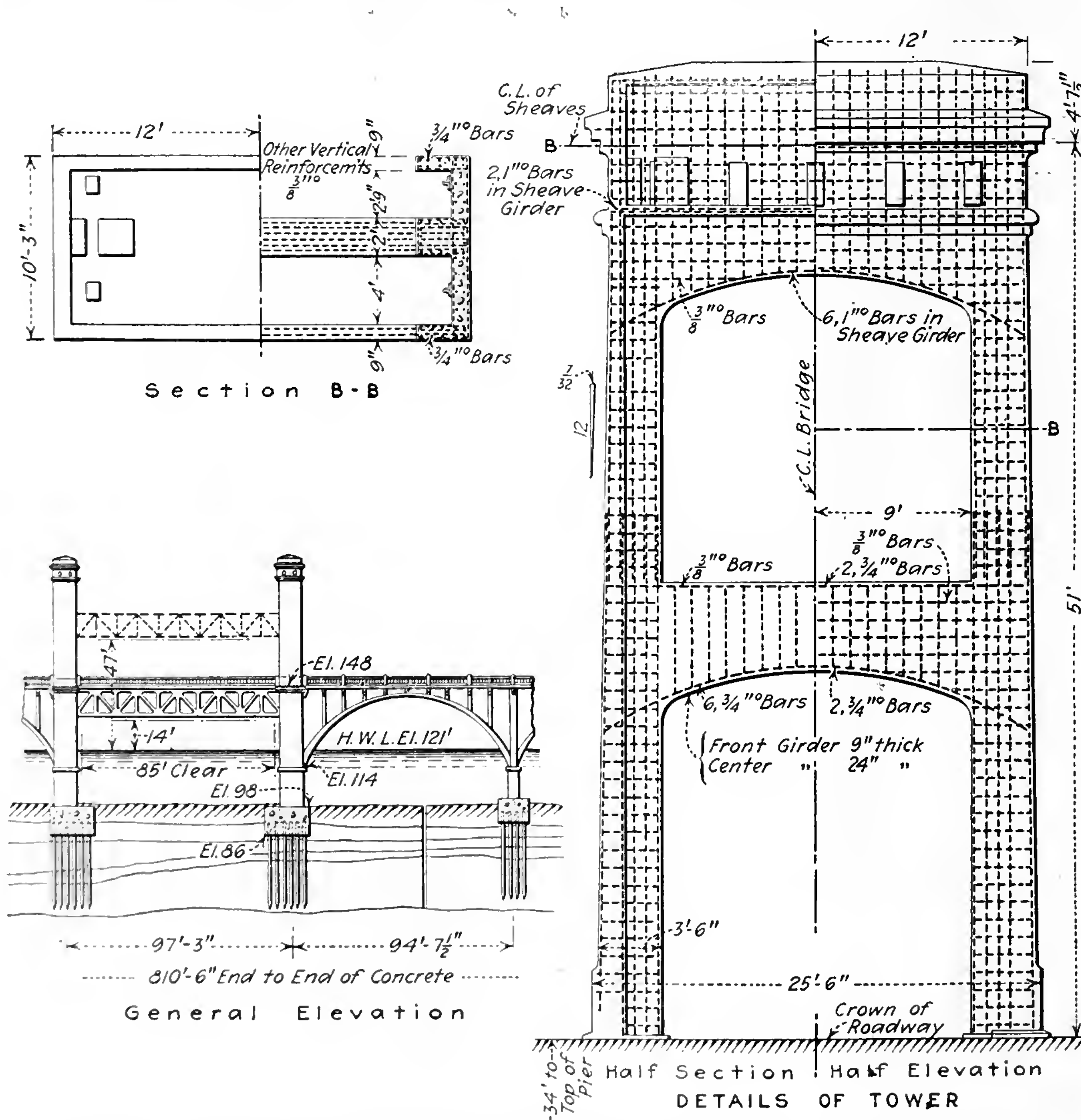
	RAILWAY EXECUTIVES	ASSOCIATION OF RAILWAY SECURITY OWNERS	INTERSTATE COMMERCE COM.	WALKER D. HINES DIRECTOR GENERAL	BROTHERHOODS	VICTOR MORAWETZ	PAUL WARBURG
OWNERSHIP AND OPERATION	Private.	Private.	Private.	Private.	Government ownership. Operation by private corporation run by employees, which pays government a rental out of the receipts of operation.	Private.	Private
MERGERS	Federal incorporation with mergers allowed, subject to approval of Secretary of Transportation.		Mergers of existing companies may be made in the public interest.	Roads of each locality to be combined into regional systems, six to twelve in number.	Roads all to be operated by one private corporation, stock of which is to be held in trust for the exclusive benefit of the employees.	Railroads to be consolidated into ten or fifteen Federal corporations. Present securities to be refunded by 4% debentures and stocks.	Under Federal franchise, mergers may be made, subject to supervision of Federal regulating body.
REGULATION OF SECURITIES	Federal control exclusively.	Under supervision of Regional and Interstate Commission.	Federal regulation of the issuance of securities.			Debentures and stock to be issued only as authorized by Federal Railway Board.	By Federal regulating body.
CONTROL	A cabinet officer "Secretary of Transportation" to be appointed. Interstate Commerce Commission should be relieved of executive and administrative duties, except as to valuation and accounting, and act as quasi judicial body. Regional Commissions.	Federal regulation through Interstate Commerce Commission, as at present constituted, co-ordinating with six Regional Commissions—Co-ordination between State and Regional Commissions.	Better defined relationship between State and Federal control. A broadening of Federal control.	Five-year extension of Federal control. Modified private operation and control thereafter. Government representation on Boards of Directors.	No "Secretary of Transportation" continuation of powers of Interstate Commerce Commission. The directors shall be selected, one-third by non-appointed employees; one-third by appointed officers and employees; one-third by President.	Federal corporations to be under regulation of a Federal Railway Board headed by Cabinet Officer. Specified number of directors of Federal corporations to be appointed by Federal Railway Board. Regional boards and one central board of regulation.	Regional Board upon which State commissions might be represented with a reorganized Interstate Commerce Commission of 5 or 7, half judicial and half administrative in character at head
RATES AND RETURN ON CAPITAL	Regulation of rates by Federal government exclusively. Carriers may initiate rates which shall become effective unless disapproved by Secretary of Transportation. Statute shall specifically provide for adequate rates, which must reflect cost of wages and other expenses. Rates may, upon complaint be brought before I. C. C. for review with power to prescribe minimum rates.	A minimum rate of return, fixed by Act of Congress, through rates adjusted as occasion may demand. Interstate rates to be left in hands of State Commissions.	Revenues should be "adequate" and "reasonable." No statement as to any change in the method of rate procedure.	Government to ascertain and guarantee railroads a fixed fair return.	Under regulation of Interstate Commerce Commission. When the government's share of the distribution of profits exceeds 5% of the gross operating revenues, reductions in rates should be made to absorb the 5%.	To be regulated by Federal Railway Board through central and regional boards; local rates to be referred to regional boards, through rates to central board.	Rates to be determined by Federal regulating body. Railroads accepting plan to be guaranteed 4½% on Federal valuation.
DISTRIBUTION OF PROFITS		Earnings in excess of fixed reasonable return to be distributed among employees, railroads earning them, and for certain improvements not to be capitalized in rate making.		Profits above the specified fair return are to be moderately shared in by the railroads and the government, possibly also by labor.	Government guarantees return on bonds issued in exchange for existing capital. Any balance over this is to be divided between operating corporation and the government for the purpose of enabling the Interstate Commerce Commission to reduce rates. The operating company will disburse its share to the employees, in proportion to their annual wages.	Government to guarantee dividends of $2.50; any distribution in excess of $4 to be divided with government. Government to have option to buy stock at any time at $85 per share.	Any return on capital between 6% and 7% to be divided with government and possibly with labor. All over 7% to go to government.
FINANCING	Provisions to be made for funding by the United States of indebtedness of carriers to it growing out of Federal control.	A Federal corporation directed by the nine Interstate Commerce Commissioners and eight railroad men to finance purchase of equipment from the Railroad Administration, purchase of new equipment, and financing of the return of the roads to private control.		Comprehensive program of capital expenditure during five-year period; probably to be provided partly by government; partly by roads themselves where able to borrow.	All financing to be done by the government.	Debentures to be issued to an amount such that interest requires 40% of operating income. Balance of operating income to be capitalized at 6% in stock.	
JOINT USE OF TERMINALS, ETC.	Subject to direction of the Secretary of Transportation; also other similar matters.	To be arranged, also rerouting of freight, etc., by above Federal Corporation.					
WAGES	This and similar questions to be settled by officers and representation of individual employees affected, if possible, otherwise by a board under the Secretary of Transporation.	Regional Commissions to act as Boards of Conciliation. Appeal to Interstate Commission.			A committee of nine direcors of operating company empowered to make binding and final decisions in all wage disputes.		

Reinforced-Concrete Lift-Span Towers for Highway Bridge

BY F. H. FRANKLAND
Consulting Engineer, New York City

ECONOMIC studies for a reinforced-concrete highway bridge over the Osage River, near Jefferson City, Mo., on the main highway between Kansas City and St. Louis, showed that at the present prices for structural steel in place, reinforced-concrete towers for the lift span were not only about $4000 cheaper than structural steel towers, but the advantages from improved appearance and the use of more permanent materials were considerable. The difference in cost for reinforced-concrete towers, as against structural steel towers, above the roadway was found to be approximately $2000. Owing to the increased vertical reactions on the piers due to the use of the heavier concrete towers, it was found possible to reduce the width of the arch abutment piers, thereby saving an additional amount estimated at $2000.

The total length (810½ ft.) includes six barrel, open-spandrel arch spans, 92 ft. c. to c. of the piers; one steel deck-truss lift span, giving a clear horizontal opening of 85 ft., and a vertical clearance of 47 ft. above standard high water, and a series of continuous concrete deck girder spans at each end, each consisting of one 30-ft. span, two 20-ft. spans, and finished with an 8-ft. cantilever girder, which is buried in the approach fill. The pavement on the approach spans consists of a 2-in. concrete wearing surface, in which special aggregate is used, and on the lift span creosoted wood block on creosoted subplanking is provided. The lift span is operated by hand power, from a capstan at the center of the span actuating a worm reducing gear which is connected directly to the hoisting drum. The worm gear is completely incased in an oil-tight box, and runs in castor oil.



GENERAL ELEVATION AND DETAILS OF REINFORCED-CONCRETE TOWERS

The lift-span towers were designed to carry the load from the sheaves and also to take care of a 30-lb. wind stress. The sheave girder is designed for the sheave loads and wind stresses, and the other cross-girders for wind stresses only. In the upper portion of the tower the central 2-ft. portion of the column is assumed to carry all of the sheave load, the wind loads being divided between this 2-ft. portion and the two 9-in. portions. At the bottom of the tower all of the loads are assumed to be divided over the entire section of the column. Below the roadway surface the tower columns carry the deck loads in addition to the sheave loads and wind loads. The towers have been designed throughout with the minimum sections which it was found practicable to use and still retain ample clearances for the counterweight sheaves and the lifting girders on the movable span.

As there is a limited amount of money available for the construction of this bridge, the general architectural appearance of the towers is perhaps not quite as satisfactory as would have been the case if strict economy in design had not been enforced. However, by a judicious use of openings, as regards shape and spacing, and by slightly battering the outside faces of the towers, together with the use of a suitable cornice and molding, it is felt that a satisfactory æsthetic appearance has been obtained, while at the same time gaining the advantage of the use of permanent materials.

The structure was designed by the writer's firm, Waddell and Son, Inc., New York and Kansas City, consulting engineers for Cole and Osage Counties, Missouri.

The bridge has been designated as a Federal-aid project, and state aid has also been obtained by the counties interested. The engineers will supervise construction.

How to Make Isometric Working Drawings to Scale

BY GEORGE PAASWELL
Civil Engineer, New York City

ISOMETRIC drawings are usually sketch attempts to visualize a more or less complicated detail, and used merely to complement working drawings. There is no reason why an isometric drawing cannot itself be properly dimensioned and scaled and used as a working drawing, thereby replacing sundry plans and sketches. With this in view, at attempt has been made below to give a few formulas and then develop tables from them, so that the ordinary draftsman will have no difficulty in making his isometric drawing as exact as his working drawings.

Lines parallel to the isometric axes are, of course, shown correctly to scale; nonisometric lines are not shown to scale. The following are some simple theorems in what may be termed isometric trigonometry, the application of which should vastly simplify the plotting and dimensioning of nonisometric lines.

ISOMETRIC TRIGONOMETRY

It is assumed that the axes of the figure have been so chosen that all lines of importance lie in planes parallel to the principal planes of the figure. The following theorems apply solely to such lines. Thus in Fig. 1, the lines L, b and c lie in a plane parallel to one of the coördinate planes adopted in space, and b and c are parallel to two of the coördinate axes. Fig. 2 shows the

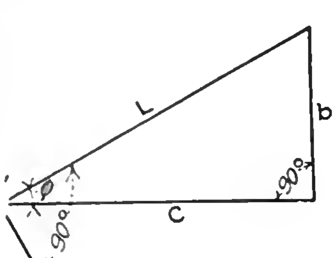


FIG. 1

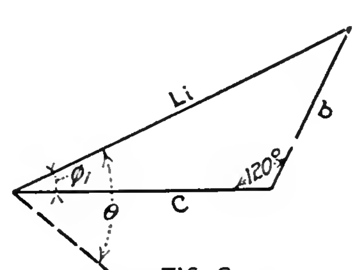


FIG. 2

FIGS. 1 AND 2. DIAGRAMS SHOW FUNDAMENTAL RELATIONS

same configuration in an isometric drawing. The lines b and c remain, of course, of the same length. The line L which made an angle ϕ with c, now makes an angle ϕ_i with c. The lines b and c which formerly were at right angles to each other, now make an angle of 120°. In Fig. 1, $\tan \phi = b/c$; in Fig. 2, by the law of sines, $b/c = \sin \phi_i / \sin (180° - 120° - \phi_i)$, whence

$$\phi_i = \cot^{-1}\left(\frac{1 + 2 \cot\phi}{\sqrt{3}}\right) \qquad (1)$$

If a line be drawn at right angles to L and in the same plane, it may be divided into two angles, ϕ and $90° - \phi$. The angle $90° - \phi$ becomes, in the isometric plane, from (1), above,

$$\cot^{-1} \frac{1 + 2 \cot (90° - \phi)}{\sqrt{3}} = \cot^{-1} \frac{1 + 2 \tan\phi}{\sqrt{3}}$$

and the original right angle now becomes

$$\cot^{-1}\left(\frac{1 + 2 \cot\phi}{\sqrt{3}}\right) + \cot^{-1}\left(\frac{1 + 2 \tan\phi}{\sqrt{3}}\right) \qquad (2)$$

Or, from $\theta = A + B$ and the trigonometrical formula

$$\cot \theta = \frac{\cot A \cot B - 1}{\cot A + \cot B}$$

by substituting the two angles in (2) for A and B, the value of $\cot \theta$ reduces to $1/\sqrt{3}$, therefore $\theta = 60°$, and a right angle in space becomes an angle of 60° in the isometric plane. Hence angles complementary in space add up to 60° in the isometric plane.

From (1) with ϕ_i given, $\phi = \cot^{-1}\left(\frac{\sqrt{3} \cot \phi_i - 1}{2}\right)$ (3)

Table I gives values of ϕ_i from ϕ, and can also be used conversely with sufficient accuracy.

TABLE I—VALUES OF ANGLES ϕ AND ϕ_i

ϕ	ϕ_i	ϕ	ϕ_i	ϕ	ϕ_i	ϕ	ϕ_i	ϕ	ϕ_i
0	0	10	8	20	15	30	21	40	27
1	1	11	9	21	16	31	22	41	28
2	2	12	9	22	16	32	22	42	28
3	3	13	10	23	17	33	23	43	29
4	3	14	11	24	18	34	24	44	29
5	4	15	12	25	18	35	24	45	30
6	5	16	12	26	19	36	25	..	.
7	6	17	13	27	19	37	25	..	
8	7	18	14	28	20	38	26	..	..
9	7	19	14	29	21	39	27	..	.

Again, to find relation between lengths L and L_i.
In Fig. 1, $L^2 = b^2 + c^2$
In Fig. 2, $L^2_i = b^2 + c^2 - 2bc \cos 120° = b^2 + c^2 + bc$
$= L^2 + bc$
From Fig. 1, $b = L \sin \phi$ and $c = L \cos \phi$, and $bc = L^2 \sin \phi \cos \phi$ whence $L_i = L\sqrt{1 + \sin \phi \cos \phi} = kL$,
where $k^2 = 1 + \sin \phi \cos \phi$
and conversely, $L = KL_i$, where $K = 1/k$.

Table II gives values for k and K.

To obtain the length of a line not lying in these so-called principal planes—i.e. planes parallel to the

TABLE II. VALUES OF COEFFICIENTS k AND K

ϕ	k	K	ϕ	k	K	ϕ	k	K
0	1.00	1.00	16	1.13	0.89	32	1.21	0.83
1	1.01	0.99	17	1.13	0.88	33	1.21	0.83
2	1.02	0.98	18	1.14	0.88	34	1.21	0.83
3	1.03	0.97	19	1.15	0.87	35	1.21	0.82
4	1.04	0.97	20	1.15	0.87	36	1.22	0.82
5	1.04	0.96	21	1.16	0.86	37	1.22	0.82
6	1.05	0.95	22	1.16	0.86	38	1.22	0.82
7	1.06	0.94	23	1.17	0.86	39	1.22	0.82
8	1.07	0.93	24	1.17	0.85	40	1.22	0.82
9	1.08	0.93	25	1.18	0.85	41	1.22	0.82
10	1.09	0.92	26	1.18	0.85	42	1.22	0.82
11	1.09	0.91	27	1.19	0.84	43	1.22	0.82
12	1.10	0.91	28	1.19	0.84	44	1.23	0.82
13	1.10	0.90	29	1.20	0.84	45	1.23	0.82
14	1.11	0.90	30	1.20	0.84		....	....
15	1.12	0.89	31	1.20	0.83		....	....

adopted planes of reference—it is too cumbersome and therefore of little practical value to establish general formulas. If the coördinates of the two terminals of the line are obtained, then its length is easily found from the expression

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

where $x_1y_1z_1$ and $x_2y_2z_2$ are the terminal coördinates.

In usual practice, however, it is possible to locate the planes of reference so that all the lines of interest lie in planes parallel to these reference planes. It is also usual to record on the drawing the true dimensions and angles, not the corresponding isometric values.

If a curve is given in space, lying in a plane parallel

to a reference plane, draw vectors to several points on the curves from the origin in the plane. The angles which these vectors make with the reference axis, and the lengths of these vectors, when properly reduced by the given tables, serve to locate the given curve in the isometric plane.

In the accompanying drawing, Fig. 3, is shown an isometric detail at the intersection of an abutment and retaining wall. The line of intersection of the two faces is taken as the vertical axis. The datum line 100 along the face of the retaining wall is taken as the x axis. The y axis is then drawn at the same elevation.

The angle between the abutment and the retainingwall is 70° or 20° with the y axis; from the tables the corresponding angle in the isometric plant is 15° and a line making this angle with the y axis in the isometric plane is drawn, giving the datum 100 along the face of the abutment.

All true dimensions parallel to this line are then multiplied by the coefficient k for 20°, 1.15 from Table II, to get the lengths in isometric projection. Similarly, all dimensions at right angles to the face of the abutment are multiplied by the same coefficient.

It is easy to see how, in making an isometric of a skew portal or of hips and valleys, etc., scale drawings can be prepared to give all necessary information properly dimensioned.

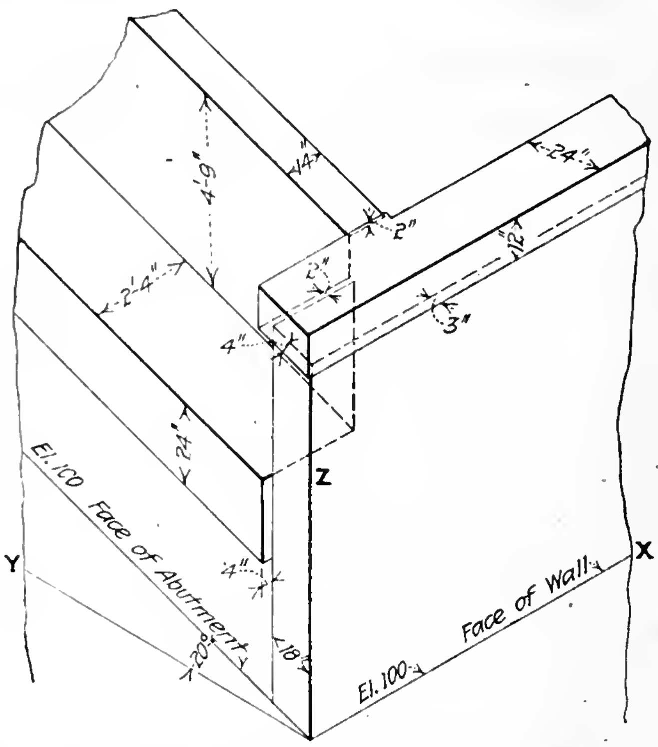


FIG. 3. INTERSECTION OF RETAINING WALL AND ABUTMENT

High Rate of Filtration Feasible for Detroit Water-Supply

Experiments Warrant Recommendation for Rate of 175,000,000 Gallons per Acre—Estimates for 300,000,000-Gallon Plant

RECOMMENDATIONS for a mechanical water-filtration plant for Detroit, with a nominal capacity of 300,000,000 gal. a day, operating at the unusually high rate of 175,000,000 gal. an acre after a retention of 13 min. in the mixing chambers and two hours in coagulation basins, have been made by R. Winthrop Pratt, consulting engineer, Cleveland, Ohio, in a report to the water commissioners. The estimated cost of the plant is $5,800,000. Under the "present rate policy," Mr. Pratt says, filtration and extra pumping "would cost domestic consumers 6c. per 1000 cu.ft., or less than 1c. a day per family." The high rate of treatment and low unit cost of filtered water mentioned further on are made possible by a relatively low turbidity and other favorable local conditions. The use of filter sand having an effective size of about 0.5 mm. will result in a large saving of waste water.

To obtain data that would be a safe guide in adapting mechanical filtration to Detroit conditions, a 200,000-gal. experimental plant was operated for a full year, ending Sept. 30, 1918. A description of this plant and a summary of the operating results are given in the report. It may be noted also that pains were taken to write a report that should be readily understood by the citizens and voters of Detroit; also, during the tests filtered water was piped to a plate-glass tank for public inspection, and visitors were encouraged to carry away filtered water. The booth covering the tank also contained a model of a filter and samples of turbid water.

The plant is designed for a regular working capacity of 288,000,000 gal. (72 filter units at 4,000,000 gal. each) which may be increased temporarily to 300,000,000 gal. Provision is made for enlargement to a nominal capacity of 450,000,000 gal. a day. The velocity in the mixing chambers would be 1.4 ft. per second and in the coagulation basins 3 ft. per minute. A 36,000,000-gal. clear-water reservoir is provided for.

The cost per 1,000,000 gal. of treating 250,000,000 gal. a day, including low-lift pumping, is estimated at $7.91, divided as follows: Low-lift pumping, $1.60; coagulation and filtration, including waste water, $2.06; capital charges, at 6.505%, $4.22.

During the experimental year the average turbidity of the raw water was 30 p.p.m. On 205 days of the year the turbidity exceeded 20 p.p.m. and on 39 days it was over 50 p.p.m. The maximum turbidity for the year was 490 p.p.m., on Apr. 12.

The tests indicated that alum would be cheaper and less troublesome than iron and sulphate of lime for coagulant.

Typhoid statistics from the Detroit Health Department, quoted in Mr. Pratt's report, show an average death rate of 13.47 per 100,000 for the past six years, ranging from 25.70 for 1913 to 7.45 for 1918. With the exception of 1913, the highest rate was 12.9 in 1917.

The investigations on which Mr. Pratt's report is based were in immediate charge of F. H. Stephenson, principal assistant engineer.

Engineers and Lawyers on a Par

County highway engineers in Missouri are considered by certain legislators to be worth at least as much as lawyers. In Senate Bill No. 427, under the heading "Compensation" the following clause appears: "The county highway engineer shall receive the same compensation as is now provided by law for the prosecuting attorneys in the various counties of this state, and his salary shall be computed and paid on the same basis as now provided by law in relation to the office of prosecuting attorney."

Segment Blocks Have Advantages on Larger-Size Drains

Lightness, Ease of Handling, and Small Breakage Are a Few of the Desirable Characteristics—Trouble with Unstable Soils

By D. L. Yarnell
Senior Drainage Engineer, Bureau of Public Roads and Rural Engineering

Although segment blocks have been used in the construction of sewers for some time, their entrance into the field of tile drainage has been only within recent years. Segment blocks are somewhat similar to building blocks in that they are hollow, with interior walls so arranged as to obtain the maximum strength. They are made of clay, vitrified and salt-glazed, with tongue-and-grooved side joints and with either square ends or ship-lap end joints. In sewer construction the aim is to have a water-tight conduit, while in drainage work the joints should be only closely butted together in order to permit water to enter the drains. Thus in sewer construction all joints of segment blocks are cemented.

In drainage work, usually, none of the joints is cemented. However, in main drains of large diameter the necessity of permitting the water to enter the joints is not so important, since the submains and laterals deliver the water to the main, and cementing might be desirable, but, to make the contractor cement all joints to give additional strength would increase the cost of constructing segment-block drains. Manufacturers of segment-block conduits in many cases have underbid manufacturers of large concrete tile.

Comparative Cost of Segment-Block and Solid-Tile Drains

Although segment-block drains of 30 inches in diameter are made, the smallest size used in drainage work, so far as the writer knows, is 36 in. The largest segment-block drain laid, to the writer's knowledge, is 52 in. in diameter, while the largest concrete tile manufactured is 50 inches.

It is interesting to compare the costs of the solid tile with segment blocks. The following table gives comparative costs obtained during July, 1917:

PRICES PER LIN.FT. F. O. B. FACTORY

Size In.	Segment Block (No. 2 Grade)	Cement Title	Size, In.	Segment Block (No. 2 Grade)	Cement Title
30	$1.08	$1.175	40	.....	$2.040
32	.....	1.275	42	$1.62	2.250
33	1.19	......	44	.....	2.475
34	.....	1.425	45	1.74	...
36	1.30	1.650	48	.....	2.940
38	.....	1.875	50	.....	3.200
39	1.51	......			

On the Hamilton County, Iowa, Drain No. 4, the bids received for 3750 ft. of 39-in. tile delivered along the line of drain were as follows: Solid tile, $11,452; segment-block, $8851 and $8993.

The complete bids received on this drain for labor, and furnishing and hauling tile, were as follows: Using solid tile, $15,500; using segment-block, $12,800.

From these data it may be inferred that the cost of installing segment blocks is about the same as for solid tile; however, that may not be true under all conditions. It should be noted that this drain was laid in the bottom of an old ditch, the average cut being about six feet.

On the Webster, Hamilton and Boone Counties, Iowa, Joint Drain No. 1-192-210, bids on the following size of tile delivered along line of drain were received: 1460 ft. of 52-in., 850 ft. of 48-in., 600 ft. of 42-in., and 6250 ft. of 39-in. A segment block manufacturer was the lowest bidder and was awarded the contract at a cost of $23,895.

Difficulties with Segment Block Drains

In construction the contractor lays the invert block to grade. The other blocks are then added, and the space around the tile is filled with earth. The last block on top, the key block, is usually slipped in place by hand, few drainage contractors using the arch form recommended by segment block manufacturers. The arch form consists of an adjustable semi-circular form mounted on a V-shaped frame. This form is designed to facilitate the laying of the upper blocks of the drain, being pulled ahead in the drain as the construction progresses. Of course, all joints on the drain are staggered.

If either tile or segment block drains are laid in trenches constructed in stiff soil where sheeting is unnecessary, excellent work can be done. The writer has seen segment block drains laid so true that the most exacting person could not find fault. However, in unstable soil, where sheeting is necessary, some trouble may be experienced after the blocks are laid and before the trench is back-filled. So far as the writer has observed, no failures have occurred after the trench has been back-filled. When the soils are unstable the lateral pressures in some cases are so great, before the trench is filled, as to cause the drain to collapse. The resistance of the drain to lateral pressure is increased by back-filling. Where sheeting is necessary, the back-filling must sometimes be done before the sheeting can be removed, and the contractor must leave it in. Resistance of the drain to lateral pressure can also be increased by cementing the joints. By leaving an occasional joint between the ends of blocks uncemented, water can be admitted to the drain. In back-filling the drain, great care should be exercised to see that the earth is carefully tamped between the drain and the side of the trench, until it is well above the springing line. Even in the best of material the trench should be back-filled as rapidly as possible after the blocks are placed.

The limit to the size of clay drain tile (due to the limits in size of machines used in manufacturing), is approximately 30 in., and for concrete tile, due to handling, about 50 in. Thus the segment block, on account of easy manufacture and handling, fills an important need for the larger sizes of drains. With large tile, where sheeting is necessary, the bracing must be far apart to admit the large tile. With segment blocks this trouble is eliminated.

The comparative weights of segment blocks and concrete tile are given in the following table:

	—Segment Block—		—Concrete Tile—	
Size	Weight per Block	Weight per Lin.Ft. of Drain	Weight for Each Tile	Weight per Lin.Ft. of Drain
In.	Lb.	Lb.	Lb.	Lb.
30	54	270	750	300
36	54	324	1,100	440
42	58	406	1,800	600
48	72	504	2,355	785

Thus it can be seen that the lightness of segment blocks constitutes a great factor in the shipping and

hauling of material. The segment block is compact and light, compared with solid tile. The loss due to breakage is not so great, since, if a block is broken the loss is slight, whereas if a concrete tile is broken, one entire length is gone. With a 42-in. drain the loss due to breakage of one segment block is 12c., as compared with $2.25 for a broken concrete tile. In spite of the difficulties of construction in unstable soil, there is no doubt that the use of segment blocks for tile drains will increase, due to the lightness and convenience of handling and the advantages in laying.

The above investigation was made and the report prepared under the direction of S. H. McCrory, chief of drainage investigation, Bureau of Public Roads and Rural Engineering.

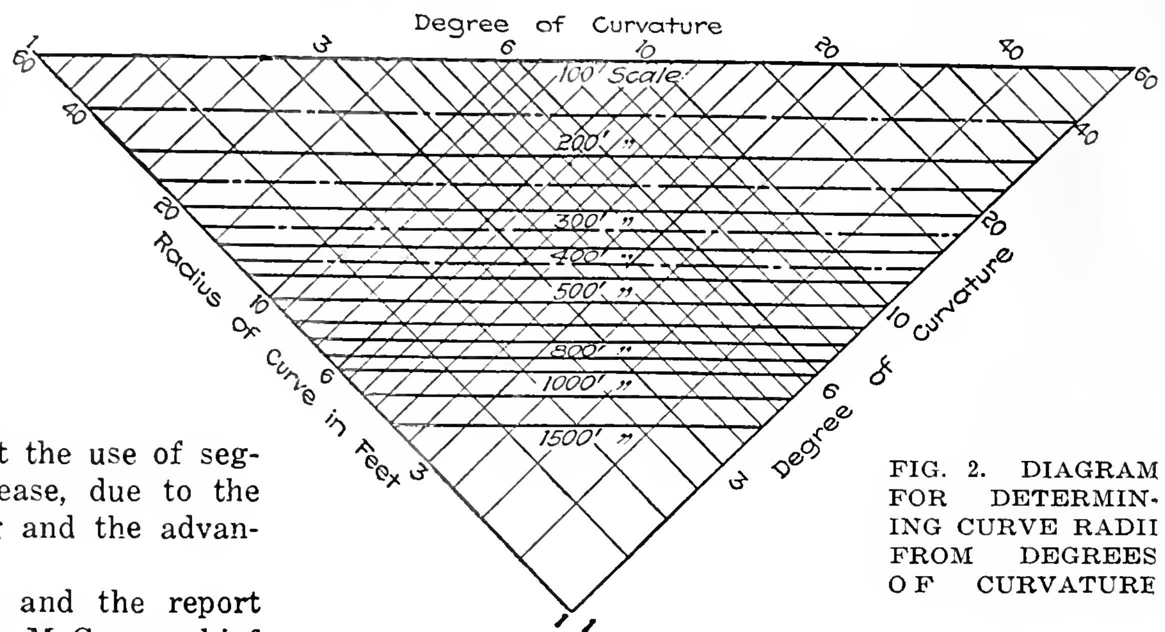


FIG. 2. DIAGRAM FOR DETERMINING CURVE RADII FROM DEGREES OF CURVATURE

Assembled Curves and Radii Diagram Aid in Railroad Drafting

By Dwight Gerber
Pittsburgh Terminal R.R. and Coal Co., Pittsburgh

Two diagrams, illustrated here, have been found useful by the writer in handling railway curve work in the drafting room.

Fig. 1 shows a plan for assembling all curves ordinarily used—with a short tangent and the tangent point indicated on each—on one sheet of tracing cloth. The curves are arranged to facilitate the choice of a particular curve through intersecting predetermined points.

A little use of such a sheet as this will demonstrate the ease with which a choice of curves can be made, as compared with the usual method of sorting curves on a fit-and-try method. It will be self-evident how to use the curves drawn to the scale of 100 ft. to the inch in connection with other scales. Even though none of the scales as drawn will fit exactly, it is very easy to make a close approximation by interpolation of what curvature will fit.

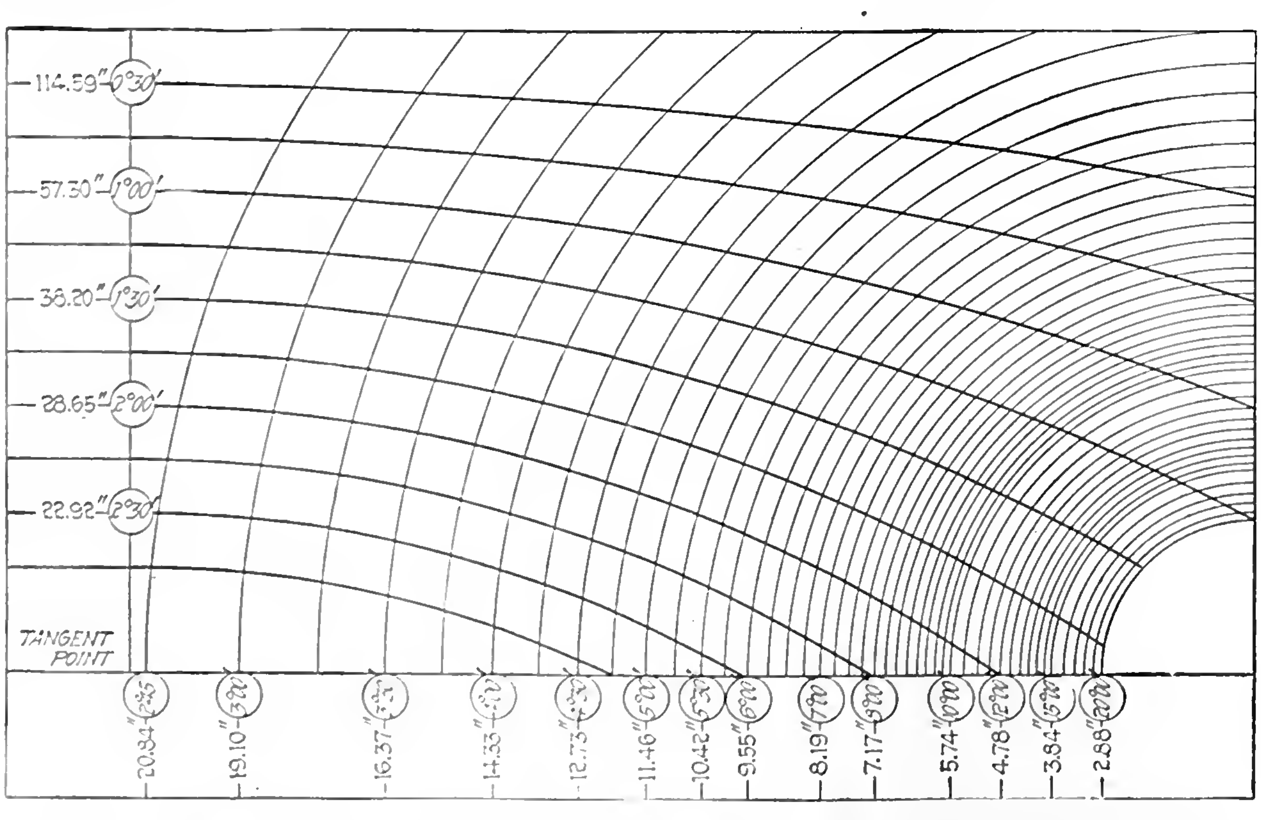


FIG. 1. PLAN (NOT TO SCALE) FOR LAYING OUT ALL CURVES WITH SHORT TANGENTS ON ONE SHEET OF TRACING CLOTH

A second sheet will be found very convenient in laying in a compound curve.

Fig. 2 shows a line chart which will serve as a ready reference to check the calculations of curve radii, which are usually made mentally and are often in error. The chart is laid out on logarithmic cross-section paper. The horizontal lines indicate the degree of curvature, the vertical lines the radii of curves, and the diagonal lines the various scales as marked.

As an example of the use of the chart, to find the radius of a 2.6° curve on a scale of 350 ft. to the inch, follow the horizontal line designating 2.6° to the 350 diagonal, then read down 62.9 feet on the vertical line.

Heavy Construction Marks New Pacific Coast Railway

The line of the San Diego & Arizona Ry., now being built across Laguna Range in California to connect El Centro with San Diego, traverses some remarkably rugged country that called for heavy construction. A map and profile of the line appeared in *Engineering News-Record* of Oct. 22, 1918, p. 365. Through Carriso Pass the grade has been kept down to 1.4%, because the cost of reducing grade later would be prohibitive. Elsewhere the grades run up to 2.2%, with 10° maximum curves. In the 12-mile section of the railroad that lies between Jacumba and Carriso Gorge there are 17 tunnels. Of these, two are about 2500 ft. long, one is about 1200 ft., and the remaining 14 are between 180 and 900 ft. The formation was loose, so that 75% of the total length required timbering. There remains to be completed a length of about 11 miles of the mountain division, and crews are now working on both ends of the gap. It is expected that the line will be ready for operation some time during the coming summer.

American Engineers Kidnaped by Chinese Bandits

Chief Engineer of American Company Building Chinese Railways Was Kept in Captivity for Nearly Two Months

SOME few outposts of civilization remain where the engineer is still pioneering, where the adventures so common in the engineering of a half century ago and between the covers of the modern novel may be had for the asking. One of these places is China. Over there, nearly a year ago, a little band of engineers, almost totally neglected in the clamor and publicity of the great war, went through an experience that ought to make good reading for those boys who wonder what they are going to do for excitement now that the war is over. One of the men, a prominent American railway engineer, George A. Kyle, has just come home from the Orient, and, on urging, has been persuaded to tell the story of his misadventure.

Mr. Kyle was the engineer selected by the American International Corporation to take charge of the construction of the railways in China for which the American Siems-Carey Railway & Canal Co. took a contract a few years ago. He left this country in November, 1916, and from the time he reached China until last spring he was engaged in the supervision of the several lines the company had under way. One of these was projected to extend from the main line of the Pekin-Hankow railroad due west a distance of about 900 miles into the Szechuan valley.

In March of last year American newspapers carried a brief paragraph to the effect that two American engineers had been taken into captivity by bandits operating in one of the eastern Chinese provinces. There was plenty of other excitement in the world just then, and the item did not reach much prominence, nor were the men heard of again until some time in May, when it was announced that they had been freed. Mr. Kyle and E. J. Pursell, a construction man with the company, were the two white men who were captured.

They had started Mar. 2 with a staff of Chinese engineers and servants, about forty in all, on a trip to the western end of the Szechuan line, where several engineering parties were working. They were accompanied by a police guard from Pekin and about 25 so-called soldiers assigned to them by the Government, because reports from time to time came into headquarters indicating that bandits were operating in the districts through which they had to pass. The men, however, were not particularly concerned regarding the dangers which they might encounter.

The Capture

After they had gotten some forty miles out of the town of Yen Shiang, which was the last headquarters of the railway forces, their caravan, made up of 18 two-wheel carts drawn by mules, was attacked without warning by a gang of bandits lying in ambush some hundreds of yards off the traveled road. The first notice was a fusillade of gunshots, on hearing which Mr. Kyle and Mr. Pursell, together with some of the loyal servants and two high-class Chinese who were with them, made for a nearby Chinese village behind its walled inclosure or compound. When they got there they found the soldier guard missing, nor were they heard from again except for some desultory firing on the bandits after the Americans had been captured.

Within the compound the small remaining party began a vigorous defense, but they were soon convinced that they were bound to be overcome by weight of numbers alone, to say nothing of force of arms, for the robbers were apparently well armed with modern rifles. Besides the servants, there was an engineer named T. C. Hu, a graduate of Cornell University, who was the Government representative for the inspection of the work which they were about to visit, and an American citizen of Chinese birth named Wu, who acted as interpreter. These four, the only ones armed in the party, threw away their revolvers and made signs of surrender, whereupon the bandit crew entered the compound and, to the surprise of the Americans, opened fire with revolvers at about 15-ft. distance. Thanks to poor marksmanship, there was no damage except a cut in the shoulder of Mr. Kyle's coat. The loyal Chinese managed to persuade the bandits of the completeness of the surrender, however, and they immediately took possession of the party and all their belongings, which included about $14,000 in silver, pay being taken out to the engineering party.

Lives in Constant Danger

In no recent time has any white man been taken captive by the Chinese bandits who roam the country apparently at will, and neither Kyle nor Pursell was very much concerned about his personal future once the gang had appropriated all the property of the party. They were, therefore, much surprised when the bandit chief announced that the two white men and Wu, the interpreter, were captives, though for what reason he did not then choose to tell. He straightway started the three men on a rapid march into the mountains, a strenuous trip taking about eight days. During all this time they were fairly well cared for as to food, but they were constantly being threatened by the members of the band and apparently in constant danger of being the victims of sudden temper on the part of some individual. After they had gotten well back into the wilds, it then being Mar. 12, the bandit chief announced that they were to be held for ransom in the following amount: Two hundred rifles with 200,000 rounds of ammunition and 200 automatic revolvers with 100,000 rounds of ammunition. The bandits themselves were well armed at the time and were apparently quite competent to take care of the modern firearms which they carried, though they were anything but good shots. It was agreed by the bandit chief that a message to this effect was to be delivered by Pursell to a Roman Catholic priest, named but not identified, and that the material was to be delivered by Mar. 25 on the penalty of the deaths of Kyle and Wu, who were to be held. For some reason the scheme fell through, and the march continued.

In the meantime Hu, the Chinese engineer, had escaped from the compound and back to the telegraph office where he notified the American legation, the Siems-Carey headquarters and the Chinese Government of the state of affairs. Immediately all kinds of machinery were set on foot to effect a rescue. It was very difficult, however, to know what move to make. The country where the bandits roam is very wild and absolutely without Governmental control, except that of the heads of the province who in a way are kings unto themselves and not much concerned about the possible

anger of the United States Government. Headquarters at Peking and all the Americans hesitated to send troops because of the fear of injury or death to the captives.

After the ammunition proposal fell through, for some reason unknown to the captives, they were taken every night on marches into country strange to all of them, even the native. They walked from 10 to 30 miles every night, sleeping in various towns or under cover in the daytime. As far as they were able to find out afterward, they were walking in circles, and were never more than 100 miles from the compound where they were captured. The only daytime walk that they made resulted in an incident which Mr. Kyle thinks was planned in advance in order to intimidate the captives. One afternoon, about four o'clock, they started out on a short march and went by a little village. Apparently all the villagers were gathered outside the compound to look at the procession, and one of the native men was summoned by a wave of the hand to come close by. He got within a short distance, when he was killed by a rifle shot by one of the bandits who then rushed the village and killed twenty-two of the villagers.

While this was possibly the ending or the middle of a feud between the bandits and the villagers, it is Mr. Kyle's opinion that it was "staged" so that they could realize that the men were dangerous and desperate characters. Immediately thereafter the chief of the band told Mr. Kyle that he must not have soldiers sent after him or the same sort of thing might happen. He did allow him, however, to send back messengers, who, by some unknown means, got Kyle's notes to Mr. Hitchcock, the representative of the railway company; the latter had by that time established himself at Yen Shiang. As a result of some of these messages, a little canned food was sent to the captives occasionally, but for the most part they had to live on what the natives could produce and what the bandits took with them. The bandits were always fairly well treated wherever they went, probably because they were known for the desperate character they undoubtedly won, though the Americans often thought that the gang was made up of a number of ostensibly peaceable farmers and villagers who took up banditing as a side line.

Attempt at Rescue

On Mar. 25, without warning that the Americans heard of, 500 Chinese soldiers crossed the path of the bandits and their captives and began an attack. A rearguard action was forced by the bandits, and the three captives were hurried off as fast as possible toward the mountains. They got to the top of the highest peak of the country and were starting to go across into another district when the bandits found they were surrounded by the soldiers, and the three captives, with four guards, lay flat on a hill while the heavy fighting was going on all around them. Here, the three thought, was an opportune time to escape, and all started to run. Kyle became separated from Pursell and Wu, who were guarded by one man only. They finally bribed this man to let them go, offering him a job as servant, which, curiously enough, he accepted. They escaped to the soldiers after being in captivity 22 days. Kyle's guards, however, stuck close by him through the fight.

Following this running battle, which lasted almost 24 hours, the bandit group, which comprised 85 to 100 men at first, was divided into small bands, one of which, consisting of seven men and the bandit chief, took Kyle with them into the mountains. They had a hard time escaping from the soldiers, but managed to break through after several attempts to get by pickets. Kyle might have escaped once when he was running along level ground and came to a deep vertical pitch over which all the men scrambled before him. Bullets were whizzing all around him, however, and he decided it was safer to follow his bandit captors down into the gully, protected from rifle fire, than to stay on top, possibly to be wounded or killed by the soldiers before they knew who or where he was.

When the bandits captured Kyle they had in their possession 17 native Chinese prisoners, whom they were holding for a ransom of $20,000. During the battle with the soldiers these prisoners escaped, much to the chagrin and anger of the bandits. Thereafter they were particularly careful of Kyle, because he was their only source of revenue. He never did find out, though, for just what ransom or reason they were holding him, although in certain conversations with Wu, before the latter escaped, the bandit leader intimated that all he wanted was enough arms and ammunition to set up as a soldier chief. Evidently, in that country political advantage is gained mainly by force of arms. At any rate, after Wu got away Mr. Kyle had no means of communication with his captors except by signs, and was ignorant of their intentions or of the progress of any negotiations for his release.

Final Period and Release

The night after the battle Mr. Kyle and his seven captors walked about 25 miles, out onto the Hunan plain. From that day, Mar. 25, they began a vagrant wandering at night, putting up in the daytime in villages where their hosts were very evidently in league with the band. At one time they crossed the railroad at a place which Kyle decided afterward must have been not more than 10 miles from Yen Shiang, where Mr. Hitchcock was conducting a campaign to reach him. Kyle managed to get occasional word via the underground messenger system to Hitchcock, but at no time did Hitchcock or any of the other Americans know just where he was. All during this time the seven men treated Kyle pretty well, though he had not had a bath for thirty or forty days and no change of clothing. The food was enough to keep him alive, although it was anything but good. Many times during the period from Apr. 1 to Apr. 12, when they were around railroads, he saw and heard trains going along, but could not get in touch with them.

On Apr. 21, however, he received in a letter from a native Roman Catholic priest the first real message from his friends. It was quite vague, but intimated that relief was assured. On Apr. 23 the party moved to a larger compound, where a Chinese Roman Catholic priest met him and told him that in two or three days he would be released. From then until Apr. 25 he was treated royally. On the latter day a local celebrity came along and took him, with the seven bandits, to Wu Yiang, where there were representatives of General Chang, one of the strong Chinese leaders. By the time they reached Wu Yiang a group of 3000 natives was marching alongside of the party, and the entry into the town was made with considerable ceremony. There Mr. Kyle found waiting some of his friends and, what he quite as much appreciated, his Chinese "boy" with a

change of clothes, and the monopoly for the day of a local bath house. It turned out that General Chang, knowing the ambition of the bandit leader, had sent the priest out to dicker, with the promise, in return for Kyle's life, of immunity from punishment and a captaincy in the Governor's bodyguard, together with positions as soldiers for the seven remaining men. The bandits agreed to this and, so far as Kyle knows, the agreement has been kept. He was in captivity 52 days.

Mr. Kyle thinks he never was in danger of his life after the first two men had escaped, but before that the very size of the gang made anything possible. The leader seemed to be pretty decent sort of pirate, who played fair and realized the value of the captives. The gunmen themselves, though, were blithe spirits who amused themselves by sticking a gun in a white man's ribs, and playing with the trigger. It was always about an even chance that one of them would consider pulling the trigger the final word in humor.

Relieving Arches in Subway Distribute Stress to Piers

Engineer's Special Design Meets Difficult Loading Conditions Imposed by Architect's Design—Groined Arches Used in Street Subway Under a Park

ARCHED sidewalk spans seated on the haunches of the roadway span in order to insure the desired distribution of stress constitute the distinctive feature of design in a three-span subway carrying a street under the grounds of the Iowa state capitol in Des Moines. The spans are groined arches with widely spaced piers instead of continuous bents for the intermediate supports. In the sidewalk spans these arches form a false roof concealing the structural or load-carrying arches. In carrying out the extension of the grounds or park it was necessary to extend a plateau south of the capitol and across Court Ave. to the crest of a bluff. At the same time it was desirable to avoid having the park intersected by a street, especially as Court Ave is a heavy-traffic thoroughfare forming one of the main routes between the city and the district beyond the capitol. The plan adopted, therefore, was to maintain the normal high level on the new fill for the park extension and to lower the grade of the street, carrying it under the park by a concrete subway.

SUBWAY UNDER IOWA CAPITOL GROUNDS HAS GROINED ROOF

From 4 ft. to 6 ft. of fill covers the structure, this depth being sufficient to allow planting of shrubbery. Tile drains are laid along the arches, leading to vertical drains in the piers. These piers are about 9 ft. square, and are spaced 38 ft. on centers longitudinally.

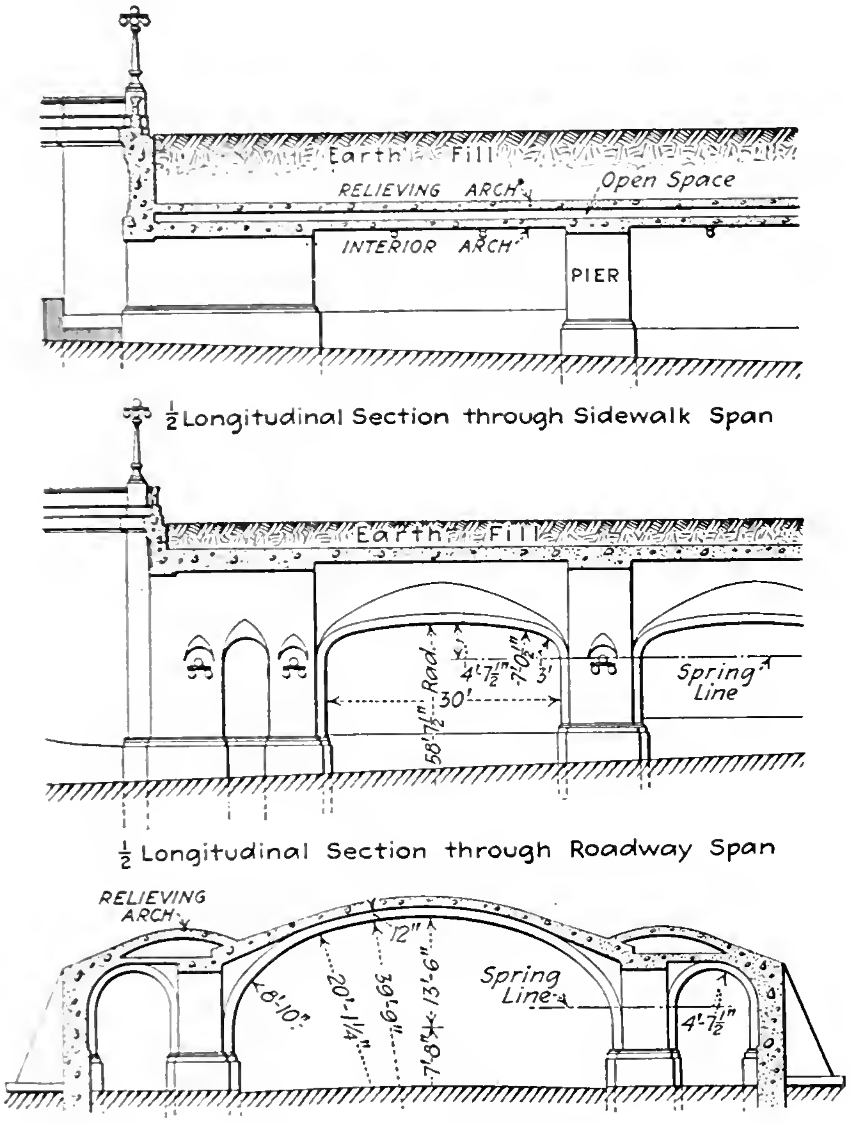
The visible or apparent span is 48 ft. clear for the central arch and 9½ ft. for the sidewalk arches. As the park surface and the crown of the arch are horizontal, while the street has a grade of four per cent., the height is different at the two ends, giving a different appearance to the portals. Thus, at the upper portal the height is 21 ft. 2 in. for the central arch and 13 ft. for the side arches, while at the lower portal these heights are 26 ft. and 19 ft., respectively. The length between the portals is 316 feet.

Architectural design of massive and monumental character is employed, and the bridge is flanked by long and high retaining walls on the street lines to retain the fill. On one side the wall has a curved return, with a winding stairway carried around its face. As it was intended that Court Ave. should have a street-car line, this stairway would accommodate visitors and employees. Reinforced concrete is used throughout, except that the portals have a decorative facing of Bedford stone and ornamental parapets of the same material. Electrical fixtures of bronze will be placed when the price of metal is lower.

Engineering conditions of the design were dictated largely by the architectural requirements, as follows:

The great difference in length between the roadway span of 49 ft. and the two sidewalk spans of 9 ft. 3 in., together with the prescribed outlines for clearance and æsthetic purposes, introduced a peculiar problem. It became apparent at once that resort must be had to some special expedient, in order to confine the line of pressures within the piers located along the curb line. Many schemes were tried and 14 different arch combinations were investigated. The adopted design consists of a relieving arch on either side, supported at one end on the haunch of the roadway arch and spanning over the sidewalk arch to the abutment. The visible sidewalk span is thus only a false arch.

The thrust of the relieving arch is introduced at such a point in the roadway arch that the resultant



SECTIONS SHOW DETAILS OF SUBWAY WITH GROINED-ARCH ROOF

of the two and the pier load fall within the prescribed outline of the pier. General reinforcement in the arches was introduced for its toughening effect, to prevent localization of any shrinkage, temperature or settlement strains in unsightly cracks.

The retaining walls and arch abutments are designed of the gravity, reinforced-cantilever or reinforced-counterfort type, as the interest of economy indicated for the several heights. It was thought that the curved plan of some of the walls offered opportunity for economy by taking advantage of the fact that such a wall, considered as a whole, has a greater stability, proportionately, than has any unit of its length. This was found to involve an analysis far more scientific in character than is warranted by any available data on earth pressure and foundation reactions. The curved walls, therefore, were designed on the same basis as the straight walls.

The live load for which the bridge was designed was assumed to be a fill 1 ft. deeper than the actual grade line, this excess providing ample allowance for any additional load reasonably to be expected. Unbalanced live load was given full consideration, but was found to make very little difference in the line of pressures. An effort was made to approximate the stiffening effect of the groins by figuring those sections of the main arch as having greater moment of inertia than that obtained by the formula $(bd)^3 \div 12$. This proved to be a refinement of theory without practical result, and it was abandoned in the later calculations.

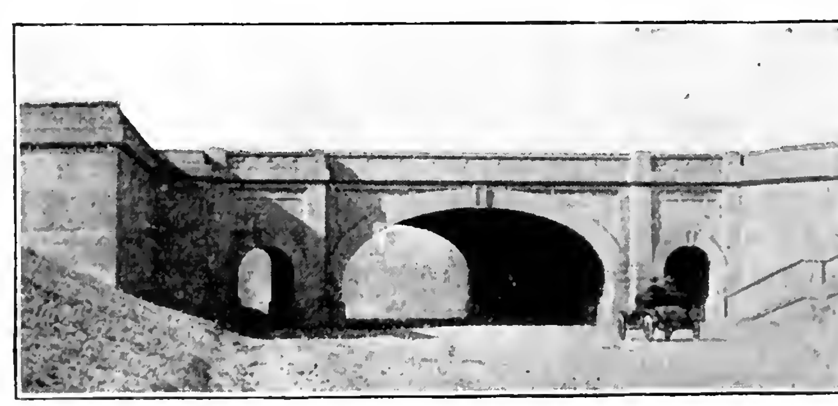
Features of Design—Owing to the fact that each relieving arch springs from a position on the haunch of the main span at which the transept and main arches act to stiffen each other, it was considered proper to analyze the relieving arch on the assumption that its abutments are rigid.

The stress conditions in the groins were investigated on the following basis: The line of pressure of an arch as usually determined is really a cross-section of a surface of pressure. The surfaces of pressure for the several intersecting arches were intersected in lines corresponding somewhat closely with the physical groins of the arches. These lines were then divided into short segments, the thrust of each arch was determined for each segment of the intersection and, being concurrent, these forces were readily composed into a resultant thrust on each segment, from which a line of pressure for the groin arch was drawn. No effort was made to apply the elastic theory to the groins.

Having a line of pressure, the width of groin band required to resist the thrust could be determined. At the haunches, near the sidewalk piers, this figured width of groin band was such that it was regarded as improbable that the material would so adjust itself that the maximum stress along the line of the groin would be satisfactory. Compression reinforcement was introduced, therefore, at these haunches.

It will be seen that the problem did not lend itself to complete scientific analysis. Theory offered only a fair guide as to the conditions of internal stress, and it was necessary to make many of the determinations with but little aid from mathematics. In the early stages of the study of this problem it became apparent that any refinement of theory was unjustifiable and possibly misleading because of the probable influence of variations in the unknowable factors.

The limiting stress in the concrete was taken as 450 lb. per square inch, but this was not even closely



COURT AVENUE SUBWAY AND CURVED STAIRWAY TO CAPITOL GROUNDS

approached except at points where reinforcement was added. Thus, compression reinforcement was introduced at the haunch of the main arch and in the sidewalk faces of the piers in order to give maximum stresses of 450 lb. in concrete and 7500 lb. in steel.

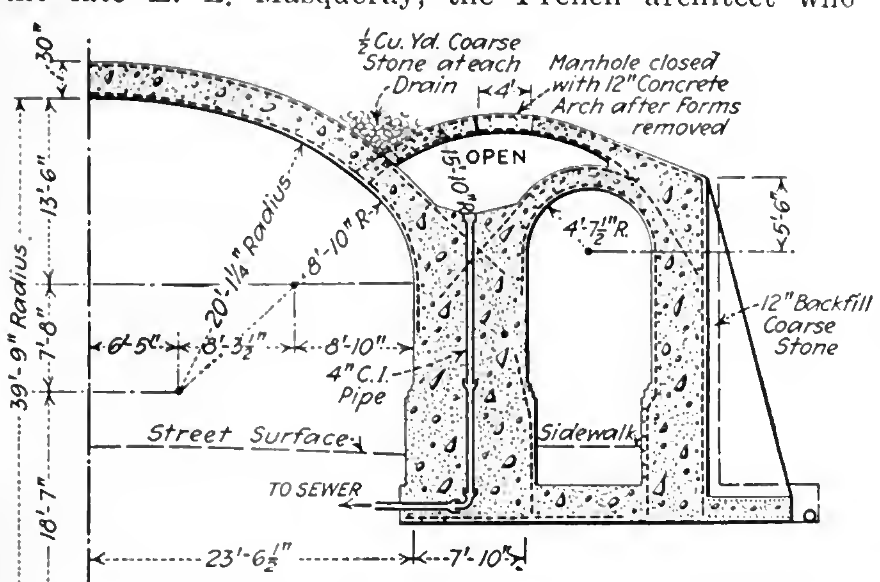
Concrete of the usual proportions of 1:2:4 was used and was made with screened gravel. To insure a smooth working mixture and to avoid staining of the surfaces by moisture, the addition of hydrated lime was specified in the proportion of 8 lb. of lime to each sack of cement. No other waterproofing was specified, except that joints between the work of two shifts were to be coated with elaterite to a depth of 4 in. from the back of the wall as precaution against seepage. Exposed surfaces were finished with cement grout and

ARCH FORMS AND CONCRETING PLANT FOR COURT AVENUE SUBWAY

machined with a surfacing tool after removal of forms.

Footings are seated in the firm gravel soil and on hard shale at some places. No foundation piles were used. Slabs extending under the sidewalk to the abutment footings form braces between footings of piers and abutments. All footings are designed for a pressure not over 2½ tons per square foot on the soil.

The architectural design was made originally by the late E. L. Masqueray, the French architect who



HALF CROSS-SECTION AT PIER SHOWS RELIEVING ARCH CONSTRUCTION

had been chief of design of the Louisiana Purchase Exhibition in St. Louis in 1904. After Mr. Masqueray's death the firm of Slifer, Lundie & Abrahamson, architects, St. Paul, Minn., succeeded to his practice, being organized by men who had been closely associated with him. P. E. Stevens, St. Paul, was the consulting engineer. The Koss Construction Co., Des Moines, Iowa, was the contractor. This bridge was completed in 1917 at a cost of about $68,000.

Columbus Channel Improvements Make Progress

Excavation for widening the Scioto River channel for flood protection at Columbus, Ohio, is about 20% completed. Work was retarded by war restrictions, but reasonably good progress has been made, and most operations will speed up as the season advances. About 90% of the required land has been purchased, and some 150 of the 200 buildings in the way of the widening operations have been wrecked. Concreting has proceeded steadily during the winter, as has excavation for retaining walls and bridge foundations. R. H. Simpson is the engineer in charge of channel improvements.

Associated General Contractors Adopt Constructive Program

IMPROVEMENT of contractual relations, encouragement of sound business practices, and coördination of construction interests, are the broad tasks set for accomplishment by the Associated General Contractors of America. Action will be taken through committees supplied with information and data collected by the secretary and a force of clerical assistants and special investigators to be developed as the need arises.

As recently completed and approved by the directors of the association, the program of operations is: (1) To promote better relations between owners and their architects and engineers on the one hand and contractors on the other hand; (2) to improve and maintain standards in the conduct of work; (3) to combat unfair practices; (4) to increase construction efficiency; (5) to support contractors and contractors' associations in efforts to rectify conditions of an unsatisfactory character; (6) to encourage those methods of contracting for work which relieves the contractor of improper risks; (7) to encourage sound business methods tending to raise the standing of contractors in the business world.

Besides the committees having charge of the routine affairs of the association, there are committees on contracts, legislation, labor, publicity and education, associated organizations, building codes, mutual aid, cost accounting, ethics, and safety. The committees named will conduct the professional work of the association. General directions of procedure have been laid down for each of the seven subjects of the program. Particular effort will be made to push the work and items 1 and 6 of the program.

Better relations between owners and contractors are to be established as follows, as the program states: (1) By teaching owners that the association stands for high ideals and that membership guarantees the reputation of the contractor for skill, honesty and responsibility; (2) by securing a more universal adoption of the cost plus sliding scale fee contract, thereby making the contractor a representative or agent of the owner; (3) by persuading contractors that the interests of their clients and of the community are identical with their own, and that a satisfied client is an asset of immeasurable value; (4) by treating employees with justice and liberality and by taking an interest in their welfare. Specific measures recommended are: Reducing lost time of men, schooling foremen, encouraging apprenticeship, and reducing jurisdictional disputes.

Contractual relations will be improved by urging the adoption of the cost plus sliding scale fee contract where practicable; by insisting that full information be given when lump-sum bids are required; by compelling elimination of the usual clauses placing on the contractor all unforeseen risks and the clauses requiring the contractor to deliver a finished project regardless of what the architect or engineer forgot to specify or show, and by studying and possibly working out a practical arrangement for quantity surveys.

Membership and income have reached a volume which guarantees the means for beginning the committee work. Headquarters have been opened at 111 W. Washington St., Chicago, with Secretary G. W. Buchholz in charge.

Maintenance Data on Twenty-Eight Sections of Test Road

Accurate Records Kept by Philadelphia City Show Relative Cost for Various Types—Traffic Census of Road

IN 1913 the City of Philadelphia laid a test road from Byberry to Bensalem, using five general types of construction in 28 sections, which varied in the details of construction and materials. The types were those ordinarily used for suburban highways. During the six years that have elapsed, considerable amounts of money have been expended in repair. It is now possible to get a preliminary idea as to the value of the various types. To make the data available to the public, the city authorities have prepared a detailed report each year of the condifion of the road and the traffic on it. The tabulations given herein were compiled from a forthcoming report.

The selection of materials, mixing and application to the road were completely described in *Engineering Record* of Dec. 6, 1913, p. 628. The data were kept in great detail, so that at any time it could be known just what the conditions were. Subsequent records of repairs have also been kept in detail as regards the various sections, but where several kinds of bituminous material were used in the same section the maintenance cost for each is not contained in the above-mentioned report. Many of the sections have recently been repaired, and are reported in good condition.

The original road was of water-bound macadam, and in reconstructing it the old surfacing was preserved as far as possible. Most of the bituminous sections were simply surfacings for this old macadam, which was shaped up sufficiently to make an even foundation. In the case of concrete, brick and Bicomac, which had concrete bases, more disturbance of the water-bound surface was necessary.

Five different general types of construction were used: Mixed bituminous; concrete, generally with a bituminous mat; vitrified brick; bituminous macadam; penetration; and Bicomac laid upon a concrete base. A number of different stretches of each of these types were laid, with the exception of the Bicomac, and various mixtures with both tar and asphaltic cement were used in the mats and surfacings.

In considering the mixed bituminous type, all sections in which the aggregate and bituminous cement were machine mixed are considered under one head. In nearly all cases, trap rock was used for the aggregate. The sections 1, 2, 6, 7, 11, and 12 are described as in fair to good condition, slightly wavy, with longitudinal and transverse cracks in some of them. Table I

TABLE I. COST, MAINTENANCE AND CONDITION OF SECTIONS OF BYBERRY AND BENSALEM TEST ROAD, PHILADELPHIA, PENN.

			Surfacing				Maintenance			
Section	Date Constructed	Type of Foundation	Type	Thickness Inches	Cost per Sq.Yd.	Total Sq.Yd.	Total Sq.Yd.	Total Cost	Average Cost per Sq.Yd. per Yr.	Remarks
1	7/12	Old macadam	Amiesite	2	$0.7573	6578	6059	$6858.05	0.1738	Good condition
2	11/12	Old macadam	*Mixed bituminous	2	1.6118	1778	63	58.11	0.0055	Losing contour
3	11/12	....	5-in. concrete	Bit. carpet	1.1432	533.3	1315.6	838.83	0.2621	Good condition
4	12/12	4-in. concrete	Vitrified brick	5	2.6531	444	16.0	29.16	0.0109	San cushion and cement grout; fair
5	8/13	....	5-in. cement	Bit. carpet Av.	0.9834	1244	2899.1	2415.39	0.3236	Good condition
6	12/12	Old macadam	Filbertine	2	1.2581	2222	102	168.30	0.0126	Cracked and slightly wavy
7	12/12	Old macadam	Mixed bituminous	2	1.4291	2222	9	7.92	0.00059	Cracked and slightly wavy
8	12/12	4-in. concrete	Vitrified brick	5	2.6032	533	0.0	0.0	0.0	Good condition
9	8/13	....	5-in. cconcrete	Bit. carpet Av.	1.2101	2933	2101	1771.07	0.1006	Fair condition
10	7/13	4-in. concrete	Brick	5	2.5532	533	0	0.0	0.0	Fair condtion
11	8/13	Old macadam	Mixed bituminous	2	1.2836	1067	188	115.10	0.0179	Good condition
12	8/13	Old macadam	Mixed bituminous	2	1.6083	1067	256	160.49	0.0251	Disintegration indicated
13	8/13	4-in. concrete	Vit. brick	5	2.8443	622	0	0.0	0.0	Good condition
14	8/13	....	5-in. concrete	Bit. carpet	1.2505	978	2093.1	1744.92	0.2973	Good condition
15	8/13	4-in. concrete	Vit. brick	5	2.6401	533	89	68.70	0.0215	Cracked; good condition
16	9/13	Old macadam	Bit. penetration	3	0.8866	1067	1491	214.81	0.0335	Good condition
17	9/13	Old macadam	Bit. penetration	3	1.0599	640	1219	334.59	0.1307	Fair condition
18	9/13	4-in. concrete	Brick	5	2.8670	427	0	0.0	0.0	Good condition
19	9/13	Old macadam	Tarvia penetration*	3	1.0577	1067	1623.75	277.20	0.0433	Good condition
20	9/13	Old macadam	Texaco asphalt penetration	3	1.0154	1067	2683.93	778.70	0.1216	Fair condition
21	9/13	Old macadam	Bit. penetration	3	1.0780	1067	1892.84	509.58	0.0796	Wavy and a few wearouts
22	9/13	Old macadam	Asphalt penetration	3	1.2150	1067	1269	152.71	0.0238	Wavy and a few wearouts
23	9/13	Old macadam	Asphalt penetration	3	1.1511	1067	1789.43	161.81	0.0252	Slightly wavy
24	9/13	Old macadam	Asphalt penetration	3	1.2997	1067	1355.4	94.16	0.0147	Fair condition; slightly wavy
25	5/13	4-in. concrete	Bicomac	3	1.8671	978	461.0	177.72	0.0303	Signs of disintegration
26	5/13	4-in. concrete	Brick	5	2.8834	1004	0.0	0.0	0.0	Good condition

* Topeka specifications

TABLE II. TRAFFIC CENSUS, TAKEN BETWEEN HOURS OF 5 A.M. AND 9 P.M.

SUMMER

Character of Traffic	Friday					Saturday					Sunday					Monday				
	1914	1915	1916	1917	1918	1914	1915	1916	1917	1918	1914	1915	1916	1917	1918	1914	1915	1916	1917	1918
1. Horse without vehicle	9	0	0	0	2	2	0	0	0	2	1	0	0	0	1	4	0	0	0	15
2. Horse vehicle, light	32	13	20	7	41	51	27	15	15	30	56	73	15	7	41	33	29	17	7	25
3. Horse vehicle, heavy	15	30	23	5	6	5	37	12	9	8	0	6	2	2	2	5	8	20	12	2
4. Two-horse vehicle, light	3	0	0	0	15	5	0	3	0	6	1	0	0	0	10	6	0	0	0	2
5. Two-horse vehicle, heavy	22	50	37	18	8	9	37	27	18	7	0	12	0	0	1	15	7	34	15	1
6. Three-horse vehicle	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
7. Motorcycles and bicycles	39	22	40	47	136	217	41	149	85	209	155	338	474	449	408	31	81	64	52	175
8. Two-passenger motor cars	36	125	133	102	154	51	192	198	123	181	81	417	211	192	248	24	87	13	82	197
9. Touring motor cars	134	238	353	453	903	371	403	698	580	1567	480	883	989	1774	2766	103	355	304	509	939
10. Light freight motor trucks	2	8	10	27	106	1	11	14	47	87	0	2	9	24	63	1	8	21	53	69
11. Medium freight motor trucks	12	10	24	16	143	6	14	14	26	113	4	21	10	7	200	4	7	21	14	94
12. Heavy freight motor trucks	3	14	24	48	152	7	19	19	36	162	1	4	3	19	160	9	11	26	48	207
13. Miscellaneous heavy traffic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total—Summer	307	510	664	723	1667	725	781	1151	939	2372	779	1756	1713	2474	3900	235	593	520	792	1721
Total—Autumn	225	461	827	....	1667	425	579	1047	....	2217	718	840	2006	....	....	272	347	759	....	1122
Total—Winter	333	563	499	367	....	370	493	1263	586	....	109	1746	657	619	....	142	395	431	53	..
Total—Spring		279	665	502	1243	....	181	880	826	2166		80	1649	1479	4099	...	233	692	400	1541

gives information as to the general construction and maintenance costs of the various sections. The highest cost of maintenance was on Sec. 1, which was about 17c. per square yard per year, while the lowest was Sec. 2, which was about 5 mills. The average cost per square yard per year was about 4c. If Sec. 1, which is abnormally high as compared with the others, be omitted, the cost per square yard per year averages about 1c.

Concrete with Various Carpets

Concrete was used for paving four sections, 3, 5, 9 and 14. Of these, sections 3, 5 and 14—the last named of which was of the Hasson type—received originally bituminous mats. These mats failed badly, and were replaced in each case in 1916, by the use of various methods. In 1918 all sections were resurfaced with 1-in. binder and 1½ in. of top, forming a sheet-asphalt surface. In figuring the yearly maintenance the resurfacings were included. Sec. 9 was constructed with bituminous mats of various kinds, one division being left plain concrete. This section had worn so badly that 860 yd. had to be replaced in 1914, after which a bituminous mat was again applied. The section is reported in good condition. The lowest maintenance cost of the concrete sections per square yard was 10c., while the highest was 32c. The average maintenance cost per square yard per year was 26c. The proportions used for this work were 1:3:6, with the exception of the Hasson type, which was grouted with 1:2 grout. It would seem that where very thin mats are used it is almost impossible to make them adhere to the concrete surface.

Vitrified Brick

Vitrified brick was used on seven sections, 4, 8, 10, 13, 15, 18 and 26. A 4-in. concrete base was used with sand-cushion and grouted-brick top. Very little maintenance was given to these sections during the six years. Only two sections received any repairs at all—No. 4, with 1c., and No. 15, with 2c. per square yard per year. There were longitudinal and transverse cracks in many of the sections, and the repairs consisted of filling these with Tarvia and torpedo gravel.

Bituminous Macadam, Penetration

Bituminous penetration 3 in. thick was used upon eight sections, 16, 17, 19, 20, 21, 22, 23 and 24. Many kinds of bituminous cement were used, and the repairs consisted of some patching of holes and a seal coat applied in 1916. The condition is described as generally good, some sections being slightly wavy, while others have longitudinal and transverse cracks. In some cases the edges are ravelling. The lowest maintenance was for Sec. 24 at 1.5c., and the highest on Sec. 17 at 13c. per square yard per year. The average for the entire eight sections was 5.9c. per square yard per year.

Sec. 26, known as a Bicomac pavement, was laid upon a 4-in. concrete base and was applied by a cold-mix method, using emulsified asphalt. The stone was thoroughly coated with the asphaltic emulsion, the sand and cement were mixed and added to the coated stone, and the whole was thoroughly saturated again with the solution. The surface is reported to be wavy and shows signs of disintegrating. The average cost of maintenance per square yard per year was about 3c.

Table II shows a traffic census, taken between the hours of 5 p.m. and 9 p.m., in the summer, autumn, winter and spring, and on Friday, Saturday, Sunday and Monday, for the years, 1914, 1915, 1916, 1917 and 1918. Large increases in the number of light and heavy motor trucks will be noted. The traffic was the same over all the sections.

Professional Consciousness Must Be Developed Through Service

PRIMARILY, an engineer is "a man whose life is devoted to promoting and planning things that actually happen," according to S. M. Swaab, who recently addressed the Philadelphia Association of Members of the American Society of Civil Engineers. The engineer is "slowly but surely assuming his rightful position in the world," he continued, and stated that the relation which professional engineers bear to modern business and the rate of their compensation will depend upon the degree to which they individually develop a professional consciousness through service and succeed in securing their share of the proceeds of their work. The following short abstracts are taken from his development of this idea.

In his financial relations to the public, the engineer should be over-scrupulous, so that it shall never be said of him that he, like so many others engaged in business and in professional pursuits, has developed a sordid money-sense; but he should undoubtedly have a well balanced commercial vision of the fitness of things and the relation of the technical effort employed to the results and benefits accruing therefrom. There is no question of the fact that as engineers are usually recruited from the ranks of those who are required to maintain themselves by their individual efforts they should see to it that early in life they get on the right track. Ninety per cent., or probably more, of all engineers are employees rather than employers, and for the reason that the engineer usually is entrusted with the conduct of work which primarily is, or at least is intended to be, revenue producing, he, like any other laborer, to use an oft-quoted expression, is worthy of his hire.

In case the profit incident to his work is shared by others, which is usual in engineering works, he should certainly know sufficient of the gentle art of securing for himself a liberal share of the proceeds of his work—not to let the other fellow get all of it—and he should recognize that it is worse than foolish to use his God-given vision, his brains and his professional attainments solely for the aggrandizement of others and entirely for their financial benefit.

He should, therefore, use every honorable means to secure for himself an adequate share of the results of his ingenuity, not alone for the actual effort involved, but also sufficient to compensate him for his "knowing how." Working for a weekly or monthly, or, in fact, any fixed stipend should be discouraged, as is the practice of that master of organization, Charles M. Schwab, whose method is to allow every man to participate in the profits derived from any piece of work in which he may be directly interested.

Evidently, the relations of the engineer and the public are reciprocal, and unquestionably, and above all and all of the time, *our first duty is service;* service without stint, service to the utmost, and this means the best that is in us. Second, the public owes us adequate recognition and remuneration commensurate with our efforts. But first, foremost and above all else, the first duty of the engineer is service.

Grit Chamber and Fine Screens for Part of New York Sewage

First Plant to Treat Sewage from Manhattan Borough—Eductors Clean Grit Chambers—Two 14-Foot Riensch-Wurl Screens

BY CHARLES E. GREGORY

Engineer of Drainage and Sewage Disposal, Borough of Manhattan, New York City

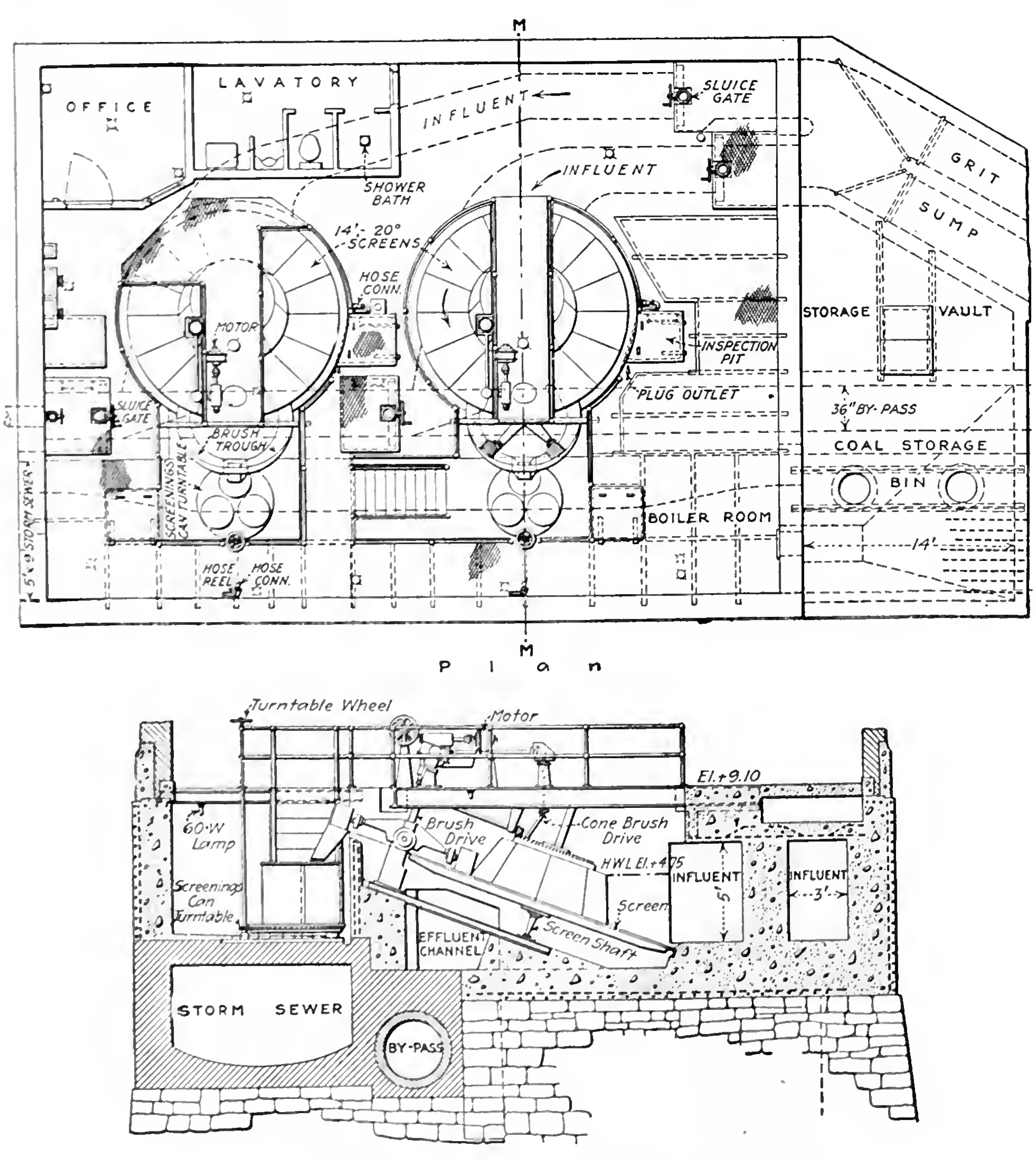
A GRIT chamber and a pair of fine screens of the revolving-disk type, recently put in operation at the foot of Dyckman St., is the first sewage-treatment plant to be built in the Borough of Manhattan, New York City. It is the first step in a comprehensive plan to control pollution of the waters of New York harbor, based on studies begun in 1903. The large volume of harbor waters, with tidal currents and upland fresh-water flow, affords favorable conditions for disposing by dilution of the 500,000,000 gal. of sewage a day produced by New York City, but because of the rapidly increasing ratio of sewage to diluting water serious nuisance exists in various parts of the harbor.

The Dyckman St. sewer, like others in New York City, is a combined sewer. It serves an area of 345 acres in the upper part of the island, of which area about 17% has been built up with apartment houses. The present maximum dry-weather flow is about 3.5 sec.-ft. As originally built, the sewer, of the brick-arch type, was 7 ft. wide by 5 ft. high, and it discharged into the Hudson River at the edge of the high-water shore line. The accumulation of sludge along the shore caused a nuisance to sight and smell.

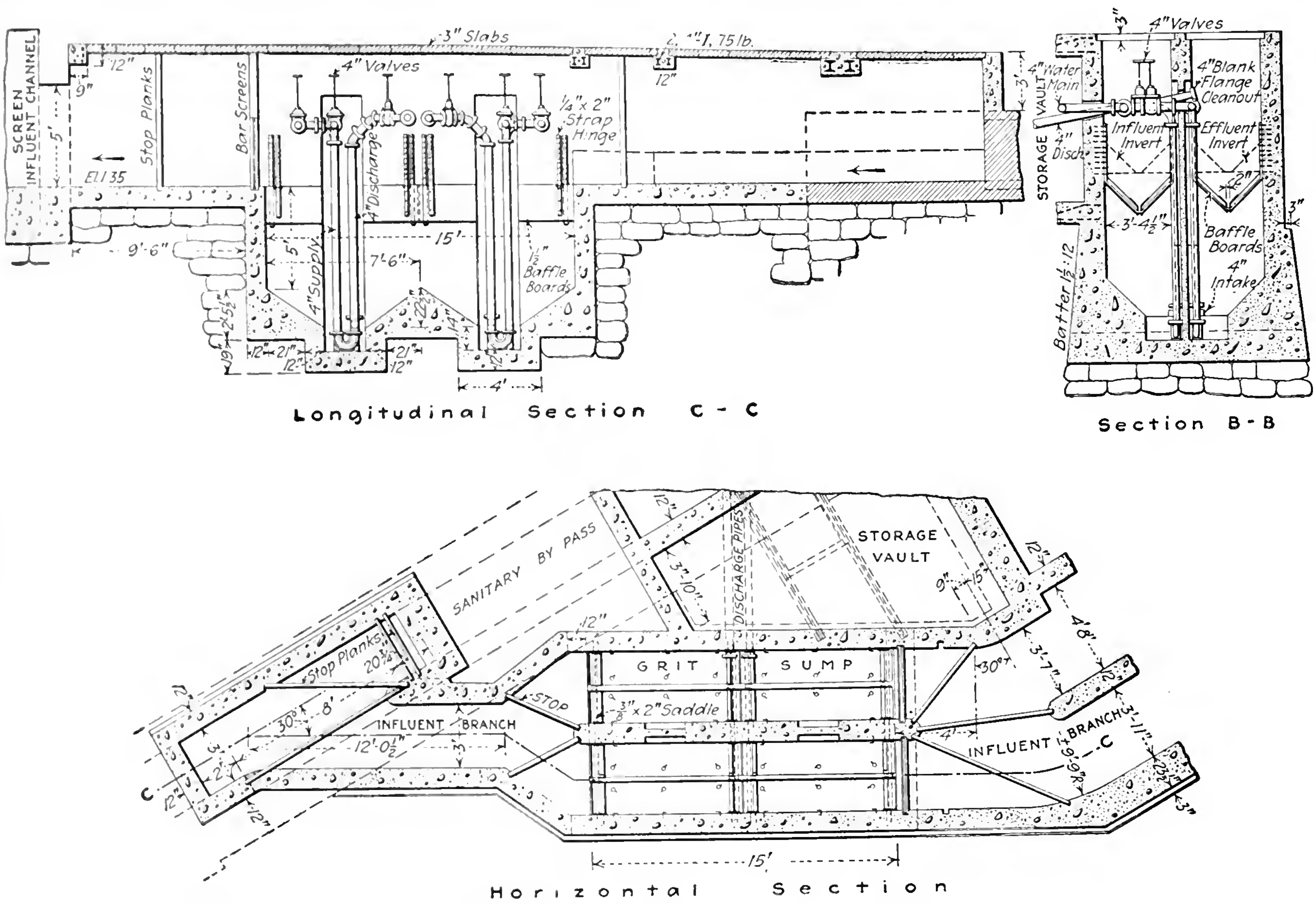
The dry-weather flow is diverted from the Dyckman St. sewer at a point about 1100 ft. above the outlet and carried through a sewer of flatter grade delivering the sewage at an elevation sufficiently above high tide to pass it through the treatment plant and a submerged outlet and discharge it by gravity on the river bottom about 100 ft. from the screen house in more than 40 ft. of water. The bottom of the river at this point is rock and is swept by strong tidal currents.

Outside the screen house provision is made for guiding the flow from the diverting sewer either into a bypass or into the grit chamber from which it passes to the screens. No regulator is employed at the upper end of the diversion sewer, as any excess quantity reaching the screens will flow over adjustable stop planks into the bypass or back into the storm sewer as soon as a maximum depth is reached on the screens. In this way reliable regulation is secured automatically, without making use of a device with moving parts, or loss of head.

The grit chamber is of the two-story type, and is equipped with Otterson eductors for cleaning. It has not been in operation long enough to furnish any reliable data, except to demonstrate the practicability of the cleaning device, which works under the head of water in the local water mains. The diaphragm separating the chamber into two stories serves to maintain a velocity in the upper chamber sufficient to carry over all the lighter organic matter, even though the lower chamber is empty. This would be impossible with a one-chamber structure. The present installation of screens has an estimated capacity of about 10,000,000 to 12,000,000 gal., which is one-half of what is expected to be the ultimate need of this outlet, and the plant has been designed to permit future extension. Two screens of the Riensch-Wurl disk type, each 14 ft. in diameter, set at an inclination of 20° with the horizontal, have been installed. They have an assumed daily capacity of from 5,000,000 to 6,000,000 gal. each, and are inclosed in a neat brick building about 48 ft. long and 35 ft. wide. The screenings are brushed from the disks into galvanized metal cans which rest on a platform; the latter is revolved as each can is filled, to bring the next can in place to receive the screenings. The cans are removed



THE GRIT CHAMBER IS FITTED WITH EDUCTORS



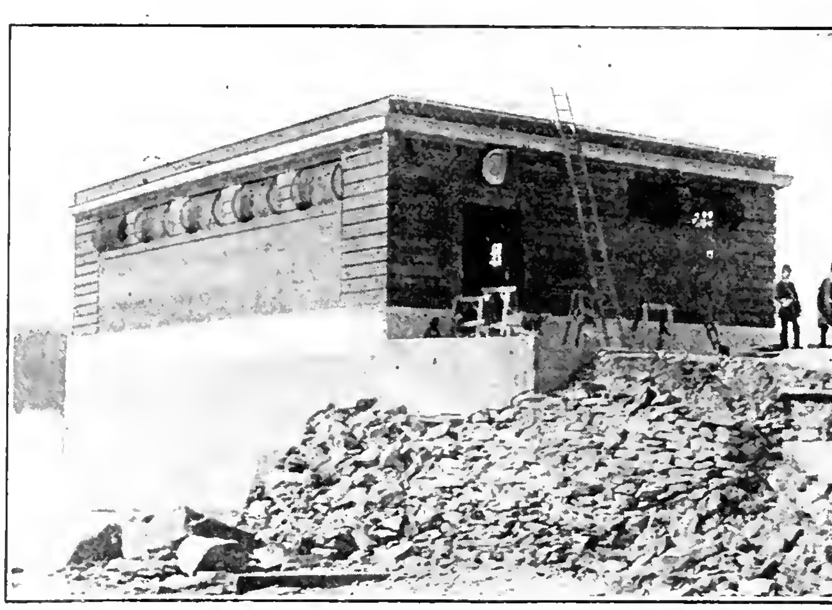
SECTION THROUGH SCREEN HOUSE OF NEW YORK SEWAGE-TREATMENT PLANT

from the revolving platform by an electric hoist which operates along a 10-in. I-beam upon which the cans may be transported to either the shore or water side of the building for loading either into boats or trucks for removal to a suitable dump, reduction plant or incinerator. At present, and until other plants have been developed, screenings are taken to the nearest street-cleaning dump and disposed of with road basin detritus and garbage.

Each screen is operated by a 2½-hp. motor. The screen disk plates are manganese bronze. The contractor was required to demonstrate the screen with apertures of various widths, the smallest being $\frac{3}{64}$ in. wide and 2 in. long. Piping for spraying the screens with hot water or other cleansing or antiseptic solutions is provided. The floors and walls of the building are finished smooth with rounded corners, so they can be washed down with streams from hoze nozzles. This especially applies to those parts liable to collect sediment or spatter from the screenings. The influent and effluent channels are provided with sluice gates for controlling the flow. One corner of the building is partitioned off into a small office and wash-room. The windows are all about 10 ft. above ground and are screened to exclude flies. Additional light is provided through skylights in the roof.

The contractor was required to operate the plant 30 days to demonstrate its mechanical perfection and determine which size of opening was best fitted to the local conditions. The smallest opening tried was $\frac{3}{64}$ in. wide and 2 in. long, and collected 50 % more screenings than the $\frac{4}{64}$-in. opening. The larger openings were not tried, for obvious reasons. The loss of head on the $\frac{3}{64}$-in. opening, when 2,000,000 gal. of sewage were flowing through about 25% of the available area of one screen, varied between 1 and 2 in. When a less area was used there was a decided increase in loss of head as well as a decrease in the quantity of screenings removed.

The sewage at this outlet is considerably weaker than typical Manhattan sewage. Samples taken at various times show that it averages about 150 p.p.m. suspended



DYCKMAN STREET SEWAGE SCREENING HOUSE

solids. The screen plates with smaller openings removed from 21 to 28 cu.ft. of drained screenings in eight hours. The estimated flow for the corresponding period varied from 520,000 to 1,000,000 gal. While no records other than of the quantity of screenings removed were kept to determine accurately the percentage of purification, a comparison of the screenings removed with the

usual total suspended solids in the sewage shows a removal of from 15 to 40% and an average of 32%, which indicates that the expected 20% average removal of suspended solids will be more than accomplished. Often the forenoon rate of removal was double that of the afternoon.

A final decision as to the efficiency of the screen will depend upon results obtained during a considerable period of operation, and it would not be without precedent if some materially different and more reliable results were obtained through such an operation.

On account of war conditions, the contract price for the plant was materially more than was anticipated. The total cost, including grit chambers and building with deep foundations below tidewater, was $77,000.

Maintain Earth Roads by Patrol Contracts in Kansas

State Highway Department Has General Supervision but Lacks Power of Initiation—Machinery Counteracts Labor Shortage

HIGHWAY maintenance by the patrol contract system has been used heretofore in Kansas with what have been considered very satisfactory results, but last year, on account of the labor shortage due to the war, it is said to have failed in many places, the farmers refusing to leave their own work to drag the roads. The county engineers, who work under the supervision of the State Highway Commission, have been forced to adopt various forms of labor-saving machinery and take over the maintenance of long stretches of road with their own gangs. While the state department has general control of the work, it has little power of initiation, and therefore has to wait for action of the people, instead of doing constructive planning.

Maintenance in Kansas consists mainly in the dragging and light grading of earth and gravel roads, since hard-surface construction exists on but a very small part of the highway system. Special attention, therefore, has been given by the State Highway Commission to the organization and methods of execution for this class of road work. While maintenance is under the charge of the county and township authorities, it is subject to supervision of the commission, whose approval of plans is required, and which has indirect control of the county and township funds.

For maintenance of earth roads the commission has arranged a road-dragging and patrol system. The county commissioners and the township highway commissioners award contracts to local drag men or patrolmen, covering specific sections of county or township roads, these sections, varying in length from three to seven miles. As far as possible, the contracts are drawn for one year. Besides dragging the road after each rain, the patrolman is instructed to take care of other maintenance matters, including minor repairs on bridges and culverts. The larger repair and construction jobs are handled by the county engineer or the township road overseer.

Printed instructions for the drag men and patrolmen are not issued by the highway commission, as conditions vary so widely in different parts of the state. County engineers give their own instructions, which usually provide that the roads shall be dragged after every rain that is heavy enough to allow the earth to pack after dragging. The patrolman is furnished usually with a steel drag, a slip scraper and a shovel. Any other tools he may find necessary he must furnish for himself.

Standard forms of contract are employed by which the drag contractor agrees to "drag and care for" a specific section of road for a specific period of time; also to provide a substitute when necessary. He agrees to do the dragging at such time and manner as required by the county engineer (or the township overseer) and to report this work promptly on cards furnished for the purpose. He must also keep informed of the condition of the road and report promptly any damage to culverts, bridges or grade.

The payment varies in different parts of the state but averages from 50 to 75c. per mile for a single round trip, $1 to $1.25 for a double round trip and $1.50 to $2 for a triple round trip. For repairing culverts or bridges and for any other service ordered the pay per hour is about 35c. for each man and 60c. for man and team. The postcard for daily report shows the date and section, the number and location of miles dragged once or twice, and the hours and location of extra work for men and men with teams. The claim or voucher made out each month is a sheet showing this daily information and is sworn to by the contractor.

Machinery Meets Labor Shortage

Labor supply is now the greatest problem encountered but the local patrol system is reported to have worked satisfactorily until last year, when several counties found it almost impossible to get patrol work done, as help was so scarce that farmers did not care to neglect their own work to handle patrol contracts. The engineers in some of these counties arranged for dragging long sections of road by motor trucks or light tractors, thus avoiding the use of teams. In some instances, where the soil is of such a character that to drag in this manner would prevent covering the road at the proper time after the rain, it has been found advisable to use a road planer or a light grader drawn by a tractor or truck, which will smooth up the road. If a little moisture is present the earth will usually compact into a good surface for traffic.

Many counties and townships found it impossible to obtain sufficient teams for grading their earth roads and purchased tractors and heavy motor trucks for the work. They found this plan much more satisfactory. One county engineer, having 1000 miles of road of which 126 are county highways, plans to keep a two-man gang on the earth roads continually with a tractor, grade and bunkhouse on a motor truck.

Where heavy motor-truck traffic is carried on gravel and earth roads, dragging is usually insufficient to maintain a good condition, and light graders are sometimes used. Under ordinary traffic conditions, however, dragging is the only type of maintenance that has been found satisfactory for such roads. Until such time as hard surfacing can be applied to the main traveled highways, dragging must be relied upon to maintain the roads. Oil has been employed on some roads having heavy motor-truck traffic near cities, but the engineers state that this has not proved satisfactory.

The Kansas State Highway Commission is composed of three members, of whom the Governor, Arthur Capper, is chairman. M. W. Watson is acting state highway engineer, during the absence of W. S. Gearhart on military service. F. W. Epps is bridge engineer.

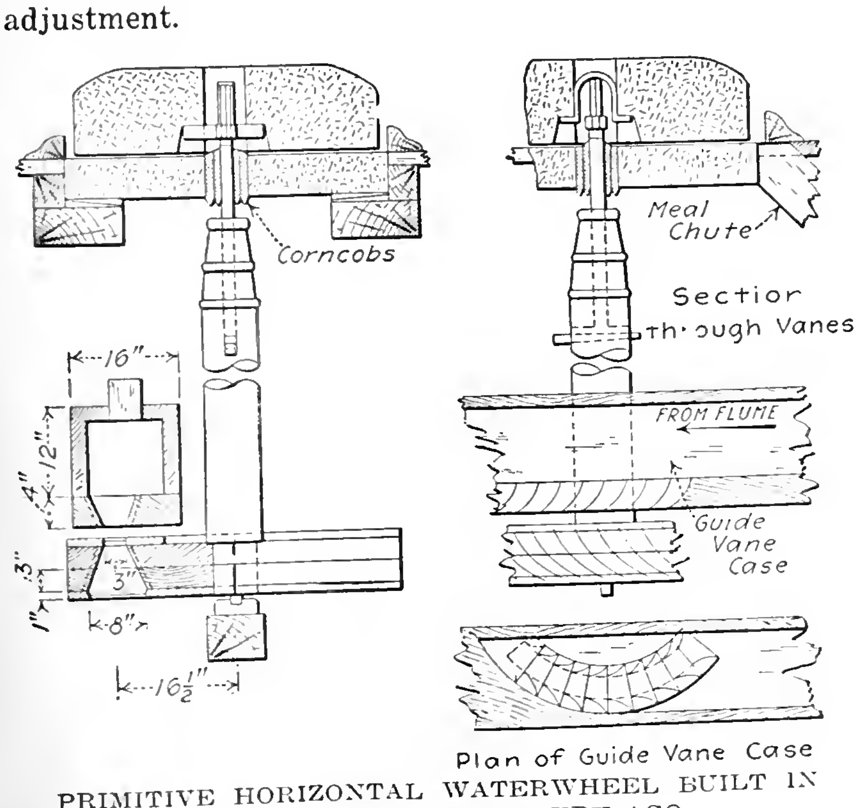
Old Southern Mill Has Curious Horizontal Wheel

Such Grist Mills Though Inefficient Have Value in These Days of Railway Freight Congestion and Grain Shortage

BY H. K. HIGGINS
Copperhill, Tenn.

THERE are scattered throughout the United States a number of old grist mills which in spite of advances of civilization, with its centralization of manufacture and production, still efficiently serve local communities. In a recent trip through the mountains of northern Georgia the writer came across one such mill which has a curious horizontal waterwheel of modern design though primitive construction. Its details seem to warrant description.

The essential part of a grist mill is the two millstones with their characteristic grooves on the grinding surface. These can be of several varieties of stone, natural or artificial. Usually some variety of local stone is available in any country where water power is available. The stones in this case appear to be of a variety of granite and give evidence of having been fully effective. The upper or moving stone is carried by the vertical shaft through two yokes at right angles, let into four notches cut into the lower surface of the stone. The lower stone, which is much thinner, is carried on wedges on heavy beams. Both stones have an axial hole of about 6-in. diameter. The shaft where it passes through the lower stone is "babbitted" with corncobs, an effective if somewhat crude device. This iron shaft or gudgeon is attached to the wooden vertical shaft by a T-shaped head which fits into a long slot in the shaft and is secured by oak fillers and iron bands. A taper key below it provides means for adjustment.



PRIMITIVE HORIZONTAL WATERWHEEL BUILT IN GEORGIA HALF A CENTURY AGO

The casing around the stone is not shown, nor the feed hopper and its shaking valve or feeder. The latter is a grooved plank hung on leather straps and jarred by a multiple cone on a short vertical extension of the shaft. Of course this mill does not bolt the flour, but grinds as fine as desired. A bolting device could easily be added.

The waterwheel is a most ingenious adaptation of the turbine principle all worked out in wood (oak) with the single exception of the wheel and guide vanes, which are evidently iron (not steel) and show little evidence of wear or corrosion. No one knows just how old they are, but the rest of the wheel has been in use 40 years at least, and so have the vanes. The wheel proper is built up of two thicknesses of 3-in. and two of 1-in. planks, pinned, nailed and probably dovetailed together. The vanes or buckets are in grooves and are retained by the outer layers of plank. The vanes curve about 1½ in. and the chord sets about 45° from the plane of the wheel. The water is led to the wheel through a guide-vane box made from two timbers about 4 x 12 x 16 in. The 12-in. timber is hollowed out and inverted over the 4-in., which carries the guide vanes set radially in grooves in a tapered slot. The wheel is about 33 in. in diameter to center of buckets. These taper from about 3 in. at entrance to 8 in. at exit. There is no draft tube—the wheel discharges freely a few inches above tail water.

The dam which serves this mill is about 12 ft. high, stone faced and earth backed. The flume is about 3 ft. or less wide, 10 ft. high, 20 ft. long, and forms the waste spillway as well as the flume proper. The stream is a brook in mountainous country some 1700 ft. above sea level. There is very little water storage; the streams carry heavy burdens of silt and soon fill the ponds.

While such a mill leaves something of efficiency to be desired, the power cost is nil, cost of attendance not excessive, and interest on capital about the only overhead. The capacity is about three bushels of corn per hour, considerably more than enough to keep the tributary community in bread. These mills are occasionally called on to grind barley and rye, making a so-called graham flour, much esteemed as a variant from the customary corn flour. The white variety of corn is almost universally grown in this region. This produces a nearly white meal or flour, making a bread at once palatable and much more wholesome than the starch flour we all know so well.

Such mills have to a great extent come to be considered obsolete for some years past, or since the advent of railroads with easy access of white flour from mid-western mills. They have therefore been allowed to fall into bad order. The experiences of recent winters, with their freight congestions and indiscriminate embargoes, indicate the wisdom of putting these local facilities, so far as practicable, into condition for further use. To some extent this is being done. It is of course also true that in localities remote from railways such mills are and always have been in constant use. Even a few miles over mountain roads means a condition in which such a mill can thrive. There are many unutilized streams all over our country; little capital is required; most communities have plenty of men available for millers; the work is far from arduous. There

should be such mills at ten-mile intervals all over the well watered part of the country. Such a mill with suitable cornfields around it effectually safeguards its community against starvation, even with the railroads worse congested than they have been recently, if that be possible.

Spraying Paint on Corrugated Steel Before Shipment

Speed Requirement and Necessity for Rapid Drying, to Allow Handling, Result in New Methods of Applying Structural Paint

By Thomas M. Wheat

Chief of Engineering Branch, Supplies Section, Division of Military Aëronautics, New York City

When the supply section of the Signal Corps was confronted with the necessity for painting a large quantity of corrugated-steel sheets in the shortest possible time, for use on airplane hangars in this country and overseas, unique erection conditions made it necessary to omit the application of a coat of paint in the field. This called for extreme care in painting and packing the sheets in the shop. Hand painting required a large amount of labor, much floor space, and handling of wet sheets. Machine painting was not practicable, on account of the corrugations, and the painting could not be done before corrugating because of the damage done to the paint by the corrugating rolls.

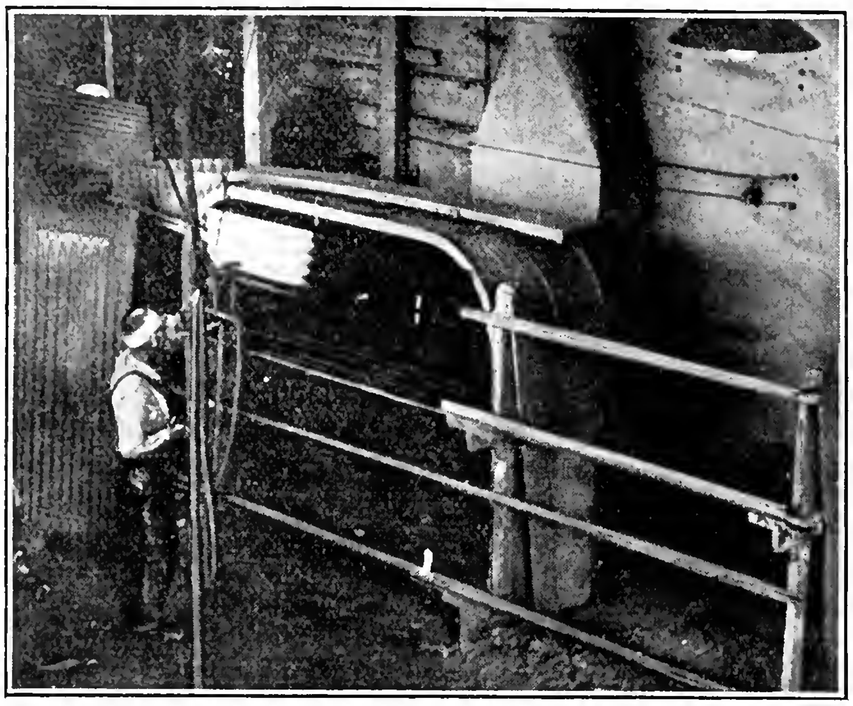
The problem was solved by the use of spraying. Figures are given to show the average surfaces covered per gallon.

This project soon developed into something entirely new. Instead of the finely atomized, delicate jet used on filing cases and such articles, this operation called for a jet 14 in. wide carrying enough actual paint to give a fair protecting coat. The metal paint containers ordinarily used, for example, have a capacity of something like 13 gal., and at the rate of operation maintained these had to be refilled about every hour. This early brought about the purchase of a double set of apparatus—containers, spray guns, hose, etc. This reserve set proved very useful in case of accident, as the layout was such that a shutdown on one gun threw two crews out of action, or about 10 men.

These containers were later abandoned, with the attendant system of air pressures, and there was substituted a gravity feed from barrels on an overhead scaffold.

The sheets required a priming coat of red lead, and this was put on by means of roller machines, before the corrugating was done. Corrugation and fabrication were then completed, and the sheets were brought to the spray operation. Here they were to receive a coat of gray on one side and a coat of green on the other. Hoods were built on the floor, and racks in front of them, for the sheets. Operators wearing gas masks stood before them and sprayed the sheets as shown in the illustration.

The gas masks were necessary at first on account of the peculiar and penetrating odor of the paint. One side of the sheet having been sprayed, the sheet was shoved along the rack to the next hood, facing the opposite direction, where a second operator sprayed the other side. The operation was then completed by hanging the sheet on a traveling chain, by which it was taken through a drying oven. Incidentally, it was discovered that the workman's hands in handling left no mark on freshly painted sheets if his hands were encased in gloves having a surface of emery cloth on the side coming in contact with the paint.



PAINTING CORRUGATED STEEL SHEETS BY SPRAYING

The hoods, as supplied by the manufacturer, were equipped with a 10-in. blade fan at the back, this being adequate for the removal of ordinary quantities of fumes and escaping spray. Not only were these fans inadequate for taking care of the volume of matter to be removed in this case, but quickly became coated with paint and were thus rendered still less effective.

This difficulty was overcome by the installation of an induced draft system by which a 20-hp. motor forced air through a 6-in. pipe into a 36-in. flue from each pair of hoods. The 6-in. pipe was contracted to a 4-in. nozzle in the flue, and the force was enough to remove the spray and fumes, discharging into the open air through a vent in the roof. Several months later it was discovered that a large area of the roof in the vicinity of this vent was covered with several inches of paint. Conduits and gutters were thoroughly clogged —a new form of industrial waste.

An attempt was made to use ordinary brush paint for this work, with indifferent results. The trouble experienced with clogging of apparatus led to the investigation of the question of what constitutes a good paint for spraying. Of prime importance was the feature of "squirtability"; that is, the property of flowing freely through the guns, where the paint is atomized and spread out in a fine fan-shaped spray by a current of air entering the nozzle. It reaches the sheet in the form of minute globules, and must be so constituted that it will flow out in a smooth, uniform coat, notwithstanding the cooling in the jet. An additional requirement of the paint in this case was that of quick drying, and hence this flowing out had to be accomplished in a very brief period.

The specifications called for a paint that would dry

in six hours, and the plan was to force the drying to an hour and a half in an oven at a temperature of 160° F. A paint that will fulfill the ordinary specification of drying "to touch" in a given number of hours is by no means necessarily dry enough to *handle.* Sheets that came from the oven not dry enough to handle and pack directly were stacked on the floor until dry and hard, and this not only took up valuable labor and floor space, but also occasioned unavoidable damage to the paint itself.

The addition of drier was inadvisable beyond a certain point, of course, and it was some time before attention was given to the air-jet agitator used to stir the paint in the mixing barrels and reservoirs. The elimination of these constantly flowing streams of air and the substitution of hand stirring for them led to very satisfactory results in drying. The theory of it seems to be that the jets effected greater evaporation and drove off the lighter, more volatile, drier and thinner liquids.

A point of great interest was the question of how many square feet of metal could be covered with one gallon of paint. During six months' observation at the plant of the Berger Manufacturing Co., Canton, Ohio, it was found that this figure varied greatly. This variation depended, apparently, upon the color of the paint, its specific gravity, the operator, the apparatus and even the weather. The average for a "battleship" gray is 350 sq.ft. per gallon and for an "invisible" green 375 sq.ft. per gallon.

These figures include all the paint actually brought on the premises. Probably 10% of all the paint bought and paid for was wasted. This considerable item was countenanced in the interest of speed, which was a matter of greatest importance. Numerous suggestions were offered for eliminating or reducing this loss, but it certainly never went below 6%. The figures given above are for square feet of sheets in the flat. The Truscon Steel Co., at Youngstown, Ohio, installed a system of automatic spraying, and this may have reduced the loss of paint.

So far as the writer knows, no data are available as to the protective qualities of a paint covering that has been sprayed on. If this structural value is satisfactory the speed of application makes it evident that this method is vastly superior to the ordinary method of hand painting, particularly for the shop coat on structural steel.

Typhoid in the Expeditionary Forces of the American Army

Began to Appear During Offensive Early in November, Due to Extraordinary Exposure—Death Rate Not Unusual

By George A. Soper

Major, Sanitary Corps, United States Army, Office of the Surgeon General, Washington, D. C.

After having been practically eliminated as a cause of disability in the United States Army, typhoid fever has recently made its appearance in the Expeditionary Forces under circumstances of broad, instructive interest. How the typhoid rate was reduced from its high place a generation ago nearly to zero and kept there during the mobilization of our troops in the present war, need not be repeated here. In the permanent American camps, sanitation, particularly as regards water-supplies and sewage disposal, together with vaccination, had eliminated the disease as a cause of anxiety. This dual method of control had proved entirely satisfactory. Its results may be said to represent an ideal toward which American cities and towns should aspire.

Army experience before and since the outbreak in France shows that these two procedures of sanitation and administration are necessary and sufficient in order to control typhoid.

Tyhpoid began to appear in the Expeditionary Forces during the offensive early in November. When, in the fighting in the Argonne, men became very thirsty, they sometimes disregarded their instructions and drank from forbidden, polluted sources. These men were protected against ordinary exposure to typhoid, but they were not, and could not, be made proof against the mass attacks of the heavily infected water.

The conditions which were encountered in the Argonne advance were repeated with certain variations elsewhere. For example, at Nevers tap water, forbidden for anything but industrial purposes, caused fifty or sixty cases. Much the same is to be said of Joinville (Haute Marne). Contact infection accounted for some of the cases which occurred among the personnel attached to hospitals and for the same reason: The danger was wholly unexpected and the dosage was excessive.

It is curious to observe that the rarity of typhoid contributed materially to its spread. Trusting implicitly to the safety afforded by vaccination, in spite of warnings that it does not afford unlimited protection under all circumstances, the thought of typhoid, the measures to be taken to prevent it, and the clinical recognition of the disease, had been banished from the minds of many medical officers.

The early cases which occurred were, therefore, not always promptly recognized, and the necessary steps to prevent contact infection were not always taken. And after it had begun to spread, the typhoid proved no

CASES OF TYPHOID AND PARATYPHOID IN THE AMERICAN EXPEDITIONARY FORCES, FRANCE

Week Ended	Typhoid Weekly	Typhoid Monthly	Paratyphoid Weekly	Paratyphoid Monthly	Total Monthly
Oct. 3	17	...	10	..	....
Oct. 10	1	...	4	..	....
Oct. 17	9	...	1	..	....
Oct. 24	7	...	1	..	....
Oct. 31	5	39	11	27	66
Nov. 7	10	...	11	..	....
Nov. 14	11	...	1	..	....
Nov. 21	24	...	6	..	....
Nov. 28	32	77	19	37	114
Dec. 5	22	...	10	..	....
Dec. 12	33	...	11	..	....
Dec. 19	62	...	15	..	....
Dec. 26	45	162	9	45	207
Jan. 2	46	...	6	..	....
Jan. 9	55	...	5	..	....
Jan. 16	63	...	14	..	....
Jan. 23	85		11		....
Jan. 30	69	318	12	48	366
Feb. 6	132		20		....
Feb. 13	93	225	13	33	258
Total	821	821	190	190	1,011

exception to the rule that epidemics when once started are extremely difficult to stop.

Although there have not been so very many cases in proportion to the great strength of troops employed, the typhoid has been widely distributed in the American Expeditionary Forces. Between Oct. 1 and Feb. 13, the total number of cases of both typhoid and paratyphoid reported was 1011, as shown in detail by the accompanying table. The death rate was not unusual.

The mean strength of the American Expeditionary Forces in France during this period may be taken as 1,833,000.

Cost of Ditches for Reclaiming Idaho Lands

Cultivated Ground Spoiled by Excess Irrigation Water Is Restored by Drainage—Caterpillar Electrically-Driven Excavators Used

By D. W. Cole

Formerly Project Manager, Boise Irrigation Project, United States Reclamation Service, Boise, Idaho

More than 120 miles of deep drainage ditches on the Boise irrigation project of the U. S. Reclamation Service have been excavated to remove excess water resulting from irrigation. As a result, excellent crops have been produced from land which five years ago were in swamp, but which formerly had been farms and orchards. Herein are presented some data on the general cost of the work.

This Idaho project includes about 143,000 acres of crop-bearing land, in addition to lower cultivated areas of about 100,000 acres in irrigation districts through which drainage waters must pass to reach the Boise River. About 17,000 acres of productive lands having become waterlogged or affected by seepage, the U. S. Reclamation Service, in coöperation with the irrigation districts, undertook to construct a drainage system for the relief of these lands and of adjoining lands into which the seepage was progressing. This work, begun about five years ago, has been completed. More than 5,000,000 cu.yd. of excavation have been made for 120 miles of drains averaging 9 ft. in depth, with a range of 6 to 12 ft.

More than 1600 structures were required, as these ditches traverse a highly improved farming country. Reinforced-concrete flumes carry the larger irrigation canals across the drains; metal and wood flumes serve for the lateral ditches. Large reinforced-concrete pipes are used as culverts in many places under highways, railways and canals. Numerous railway and tramway bridges were provided, and bridges for highways on nearly all section lines; and bridges of the same class were supplied for many farm crossings.

For determining the subsurface water conditions, numerous test pits and borings were located, and underground water contours were plotted. In conjunction with surface topography, these were employed for locating the drainage ditches for the greatest efficiency in tapping the subsurface waters. The entire area to be drained was practically underlaid with coarse gravel of an indefinite depth below the surface soils, 2 to 4 ft. deep.

Discharge of seepage water from the numerous drains ranges from 1 to 80 sec.-ft., according to the length of the drain and the tributary area. A group of the principal trunk drains discharged during 1916 approximately 224,000 acre-ft. of water, of which about 57% was seepage water, 28% surface run-off from irrigated fields, and 15% storm-water run-off in January and February.

Four electric dragline excavators mounted on caterpillars, with 50-ft. booms and 1½-yd. buckets, were the principal equipment. They operate on 440-volt alternating current, furnished at less than 1c. per kw.h. from the project's hydro-electric plant in the Boise River. Transmission line service at high voltage was obtained through contract with the Idaho Power Co., the branch lines at low voltage being installed temporarily by Government forces with the progress of each excavator. A central camp with an electric substation, a repair shop, an electric shop and all necessary accessories was maintained during the operation of the four excavators. The machine efficiency of the excavators is exhibited in one of the accompanying tables.

All four machines were operated in 1916, resulting in 2,660,465 cu.yd. of excavation in the total digging time of 17,732 hours, or 150 cu.yd. per hour per machine. With the rated 1¼-yd. capacity of the buckets this shows two buckets per minute as the average working rate of the machines. The material averaged 2 to 5 ft. of top soil with underlying heavy gravel, streaked with hardpan 4 to 8 ft. deep; occassionally a ridge of hard lava rock made blasting necessary.

Careful cost records were kept for each drain and

EFFICIENCY RECORDS OF ELECTRIC DRAGLINE EXCAVATORS ON DRAINAGE DITCH WORK IN IDAHO

A. Two Excavators: Nov. 16, 1913, to May 30, 1915

	Machine No. 1 Hours	Machine No. 1 Per Cent.	Machine No. 2 Hours	Machine No. 2 Per Cent.
Digging	7,642	75	7,533	73
Mechanical repairs	1,371	13	1,536	14
Electrical repairs	467	4	505	5
Moving	404	4	418	4
Power off	77	1	79	1
Blasting	284	3	314	3
Total	10,245	100	10,385	100
Yardage moved	884,222	...	884,504	...

B. Four Excavators for One Year (Each Working Three Shifts Daily Except on Sundays and Holidays)

	Hours	Per Cent.
Digging	17,732	51.0
Repairs	2,730	7.8
Moving up	1,486	4.3
Side drains and runways	592	1.7
Blasting	65	0.2
Power off	430	1.2
Sundays and holidays	3,968	11.5
Structures—laying tile	820	2.3
Breakdown	2,522	7.3
General moving	895	2.6
Substation fire	960	2.7
Moving substation	880	2.5
General repairing	1,696	4.9
Total	34,776	100.0
Machine idle (no work)	360	....
Grand total—full year, 4 machines, 24-hr. days	35,136	......

COST OF DRAINAGE OF NAMPA AND MERIDIAN DRAINAGE DISTRICT

Average depth	10 ft.
Base width	4 to 10 ft.
Slopes	2 to 1
Excavation	2,015,162 cu.yd.
Ditches	224,322 lin.ft.

	Total	Per Lin.Ft.	Per Cu.Yd.	Per Cent of Total
Investigation and surveys	$26,261	$0.116	$0.013	9.2
Excavation	126,751	.567	.063	44.3
Minor structures	43,758	.194	.022	15.4
Major structures	35,193	.157	.017	12.4
Rebuilding laterals destroyed by deep drains	15,231	.068	.008	5.3
Water rights	25,032	.112	.012	8.9
Right of way	12,723	.055	.006	4.5
Totals	$284,950	$1.269	$0.141	100.0

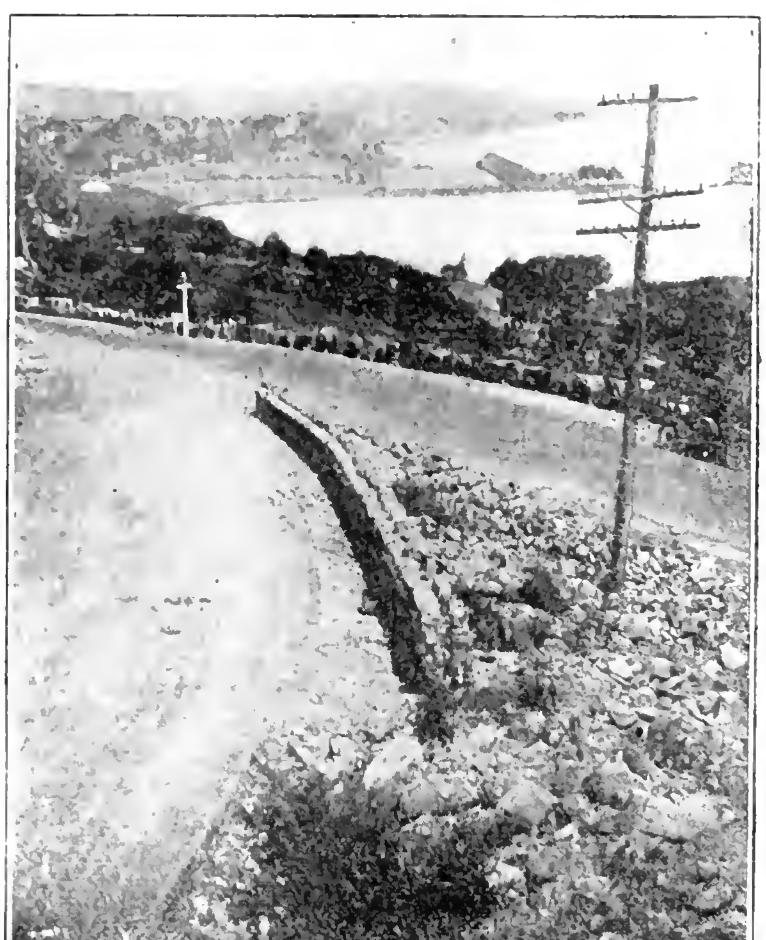
structure separately, and a full report has been compiled showing the length, depth and cubic contents of every drain and the elements of all its accessory structures, with total and unit costs. A tabulated summary with results for one of the three districts is given herewith. The total cost of the work complete was $615,000.

Elimination of Dangerous Road Junction and Its Cost

Deep Rock Cut and Fill Improve Conditions—Traffic Maintained by Sectional Building—Special Drainage System Installed

By Eugene Gedney
Nyack, N. Y.

ELIMINATION of a dangerous junction by the making of a deep rock cut on a connecting road and a deep fill on the main road, and the reduction of the grade of the connecting road from 18 to 10%, were effected on the Short Clove road which connects two highways near Haverstraw, Rockland County, N. Y. Considerable difficulty was experienced in the construction of this road, due to the very hard rock encountered and the trouble produced by numerous springs adjacent to and within the work. Inasmuch as traffic could not be interrupted on the main highway, the deep fill at the junction had to be built in sections, so that there would always be a driveway open.



NEW JUNCTION HAS CLEAR VIEW AND FAIR TURN

Short Clove road, which joins the main river route No. 3 of the New York State highway system, has a very sharp curve at the point of union. Coupled with this, the clear view was obstructed by a high rock ledge, and in the laying out of the new connection the main idea was to get a reasonably good junction with a fair grade and a clear view, and at minimum cost. After several schemes were discarded, it was decided to raise the grade of the main road approximately 10 ft., moving the junction of the two roads to the south about 75 ft. This created a short plateau 40 ft. wide, afforded an unobstructed view to travelers on both roads, and gave those coming from the south sufficient space to turn into the cross road, which was almost impossible before. A photograph of this new junction as constructed is shown.

SPILLWAY FROM SPRING PASSES INTO CATCHBASIN THROUGH DRY MASONRY WALL

The connecting road, which is only 1280 ft. long, is partly in rock cut from 5 to 25 ft. deep. Above this rock the geological formation changes to a soft clay and muck pocket about 300 ft. long and 3 to 18 ft. deep. Underlying the clay pocket there is a stratum of fine sand which contains many springs and considerable seepage water from the adjoining mountains. As soon as the clay stratum was cut through, the seepage and spring water began to run freely, at times nearly flooding the cut. The amount of water encountered is evidenced by the fact that one of the springs near the north edge of the roadway supplied at all times sufficient water for the contractor's steam boiler and other equipment.

To make these unstable soil conditions safe for a roadway, a 6-in. pipe underdrain was laid under the north ditch line and about 3 ft. below the pavement line. Under the south ditch line, where the seepage was less, a blind stone drain was placed. To facilitate drainage into these side drains, a sub-base foundation with porous filler, having a width of 20 ft. and a depth of 24 in., was laid for the full length of this unstable section.

Near the point where the road passes into the rock cut, and 60 ft. to the north, is an exceptionally large spring, for which it was necessary to provide drainage. A concrete apron was built down the side of the cut, and this was connected with the spring by a cement grouted cobble gutter, the drainage passing into a catchbasin in the gutter. This apron and catchbasin are shown in an illustration. The catchbasin is of special

construction and is drained across the roadway by means of an 18-in. pipe, connecting with a similar catchbasin on the other side. Into these catchbasins all drainage from above is carried. In one case it was necessary to form a basin for one of the springs in the middle of the road and lay a special drain from it into the catchbasin. From the catchbasin on the south side and passing through the rock cut, a 12-in. pipe underdrain was laid in a trench 2 ft. wide and 3 ft. deep and covered with crushed stone and small rock. The method of laying this drain is shown in a view (see next page). This drained into an open ditch at the far end of the cut.

Another difficulty encountered was the fact that the side slopes of the clay cut were so unstable that after every rain a part would slide in, blocking the ditches and some of the road. As a protection against these slides, the dry masonry wall, shown about the catchbasin, was built on both sides of the cut.

The rock excavation was also a rather difficult part of the job, as it was done in trap rock that was full of fissures. This made drilling very hard, the run of drill per nine-hour day ranging from 6 ft. to a maximum of 20 ft. On account of this, the contractor endeavored to get along with as little drilling as possible, spacing the holes about 6 ft. apart and drilling from 10 to 15 ft. in depth. It was always found necessary to drill lift holes beyond the bench holes. As the holes were spaced rather far apart, the contractor tried to get as much dynamite into them as possible, and for this purpose the holes were sprung by exploding small charges of dynamite at the bottom, thus enlarging their capacity. In this manner 40 to 50 lb. could be used in each hole.

Two Tons of Dynamite Used

The usual blast consisted of one row of four or five bench holes with about three lift holes 15 ft. back from the face. The average amount of rock loosened by one blast was from 200 to 225 cu.yd. It broke up in rather large pieces, many of them as large as a cubic yard, and the removal of these large stones was effected by means of stoneboats on which they were dragged to a point a short distance from the excavation. Data which were collected show that a total of 1600 lin.ft. of drilling was necessary, and that 4400 lb. of dynamite were used to remove approximately 4800 cu.yd. of rock; about 0.33 ft. of drilling and 0.9 lb. of dynamite for each cubic yard removed.

During the making of the fill upon the main road the contract called for keeping the road open for traffic. This fill was 10 ft. deep on the center line of the road and was 50 ft. deep on the east side, a dry masonry toe wall 5 ft. wide and 15 ft. high being built at its foot in order to prevent it from going upon the railroad property at the foot of the slope. This fill was used as a spoil bank. The method followed was to bring the fill even with the old road; then to build half of the fill up to the new grade, using the other half of the road for traffic; then to turn the traffic over the new fill and raise the other side. This method was found feasible, and traffic on the main road was uninterrupted.

The surfacing of the road consisted of a combination of bituminous and water-bound macadam 20 ft. wide, the middle 10 ft. being bituminous macadam, penetration method, while 5 ft. on either side was of water-bound construction. The water-bound macadam was adopted to take care of horse traffic, as it was thought that the other construction would be too slippery on a 10% grade.

CONSTRUCTION COSTS ON SHORT-CLOVE ROAD
NEW YORK STATE HIGHWAY DEPARTMENT

Earth Excavation	
Labor	
Superintendent, 50 days at $5 00	$250.00
Foreman, 80 days at $4.00	320.00
Common labor, 660 days at $2 75	1,815.00
Carts, 170 days at $3 50	595.00
Total labor	$2,980.00
Materials, small tools, incidentals	90.00
Cost of removing 4,200 cu.yd	$3,070.00
Cost per cubic yard	$0 73
Rock Excavation	
Labor	
Superintendent, 90 days at $5 00	$450.00
Foreman, 10 days at 4.00	40.00
Blacksmith, 60 days at 3.50	210.00
Drill runner, 176 days at 3 50	616.00
Drill helper, 143 days at 2 75	393.25
Total labor	$1,709 25
Materials	512.00
Depreciation of plant, small tools and incidentals	100 00
Total cost of drilling 1,600 lin.ft	$2,321 25
Cost per linear foot	$1 45
BLASTING AND DISPOSAL OF ROCK	
(Average haul 500 Feet)	
Labor	
Superintendent, 100 days at $5 00	$500.00
Foreman, 80 days at 4 00	320.00
Common labor, 1,100 days at 2 75	3,025.00
Teams, 150 days at 6 50	975.00
Carts, 200 days at 3 50	700.00
Total labor	$5,520 00
Materials and tools	
Dynamite (3000 lb. at 28c. and 1800 lb. at 35c.)	$1,470.00
Blasting caps, wire and incidentals	100.00
Small tools, etc	60.00
Total materials and tools	$1,630.00
Cost of blasting and disposal of 4,800 cu.yd	7,150.00
Cost per cu.yd	$1 49
Total cost of rock excavation	$9,471 25
Cost per cubic yard	$1 97
Macadam Surfacing	
Labor	
Superintendent, 15 days at $5 00	$75 00
Foreman, 15 days at 4 00	60 00
Common labor, 55 days at 3 00	165 00
Cart, 5 days at 3 50	17 50
Team, 3 days at 7 00	21 00
Steam roller, 15 days at 15.00	225 00
Incidentals	25 00
Cost of manipulation, 536 cu.yd	$588.50
Cost per cubic yard	$1 10
Materials	
Crushed stone, 850 tons at $2.50	$2,125.00
Tarvia-X binder, 4,740 gal. at 17c	805 80
Tarvia-B cold application (850 gal. at 17c.)	144 50
Filler for bottom course	25.00
Total for 536 cu.yd	$3,100 30
Cost per cubic yard	$5 78
Total cost of macadam per cubic yard	$6 88

On this 0.24 mile of roadway the material excavated amounted to about 9000 cu.yd. Itemized costs of the major items of the work are shown in the accompanying table. The equipment used consisted of one 25-hp. steam boiler, one steam drill, one jackhamer drill and the necessary small tools. The dump wagons, carts, steam roller, sprinkling carts, etc., were hired locally. Crushed stone for the macadam was furnished by the West Nyack quarries, and was hauled eight miles by five-ton motor-trucks. The bituminous material was furnished by the Barrett Co., and the price quoted covers applying. It was hauled about 35 miles in asbestos-covered auto tanks, and delivered at 275° Fahrenheit.

Work was started June 1917, shut down December. 1917, started again in March, 1918, and completed in August, the working time being approximately 300 days. It was impossible to run the job economically on account of the labor conditions due to the war. The large amount of coal used in drilling was due to the necessity.

VITRIFIED TILE DRAIN IS COVERED WITH STONE

of keeping up steam on days when the drill runner did not appear.

The construction was carried on under the Construction Department of the New York State Highway Department, H. E. Breed, first deputy highway commissioner, J. H. Sturdevant, division engineer, and the writer as engineer in charge. Eugene Cavallo, of Haverstraw, N. Y., was the contractor.

Move Equipment and Material for Dam Through Small Tunnel

In Building Dam Everything Had To Go Through 42 x 48-Inch Section of Santa Barbara Water Conduit Then in Service

BUILDING the Gibraltar Dam for the City of Santa Barbara, Calif., involved the unique problem of getting all equipment, materials and supplies through a tunnel four miles long which has a clearance of only 42 x 48 in. The tunnel was built some years ago for the city water-supply. This supply could not be interrupted, so there was always a depth of 12 to 18 in. of water in the tunnel to contend with, not to mention the continuous downpour from the roof in many places. On account of difficulties encountered in driving the tunnel, its alignment is not good. It is lined with concrete for part of its length, the remainder being irregular rock section. The problem of transportation through the tunnel has been effectively worked out, however, and in the first three months of the construction period 15,000 cu.yd. of concrete was poured with but little delay on account of tunnel difficulties.

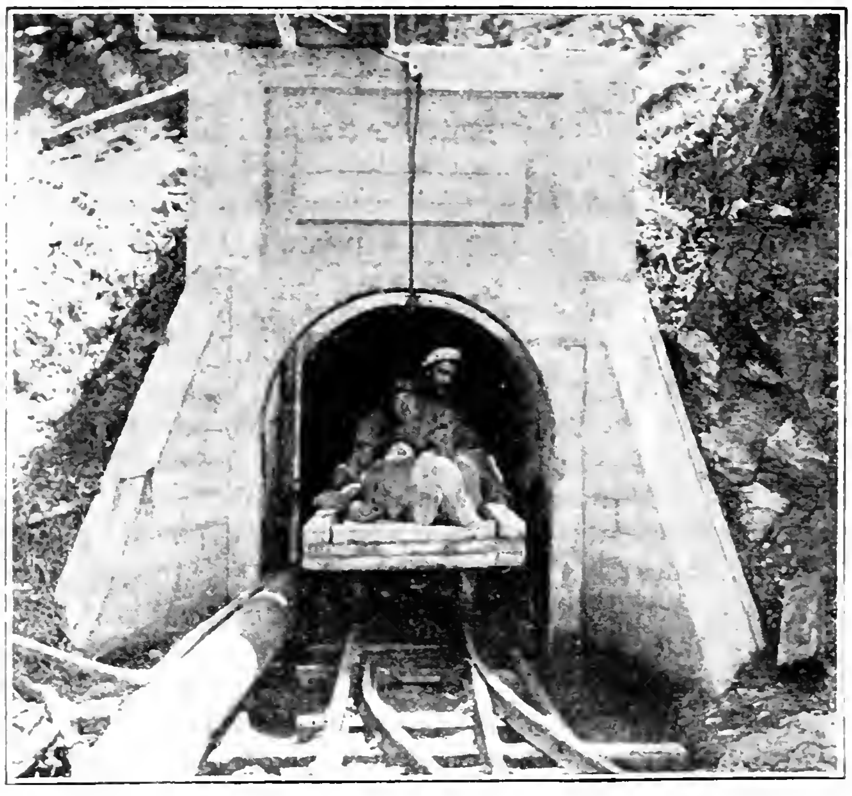
Rails were laid and a 220-volt trolley line was strung through the tunnel so trains could be operated electrically, but in order to secure the maximum clearance mentioned large pieces such as motors, steam-shovel boilers, and other equipment that could not be cut apart, had to be taken through on a special "low" car which was pushed through by hand, a trip that required from 9 to 11 hours. The operation of the tunnel railway is under the direction of the City of Santa Barbara, the cost to the contractor being $2 per ton laid down beneath the aërial cableway near the dam, 2000 ft. upstream from the tunnel.

Trains are operated through the tunnel for 16 hours out of each 24, there being two 8-hour shifts on each train crew. There are four locomotives, one considered a spare, so it is expected that three trains will be in service continually. It is expected that one of these will be loading or unloading while the others are going and coming. A siding was provided midway in the tunnel, so trains ordinarily pass at this point. The time required for a round trip is about an hour. With three trains, allowing for time of loading and unloading, there should be therefore a trainload delivery at destination every 30 minutes.

Cement is taken through in three-car trains, the load being 51 sacks per car. Each car is covered with heavy tarpaulin for protection from the leakage in the tunnel and the splashing from the car trucks. The cement is not unloaded from these cars at the railway terminal, the cars being picked up bodily from the rails by the cableway carrier and hoisted across the gorge to an eminence at one end of the dam.

Between July 9, when the contract was signed, and Sept. 1, when the first concrete was poured, there went through the tunnel piece by piece two 1-cu.yd. mixers, six electric hoists, rock screens, skips, hoppers and a steam shovel which the contractor had selected with an eye to the fact that the boiler would just meet the tunnel clearance requirements. Between shipments of all this equipment there were also handled through the tunnel 40,000 sacks of cement and 275,000 ft. b.m. of lumber. By reason of this expeditious delivery the contractor was able to pour 15,000 cu.yd. of concrete in the first three months; sometimes a day's run was as high as 420 cubic yards.

Getting the larger equipment through the tunnel meant using an oxyacetylene torch to cut each machine to pieces and, after the pieces were delivered at destination, welding them together again with a similar oxyacetylene apparatus. Perhaps the largest welding job was on the big concrete mixers whose mixing chambers were cut neatly in half and successfully welded again at the site of the dam. In fact, of the two mixers that were sent through the contractor finished with one and cut it apart again, and after it had been returned to Santa



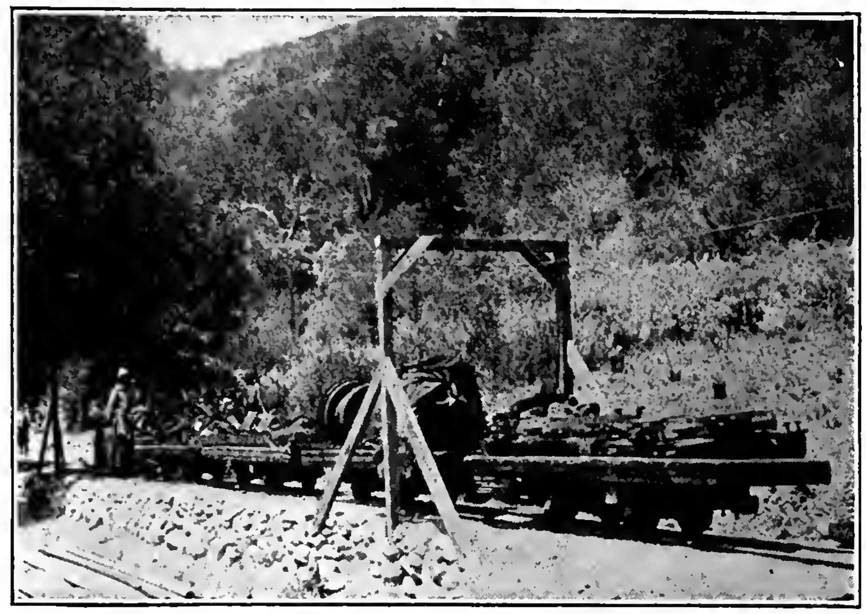
PORTAL OF 4-MILE TUNNEL THROUGH WHICH PASSED ALL MATERIAL AND EQUIPMENT

Barbara it was welded up for the second time and was then still in first-class condition.

The largest assembly job was that of putting together a steam shovel. The miscellaneous collection of machinery had all the general appearance of a wreck. The boiler had to go through intact, but practically all the other large parts were dismantled. The platform and turntable were taken apart, and even the teeth were taken off the bucket. Approximately 1000 rivets were cut out in dismounting the shovel and later put back at the dam.

Special tank cars were built for conveying fuel oil through the tunnel, as the city refused to run the risk of possible leakage into the water-supply system from oil transported in barrels. Dynamite the city absolutely refused to permit in the tunnel, so this had to go by pack horse over a long, rough trail. The work was closed down for the winter in December, but it is expected that it will be completed early this year.

Quinton, Code & Hill are consulting engineers on the work. The contract is being carried out by Bent Bros.



CONSTRUCTION MACHINERY ON WAY TO DAM

and W. A. Kraner, the latter being in personal charge of the work. E. E. Haskell is resident engineer for the city.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Deterioration of Burlap in Waterproofing

Sir—The communication in your issue of Feb. 27, 1919, p. 440, by J. B. W. Gardiner, on "Deterioration of Burlap in Waterproofing," comes to me as a considerable surprise. Mr. Gardiner states "reference to any standard work on industrial organic chemistry will show . . . that it is the most perishable of all vegetable fibers; that even the small amount of moisture in the air will cause it to deteriorate very rapidly, and, finally, that this rate of deterioration is greatly increased where the moisture carries alkali."

This is great news to me. I should like to get a list of the standard works on industrial organic chemistry that make this statement; I should like to know why it is that ever since linoleum and floor oilcloth have been invented burlap has been used as the foundation for the manufacture of this important product. I should like to know why burlap when used in floor coverings does not rot or deteriorate even if water soaks in between the seams, and I should also like to know why the sandbags used in Europe during the great war for the protection of buildings, particularly, and for the protection of the parapets of trenches, stood up so thoroughly and completely even though they were soaked with rain and mud, and the burlap bags served a remarkably useful purpose.

Furthermore, I should like to know by what process of reason or chemistry cellulose fibers are attacked by weak alkali. I know from my own experience that the animal fibers like wool are attacked by alkalies, and vegetable fibers like cotton or flax resist alkali; in fact, the well known method of the analysis of wool which is mixed with cotton or cellulose fiber is to apply the caustic alkali test. It is also very well known that the method of separating wool from cotton is with a weak solution which attacks the cotton and leaves the wool intact.

The oxides of sulphur generated in many of the waterproofing materials in conjunction with moisture are known to rot burlap or cotton, and if a waterproofing material is made which resists the action of water so sulphur acids are not generated, burlap will stand up as well as anything else.

I have no desire to take issue with anyone on this, but it is obvious that there are certain waterproofing materials which are unsuitable with burlap because inherently the waterproofing materials are not adaptable. MAXIMILIAN TOCH.

New York City.

[The foregoing letter was referred to Mr. Gardiner for his comment, which follows.—EDITOR.]

Sir—Referring to the communication of Dr. Maximilian Toch, I feel flattered that I have given Dr. Toch such great news. In "Industrial Organic Chemistry," by Samuel P. Sadtler, published in 1912, we find, on pp. 307 and 308, the following statement:

"Chemically, jute differs from the bast fibers hitherto mentioned (i.e., flax and hemp) in that it contains no free cellulose but consists of a chemical compound of cellulose with lignin."

This fact Dr. Toch has overlooked and has assumed that the jute fiber contains free cellulose. It is, of course, a fact that weak alkali solutions do not attack cellulose, which is one of the main reasons why a cotton fabric, which is almost pure cellulose, is superior as a waterproofing membrane to a jute fabric. But to continue the quotation from Professor Sadtler:

"It is much more easily affected by the action of acids and alkalies than flax or hemp. The influence of air and moisture will also rot the jute fiber. It cannot be bleached safely with chloride of lime because of the readiness with which the fiber is oxidized."

Again, in the "Manual of Chemical Technology," by Rudolph von Wagner, published in 1904, we find on p. 811 the following, referring to jute:

"It is not a material adapted for purposes of nautical application as it has not sufficient firmness to withstand water."

And in J. Merritt Matthews' "Textile Fibers," on pp. 405 and 406, we find that "the chief defect of jute is its lack of durability; when exposed to dampness it rapidly deteriorates." Also, "Jute is also more sensitive to the action of chemicals in general than cotton or linen. . . . Treatment with alkalies . . . weakens and disintegrates the fiber to a considerable extent."

I might go on indefinitely with similar quotations, but when it is appreciated that we are not dealing with free cellulose at all but with a new compound with essentially different characteristics, it would seem unnecessary. The susceptibility of burlap, which is a jute fabric, to air, water and alkalies having been settled, the only question remaining is this:

Is it logical to place in the very heart of a waterproofing system and as an essential part of it a material which, it is known, will be destroyed by contact with those elements against which it is designed to give protection? J. B. W. GARDINER.

New York City.

More Light on Engineering Compensation

Sir:—Since you published my letter on engineering education and compensation on March 6 (p. 482) I have received a number of letters asking my opinion of the proper compensation to be paid to draftsmen on various classes of designs, and to surveyors, instrumentmen, chiefs of parties, and the like. This fair rate of compensation manifestly lies somewhere between what the meanest employer is willing to pay and the largest amount a man engaged in the work—and skilled in it—honestly thinks it is worth. It varies in different sections of the country and in different years. Several attempts have recently been made to fix such compensation, by engineering organizations. The recommendations I have seen are fair averages of what I am told are the rates for the most competent men in their respective classes. It is doubtful, however, that recommendations made by the employing class alone will ever be accepted as satisfactory by employees.

My letter of Mar. 6 did not discuss the actual amount of compensation paid today to employees of engineering offices. It dwelt entirely on the relation between the years of study and the expense of the education, and the very moderate salaries which large numbers of young men find to have come to them after such study and expense. There is little if anything about the study of higher mathematics, chemistry, physics, the strength of materials or the stresses in long-span bridges which fits the student of them to be better citizens, and consequently the value of the education must lie in the increased earning power of the person who completes the four-year undergraduate technical course of instruction in these and related subjects.

The information I have collected concerning the compensation of graduates of five or more years' experience in earning their living with the help of their technical studies has raised a doubt in my mind regarding the value of much of the undergraduate instruction, for many of the students. Is a four-year course of study which does not insure more than $1800 after five years and not more than $2500 after ten years necessary or even desirable, except for those whose circumstances are such that the education imposes no hardship on the family of the student? Would it not be far better to give a short, thorough course in those subjects every civil engineer must know and then, after actual experience has shown the young man in what direction he desires to acquire special knowledge, let him come back for special instruction in subjects of restricted interest necessary only to specialists?

Upper Montclair, N. J. JOHN M. GOODELL.

How Were Cost-Plus Contracts Obtained?

Sir—In your issue of Mar. 6, 1919, p. 485, is a communication from J. B. Chaffey, major, Quartermaster Corps, U. S. A., Fort Sill, Oklahoma. He descants upon the beauties of cost-plus contracts. What especially interests me he does not touch upon—that is, how to get one. I am a contractor and tried hard during the war to get a cost-plus contract, not only in construction, but also in spruce production. What I received was a polite bowing out. I could not find any way at all to break in.

I might mention that I am not at all a politician, not a Democrat, and have no pull of any kind. I have tried hard to find how to get these good things, and for the life of me can't find anyone who will point the way; so if the major will tell how these contracts can be had I would greatly appreciate it.

I was never fortunate enough to get a chance to look into the vitals of one of the cost-plus contracts, so could not criticise them, and have an idea that if I were a supervising engineer and had a friend that I wanted to see make money and be absolutely safe I would work him in, but in an ordinary contract the less "force-account" work an honest contractor has the better off he is, so I am sure the Government cost-plus is a great improvement on the usual "force-account" of civilian engineers.

There has been advanced a form of cost-plus contract in which there is competitive bidding and which extends a margin of safety, though not a limitless margin, that I wish engineers would pay more attention to—a much better plan than that adopted by the Massachusetts Highway Commission, I think. It is the sliding scale of profit and division between contractor and contractee. E. T. JOHNSON.

Portland, Ore.

[The plan of the Massachusetts Highway Commission referred to in the foregoing letter was published in *Engineering News-Record* of July 26, 1917, p. 172.—EDITOR.]

Chicago Engineers Endorse Labor Bureau Employment Service

Sir—In your issue of Feb. 13, p. 328, appeared an article by C. E. Drayer, secretary of the American Association of Engineers, attacking the activities, or lack of them, of the General Committee of Technical Societies of Chicago, more especially along the lines of employment service.

Mr. Drayer puts the case very positively; namely, that there were but two courses open to the General Committee—to get behind the employment service of either the American Association of Engineers or of the Professional and Special Section of the United States Employment Service, Department of Labor. The committee is quite in accord with Mr. Drayer to this extent. It finds that the United States Employment Service is being run with great intelligence and skill under the direction of trained engineers and technical men, giving valuable service absolutely free of charge

to all technically trained people who are out of employment, either returning soldiers or those who may be out of work for any other reason. On the other hand, they find that applicants to the employment service of the American Association, before they are registered for a position, must pay $6 and sign an application for membership in the association, and before they receive a chance for a position must pay $10 additional, or $16 total, upon election to the association. This payment is waived for a period for men in uniform.

With the above situation in mind, the committee which represents a number of technical societies and is interested in the welfare of technical men regardless of their society affiliations, decided that the free service of the United States Labor Bureau was what they should endorse and work with rather than the paid service that carried with it the propaganda of one society alone.

FREDERICK K. COPELAND,
Chairman, General Committee of
Technical Societies of Chicago.
Chicago, Ill.

Canal Seepage, Temperature and Evaporation

Sir—In the article on "Canal Seepage Losses Are Affected by Temperature," by Lynn Crandall, in *Engineering News-Record* of Feb. 13, 1919, p, 323, no mention is made of the loss of water by evaporation. The loss over the entire canal system of 2600 acres of water surface is computed from daily records of use and supply, and is called seepage. The loss thus computed is the sum of two losses: (1) That which seeps into the ground through the wetted perimeter and (2) that which is evaporated from the water surface. It is well known that the rate of evaporation from a water surface increases rapidly with increase in temperature —it may be 100% greater during July than during April. Therefore, to study the effect of temperature on the loss due to seepage, the loss due to evaporation should first be measured and eliminated. E. C. MURPHY.

Napa, Calif.

[To the foregoing letter the following reply has been received.—EDITOR.]

Sir—In reply to Mr. Murphy's inquiry regarding evaporation losses, I would say that these losses are such a small percentage of the seepage losses in irrigation canals under normal conditions that it is generally customary to consider them as part of the total loss, which for convenience is usually called "seepage."

The evaporation losses become more important in the studies of water requirements of plants where relatively large areas of moistened soil in the fields are subject to evaporation, and in reservoir storage projects, but they are of minor importance only in the study of canal losses in earth formation.

A United States Weather Bureau Class A evaporation station has been maintained at Jerome in connection with the hydrometric studies. The following are the observed amounts of evaporation in inches during the 1917 irrigation season: April, 4.23; May, 6.40; June, 9.17; July, 8.20; August, 7.03; September, 3.60; total, 38.63.

The relation between evaporation from floating pans in canals of average size and evaporation from pans on the ground, given above, varied from 65% to 72%, averaging 68%, during the irrigation season. The evaporation from the floating pans, corresponding to the 38.63 in. from the ground pan, was 26.2 in. for the season.

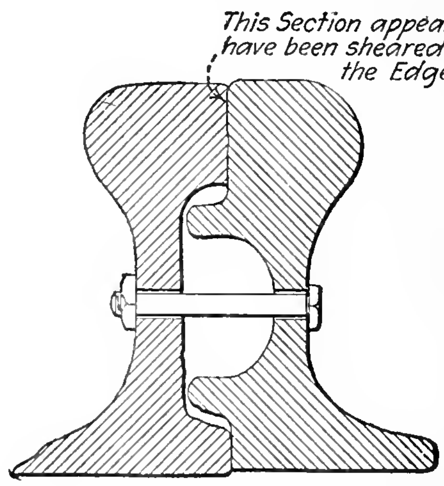
The total loss during the 1917 season due to seepage and evaporation averaged 0.70 ft. depth per day over the water surface area in the canal system, or a total for the six months' season of 128 ft. in depth. The loss due to evaporation is accordingly only 1.7% of the total loss—or, in other words, the seepage loss in three days is equivalent to the evaporation loss during the entire six months' season.

The larger loss with increasing temperature is due to the fact, not always fully appreciated, that water moves through soil more readily when warm than when cold. This has been brought out by Allen Hazen in the development of his formula on ground-water flow, and by Prof. C. S. Schlichter in Water Supply Paper No. 140 on the "Rate of Movement of Underground Waters" (United States Geological Survey).

Jerome, Idaho. LYNN CRANDALL.

More Peculiar Railroad Rail Sections

Sir—The diagram reproduced here was taken from a paper-weight which has been in the real estate office of the Baltimore & Ohio R.R., for years, and may be of interest in connection with the peculiar sections



shown in your issue of Feb. 27, 1919, p. 441. The bolt was probably put in simply to hold the parts in place.

No one here seems to know where these rail sections originally came from. W. H. McLAUCHLAN.

Baltimore, Md.

Wider Pavements Needed by Motor Vehicles at Curves

Sir—The article by G. S. Eaton on "Wider Pavements Needed by Motor Vehicles at Curves," in *Engineering News-Record* of Mar. 6, 1919, p. 461, is both interesting and exceedingly timely. It marks, I believe, a step in the direction of substituting scientific analyses of such problems for "rule-of-thumb" methods—a thing long needed in highway work.

It will be noted that the analysis as given is for the trace lines of the wheels and is of course satisfactory for single-track roads. For double-track roads, however, it should be noted that the fender clearance lines and not the wheel trace should be used. For the vehicle on the inside of the curve, this can be determined by the formula with sufficient accuracy if $R_1 + B$ is made to equal the distance from the center to the outer face of the fender, and L the distance from the center of the rear wheel to the front end of the fender. Sufficient

clearance must then be allowed to the inside wheel trace of the vehicle on the outside of the curve, and then the formula giving the radius of the outer wheel trace can be used. Some measurements of my own on a truck with a wheel-base of 13½ ft. show that, on a curve with an inside radius of 40 ft., nearly 9 in. more width is required to the fender line than to the wheel trace.

Incidentally, it might be noted that, where the quantities are odd, the trigonometric method of solving a right triangle is invariably faster and less subject to error than the "square root of the sum of the squares" method. In a case of this kind the "correction method" is even more suitable, and the formula is much simpler to use and sufficiently accurate in the form:

$$R_2 = R_1 + B + \frac{L^2}{2(R_1 + B)}$$

C. C. WILEY.
Associate, Civil Engineering Department,
Urbana, Ill. University of Illinois.

Gas Plant Wastes and City Water

Sir—The article by H. P. Bohmann, on "Obnoxious Tastes in Milwaukee Water" in *Engineering News-Record*, of Jan. 23, 1919, p. 181, reminds the writer of a similar experience encountered several years ago. The Quincy water-works office had always received occasional complaints regarding the water. Many of these complaints were due to sudden changes in the character of the water at the source of supply, the Mississippi River. Others were probably due to algæ growths in the storage reservoir. But in 1911 complaints of a medicinal taste in the water began to come in. Some of the persons entering complaints described the taste as being similar to that of carbolic acid; others thought it was creosote and still others mentioned iodoform and ammonia.

These complaints were not of daily occurrence. They were received at intervals of a month or six weeks. When they came, several were usually received within a few minutes, but by the time an inspector could get to the source of the complaints the trouble was practically over. It soon became evident, however, that these complaints began in the vicinity of the gas plant and followed the direction of flow of the water in the mains from the gas plant to the city limits. No complaints were received from the consumers living along the 10 blocks of mains lying between the pumping station and the gas plant.

An examination of the check valve on the 2-in. water service running into the gas works revealed the fact that something more corrosive than city water was getting through it. It was no longer a check valve, and it was very evident that gas-house liquids might be forced or drawn into the water mains at any time by the simple process of shutting off the water pressure in the district at the gas plant. Two check valves were inserted tandem in the service pipe, in 1912, and there has been no recurrence of the trouble.

At the time this trouble developed the Quincy water-supply was not sterilized. When the source of the taste was finally located, hypochlorite was being used. This would indicate that the addition of chlorine is not necessary to develop the obnoxious taste from gas-house waste.

W. R. GELSTON,
Quincy, Ill. Superintendent Water Department.

History and Use of the Manning Formula

Sir—On reading the letter by H. R. Leach and R. E. Horton on the Manning formula, in *Engineering News-Record* of Mar. 13, 1919, p. 536, it occurs to me that American engineers generally are not very familiar with that formula. Accordingly, I submit the following notes on the history and purpose of the Manning formula:

Before the publication of Parker's "Control of Water," the so-called Manning formula for open channels was not generally known to American engineers. It has, however, been used by English engineers, to some extent, in India, Australia and Egypt, during the past 20 years. It is mentioned in "Elementary Hydraulics," by Sir William Willcocks, 1899, and in Flamant's "Hydraulique," of about the same date. Buckley's "Irrigation Pocket Book" (second edition, 1913), contains an interesting discussion of the relation between Kutter's and Manning's [illegible]

It is interesting to note that the Manning formula apparently never was written by Manning in the form now used. Manning's investigation (Trans. Inst. C. E. of Ireland, Vol. XX, 1891) resulted in the derivation of an open-channel formula which has now little more than historical interest. The formula which is now used and bears Manning's name appears to be simply the result of a casual observation.

As a step in the derivation of the formula which he recommended, Manning investigated the formula $v = cr^{\frac{2}{3}} s^{\frac{1}{2}}$, and noted that the value of c (with the formula expressed in metric units) appeared to be very nearly equal to the reciprocal of Kutter's n. He did not, however, write the formula in the obvious form $v = \frac{1}{n} r^{\frac{2}{3}} s^{\frac{1}{2}}$, in which n is to be given the same value as n in Kutter's formula. This is what is now generally known as the Manning formula expressed in metric units. Expressed in English units the formula becomes,

$$v = \frac{1.486}{n} r^{\frac{2}{3}} s^{\frac{1}{2}}$$

The advantages claimed for the Manning formula are chiefly those of simplicity. Results obtained by using this formula agree very closely with those obtained with the Kutter formula, and those engineers who think of open channels in terms of Kutter's n may shift to a simpler formula without familiarizing themselves with a new set of coefficients and, it is asserted, without making any sacrifice in accuracy.

HORACE W. KING,
Professor of Hydraulic Engineering.
University of Michigan, Ann Arbor.

Water Treatment in Detroit Effective

Two pounds of liquid chlorine per 1,000,000 gal., costing Detroit 33⅓c. per 1,000,000 gal., reduced the gelatin 20-deg. bacterial count on the average from 213.7 to 10.6 per cubic centimeter. B. coli in 1 c.c. in the river water was found on six days, or 17 times in 772 tests. In 10-c.c. portions positive reactions were obtained on 178 days, or 642 times in 3860 tests. None was found in the treated water in 1-c.c. samples out of 775 tests, but in 10-c.c. samples the tests were positive on 22 days, or 23 times out of 3875 tests.

Hints for the Contractor

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Cafeteria Plan Cuts Time of Serving Meals in Camp Mess

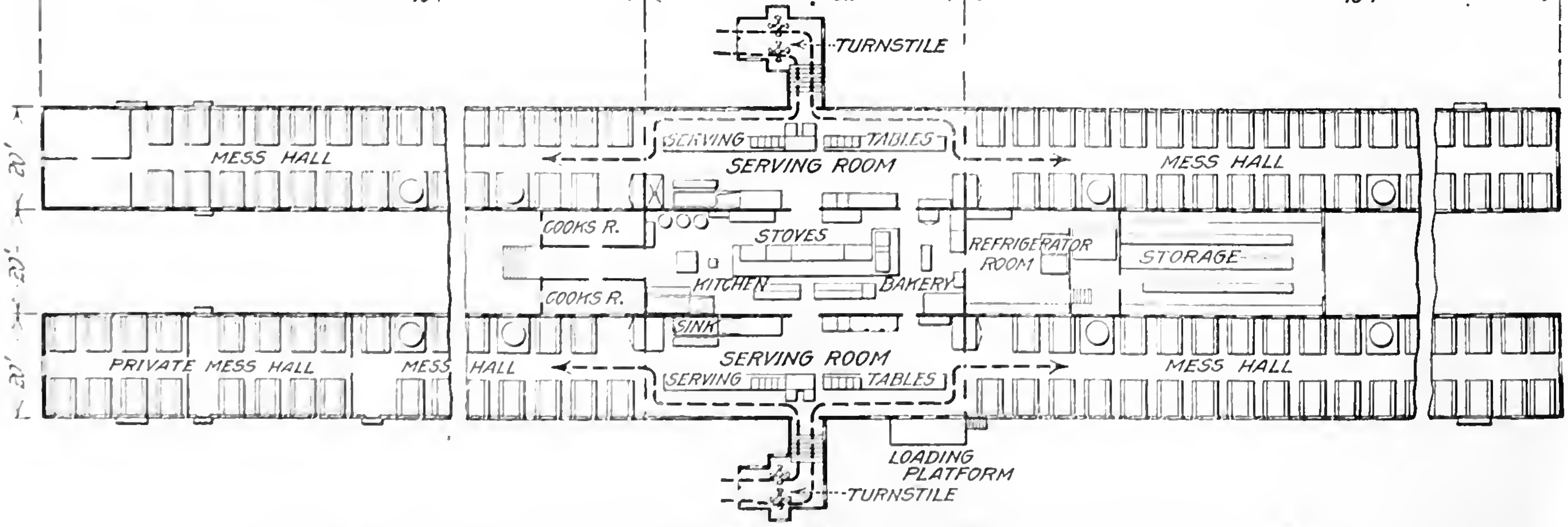
MESS-HALL arrangement and cafeteria service made possible the serving of meals in 25 min. to 1360 men constructing the extension to Camp Custer, Michigan. From Oct. 6 to Dec. 31, 1918, a total of 161,609 meals was served at a cost to the workmen of 33½c. per meal. The actual cost of each meal was 30.8c.; the remainder was profit. To accommodate the construction force, four regulation Army mess halls were connected, as shown by the drawing, using temporary construction consisting of two serving rooms and a kitchen. The meats and vegetables, when prepared, were put in copper steamers and removed from the kitchen to the steam tables, in the serving room, where they were kept hot for serving. There was one central entrance to each serving room, and the steam tables were located on either side of the two entrances. The workers passed in two lines through the turnstiles and into each serving room. At the tray and plate tables, directly opposite the entrance, the lines separated, turning to the north and south wings, and as the men passed along the steam tables they were served with meat, potatoes and two other vegetables. At the adjoining tables they received dessert, coffee, knives, forks and spoons. Then, continuing in formations, they filed into the mess halls and seated themselves at the tables. The bread and butter were served on the tables and, with this exception, it required only 25 min. for serving the food for 1360 persons, the total capacity of the four mess halls. The number of waiters depended entirely upon the number of meals served. When the noonday meals averaged 1300 daily there were two waiters stationed in each mess hall and seven at each set of serving tables, making a total of 36. During the week of Nov. 8 to 14, inclusive, when 17,859 meals were served, the mess hall force consisted of one manager, two assistant managers, two bakers, one bakers' helper, six cooks, three vegetable men, 38 waiters, seven dishwashers, four scrubmen, three laborers, one ticket seller, four checkers, three exit men and one storekeeper.

The construction of the extension to Camp Custer was under the direction of Maj. T. A. Leisen, constructing quartermaster, and Samuel A. Greeley, supervising engineer. The W. E. Wood Co., Detroit, Mich., was the general contractor. M. D. Kauffman was division engineer in charge of sanitation. In last week's issue of *Engineering News-Record*, p. 619, Mr. Kauffman told how the sanitary service rid the extension to Camp Custer of influenza.

Other Articles in This Issue of Interest to Contractors:

Saucer-Topped Garbage Table Prevents Spattering

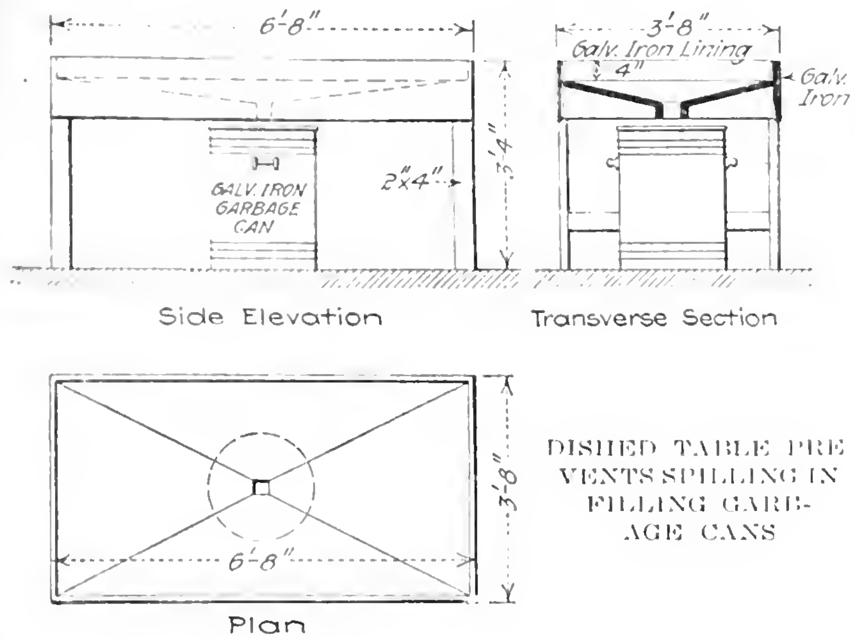
CLEANLY handling of garbage in a construction camp mess hall for the workmen building the extension to Camp Custer, Michigan, was made easy by dished tables and covered cans. The dished top of the garbage table was sheeted smoothly with galvanized iron. Through an opening in the center the garbage fell into the garbage can, which was of a height to fit closely under the table and thus prevent spattering.



FOUR MESS HALLS SUPPLIED FROM COMMON KITCHEN AND SERVING ROOMS

The dash lines indicate the lines of travel of workmen through the turnstiles, past the serving tables, to places in the mess halls

Each can held 40 gal. When filled it was covered and moved to the loading platform outside the kitchen. From here the cans were loaded into wagons designed to hold 15 cans, and were hauled to the garbage burying ground. The dished, iron-covered top of the table



DISHED TABLE PREVENTS SPILLING IN FILLING GARBAGE CANS

made washing and scouring easy, and was large and deep enough to eliminate spattering unless the kitchen help was grossly careless in the handling of the camp garbage. The names of the officials in charge of the camp are given in the preceding page, in the article describing the cafeteria plan of serving meals there.

Derrick With Drop Weight Wrecks Old Concrete Building

WRECKING a reinforced-concrete structure by means of a drop hammer, acetylene torches and cables was work required in the removal of part of the old National Guard armory in Minneapolis, Minn., in 1918. This proved a difficult task, owing to the great thickness and density of the concrete. Some of the floor slabs were nearly 2 ft. thick, and it is stated that concrete seemed to have been poured in to level up the floors in some parts. In the main hall the floor was 14 in. thick.

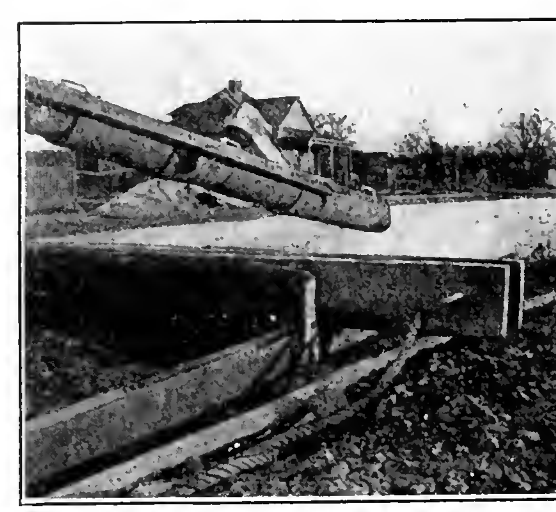
For breaking up the floors, a stiffleg derrick with a 20-hp. engine was installed, handling a 2600-lb. drop weight. At first an ordinary pile hammer was used as the weight, but this proved unsatisfactory, as it cut the wire strands of the cable. A pear-shaped drop was substituted, therefore, and was similar to the drop used in the wrecking of a Chicago building, as described in *Engineering News-Record* of Dec. 27, 1917, p. 1208. The Minneapolis derrick had a 40-ft. mast and a 60-ft. boom, using a drop of about 20 ft. as a rule, although at times this was increased to 40 ft. This machine was stationed first on the top story, so that it could break down the roof and then the floor, being shifted over the floor as required. It was then moved down to the lower floors, successively. Blows were concentrated at the center of the panel whenever convenient, but this plan could not be followed generally, as the work had to be done in such a manner that the vibration would not affect the remainder of the building, which has a large auditorium with the front part of the roof carried by a 160-ft. steel truss. The lower portion of this truss was connected to the slab which had to be broken down in the adjacent part of the building, so that special care was necessary to prevent damage to the truss.

Concrete girders were either broken by the drop hammer or pulled down by slings and the cable of the hoisting engine. Most of them were pulled down and then broken up on the floor by the drop weight, these blows also helping to break the floor slab. Concrete columns were pulled down and broken in the same way. An acetylene torch was used in cutting the reinforcing bars. The débris was wheeled to a chute ending in a large bin from which the wagons were loaded, the loading being done in this way in about two minutes.

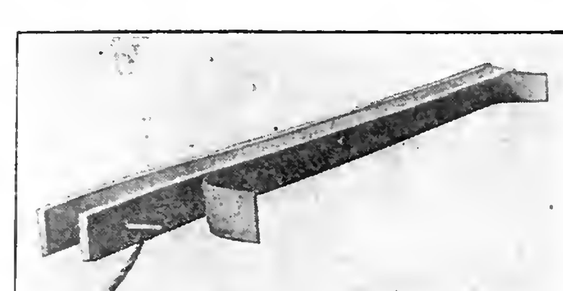
Dynamite was necessary to blow up the brick arch over the main entrance, as this work was done after the derrick had been removed and hand labor was too slow. The wrecking of this part of the building and the erection of a lighter structure to replace it was done by the Cleveland Wrecking & Contracting Co., Minneapolis, Minn.

Curved Steel End Plates for Concrete Screed Prevent Waste

TO PREVENT the concrete which piles up in front of a screed on a concrete paving job from wasting over the sides as the screed is pulled back and forth, the Merrill Road Improvement Co., of Chattanooga, Tenn., has devised a curved steel plate, which is fastened to the screed, and projects out in front of it. With one of these plates at each end of the screed, the surplus concrete at the edges is dragged toward the center of the pavement each time the screed moves from side to side. Another feature is the method of operating the screed. At each end is a steel rod by which the screed is pulled back and forth, and a rope by which it is pulled forward. This arrangement is a good one for getting good screeding, as the men who pull back and forth do not pull forward, and the men who pull forward cannot push backward. This gives a steadily forward motion, and eliminates the possible backward movement which causes poor screeding. The pictures were taken on Government road work between Fort Oglethorpe, Georgia, and Chattanooga. Tenn. Maj. P. M. Ripley is constructing quartermaster, under whom W. L. Dodds is engineer in charge.



SCREED OPERATED BY ROD AND ROPE



BENT PLANK ATTACHED TO SCREED

NEWS OF THE WEEK

April 3, 1919

Hurley Submits a Plan for Steel Ship Operation

Would Sell Vessels at Market Price but Retain Control for a Limited Period Through Mortgage

Chairman E. N. Hurley of the United States Shipping Board announced in a speech in New York last week a proposed plan for the future control and operation of the ships which have been built under the auspices of the United States Shipping Board. Briefly, the scheme which he purposes to recommend to Congress contemplates the eventual sale of all of the Government-owned ships to private interests, but the retention of partial Government control through a period of years by means of the Government holding of a mortgage and the Government issuance of insurance. There is to be established a special fund, under the control of the Government, which will be used to foster the development of certain trade routes.

Mr. Hurley stated that when the present contracts are completed there will be under the American flag next year 16,732,700 dead-weight tons of oceangoing steel cargo and passenger ships. He is convinced that Government ownership and operation of these ships, except as a last resort, is undesirable. On the other hand, he thinks that were the ships built at Government expense to be used now merely for the advantage of groups of ship operators with sufficient capital to purchase the ships from the Government, he would unhesitatingly advocate the retention of the whole fleet by the Government. His plan is intended to provide as soon as possible the necessary development of the American merchant marine, at the same time guaranteeing to the people of the United States as large a return as possible from the war expenditure for ships.

Prices for Sale of Ships

The primary recommendation of the plan is that the ships should be sold at a price which fairly reflects the current war market for similar tonnage. Twenty-five per cent. of the purchase price of each ship is to be paid down, the remainder to be paid in annual installments over a period not exceeding 10 years. The Government will take a mortgage for this unpaid balance, charging interest at the customary commercial rate of 5%, but inasmuch as the Government ordinarily borrows money at 4%, the 1% difference will be diverted to the merchant marine development fund noted above. At the same time, the purchaser is to be re-

(*Concluded on page 690*)

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Hold Hearing on Professional Railway Engineers' Wages

Representatives of Engineering Council and of the American Association of Engineers appeared before the Railroad Administration at Washington on Mar. 31 and Apr. 1 in reference to the proposed revised scale for the professional engineers in railway service. By restriction of a previous ruling of the administration consideration at this hearing was confined to salaries below $250 per month.

Seattle Acquires Street Railways

Transfer of the Seattle street-railway lines of the Puget Sound Light & Power Co. to the city for $15,000,000 in bonds was made Mar. 31, to become effective Apr. 1. The interest and redemption charges are to be paid from the revenues of the system. The company agrees to sell current to the city at 1c. per kilowatt until the city is ready to supply its own current. Some 2000 company employees will be put on the city payroll. Negotiations for the purchase of the Seattle & Rainier Valley Ry. are said to be well under way. The city already has some municipal street-railway lines. Thomas F. Murphine, superintendent of public utilities, announces that tickets will be eliminated and the nickel made the standard fare, except for children.

New York Engineers Move to Form Local Society

Action Taken at Meeting Called to Discuss the Engineer as a Citizen

On Mar. 26 a meeting in New York, having as its theme "The Engineer as a Citizen," resulted in the adoption of resolutions looking to the organization of a New York local engineering society, through the affiliation of existing locals and of local sections of the national engineering societies.

The meeting was held under the auspices of the New York local sections of the mining, mechanical, and automotive engineers' societies. The local members of all other societies were invited to attend and participate in the discussion. Gano Dunn presided. Philip N. Moore, of St. Louis, spoke on the civic responsibility of the engineer, Calvert Townley on his relation to legislation, Nelson P. Lewis on his relation to administration, Spencer Miller on his relation to public opinion, and Comfort A. Adams on his relation to production and distribution. In the main, the addresses followed lines already well covered in discussions of these topics. There was repeated emphasis on the need for the engineer's clear thinking in the present social crisis, while the governing idea in Mr. Miller's discussion was that the engineer's influence on public opinion would be in proportion to his spiritual strength and his character.

Except for discussions by J. E. Johnson, Jr., and G. S. Van Gilder, the remarks following the opening discussion referred to professional organization, and particularly to that of the engineers of the metropolitan district. Mr. Johnson, pointing out the function of the Engineering Council, declared that its membership was too much concentrated in New York and that it lacked the authority necessary for a strong unifying body. One of the reasons for the failure of engineering societies to rise to their responsibility, was, in his opinion, that those elected to office are men who have made reputations and do not want to risk spoiling them by turning their hands to new tasks. Lieut. Van Gilder pointed out that the responsibility of the engineer for the sociological conditions springs out of the present industrialism, which is the creation of the engineer.

Daniel L. Turner, chief engineer of the New York Public Service Commission, in the discussion of professional organization, urged the support of the American Association of Engineers as the unifying medium in civic activity.

The resolution looking to organiza-

tion of a New York local engineering society suggests that action be taken through a meeting of the secretaries of local sections and local societies, these secretaries then to call a general meeting for consideration of whatever plan may be formulated.

Resolutions were also passed calling upon all engineering societies to appoint committees on development, and upon the national engineering societies to appoint representatives to a conference committee which would draw up a simple, standard code of ethics.

The meeting was fairly well attended. Perhaps the attendance would have been larger had the notices supplied to the American Society of Civil Engineers for mailing actually been sent out to the New York members of the society.

Northwest Association of General Contractors Formed

The Northwestern Association of General Contractors was organized at a meeting held in St. Paul Mar. 26-27, at which D. A. Garber, president of the Associated General Contractors of America, and G. W. Buchholz, acting secretary, spoke on the work of the national association in its relation to local organizations. The convention was attended by about 100 of the most prominent contractors in the Northwest territory, including Omaha, Portland, Tacoma, Seattle, Duluth, Kansas City, and Grand Forks, N. D.

J. H. Ellison, of Minneapolis, spoke on "Relations of Employees and Employers," and W. L. Darling, of St. Paul, on "Unit Price Contracts." The following officers were elected: President, W. O. Winston, of Winston Bros. Co., Minneapolis; vice-president, Charles Ffolliott; second vice-presidents, A. Guthrie, of St. Paul, and Charles B. Hurley, of the Hurley-Mason Co., Tacoma; secretary, H. M. Leighton, of Minneapolis; treasurer, Claude H. Siems, of Siems, Helmers & Schaffner, of St. Paul.

Concrete Pipe Association Reorganizes

The American Concrete Pipe Assocation was reorganized by action of the annual convention, Feb. 14-15, and by further action of the executive committee, which met at Chicago Mar. 15. Greater support has been voted for the technical committee studying concrete sewer pipe, drain tile, and culvert pipe, and a series of tests has been outlined for further study of the reinforcement for culvert pipe.

There are at present, approximately, 400 manufacturers of concrete drain tile and sewer pipe in the United States and Canada, a large majority of which will be members of the association. It is planned to open offices in a short time, with executive officers in charge, to further the educational work which is now started.

T. H. MacDonald, Appointed Engineer of Federal-Aid Road Act

Thomas H. MacDonald, whose appointment as engineer in charge of work under the Federal-aid road act has been announced by the Secretary of Agriculture, was born in Colorado 37 years ago. He was educated as a civil engineer at the Iowa State College and, after a short service with the Chicago Great Western R.R., on track work, he became, in 1904, assistant professor of civil engineering in charge of road investigations at Iowa State College. Practically his entire professional career has been spent in developing the highway system of Iowa. The first legislation toward state supervision of road work in Iowa in 1906 placed this work under the supervision of the Iowa State College, and Mr. MacDonald became the executive officer at the beginning. As the work increased, an engineering as well as an administrative staff was placed under his direction, and, when the Iowa Highway Commission was created as an independent body he was naturally made the State Highway Engineer and its executive officer.

T. H. MACDONALD

The work in Iowa has been unusual, in that it is all done through the county organizations. It has required both engineering and administrative ability of a high order, and the successful manner in which the counties have been encouraged to develop sound engineering departments doubtless had a marked influence in the choosing of Mr. MacDonald to take charge of the Federal-aid work of the Bureau of Public Roads. While for the present he will devote his time more particularly to the solving of problems arising from the increased appropriations for Federal aid, it is planned that in the near future he will formally assume the position of director of the Bureau of Public Roads, made vacant by the death of Logan Waller Page. Mr. MacDonald has been active in a number of highway organizations and has been one of the influential members of the American Association of State Highway Officials.

Federal-Aid Road Bill Introduced In Canadian Parliament

A bill which would appropriate $20,000,000 to be used in aiding the provinces to build roads has been introduced in the House of Commons of the Canadian Parliament, at Ottawa. The bill provides for the payment of $80,000 per year to each province, plus a further payment based upon population as determined by the latest Federal census. It also provides that any highway for which aid is granted shall be constructed or improved in accordance with an agreement to be made with the provincial Government, covering cost and specifications. The amounts given to the provinces must not exceed 40% of the actual and necessary cost of the improvements. The sum of $25,000 was appropriated for the organization staff of the Highway Department, of which A. W. Campbell is commissioner.

Canadian Building Construction Industries Organized

A permanent organization of the Association of Canadian Building and Construction Industries, with headquarters in Ottawa, has been effected. A. S. Clarson, of Montreal, has been appointed general secretarial manager and organizer, and he will shortly visit the prinicipal Canadian cities for the purpose of establishing local branches. Mr. Clarson has had over 30 years' engineering experience, and during the past 10 years has resided in Montreal, practicing as a consulting engineer. The association, which was formed for the purpose of stabilizing Canadian construction industries, will coöperate with the national reconstruction movement inaugurated by the Government.

Interstate Flood Control Proposed

Interstate flood control through the coöperation of North and South Dakota and Minnesota is authorized so far as one of the states is concerned by a bill that has passed the North Dakota legislature and has been signed by the Governor. The bill provides for a flood-control commission, composed of the State Engineer, the dean of the School of Engineering and Mechanic Arts of the North Dakota Agricultural College, and the dean of the School of Mines of North Dakota. The commission will appoint a flood-control engineer. It is directed to coöperate with the Departments of the Interior and of War as well as with the States of South Dakota and Minnesota. Preliminary surveys of the Red River Valley, looking to flood control, are already being made by P. G. Simons, of the United States Department of Agriculture.

Hurley Submits Plan for Ship Operation

(*Concluded from page 688*)

quired to insure with an American marine insurance company his equity in the vessel, but the Government will carry in its own fund for the purchaser's account the hull and machinery insurance covering that part of the vessel for which payment has not been made. Inasmuch as the Government can carry this insurance for at least 1% less than the market rate, this 1%, too, will be diverted to the development fund.

Each purchaser who wishes to operate in foreign trade should be obliged to incorporate under a Federal charter, for which legislation will have to be obtained, and provision is to be made that all control shall remain in American hands. One member of the board of directors of each company is to be named by the Government, and these directors will be formed into a board of Government directors, who will have certain advisory powers in relation to the administration of the development fund. This fund is to be used to relieve such financial difficulties as may be encountered in the development of an adequate and well balanced American merchant marine. For instance, one suggestion is that if the Government thinks that a certain trade route should be opened, a company may buy ships for the express purpose of operating on that route. If operation does not prove profitable at once, it will be necessary to provide for the payment of defaulted interest from the merchant marine development fund in the discretion of the Government agency, and when the ships of the route earn their annual interest rate and a profit, one-half the profit earned each year should be paid into the development fund until all moneys drawn from that fund, on account of the vessel in question, shall have been replaced. The other half should go to the stockholders of the company. If the route does not prove profitable, the ships on it may be transferred by the Government to other routes and if the Government becomes convinced that the vessel has failed to make expenses solely or chiefly because of incapable management, it may foreclose the mortgage which it holds on the vessel.

A final clause in the plan is that, until sold under the terms stated, all vessels should remain the property of and should be operated by the Government of the United States. Mr. Hurley specifically stated that the wood ships are not included in this plan.

To Start Sewage-Treatment Works for Cleveland

Plans for sewage-treatment works at the westerly site, Cleveland, Ohio, will be ready Apr. 15 and bids will be received May 6. The plant will include grit chambers, two-story settling tanks, outfall conduits, buildings and appurtenances. This is the first of three proposed plants. Ed. Shattuck is commissioner of purchases and supplies, Robert Hoffmann is city engineer, and George B. Gascoigne is city sanitary engineer. The announcement of Apr. 22 as the date for opening bids made in our advertising columns of earlier date was due to a misunderstanding.

New Assistant Secretary for Civil Engineers' Society

The March *Proceedings* of the American Society of Civil Engineers announces the appointment of Capt. Stephen L. Coles as assistant secretary, succeeding Thomas J. McMinn, who for 21 years has been assistant secretary of the society. Mr. McMinn will continue to give the society the benefit of his experience in the society's work until Captain Coles becomes familiar with his new duties, after which the former will be retired on half pay.

Captain Coles has been identified chiefly with electrical engineering work, having made a special study of service and public-policy questions affecting central electric-light stations. After leaving the Massachusetts Institute of Technology he became Boston correspondent and later managing editor of the *Electrical Review*. He has written extensively on electrical subjects, both for the lay and engineering press, was at one time acting secretary-treasurer of the Society for Electrical Development, aided the Toronto Electric Light Co., Ltd., of Toronto, Can., in working out its general policies, and just before entering the Ordnance Department of the Army, during the war, was on the engineering staff of M. W. Thompson, specialist in litigated engineering matters and in reports on railroads and other large properties. In this work Captain Coles devoted his attention principally to electrical public utilities having problems of service, policy, and competition to solve.

Captain Coles is not a member of the society.

National Lumber Manufacturers to Hold Convention

The National Lumber Manufacturers' Association will hold its annual convention Apr. 16-17, at the Congress Hotel, Chicago. Most of the sessions will be devoted to a discussion of subjects which more particularly pertain to the industry, but on the morning of Apr. 15 a technical session will be held at which the following subjects of interest to engineers will be presented:

"Standards of Wood Construction from the Standpoint of the Architect," by Sullivan W. Jones, chairman of the Structural Service Committee, American Institute of Architects; "Commercial Uses of Treated Lumber," by A. R. Joyce, acting president of the American Wood Preservers' Association; "Development in Heavy Timber Construction," by C. E. Paul, construction engineer, National Lumber Manufacturers' Association; "Protection from Fire in Wooden Buildings," by W. C. Robinson, vice-president and chief engineer of the Underwriters' Laboratories.

Two-Day Technical Meeting of Water Producers

Purification and Other Topics Occupy Attention of Illinois Section of Water-Works Association

Practically all of the twenty papers presented Mar. 25-26 at the well attended meeting of the Illinois Section of the American Water-Works Association were technical. Chemical treatment for the softening, clarification and sterilization of water was treated in five papers. Well supplies, pumping, construction and operation received attention in three papers. War work was reflected in an equal number.

M. F. Stein reviewed the work of the testing station at Cleveland, Ohio, on water softening. The design of the chemical treatment process as dictated by the experimental work was brought out to indicate that local tests should precede design in most cases.

Several typhoid fever outbreaks in Moline, Ill., have occurred in the past two years. M. C. Sjoblom traced the cause to a bypass valve permitting unfiltered water to enter the clear well at a time when little or no chlorine was being applied.

Lieut. Everett Judson, of the United States Public Health Service, detailed experiments on adonite, a fermenting sugar, to differentiate B. coli. Opinions expressed in discussion indicated that the test was not yet a safe one.

Chlorine, Chloramine and Crenothrix

After a trial of more than a year the Champaign & Urbana Water Co. still finds the use of 4.6 lb. of chlorine per 1,000,000 gal. is an effective agent in eliminating crenothrix from its ground water-supply, said F. C. Amsbary. W. F. Monfort, in detailing work done on the problem in conjunction with O. A. Barnes, indicated that chloramine was a better reagent, but that the difficulties of its application and in preserving its stability made the chlorine more desirable so long as it continued to kill the crenothrix.

Minna E. Jewell has been making intensive studies of the Sangamon River, one of the most polluted streams of the state. Her findings indicate that biological tests are perhaps more practical than chemical or bacterial in determining the extent to which stream pollution may be permitted without the creation of a nuisance.

Experience with the new large-capacity 36-in. well at the University of Illinois was described by Prof. M. L. Enger. Unlike the smaller wells, its capacity per foot of draw-down has increased in two years from 19.5 to 21.5 gal. per minute. One of the older wells was reduced in 10 years from 7.2 to 4.9 gallons.

Consumption of water at Illinois state institutions varies from 70 to 350 gal. per capita per day, said F. J. Postel. Meters are installed on the low-consumption systems. Deliberate waste of water through compression

cocks in the reform school where the boys balanced the valves open so as to wash in running water is being stopped by arranging the cocks with a stop which prevents opening them wide. So serious was the water shortage in Jacksonville in the winter of 1918 that snow was thrown into the reservoirs and even brought in to the bath tubs. Wells are always provided at state institutions because of their desirability if there is any chance of an adequate supply being found.

UNUSUAL WELL-WATER SUPPLY AT BATON ROUGE

L. R. Howson outlined the unusual well-water supply conditions of Baton Rouge, La., where 2050-ft. wells deliver water at a temperature of 92° F. with a static head of 120 ft. One well sunk in 1916 discharged for 6 hours at night directly into the city mains, delivering at a 300,000-gal. rate and maintaining a pressure of 30 lb. The practice has recently been discontinued on account of additional pressure required for automatic sprinklers. There are 14 separate sand strata bearing water of different character. Through the fine sand of Louisiana water at 92° is transmitted 1⅔ times as rapidly as through a similar sand with a temperature of 50 degrees.

The Old Hickory Powder Works water-supply was described by O. E. Bulkeley. Ninety-six tub gravity filters with a daily capacity of 65,000,000 gal. were hand-operated. Determination of the rate by noting the drop each hour, and the satisfactory utilization of women as filter attendants, were features of the operation.

The officers chosen for the coming year are: Chairman, W. E. Lautz; vice-chairman, F. C. Amsbary; treasurer, H. E. Keeler; secretary, G. C. Habermeyer, Urbana.

Augusta, Ga., Flood-Protection Work Completed

Flood-protection levees at Augusta, Ga., started in 1909, were recently completed, according to a report by Nisbet Wingfield, city engineer, who has also been chief engineer of the river and canal commission which has had charge of the protection work. This whole system was described in *Engineering News* of Aug. 6, 1914, p. 277. It comprises an 11-mile earth levee with reinforced-concrete bulkhead gates at intervals from a point just above the city, three miles through the city, to a point eight miles below. It was started after the disastrous flood of 1908. Flood tide on Dec. 24, 1918, reached a height which under the old conditions would have overrun a large part of the city, but, due to the effectiveness of the protection, no damage was caused, except the shut down of power plants for a few days, owing to the shutting off of their connecting water-supply. The total cost of the work ran above $2,000,000.

Providence Water-Supply Project Goes Forward

Construction work on the new gravity water-supply for Providence, R. I., is going forward immediately, according to present plans. Bids for 5.2 miles of road work as a part of the Scituate reservoir road relocation will be received Apr. 9, and it is expected that further bids will be invited later in April. In the late summer, or early autumn, if conditions then are favorable, bids will be asked for the main dam and dike. This will involve about 2,500,000 cu.yd. of earth, besides gate chambers, masonry spillway and a reinforced-concrete bridge. Some preliminary work on the project has already been done. Frank E. Winsor is chief engineer of the Water-Supply Board.

Heavy Reduction in Lowest Bid Compared with Last August

Bids for furnishing and laying 34,590 ft. of 72-in. riveted steel pipe line to duplicate the portion of the Jersey City water-supply conduit from the Boonton reservoir to the Watchung tunnel were opened on Mar. 25. They were 15 in number. The range was from $1,098,076 to $1,783,977. The lowest bid for the same work on Aug. 13, 1918, was $1,578,921, showing a reduction of $480,845. The award was not made last year because the Priorities Board withheld its approval of the use of steel plate at that time. Clyde Potts, New York City, is consulting engineer for the work and Michael I. Fagen is director of the Department of Streets and Public Improvements of Jersey City.

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

United States.—Expert patent investigator, $1800 to $2400 per year, and technical patent expert, $2400 to $3600 per year, May. 20.

United States. — Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

United States.—Statistician, Department of Interior, $1800 per year, May 13. Apply for Form 2118.

United States.—Junior recreational engineer, Forest Service, Denver, Colo., $1800 to $2400 per year, May 6. Apply for Form 2118.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City.

The Engineers' Club of Philadelphia was addressed at the weekly luncheon Apr. 1 by Col. W. B. Ladue, Corps of Engineers, U. S. district engineer at Philadelphia, on "Harbor Developments for the Port of Philadelphia." Dr. Henry Leffman will read a paper on "The Truth About Whisky" at the weekly luncheon Apr. 8.

The Montreal Branch of the Engineering Institute of Canada will be addressed Apr. 3 by V. I. Smart, who will speak on the "Operation of Railways as an Engineering Problem." At the meeting Apr. 10 J. A. DeCew will present a paper on "Waterproof Paper Productions and Their Industrial Possibilities."

The Architects' and Engineers' Club, Ann Arbor, Mich., is the name adopted for the new organization formed at a meeting of the engineers and architects of Ann Arbor Mar. 25, at which the object of organization was stated to be "the promotion of the social, economic, and technical interests of its members, and civic activity and public service." The club has 72 members. A committee was appointed to follow pending legislation in the state legislature concerning the regulation of public utilities, and it was instructed to exert the influence of the club for proper recognition of the engineering profession.

The Texas Association of Members of the American Society of Civil Engineers will hold its semi-annual meeting at San Antonio Apr. 25-26. R. J. Potts of Waco is president of the association and J. H. Brillhart of Dallas is secretary.

The Ottawa Branch of the Engineering Institute of Canada on Mar. 20 held its first meeting since the annual general meeting. Lieutenant Commander Edwards, superintendent of the Canadian Radio-Telegraph Service, provided a series of interesting experiments to illustrate the sending and receiving of electric waves, the meeting

being held in the testing room of the Canadian Naval Radio Telephony Service. Each member of the audience was provided with a telephone receiver and was enabled to listen to some of the high-power sending stations. The second meeting of the branch was held Mar. 27 to discuss the subject of proposed provincial legislation defining the status of engineers throughout Canada.

The Engineers' Club of St. Louis held a meeting Apr. 2, devoted to a discussion on the prospectus for a conference of engineering societies, to be held in Chicago Apr. 23-25, on the establishment of a Department of Public Works.

The Associated Engineering Societies of Seattle and the Engineers' Club of Seattle held a joint meeting Mar. 21 at which George F. Nicholson, chief engineer of the port of Seattle, presented a paper on "Port of Seattle Engineering Problems," illustrated with motion pictures of port operation along the Atlantic coast.

The Engineers' Club of Seattle was addressed Mar. 20 by Lloyd Robey on "The Chuquicamato Mine of Chile," of which he is assistant superintendent.

The Indiana Sanitary and Water Supply Association will hold its annual meeting in Indianapolis Apr. 9-10.

The American Welding Society, the formation of which was noted in *Engineering News-Record* of Mar. 13, p 545, held its first meeting Mar. 28 in New York City. The constitution and bylaws recommended by the organization committee were adopted, and the following officers were elected: President, C. A. Adams, Cambridge, Mass.; secretary, H. C. Forbes, 33 W. 39th St., New York City.

The Cornell Society of Civil Engineers will hold its spring meeting Apr. 14, at the United Engineering Societies' Building, New York City. Prof. C. R. Mann will speak on engineering education, and the proposed combination of Sibley College and the College of Civil Engineering will be discussed. It is expected that this will be a joint meeting of the recently organized association of Sibley men and the Cornell Society of Civil Engineers.

The Engineers' Club of Trenton, N. J., was addressed Mar. 27 by R. J. Wig, chief of the concrete ship section, Emergency Fleet Corporation, who presented a paper on "The Present Status of the Concrete Ship," illustrated with slides.

The Rochester Society of Technical Draftsmen was addressed Mar. 27 by Frank C. Taylor of the Rochester Railway & Light Co., who spoke on "Illumination."

The Oregon Society of Engineers held a smoker in Portland Mar. 21, at which various members and guests spoke on the subject of the compensation of engineers, although no prepared addresses had been planned. There was a general discussion of the advisability of organizing engineers for the purpose of obtaining higher rates of pay.

The Oregon Association of Members of the American Society of Civil Engineers held a meeting in Portland Mar. 20 at which Robert A. Cummins, consulting engineer and contractor of Pittsburgh, member of the Committee on Development, spoke on the work of the committee. Mr. Cummins was in Portland serving with a board of four other engineers, studying the subsidence of the Portland municipal grain elevator on the Willamette River.

The Rochester, N. Y., Engineering Society will hold its regular monthly meeting Apr. 11. George Halcott Chadwick, assistant professor of geology, University of Rochester, spoke on "What is Under Rochester" at the weekly luncheon Mar. 31.

The Pittsburgh Chapter of the American Association of Engineers will be addressed Apr. 17 by C. E. Drayer, national secretary. The chapter has taken headquarters in the Fulton Building; they are in charge of F. E. N. Thatcher, secretary.

The Civil Engineers' Club of the Carnegie Institute of Technology, Pittsburgh, was recently addressed by C. K. Harvey, of the Koppers Co., who spoke on "Civil Engineering Work in Byproduct Coke Plants."

Personal Notes

CAPT. LITTELL SNIVELY, Engineers, U. S . A., has received his discharge from the service and has become mine engineer, Guanajuato Consolidated Mining & Milling Co., Guanajuato, Mexico.

WILLIAM C. HALE, assistant chief engineer, Rust Engineering Co., Pittsburgh, has resigned to become chief engineer of the Andrews Engineering Co., also of Pittsburgh.

ALBERT LADD COLBY, consulting engineer and iron and steel metallurgist, South Bethlehem, Penn., has been appointed representative of the American Society for Testing Materials on the Engineering Council.

CAPT. ELWOOD AVERY, Construction Division, U. S. A., has received his discharge from the service and has become associated with G. W. Ensign, Inc., engineers and contractors, Harrisburg, Penn., as chief engineer.

E. L. MARTIN, engineer maintenance of way, Missouri, Kansas & Texas R.R. and associated railroads, has been appointed chief engineer with jurisdiction over the Missouri, Kansas and Texas Lines of Texas and the Missouri, Kansas & Texas R.R. He was born in 1879 and received his education at the Agricultural and Mechanical College of Texas. He entered the service of the Southern Pacific Lines in 1899, becoming assistant engineer three years later. He afterward became connected with the Kansas City Southern and later became division engineer for the Gulf Coast & Santa Fé Railway in Texas. Afterward he served as assistant superintendent for the Southern Pacific at Lafayette, La. In 1913 he became division engineer for the Missouri, Kansas & Texas, and was appointed engineer maintenance of way in 1917.

CAPT. A. L. MULLERGREN, Construction Division, U. S. A., having been discharged from the service, has returned to his work as secretary and treasurer of the Benham Engineering Co., consulting engineers, Oklahoma City, Okla. Captain Mullergren was officer in charge of steam heating and assistant to the constructing quartermaster at Camp Funston, Kansas.

C. H. PURCELL has been appointed bridge engineer for the Oregon State Highway Commission, assuming office Apr. 1. Several years ago Mr. Purcell served as bridge engineer for the commission, when H. L. Bowlby was its chief engineer. Later he was bridge engineer for two years in the Multnomah County engineer's office, after which he returned to the Highway Commission as bridge engineer and assistant chief engineer. More recently he has been attached to the Portland office of the Department of Roads and Rural Engineering.

LIEUT. HARRY B. FRIEDMAN, Air Service, U. S. A., who received his discharge in January and entered the service of the W. E. Wood Co., general contractors, Detroit, as engineer and representative in Fort Worth, Tex., has resigned to enter into a partnership with Butcher & Sweeney, general contractors, Fort Worth.

LIEUT. C. E. PRETZ, Engineers, U. S. A., has received his discharge from the service and resumed his work with the Public Service Commission, with headquarters in New York City.

CAPT. H. RAY KINGSLEY, Engineers, U. S. A., who received his discharge from the service in February, is now engaged in his former work as building engineer for the insular government, Bureau of Public Works, Manila, P. I. In 1916 he went to France on leave from the insular service and enlisted in the American Ambulance Corps of the French Army, where he served for three months, afterward returning to the United States on his way to the Philippines, where he was commissioned in the Engineers in October, 1917.

MAJ. WALTER B. ELCOCK, U. S. A., has been discharged from the service and has returned to his work as manager of the Atlanta office of the Portland Cement Association.

LIEUT. COL. W. M. DENMAN, Engineers, U. S. A., has been discharged from the Army in France and has become a member of a company known as "Société d'Importations Américaines," with office at 57 Rue de

l'Université, Paris-7e. The new organization, as its name indicates, will engage in importing American products into France. Colonel Denman's home is in Springfield, Mass.

MAJ. JAMES H. BRACE, 22nd Engineers, a light-railway regiment who recently returned from France, has been discharged from the Army and has resumed his work as vice-president of Fraser, Brace & Co., contractors, New York City.

LEWIS R. ASH of Harrington, Howard & Ash, consulting engineers, Kansas City, has tendered his resignation as city manager of Wichita, Kan.

GEORGE WORTH, formerly associated with the Sager Lock Co., North Chicago, has been appointed chief engineer of the city water works of Waukegan, Ill.

ADOLPH F. MEYER, chief engineer and general superintendent, Minnesota & Ontario Paper Co., International Falls, Minn., has resigned and will resume private practice, specializing in hydraulic, structural and paper-mill engineering, with headquarters in St. Paul or Minneapolis.

MAJ. ERNEST MCCULLOUGH, of the Chemical Warfare Service, formerly consulting engineer of Chicago, Ill., has been made lieutenant colonel. He is still in France.

COL. FRANCIS F. LONGLEY, Engineers, American Expeditionary Forces, in charge of water-supply in the advance and rear sections, has been detailed to go to London and take charge of Army educational work at English universities. Before entering the Army he was a member of the firm of Hazen, Whipple & Fuller, New York City.

MAJ. J. C. SMITH, American Expeditionary Forces, who recently returned to this country, has received his discharge and has become office engineer, Northwestern Region, United States Railroad Administration, with headquarters in Chicago. He was formerly in the service of the Spokane, Portland & Seattle Railroad.

W. E. BECKER and C. R. SMYTH have become associated under the firm name of Becker & Smyth, contracting engineers, Chicago.

MAJ. G. T. LEMMON, Engineers, U. S. A., who received his discharge from the service in January, has become resident engineer of the Virginia State Highway Commission, with headquarters at Suffield. He entered the service as a first lieutenant of engineers in July, 1917.

CHARLES WUEST, JR., formerly engineer of roads, United States Nitrate Plant No. 4, has been appointed office engineer, Division of Highways, Illinois Department of Public Works and Buildings, with headquarters in Springfield.

MAJ. CARLISLE MASON, American Expeditionary Forces, having returned from France and received his discharge from the service, will resume the practice of general consulting engineering, with main office at 207 Broadway, New York City, and branch office at 81 Rue St. Lazare, Paris, France.

A. E. TRIPLEGG, district engineer of the Missouri, Kansas & Texas R. R. of Texas, has been appointed engineer maintenance of way, with headquarters at Dallas.

H. R. CARTER, state highway engineer of Arkansas, has resigned to engage in private practice.

BRIG. GEN. B. P. DISQUE, chief of the Spruce Production Division, U. S. A., has been appointed to the chairmanship of the export and import branch of the American International Corporation, New York City, having received his discharge from the service Mar. 15. He is succeeded as president of the Spruce Production Corporation and commander of the first division by his former chief of staff, Lieut. Col. C. P. Stearns.

CAPT. M. Z. BAIR, Construction Division, U. S. A., has resumed his duties in the division of sanitary engineering, Ohio State Department of Health, having received his discharge from the Army.

CHARLES H. HURD, consulting engineer, Indianapolis, has resigned from the Board of Sanitary Commissioners and will devote his entire time to private practice. Lucius B. Swift, member of the bar of Indiana, has been appointed a member of the commission.

CAPT. ALVAH G. HUSTED, Sanitary Corps, U. S. A., will resume his work with the Indianapolis Sanitary Commission, having left the Army.

CAPT. S. M. SMITH, Engineers, U. S. A., recently returned from overseas, has received his discharge from the service and has returned to the office of the chief engineer, Wabash Ry., as principal assistant engineer. In France Captain Smith was engaged in the development of the canvas portable-type foot bridge, which met with success in the battle of the Meuse during the week previous to the armistice.

F. RAYMOND KEYS has left the service of the Bureau of Yards and Docks, U. S. N., with which he was associated during the war, and has become connected with the Nugent Construction Co., New York City.

CAPT. JOHN W. TOYNE, Utilities Officer, Camps Chickamauga Park and Fort Oglethorpe, Georgia, has received his discharge from the service and will resume the private practice of engineering at South Bend, Ind.

D. J. CAMERON, who recently received his discharge from the Engineers, U. S. A., has been appointed to take charge of the northern New Jersey territory of the Fireproof Products Co., Inc., New York City, with headquarters in Newark.

H. H. JOHNTZ, division engineer, Missouri, Kansas & Texas R.R. at Parsons, Kan., has been appointed engineer maintenance of way of the Missouri, Kansas & Texas R.R. and the Oklahoma Belt, with headquarters at Parsons.

OSCAR F. LACKEY and LYMAN L. LIVINGSTON have become associated under the firm name of Lackey and Livingston, consulting engineers, 17 Battery Place, New York City.

W. H. VANCE, engineer maintenance of way, St. Louis-Southwestern and Louisiana & Arkansas Rys., has been appointed engineer maintenance of way, St. Louis, Southwestern and Associated Lines, including the St. Louis Southwestern of Texas, the Eastern Texas, Dallas Terminal & Union Depot, and the Southern Illinois and Missouri Bridge R.R., with headquarters at Tyler, Tex.

OBITUARY

MAJ. JAMES ALFRED ROOSEVELT, U. S. A., previously general superintendent of the Third Avenue R.R., New York City, died Mar. 26 on the naval transport Great Northern, on its way to the United States. He was born in 1885 and was graduated from Harvard University in 1905, soon afterward forming the engineering firm of Roosevelt & Thompson, New York City. In 1907 he became general superintendent of the Third Avenue R.R. Four years later he was appointed to direct the system of street-railway and interurban lines of the British Columbia Co., with headquarters in Vancouver, B. C. He received the commission of captain early in 1917 and was assigned to the 308th Infantry. He was in much of the heavy fighting with the 77th Division.

CAPT. STUART THOMSON, Ordnance Dept., U. S. A., died in Brookline, Mass., Mar. 23. He was graduated from Harvard University in 1908 and from the Massachusetts Institute of Technology in 1909. He had recently returned from Washington, where he had been engaged in the production of aircraft armament for the past year and a half.

CAPT. ARLY L. HEDRICK, Engineers, American Expeditionary Forces, died recently in Brest, France. He received his education at Yale University and the University of Wisconsin.

AUGUSTUS W. NEWELL, railway and mining engineer, died at his home in Bradford, Penn., Mar. 25. He was born in 1832 and did his first work on the Brookline reservoir and later was employed by the Boston & Maine R.R. He was also engaged in the location of the Charles River R.R. and the "Air Line" of eastern Massachusetts. In 1856 he became associated with the Buffalo, Bradford & Pittsburgh R.R., becoming a director of the line in 1863. After that time he engaged in mining operations and assisted in the development of the Bradford oil fields.

Tractor Output for 1918-19

A total of 132,697 tractors was manufactured in 1918, and it is estimated that 314,936 will be manufactured in 1919, according to a report of the United States Department of Agriculture based upon inquiry made among manufacturers. The figures for 1919 are of course merely estimates, and represent the aggregate of the estimates submitted by the tractor manufacturers in January and February of this year.

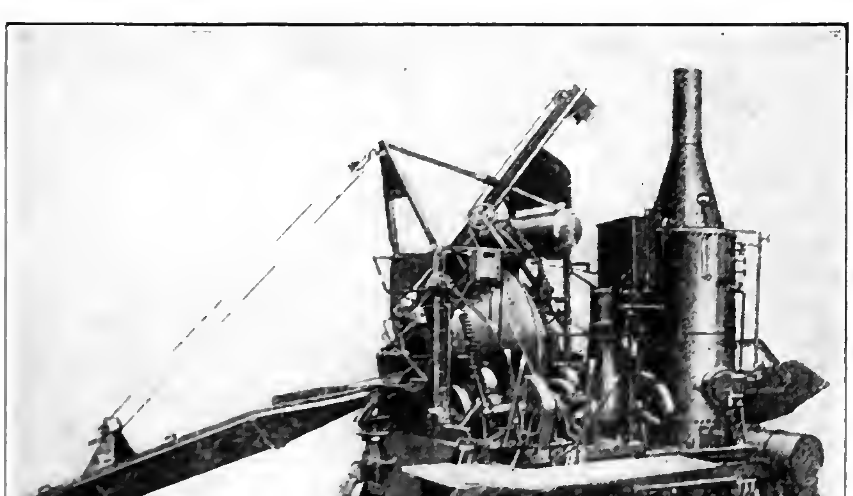
Construction Machinery Exports

An indication of the extent of American export trade in construction machinery is contained in the reports of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, Washington, D. C., for January. Two of the items are: Pumps and pumping machinery, $572,445; excavating machinery, $26,627.

New Paving Mixer Propelled by Multiple-Tread Apparatus

A concrete paving mixer with track-laying propulsion is shown in the accompanying illustration. It is intended to obviate the necessity of using planking over subgrade too soft to bear the load of the ordinary wheel-propelled outfit. The machine is also equipped with a batch-timing device which locks the discharge trough, so that each batch must be mixed until any fixed time previously determined and set in the timer has been completed.

The treads are 9 ft. long and 14 in. wide, which, with the 18,000 lb. weight carried, gives a ground pressure per square inch less than that of the average walking man. The treads are driven independently of one another through friction clutches, which permits the turning of the machine in its own length.



PAVING MIXER EQUIPPED WITH MULTIPLE-TREAD PROPULSION

Other advantages claimed are: A large saving in cost, due to the elimination of planking and the delays incident to its use; noninjury to the finished subgrade, and ability to operate where machines of the old type cannot go.

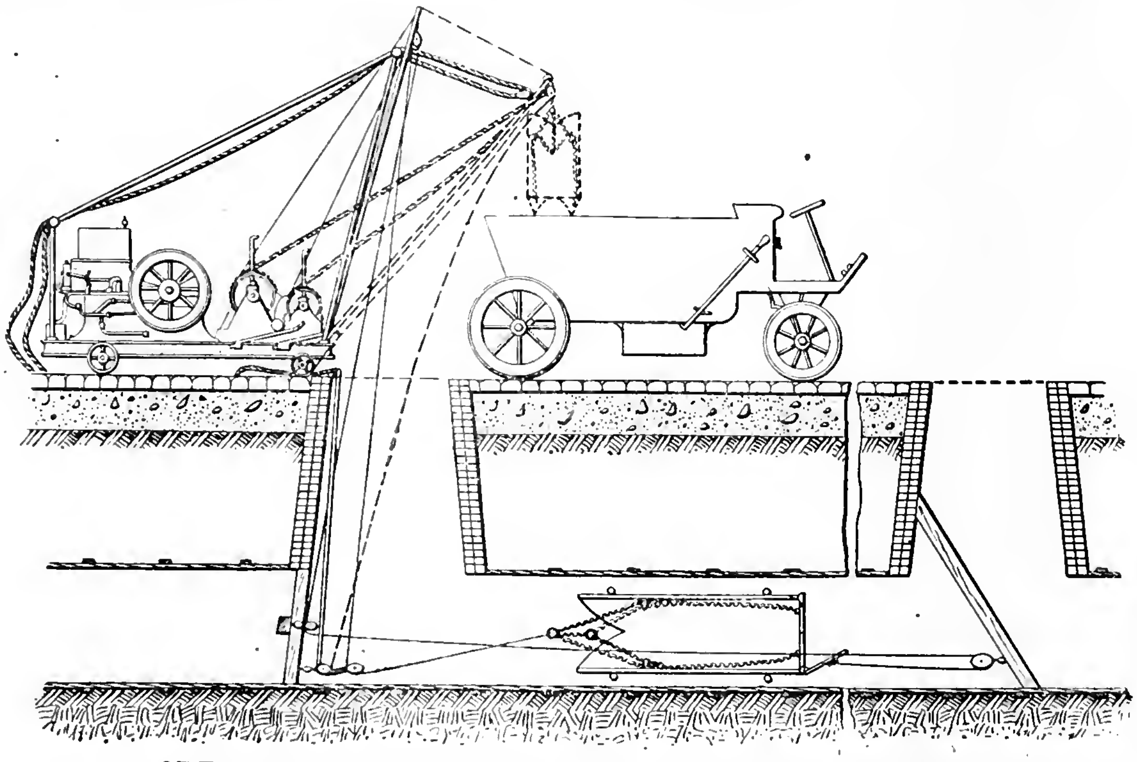
The machine illustrated is manufactured by the Foote Co., Inc., Nunda, N. Y., and these treads are put on both sizes of its paving mixers. Application has been made for a copyright on the trade name "Multi-Foote" for the tread.

Sewer Cleaner is Operated by Crew Above Ground

Elimination of the necessity for a sewer-cleaning crew to work in the water and poison gas of the sewer chamber is the purpose of a device invented and patented by P. J. Healey, contractor, of 30 Church St., New York City. Cables and pulleys are arranged so that a small pipe derrick with a gasoline engine may drag a digging bucket back and forth through the sewer and then hoist it to the street level, while the whole crew remains above ground.

It is necessary to place a timber in each manhole to hold the pulleys. The cables pass down the near manhole, and change direction on blocks, and are fastened to either end of the bucket, the line to the bottom of the digging bucket passing around the block in the far manhole. To make it possible to lift the bucket from the sewer, the direct line block at the near manhole is attached to the end of a rope passing through another block which is secured to the timber. When the bucket is pulled up, the first block comes up with it, pulling the rope through the second block. By pulling in and fastening the rope as the bucket is lowered, the outfit is again prepared for digging.

The bucket has a double shovel-shaped nose and a two-leaf dump bottom, as illustrated. In order to facilitate travel through the sewer, small casters have been placed on its sides. Digging is a scraping process, the bucket being dragged back and forth, loosening and collecting the spoil, until full. It is stated that members of the crew are required to work in the sewers only when placing the timbers which hold the pulleys.



OPERATION OF IMPROVED SEWER-CLEANING MACHINE

Business Notes

The Berger Mfg. Co., sheet steel products, New York City, announces that it has moved its office from 154 Eleventh Ave. to 516-524 West 25th St., New York City.

The New Way Motor Co., Lansing, Mich., manufacturer of air-cooled gas engines, announces the appointment of Harry J. Sproat as secretary and factory manager.

The Flower-Stephens Mfg. Co., Detroit, manufacturing valves and hydrants under the trade name "Michigan," is now to be known as the Flower Valve Manufacturing Co.

The Eastern branch of the Independent Pneumatic Tool Co. in New York City, has been moved from 170 Broadway to 1463 Broadway. The company's pneumatic and electric tools and gasoline engines are sold under the trade name "Thor."

The excavation machinery manufactured by the Pawling & Harnischfeger Co. is to be handled by the following newly appointed agents: the W. E. Austin Machinery Co., Atlanta, Ga.; the Henry H. Meyer Co., Baltimore, Md.; Edlen & Co., Philadelphia, Penn.; Charles J. McCarty, Boston, Mass.; the W. W. Williams Co., Columbus, Ohio; the W. B. Louer Co., Chicago,

Ill.; the H. W. Moore Co., Denver, Colo.; W. H. Zeigler, Minneapolis, Minn., and Gaston, Williams & Wigmore, Inc., New York City. The last named firm is an expoiting agent.

H. A. Frank, managing director of the Nova Scotia Shipbuilding & Transportation Co., Ltd., Liverpool, N. S., has also recently been made managing director of the Mirimachi Construction Co., Ltd. The new company has taken over the assets of the International Shipbuilding Co., Ltd., Newcastle, N. B., consisting of yard, plant, machinery, stock of material and a vessel framed on the stocks. Operations will begin immediately for the completion of this boat, and the same company will also construct a small vessel of about 150 tons net register.

The Poston Paving Brick Co., of Crawfordsville, Ind., one plant, and the Burton-Townsend Co., of Zanesville, Ohio, two plants at Zanesville and one plant at Ashtabula, Ohio, have become licensees of the Dunn Wire-Cut Lug Brick Co., of Conneaut, Ohio, and will engage in the manufacture of wire-cut lug paving brick.

The Carson Petroleum Co., 208 So. La Salle St., Chicago, Ill., announces that George Fuchs, formerly of the Texas Co., asphalt sales department, has been appointed Southern representative of the asphalt and road-oil sales department of the Carson Co., with headquarters at Tampa, Fla.

The W. A. Jones Foundry & Machine Co., of Chicago, manufacturer of power-transmission apparatus, special foundry and machine work, together with the Jones spur gear speed reducer, has opened an Eastern office at 30 Church St., New York. Lemuel C. Biglow, formerly with the Morse Chain Co., of Ithaca, N. Y., is in charge of the New York office.

The Epping-Carpenter Pump Co. announces the appointment of F. S. Healey as manager of sales, in addition to his former office of chief engineer. He will replace F. F. Woods, who is now located in New York as Eastern sales manager. Other appointments are those of Albert A. Scheuch of the sales department as assistant sales manager, and Paul D. Goodman, formerly of the McClary-Jemison Machinery Co., of Birmingham, Ala., to the sales department.

The United Gas Improvement Co., Philadelphia, Penn., announces the formation of another department, to be known as the U. G. I. Contracting Co. The new organization, besides handling the construction and sale of water-gas apparatus, vertical retorts, etc., will design and erect power plants and will maintain a special road division competent to construct and maintain roads. Paul Thompson, one of the vice-presidents of the parent company, will have charge of the new organization. The other officers are J. A. P. Criffield, vice-president, for engineering; D. J. Collins, vice-president, for sales.

Construction Costs Stabilizing—Material and Labor Markets

Only General Decline Was in Steel—Labor Conditions Shown in Many Sections—Stagnation in the Building Trades

By Alden W. Welch

Common Labor

The impression seems to be quite general that there is a heavy surplus of common labor. It is true that in certain sections — particularly on the Pacific Coast — labor is plentiful, but this condition does not prevail throughout the country. It might be expected that at a great port of debarkation, such as New York City, common labor would be a drug on the market. Yet the reverse is the case, according to the Building Trades Employers' Association of this city. In spite of the homecoming soldiers, common labor is not over-plentiful and the wages are high. Pick and shovel men are paid $3.50 to $4 per eight-hour day; semi-skilled laborers, $4 to $4.50.

On the Pacific Coast

The unstable condition created by the Government in acceding to the shipyard laborers' demand for higher wages is noticeable on the Coast, as elsewhere. The rate of shipyards under the Macy award is $4.16 per eight-hour day; while at Government-owned yards $4.64 is paid. This unbalance exists in San Francisco, at the Puget Sound Navy Yard at Bremerton, Wash., and in the privately owned plants in the same district; and at San Pedro, in southern California.

For unorganized or nonunion labor the wages paid all along the Western coast are $3.50 to $4 a day. It is reported that the City of Oakland has just advertised a civil-service examination for laborers, offering wages of $3.50 per day.

Unskilled labor out of employment in the larger cities of California is estimated at from 20,000 to 25,000.

In Portland, Ore., the unemployed are estimated at 10,000 to 12,000; in Seattle and Tacoma, Wash., at about the same figure. Before the armistice was signed it was almost impossible to obtain labor, the minimum wage being $4. There are several reasons that account for the present abundance of labor. There has been the usual migration into California from nearby sections where there is little winter work. The cessation of war activities has, of course, thrown many men out of work. The copper mines have either closed down completely or have curtailed production greatly. The same situation obtains in the lumbering sections. Owing to the high cost of construction, very little new work is starting. The public utilities are doing only maintenance work. Finally, but not least, the soldiers are returning.

In St. Paul the largest employer of labor, at the present time, is the Armour plant at South St. Paul, where 42½c. per hour of a ten-hour day is paid. Paving contractors, who expect to bid on a large amount of city work, seem to think that labor may drop to 37½c. about July, but that this rate will mark the minimum for 1919. Contractors in the Northwest do not anticipate a surplus of labor after the season opens. There is a difference of opinion as to the number of unemployed at the present time. Building contractors, who are not doing much work, say that there are 15,000 men in St. Paul and Minneapolis. Busy contractors deny this. As an indication that small municipalities will go ahead with their paving programs, one contractor points out that Tracy, Minn., has just let a contract for concrete pavements at $1.87 per square yard, against last year's contract price of $1.57 for work under the same specifications.

In St. Louis there is a surplus of common labor. On sewer work the rate has fallen to 35c. an hour. On brick work the wages paid are 27c. to 30c. On grading and concreting the minimum is 25c. to 27c. These are the rates paid by general contractors. Union labor in the building trades has just received an advance, but there is practically no building work going on at present.

In Birmingham, Ala., and vicinity there is a surplus of common labor, according to local employers, owing to the temporary closing of the large furnaces and the curtailment of production by some of the coal mines. Common labor is paid from $2.50 to $3 a day. The Board of Revenue of Jefferson County is paying $2.50, and is obtaining at this figure all the labor required for the work of the county. Contractors are paying, in a number of instances, $3, and in some cases slightly more. It is reported that there is a considerably greater surplus of skilled labor than of common; but the contrary is asserted by several contractors.

The City of Dallas pays labor $2.50 to $2.80. Contractors pay building laborers 30c. an hour; hod-carriers, 35c. and 40c.; sewer and paving men, $2.50, $2.80 and $3; for eight-hour days in all cases.

In Pittsburgh hod-carriers, mortar mixers and skilled laborers are paid, under the union scale, 60c. per hour, $4.80 per day, $26.40 per week of 44 hours. Common laborers receive 45c. per hour, $4.05 per nine-hour day, $25.00 per week of 54 hours. These rates hold until further notice, as there is no expiration agreement, and there are therefore no arbitration rules.

In Kansas City labor is plentiful. It is reported that many returned soldiers were employed as common laborers, but shortly were dismissed on request of the unions. Several soldiers applied for admission into the unions, but were informed that for the present no new members were being accepted. No non-union labor is employed in the building trades in this city. On street paving, on the other hand, only nonunion labor is used. The schedule paid on brick, concrete or stone-block paving is as follows:

Crafts	1919
UNSKILLED	
Rock wheelbarrow men	$0.40
Shovelers	.40
SKILLED	
Concrete graders	$0.55
Brick setters	.65
Stone setters	.75
Roller engineers	.75
IN ASPHALT PAVING—UNSKILLED	
Rock wheelbarrow men	.40
Shovelers	.40
Clean-up men and roustabouts	.40
SKILLED	
Smoothers	.45
Tampers	.45
Concrete graders	.55
Roller engineers	.75

SUMMARY

The foregoing can be best summarized by a table showing conditions—rates, hours in a working day, availability and classes of common labor—in the important centers of the country. Such a tabulation follows:

COMMON LABOR TODAY

(In 3rd column, P means labor is plentiful, S means scarce)

City	Rate per 8-Hour Day	Situation	
Birmingham	$2.50	S	
Boston	3.20	P	
Dallas	2.40	..	Buildings
Dallas	2.80-3.20		Hod carriers
Dallas	2.50-2.80		City
Dallas	2.50-3.00		Sewers (and paving)
Kansas City	4.20		Buildings
Kansas City	3.20		Nonunion
New Orleans	2.40	P	
New York	3.50-4	S	Pick and shovel
New York	4.00-4.50	S	Semi-skilled
Pittsburgh	4.05 (9 hour)		Common
Pittsburgh	4.80		Hod carriers
San Francisco	4.16	P	Shipyards Macy award
San Francisco	4.64	P	Shipyards government owned
San Francisco	3.50-4	P	Nonunion
St. Louis	3.50 (10 hour)	P	Sewer
St. Louis	2.50-2.70 (10 hour)	P	Concrete
St. Louis	2.70-3 (10 hour)...	P	Brick
St. Paul	4.50 (10 hour)....	P	

Construction Materials

The general price tendency is downward. About half of the construction materials have declined, the other 50% remaining firm. Of course, the principal movement was in iron and steel, as follows: Pig iron, basic, to $25.75 per ton, reduction $4.25; 4-in. billets, to $38.50, reduction $5; sheet bars, to $42, reduction $5; slabs, $42, reduction $5; skelp, merchant bars, sheared plates and structural base, No. 28 black sheets, No. 10 blue annealed, No. 28 galvanized sheets, all reduced $7 per net ton. As for rails, both standard bessemer and openhearth were lowered $10 per net ton, to $45 and $47, respectively. Steel and iron pipe were lowered 3½ points. These new prices are not arbitrary prices fixed by the Government, but are prices suggested by the Government and met by the manufacturers. The Government has committed itself to make purchases at these prices and has recommended the same course to general consumers. Every indication points toward a continuation of the new schedule. The decrease was not the result of panic. Its moderateness proves that it was arrived at coldly. Many buyers expected a more substantial reduction. That the Government accepts this revised schedule and agrees to do business under it indicates that the schedule is the minimum that can be made under present conditions.

All precedent is against a sharp decline this year. Except for steel products, sewer pipe, lumber in certain sections, and dynamite, the market is practically as it was a month ago. Prices will continue to fall, but not appreciably this season. Whoever has a project that should be got underway this year may call for bids and award it to the lowest bidder, feeling practically certain that he is not only getting it done at the best price obtainable this season, but that he is helping to turn the wheels of industry at large.

WHAT THE COUNTRY SAYS

Minneapolis has just let the following contract for paving materials for 1919: 100,000 bbl. of cement at $2.30 (without bags) f.o.b. city, to P. G. Speaks and to the Landers-Morrison-Christenson Co., local concerns; 500,000 sq.yd. of 3½-in. yellow-pine creosote blocks at $2.07 per square yard f.o.b. city, to the Central Creosoting Co.; 100,000 sq.yd. of brick pavers at $1.45 per square yard, to the Streator Clay Mfg. Co. The present price of cement, in carload lots, is $2.40 net in the Twin Cities. Wood blocks are quoted at $2.20 per square yard.

Probably the liveliest class of construction throughout the country is street and road work. It is, therefore, interesting to note the following sharp decline in the price of wood blocks, just reported in St. Louis, as shown in the table at the top of the next column.

This reduction is probably due to exceptionally keen competition. It is allaged that bidding in St. Louis by manufacturers not of that city reduced the price of wood block in a recent letting to less than the figures given in the table.

DECLINE IN PRICES OF WOOD BLOCKS, ST. LOUIS

Size	Per Square Yard Mar. 1	Apr. 1	Decrease
3½-in.	$2.45	$2.19	$0.26
4 in	2.60	2.50	.10
3½-in., Minneapolis specifications	2.40	1.94	.46
4 in., Minneapolis specifications	2.55	2.25	30

Stanolind asphalt in St. Louis has declined $3 per ton (in bulk), $3.40 per ton (in packages), owing, apparently, to heavy stocks. The same is true of Texaco, the price of which is slightly above that of Stanolind. Common (salmon) brick has dropped from $12 per 1000 to $10, while paving brick lowered from $28 to $26. Brick manufacturers assert that these decreases were made to stimulate construction, and that they will incur a loss unless a large volume of business ensues. The reduction in the price of sewer pipe is apparently on the same basis. It is stated on authority that the reduction most desired in St. Louis would be in cement.

In Kansas City there is practically no change since last month. The stated belief is that prices, except of lumber, may decrease in harmony with the drop in steel. The immense campaign now on, however, may create a demand for materials that will hold up the present prices for a time. Considerable public work is underway and much more scheduled. The largest job is the 23rd. St. viaduct, let to the A. S. Hecker Co., Cleveland, for $716,000, which includes a $50,000 profit fee. A $1,500,000 sewer contract and $900,000 worth of dikes for flood protection are to be let soon.

Everybody is anxious for building operations to get underway. From Chicago comes the encouraging report as to the building permits issued in the last three weeks of March shown in the accompanying table.

ANALYSIS OF BUILDING PERMITS, CHICAGO, IN LAST THREE WEEKS OF MARCH, THIS YEAR

Week Ending	No. of Permits	Residences	Stores	Factory	Storage	Miscellaneous Buildings	Tatal
Mar. 15	49	73	4	4	2	4	87
Mar. 22	58	80	1	3	5	4	93
Mar. 29	..	124	6	6	5	7	148

Week Ending	No. Over $100,000	No. Over $50,000	No. Over $5,000	No. Less Than $5,000	Total Amount
Mar. 15	None	2	19	28	$521,000
Mar 22	2	3	19	34	1,370,500
Mar 29	3	3	42	40	1,437,000

While on the subject of building permits it may be worth while to give a comparison of values issued in February, 1919, and the preceding year in five of the larger cities of the Canadian province of Quebec, as indicating that building work is increasing outside the United States as well as inside our country.

City	February, 1919	February, 1918
Montreal	$151,740	$77,045
Quebec	53,630	25,147
Sherbrooke	90,000	....
Three Rivers	24,800	17,000
Westmount	....	15,500
Total	$320,170	$134,692

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 NEW YORK, THURSDAY, APRIL 10, 1919 Number 15

Society Considers State Legislation

ENGINEERS' meetings to discuss public affairs are sufficiently rare to warrant calling attention to a recent meeting held by the Western Society of Engineers for the purpose of informing its members as to various measures now before the state legislature. The main purpose was to arouse engineers to a broader sense of their responsibilities and opportunities as citizens. Several phases of the general subject were illustrated by a review of bills affecting engineers and engineering work. There were talks by a state senator, the engineer of a public service commission, an architect and the secretary of a civic organization. It is worth noting that the attendance was larger than at many of the meetings when technical subjects are presented. There is a wide field for activity along such lines, and it is to be hoped that the society will take further steps in this direction—including both city and state legislation—and that other societies will follow its example.

Interest in Future of Civil Engineers' Society

IT WOULD be erroneous to interpret the failure of the members of the American Society of Civil Engineers to express themselves freely to the Development Committee, commented upon recently in these pages, as evidence of a lack of interest in the society's future. Wherever two members are gathered together, particularly in the Middle and Far West, there society activities come under discussion. The interest is intense; nor is it a birth of yesterday nor of last year. For a long time the demand for activity has been growing, and that demand has become tempered with impatience because of the inaction. Nevertheless, human nature is the same in the civil engineer as in other members of society. We all have opinions and express them freely to our friends, but we communicate them to the press or to official bodies only on request or when the situation is of a nature that makes it impossible to withhold comment. The views are existent. They are receiving constant expression man to man. The bringing of them to light is but a problem of proper stimulation or of providing the proper forum.

Efficiency and Low Cost In American Shipbuilding

BELATED references to shipbuilding costs are found in the report made by Edward N. Hurley on his European trip in behalf of the Shipping Board. Until this document appeared, two weeks ago, the Emergency Fleet Corporation and its parent, the Shipping Board, published no cost figures save for a few general statements before Congressional committees. However, what Chairman Hurley now says about the cost of shipbuilding is much less important in its specific data than in its strong assertion of his conviction that we can build as cheaply as foreign shipyards. Not only as cheaply, he intimates, but even more cheaply if we will further increase our efficiency. This is a conviction that needs to be emphasized more and more, and supported in thorough fashion by facts and reasons. It is necessary to get all cost-pessimism out of the shipyard. Some of our best yard managers are victims of the belief that shipyards abroad—anywhere—are predestined to build ships more cheaply than we can. Such a conviction paralyzes shipyard effort. Knowledge and study of costs can remove it.

Overtime Work Decreases Efficiency

OVERTIME is so seldom named in listing the influences which tend to reduce the efficiency of labor in construction that its indictment by J. B. Lippincott in *Engineering News-Record* of Mar. 27, 1919, p. 605, deserves comment. Many causes led to low labor efficiency in our recent war construction, but some very shrewd observers have asserted that none was more potent than the wholesale indulgence in overtime work. Besides the normal reduction in output of 25 to 50% expected of men in overtime hours, greed for large pay, due to knowledge that overtime was encouraged, decreased output in straight-time hours. It is the merit of Mr. Lippincott's article that in some measure it evaluates this effect instead of expressing it in general terms. Overtime work as a practice is one of the most vicious sins into which the construction manager can fall. If others who, like Mr. Lippincott, have close knowledge of war construction, would in a similarly exact manner recite the lesson of experience with overtime, they would help greatly in clearing up the confusion which now exists. In particular, they would help to free the cost-plus contract from the criticism made by many, who know it only as a war measure, that it encourages workmen to loaf and shirk.

New York City Starts Sewage-Treatment Program

WHAT may be regarded as a beginning of a sewage-treatment program for New York City was described on p. 674 of our last issue. We do not mean that fine screens are sure to be adopted at each of the numerous treatment works that the peculiar topography of New York City seems to require, but merely that a start has been made in accordance with the general principles deduced from the long and detailed studies of the Metropolitan Sewerage Commission. The earlier fine screens at the Brooklyn sewage experiment station should not be overlooked, but they seem to be in a different class

from those at Dyckman St., which, with the grit chamber, compose the first plant built to treat Manhattan sewage and perhaps may be regarded as the first permanent modern plant for the city. Inasmuch as fine screens have some decided advantages for New York conditions, and since data for this type, as applied to American sewage, are few and not readily comparable, it is to be hoped that thoroughgoing scientific observations on the Dyckman St. screens, yielding both physical and financial unit-volume data, will be made. If New York City would lead the way some at least of the other cities using fine screens might be expected to follow—to the advantage of both New York and the country at large.

Advancing Views on Railway Labor Relations

CHANGING labor conditions are keenly appreciated by railway engineers. Track labor, drawn from the very lowest strata of the unskilled-labor supply, has in the past been treated with a thoroughgoing neglect of its human aspects. But in the light of the new labor conditions that have arisen since we took up arms two years ago, it is coming to be understood that efficiency no less than human justice calls for a different attitude. More consideration must be given to the human element, said a speaker at the recent meeting of the American Railway Engineering Association. He demanded that railway men work ahead toward the future demands of a public sentiment, rapidly developing not only here but all over the world. And the succeeding speaker, emphatically confirming this view, stated, "There has been more progress made by the railroads of this country in handling and caring for their common labor during the past year, I think, than in ten years before." He asked for further careful attention to the matter during the coming year. The speakers were seasoned railway men. Their years of experience are warranty that no sudden enthusiasm or impulse of oratory prompted their words, and what they said was but a reflection of general conviction among the men who direct the maintenance of our railways. There is a great promise in these new views. Most hopeful of all is the recognition of the fact that the doctrine of decent treatment of labor rests on sound reasons of efficiency, and that the high-priced laborer may, if properly handled, justify the larger wage paid him by the larger return he yields.

Scenic Highway Location Questions

DISREGARD of attractive scenery is charged against highway engineers by so many persons who influence public opinion that these engineers will do well to consider the subject. In their desire to attain long tangents, uniform grades and simple, easy curves, the improvers of highways have, it is asserted, forced the traveler to ride in cuts between banks which shut off picturesque views that are famous, and have compelled him to turn away from old, winding roads which offered beautiful scenes worth going miles to enjoy. We all know that the conservator of natural scenery detests any innovation that cuts a tree or drains a swamp. Many of us have felt the lash of his criticism even when we planned our improvements to meet his wishes to the best of our ability. He will never be satisfied; no specialist in artistic matters ever is satisfied But that is no reason why we should not do our utmost to assist the traveler to all the enjoyment of nature's charms, while doing our engineering duty of making his way smooth. The road located on paper may have the best grades and curves and the best balancing of cuts and fills, but when the line is finally run out on the ground and it is found that changes in it will certainly add to the pleasure of the traveler, those changes should receive very thoughtful consideration before they are rejected. Any other course wastes a natural asset and deprives the traveler of the best kind of enjoyment, without accomplishing any good.

Utilitarian and Scenic Need Not Be in Conflict

OBVIOUSLY, the point of view expressed in the preceding note brings into opposition the respective advocates of the scenic and the utilitarian highway. Between the two, however, there need be no real quarrel. Where roads obviously serve only light traffic andrun through a scenic district, greater emphasis can be laid upon the scenic feature. On the other hand, roads carrying heavy traffic through a flat or relatively uninteresting country need give little or no consideration to the scenic features. Only where heavy-traffic roads traverse a scenic district need there be a consideration of the two ideas and a balancing of one against the other. Obviously, common sense will control in the weight to be given to each factor. A point that needs emphasis, however, is that oftentimes the utilitarian purpose can be as well served by an interesting as by a dull road.

Pipe-Casing Job Furnishes Lesson in Co-ordination

COÖRDINATION of operations is absolutely essential in certain kinds of construction if reasonably economical results are to be secured. Road building is one of these kinds. A more unusual and also a more extreme example is the concrete casing of pipe lines. The linear extension of construction operations is great, and the volume of construction at any point is small. To schedule the performance of working gangs and machines so that each will be in close coördination with all the others, either adjacent or remote, becomes under these conditions an exceedingly complex problem. Its solution must be accomplished, however, if the work is to proceed smoothly and cheaply, and every example of successful solution, like that outlined on page 725, is helpful in perfecting procedure.

The necessary requirements for coördination on construction work of the kind being considered are: Extreme mobility of equipment, precise scheduling of performance, regular arrival of materials and supplies and prompt repairs of plant. Note how on the Louisiana pipe-line work fulfillment of these requirements was guaranteed. All equipment except mixers could be picked up by hand and carried ahead as fast as the men could walk. Corresponding mobility of mixing plant, which was too heavy for such quick movement, was secured by having two mixers, one of which was traveling ahead while the other was working. Materials supply was separated from the construction operations proper. Also, the detail task of handling and stocking materials on the work was separated from the general task of maintaining and routing deliveries. This subdivision of foremanship was extended to the pipe handling and also to the concreting operations. One concret-

ing foreman had the specific duty of keeping equipment in repair.

Construction seldom furnishes the opportunities which the factory offers for nice subdivision of the duties of foremen or for the application of functional foremanship, but the advantages of both need to be kept in mind by the contractor. The fewer the duties any one foreman has to perform the more precisely, ordinarily, will he perform them. Also, it is more easy to find the man who can perform one task well.

Comprehensive License Laws for Engineers

ENGINEERING license laws are being proposed and passed so rapidly that there is quite evidently no further need for argument to demonstrate the trend of the movement. It is rather only a question of what form the bills will take. The latest bills, abstracted on p. 616 of the issue of March 27 as well as previous bills which were compared in our issue of Feb. 27, 1919, p. 423, indicate the strong tendency toward the adoption of comprehensive laws including all classes of engineering—civil, mechanical, electrical, mining—also, in some cases, land surveyors as a separate and specific class. In the case of the proposed bills in Indiana (which failed to pass the last legislature), Michigan and Ohio, architects are also to be registered with engineers under a single law. The proposed Ohio bill goes so far as to include responsible assistants, even when working under a registered professional engineer or architect, on the plea that the law would be a farce if only the chief engineer of a city or large corporation, for example, need be registered while his many assistants in charge of work are not.

One of the essential features in any sound progress in this movement toward licensing is seen in the provision for specialized examinations. All bills authorize the practice of general engineering, even though separate certificates are granted. This is good practice. The examinations, however, should be devised to test the candidate in two particulars: First, as to his knowledge of fundamental principles underlying all branches of the profession, and second, as to his specific knowledge in the higher technique of his own specialty. Examinations of this type should properly safeguard both the profession and the public, and make the granting of general engineering licenses feasible and logical.

Whether a single comprehensive law to include architects as well as engineers is the best form, depends directly upon whether the architects really desire a law which will not overlap or interfere with any law proposed by the engineers. Aside from the tendency to draw the two professions into closer relation, which would naturally result in their working together for the passage of a common law, there seems to be no valid or convincing reason for bringing both professions under the same machinery of registration.

Whether those states in which surveyors or civil engineers only are now licensed will soon join the movement for more complete protection, as has just been done in Idaho, remains to be seen. In any case, the tendency toward comprehensive licensing bills is certainly strong and should be advanced by all engineers who have faith in the advantages of public recognition and believe in the necessity for greater solidarity in the profession.

Lessons from Professional Organization in England

PROBABLY no discussion of professional organization has had as wide a reading in this country as that which will be accorded to the abstract in this issue of the report by Sidney and Beatrice Webb on professional organization in England. The conditions disclosed bear a striking similarity to those that obtain in this country. On second thought one realizes that such would be the case, for the reasons for class groupings are always fundamental; the variations, therefore, are accidental rather than essential.

It will help to emphasize the applicability of the Webb findings to conditions in this country if we visualize the drama of American engineering society activities. Only a few years ago the four national societies alone occupied the stage, pursuing an even, dignified technical course. The next actors to appear were the local engineering societies, content for a while to play a relatively important rôle, but having a tremendous reserve of suppressed virility. Closely following were the sections of the national societies, bolder than the parents, becoming more indignant and more articulate as the insensibility of the parents to their needs and desires became apparent. Then entered the American Association of Engineers, young, unhampered by precedent, fearing not to tread where the older societies hesitated. Then came the Engineering Council, erected partly out of a desire to do the broader things demanded by the profession, partly as a means of defense against the swift-moving organizations that threatened to steal a march on the older societies. Last to enter are the unions, enunciating the theory that only by collective bargaining, by combining on demands, can adequate compensation be secured.

Nor are the characters in this drama of engineering organization willing to stand about and pose. Some of them—the older societies—were content formerly with that part. Now the action is swift. The initiative proceeds from the younger members of the cast—the locals, the sections and the A. A. E. The older societies are plainly on the defensive. Moreover, their weapon of defense, the Engineering Council, is itself in difficulties. The progressive elements damn it as too conservative and unrepresentative; the conservatives contend that it is too progressive; they question its budget, one of them has refused to appropriate the amount the council requested for the National Service Committee. The locals, meanwhile, in a corner by themselves, earnestly debate national problems and seek a mechanism for united action, while here and there are voices shouting for the submergence of all elements of differentiation and the formation of a single society for the whole profession.

But the action does not end there. Someone raises the question of licensing, and immediately there is a new hubbub, though shortly those demanding licensing prevail. However, in the wrangle the justifying argument has been changed from "protection of the public" to "the advantages to be derived from having a legal status."

The plot now becomes deeply involved. The clear cleavage between groups disappears, as factions split off due now to one issue, now to another, until it is apparent that there is need for someone to come in, to demand a truce, that consideration may be given calmly

to conflicting aims, that through crystal-clear statement harmony may be obtained when harmony is possible. Where the conflict is fundamental, clear statement will enable the dissenting groups to direct their courses more intelligently.

Feeling this need, let the reader turn to the Webb report. He will find there a keen analysis touching on most of the elements of the plot of the drama of American engineering society organization. He will find there the story of a matured conflict between the leaders and the rank and file; he will find union tactics discussed, not as a novelty, but as an abiding feature in even the most eminent of professional organizations; he will find argument justifying a multitude of engineering societies; he will find raised the question of amalgamation versus federation; he will find licensing (or registration, as they call it in England) treated as an essential feature of professional-society activity; he will find, above all, an insistent emphasis upon the need for placing ideals of community service side by side with the present selfish aims of professional societies.

One comes away from the report with the feeling that we are but beginning in the organization of engineers. and that we can modify our society activities very materially without detracting from the standing that we desire them to have. It is a bit of a shock to learn that eminent professional bodies have resorted to union methods. Yet we cannot dodge the advantages to some of such procedure, even as the Webbs do not condemn it.

This much, certainly, the report should do for us—make us more tolerant in the working out of our problems. There is no doubt that the older societies look with deepest apprehension at the growth of the A. A. E. and of the draftsmens' and inspectors' unions. To them, the structure of professional organization seems to be attacked at its very foundation. Yet does not the Webb analysis help us to conclude that the movements are but expressions of the needs of the rank and file, as against those of the leaders of the profession? The A. A. E. is already talking in those very terms, contending that it represents the "employed" engineers, and that the older societies represent the "employing" engineers.

Should we not, too, soften our intolerance of the licensing movement as a result of the Webb analysis· should we not get a clearer view of the ideal of general service, and of the tremendous difficulty of so organizing the profession that all its groups will be articulated?

Certainly we should be directed by the report back to fundamentals. There must be recognition that no power on earth can thwart movements that serve the interests of a large group, however much those interests may depart from our traditional views. Wherever there is a group of goodly size with interests clearly different from those of other groups, there will be found a new movement, a new society. To attempt to destroy it is futile. The part of wisdom is to help it find its place in the whole scheme, fit it in if it can be fitted, letting it work out its specialized problems itself, but in coördination with the interests of the whole profession.

Then should come recognition of the fundamental of conservation of energy—the elimination of duplication. Then the fundamental of efficiency—the recognition that real service lies not in declared intention, but in works, and in works based upon heartfelt sympathy, not on the cold logic of theoretical advantage. For example, as between the Engineering Council and the A. A. E., that one will dominate eventually which comes nearer the heart of the greater number in the profession.

If the fundamentals of professional organization are to be summed up in a sentence, we would say that self-interest, the development of technique, and service to the community are the three principles on which it is to be based, the service-to-the-community ideal enlightening the self-interest no less than the ideals of scientific research and development, which have been the important leaven heretofore. If these principles are kept to the front in all discussions of society organization, the difficulties will dissolve themselves more easily and the fitting of the parts into the whole will become a less complex task. Tolerance, too, will help, and to this the Webb report should make no small contribution.

Engineering Standardization—A Problem

A REVOLUTIONARY change in the mechanism of our technical and industrial life was inaugurated during the war period, by the formation of an Engineering Standards Committee, a joint committee of five national engineering societies. The new movement diverges sharply from the established system, under which competent bodies of specialists formulate standards of shape and quality for commercial products involved in technical needs.

The Engineering Standards Committee represents centralized effort in place of logically distributed effort. As a mere piece of centralization it has no special claim to support, for we already have possibly too much unconsidered centralization. But the new organization will stand or fall according to its effect in producing good or bad results. If it will disrupt and rearrange large portions of the present system, built up by several decades of labor and now in full and successful operation, it must show that it will accomplish a net benefit. Up to the present it does not appear to have received much attention, certainly not the wide and careful consideration that it merits. The individual engineer, in fact, has had no opportunity to study it.

Taken up as a war-time measure, when minds were not inclined to weigh the minutiæ of any undertaking that seemed to promise war service, the formation of the Engineering Standards Committee is now to be thought of solely with regard to peace purposes. The new body has produced no results so far. A more active period lies ahead, however. The problems which this coming activity involves are of large scope.

No great movement can succeed, whether in engineering or elsewhere, unless based on a commanding need, and unless planned with care to meet that need. What need will the Engineering Standards Committee meet?

Under present practice standardization is dealt with by bodies obviously competent in the specific subjects dealt with. Natural processes are relied upon to direct the work in proper channels. There is automatic selection of the appropriate tribunals to formulate the various standards, and equally automatic acceptance of well drawn standards. In many years of standardization this process has worked with entire success.

So, for example, the Master Mechanics' and Master Car Builders' Associations deal with uniformity and adequacy in the proportioning of cars and locomotives. Screw threads and fittings and many other subjects have been taken care of by the American Society of Mechanical Engineers. Quality requirements and uni-

form test and acceptance methods for a large range of material are studied to remarkably good effect by the American Society for Testing Materials, and cement-testing methods by the American Society of Civil Engineers. The latter society in the early days, and more recently the American Railway Association, promoted uniformity in rail sections. Bridge design, tie practice, and a host of track details are in the care of the American Railway Engineering Association. Lumber, cast-iron pipe, and other items in very large number are handled by other societies, all competent and recognized as such. So much for organized standardization. But far more important and more constant has been the standardization going on through industrial and commercial processes—as an example, standardization of electric lamp sockets. And one distinct virtue of the system now prevailing is that it avoids all interference with this natural growth of standards.

This complex mechanism has operated in prompt and delicate response to the developing requirements of industry. It has rarely sought to go ahead of these requirements, and has never succeeded in so doing.

What gain will be realized by the new system? This question is primary. No showing of advantage has yet been made, so far as we are aware. There has indeed been talk of conflict between existing organizations, and of failure to coöperate, requiring the firm hand of recognized leadership to bring about harmony. But what are the specific instances? The few cases of recent years in which there has been conflict of authority, or lack of joint consideration, do not, we believe, show a need for controlled coöperation, but contained in each case evidence that the field of work was not yet ripe for effective standardization. But there are further questions to be faced, questions that have not yet been answered; we desire to suggest a few of them.

What are engineering standards? What, in other words, is the field of the new committee? Can it define and delimit its scope, or does it propose to act on the plan of taking over everything resembling standardization work that may come into view? Frankly, we doubt whether the engineers and industrial men of the country are prepared to give a blanket warrant to a new and powerful body to bring about uniformity in any and every subject. Premature standardization is bound to prove confusing, and temporarily fettering to both engineering and industry. And, on the other hand, the delay to proper standardization from adding another element of mechanism may prove equally annoying.

The dangers of a lack of delimitation of scope are obvious, and yet compel scrupulously careful consideration. But it needs to be remembered also that questions of engineering design are often closely interlaced with those of standards, and that, if an unlimited field of action is at hand, mistakes are by no means unlikely, especially at the hands of a body acting by virtue of judicial character rather than competency.

Are we backward in standardizing? With our present mechanism we have taken account of all needs of technical industry as they developed; and standardization may easily run riot if a ponderous machine once gains momentum. Has there been failure to accept standards that have been formulated? Automatic acceptance has been readily accorded on merit to satisfactory standards. Shall we gain through standardization by fiat, by rubber-stamp approval, as a substitute for voluntary acceptance? These are but a few of the many questions surrounding the new movement, questions that address themselves to every member of the profession.

When so many doubts surround the matter, it is surprising indeed that the movement went ahead so smoothly and silently. To look back a few months: It was initiated in the early summer of 1917, with a view to building up an analogue of the British Engineering Standards undertaking, now a dozen or more years old. Whether any regard was had for the fact that conditions here are radically different is not apparent. At the time the first Engineering Standards commission was formed in England there was a deplorable lack of uniformity as well as of means to bring about uniformity. Every mill, for example, rolled different shapes and sizes of I-beams; and this subject was in fact one of the first to be taken up by the commission. Here, on the other hand, an extensive commercial automatic standardization had progressed far, and elaborate society work had long been under way, as already mentioned. These fundamental differences, if noticed, did not discourage the organizers of the American movement, however. After more than a year's work the present committee emerged. It has three representatives from each of the national societies of civil, mechanical, electrical, mining and testing engineers. It is to take control of all existing standardizing bodies, and act not through its competence but by exercising supreme-court judgment on the competency of others.

If representative character is needed to give the authority which this Engineering Standards Committee is to exercise, it has not been realized. Present difficulties surrounding the committee involve this very question, and a reorganization may be brought about. But will even a broadly representative committee or board add authority to a well drafted technical specification by its approval? Will a specification for steel rails, to take a definite example, gain in authority by approval on the part of a body composed of electrical, fire-insurance and boiler experts? This, after all, is one of the inevitable foundation questions, a psychological one rather than one of engineering method.

What we have said is of direct moment, we believe, to engineers in every branch and every society. Two groups of existing organizations, however, are additionally concerned in an even more personal way, as the fields in which they have long worked, with well earned recognition, are now to be gathered into the sphere of the Engineering Standards Committee. The one comprises the technical railway associations, chief among them the American Railway Engineering Association. The other consists of the American Society for Testing Materials. It seems likely that the railway associations will continue their work without thought of the new body, and will maintain their full authority over the matters entrusted to them. With respect to the American Society for Testing Materials, however, the case is otherwise. All its interests, and the peculiarly enthusiastic collaboration of many minds which for years has distinguished its activities, are involved in the risk of a seriously weakening process. No member of the testing society can be indifferent to the developments in connection with the Engineering Standards Committee; nor will any engineer who, though not affiliated with the society, has observed its excellent work, wish to see the new movement proceed if it is to take from the interest concentrated in its committee work, or reduce the service it renders.

Wood Construction Feature of Charleston Port Terminal

Design at Army Supply Base Largely Dictated by War Emergency, But Docks and Warehouses Illustrate Modern Use of Timber for Such Work

By Hunley Abbott
Engineer of Docks, Charleston Port Terminal, Charleston, S. C.

TIMBER construction mainly was used for the docks and warehouses of the Charleston port terminal, an Army supply base on the Cooper River at Charleston, S. C., because timber was the material most readily available for the rapid construction demanded last summer when the work was started. Concrete plans were originally prepared for the docks, but the pressing demand for speed necessitated the change to wood, although some concrete dock work was done after the armistice was signed. The timber details, however, represent the modern use of an old material in harbor structures, and as such are worth describing.

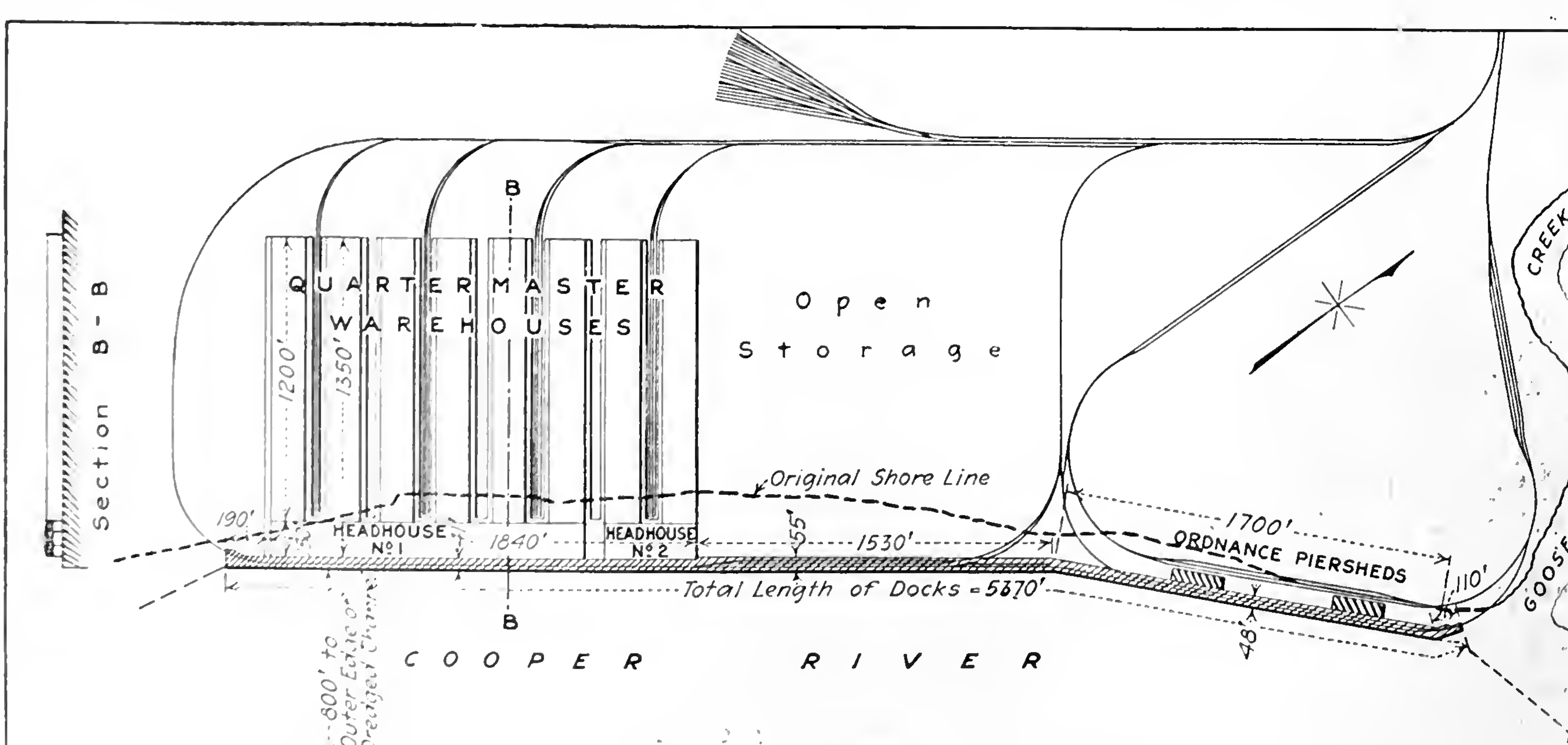
The Charleston port terminal is really three adjoining terminals: (1) A remount station and animal embarkation depot for the empoundment of Army horses and mules and their shipment abroad; (2) an ordnance depot for the storage and shipment overseas of ammunition, powder and TNT, and (3) a quartermaster depot for the storage and shipment of all quartermaster materials. It is only the quartermaster depot which will be described in this article.

The quartermaster depot consists principally of six large warehouses and two large sheds lying parallel to each other and at right angles to the waterfront. Connecting the outshore ends of these buildings are two headhouses, one running along the ends of the six warehouses and the other along the ends of the two sheds. On the outshore side of the headhouses, and connecting therewith, is the dock. The combined floor area of these warehouses and headhouses is 1,700,000 sq.ft. To the north of the warehouses is an open storage area, formed by dredge-filling the marsh, gridironed with tracks and with an available storage space of 1,320,000 sq.ft. Also, there are tanks and water towers, a power house, a locomotive roundhouse, several fire houses, barracks for about 3000 guard, stevedore and other operating troops, an ice plant, a bakery, a hospital and many other miscellaneous structures.

The warehouses and sheds are each 160 ft. wide by 1200 ft. long, with an 80-ft. space between buildings. A 20-ft. platform runs on either side of each warehouse. Three lines of track run down between each pair of warehouses and sheds. These connect with the yard trackage and are used for unloading incoming material. The elevation of these tracks is such as to bring the floor of the car flush with the platforms and warehouse floors, which are at El. 13, zero being mean low tide in the river.

The details of construction of the warehouses follow standard Construction Division practice: Wooden floors, columns spaced 20 ft. on centers and purlins, with tar and gravel roof. The floors are designed for a live load of 500 lb. per square foot. The warehouses, being built on marsh land, rest on pine piles, spaced on 6 ft. 8 in. centers both directions, and which extend above ground and are cut off and capped with 10 x 12-in. floor stringers. The main walls are of tile and brick, and the warehouses are divided transversely every 100 ft. by brick and tile fire walls entirely free of openings, thus dividing the warehouses into a number of fire-insulated compartments. All warehouses are one-story high, except that a second story is built on the lower end of warehouse No. 6 for offices, etc. All openings are provided with fire-resisting doors, and a complete automatic sprinkler system has been installed throughout these buildings, thus providing another safeguard against fire.

The headhouses are 150 ft. wide and have a combined length of 1840 ft. They are of similar construction to the warehouses except that they are considerably



PLAN OF THE TERMINAL END OF THE CHARLESTON ARMY SUPPLY BASE

higher and have a column spacing of 20 x 50 ft. with wooden trusses in the 50-ft. spans. There is a clear height of 20 to 25 ft. from the floor to the under side of trusses. The headhouses are divided into compartments by tile and brick cross walls every 120 ft., and are provided with fire doors and sprinklers, as in the warehouses. All the walls are supported on concrete foundation walls (supported by wooden piles) and the outshore headhouse foundation wall also supports the inshore end of the dock caps.

The columns resting on this outshore wall are of steel instead of wood, and project some 35 ft. above the roof, leaning forward at a slight angle to form a system of cargo masts extending the full length of the quartermaster headhouses. Between the tops of the masts are hung 15-in. I-beams, pin-connected so as to permit the I-beams to swing. Fastened to the web of the I-beam and depending below the lower flange are pin-connected shackles spaced 5 ft. on centers.

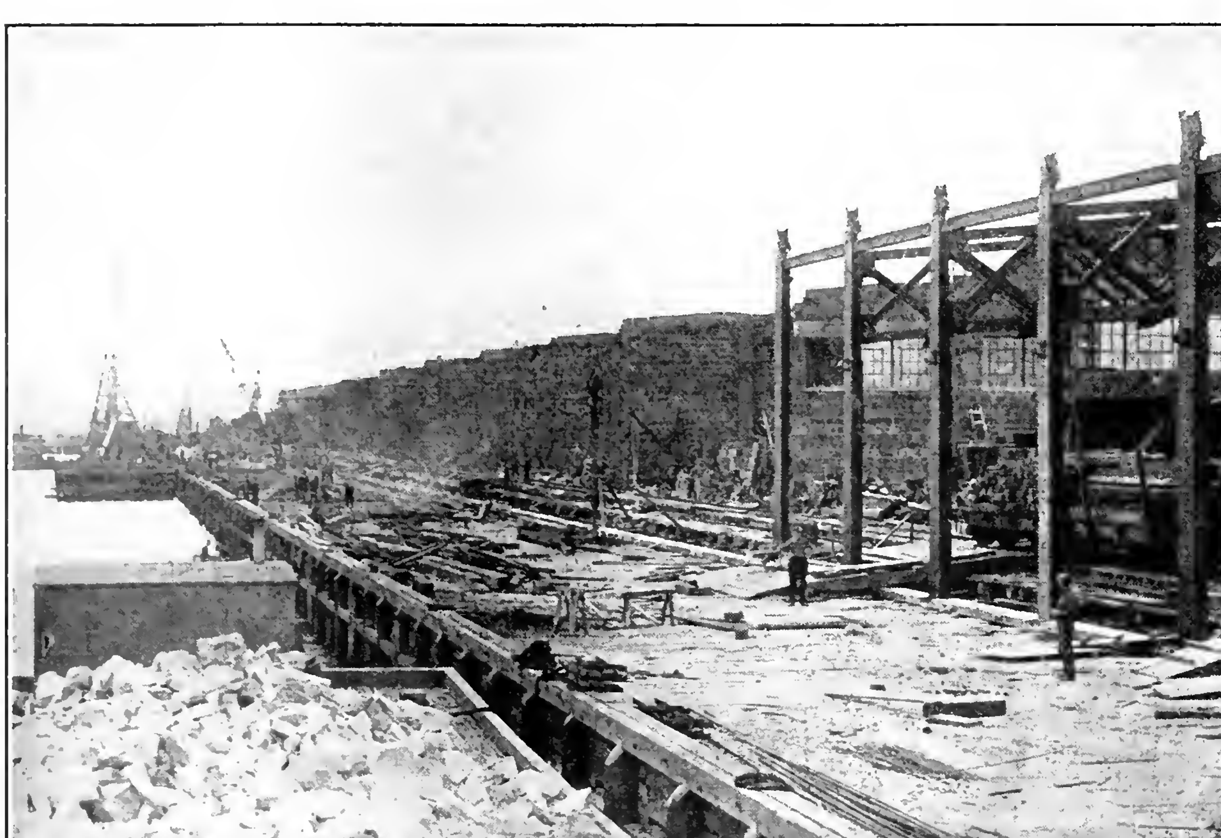
Extending along the front of the quartermaster headhouses, north through an open stretch of about 2000 ft., and in front of the two ordnance pier sheds, run the docks, which are slightly over a mile in total length.

The ordnance pier sheds and the quartermaster headhouses are built out in the water and are supported by untreated pine piles. The teredo is very active in the Cooper River even as far upstream as this terminal, consequently it became necessary to protect these piles from attack. This was done by driving wooden sheet piling in front of and returning shoreward to the north and south of the warehouses. Back of this sheeting, under the warehouse floors and surrounding the bearing piles, was pumped a dredged fill to El. 7.5. At this point there is an average tide of 5 ft. in the Cooper River, so this fill protects the piles at all stages of water. The sheet piling is of untreated lumber, and to protect it from the teredo it was originally planned to bank up filled material in front of it and under the dock, allowing it to slope out to deep water at the face of the dock. Owing to the very flat slope assumed by this material, however, and on account of the narrow width of the dock, it was not found possible to pile this fill up to the top of the sheeting without having the toe of it extend far out beyond the face of the dock. Therefore, a triangle of riprap stone was used instead. The depth of water at the sheet piling varied from 8 to 22 ft. Six-inch sheeting was used in the shallower depths, and 12-in. sheeting in the deeper water. The 12-in. sheeting ran 40 ft. in length and was made of 12 x 12-in. Oregon fir with 3 x 4-in. tongue-and-groove strips spiked thereto.

The progress of the work necessitated the placing of the fill behind the sheeting considerably in advance of the receipt of the riprap, and it was, therefore, necessary to brace the sheeting sufficiently to withstand this earth pressure. This was done by tie rods of 1¼-in. diameter, spaced 5 to 6½ ft. apart, passing through 12 x 12-in. wales at the top of the sheeting and tied back into a 12 x 12-in. deadman about 35 ft. in the rear. This deadman rested behind a row of warehouse piles, and two batter piles were driven, one on either side of each vertical pile in this row. The heads of the batter piles were cut with a vertical and horizontal face, the pressure being transferred to the batter piles by the deadman, and the upward reaction of the batter piles being taken care of by 12 x 12-in. chocks bolted to the vertical piles.

Additional resistance was provided by 3 x 10-in. cross-bracing on each row of foundation piles running at right angles to the deadman and extending from the deadman forward toward the sheeting. A cross-section through the 12-in. sheet-pile bulkhead is shown in a drawing. The bracing for the 6-in. sheeting is similar to the 12-in., but only one batter pile is driven at each vertical pile, and the cross-bracing is omitted. There is approximately a half mile of this sheet-pile bulkhead wall in front of the quartermaster and ordnance warehouses.

The original plan of the docks called for an all-concrete construction comprising concrete piles and a reinforced-concrete dock. When the job was very young and only a few of the piles had been cast, it became very evident that the inexperienced labor available here and the inherent nature of this type of construction would prevent the completion of this work in anywhere near schedule time. Since speed was "of the essence," this type of construction was thereupon abandoned, and a creosoted-pile and wooden-deck design was quickly prepared; this is the dock which has been built.



LOOKING ALONG THE DOCK FRONT OF THE CHARLESTON PORT TERMINAL DURING CONSTRUCTION

The dock widths vary from 41 ft. in front of the quartermaster warehouses, 55 ft. in the open dock north to a slight angle in the dock, and 48 ft. from there on north in front of the ordnance pier sheds to the north end of the dock, which terminates at the mouth of Goose Creek. The depth of the water along the dock front varied from 10 to 30 ft. This has been dredged to give 30

DOCK WAS BUILT OUT IN RIVER AND FILLED IN BEHIND LATER

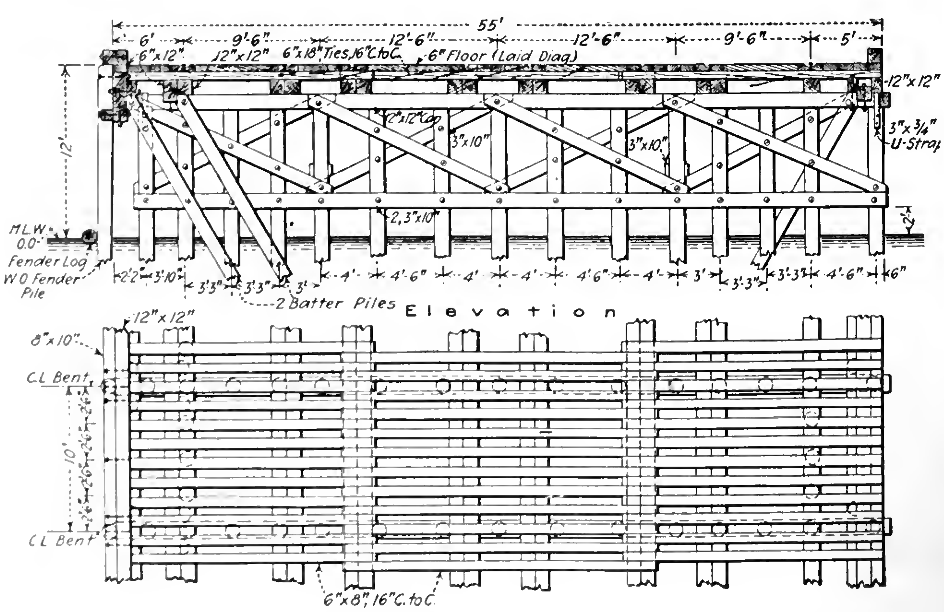
ft. of water below mean low tide throughout the entire length of the docks. A 400-ft. channel was cut from the navy yard up to this terminal, which channel widened out to 800 ft. in front of the quartermaster warehouses and to 1000 ft. in front of the ordnance pier sheds, thus forming a turning basin for ships. The dredged material, consisting mostly of a bluish-green clay, was used to fill in under the warehouses and on other marsh ground along the waterfront. Approximately 2,000,000 cu.yd. of material was moved to cut this channel, several rotating cutter dredges being used.

The docks are designed to carry a live load of 500 lb. per square foot, together with certain railroad and gantry loads. The floor of the dock is at El. 12, with a slight upward slope from face to rear. This floor comes flush with the warehouse floors where the two meet. All piles, except fender piles, are creosoted, the lengths varying from 40 to 80 ft. They are driven in bents spaced on 10-ft. centers, and each bent is capped with a continuous stick of 12 x 12-in. Oregon fir, drift-spiked to the piles.

A system of bracing on each bent extends from the cap down to El. 2. Two horizontal 3 x 10-in. timbers are bolted on either side of the piles at that elevation, and 3 x 10-in. cross-bracing runs between these and the pile cap, being bolted to the piles and the cap at intersections. All the bolts are of 1-in. diameter. It was originally planned to use creosoted timber for all this bracing, since it will be under water at high tide. On account of the delay in obtaining this creosoted material, however, untreated pine lumber was used. This will be eaten away in time by the teredo and will have to be replaced, and at the time of replacement creosoted lumber will probably be used.

On those sections of the dock that are in front of warehouses there are two batter piles in front and one in the rear at each bent. In the open sections of the dock there are four batter piles per bent in front and one in rear. The heads of the batter piles are cut so as to have a part horizontal and part vertical face. These faces bear against longitudinal timbers running over the pile caps and bolted thereto. At such point on the cap a 3 x ¾-in. steel U-strap ties the cap to a vertical pile, thus transmitting the upward reaction of the batter pile through the timbers and cap and down into the vertical pile.

On the dock in front of the quartermaster warehouses there is one line of standard railroad track and two rails spaced 19 ft. apart for a 5-ton gantry crane. On the 55-ft. wide section of the open dock there are three lines of railroad track and rails spaced 44 ft. apart



DETAILS OF TIMBER DOCK BETWEEN QUARTERMASTER AND ORDNANCE SECTIONS

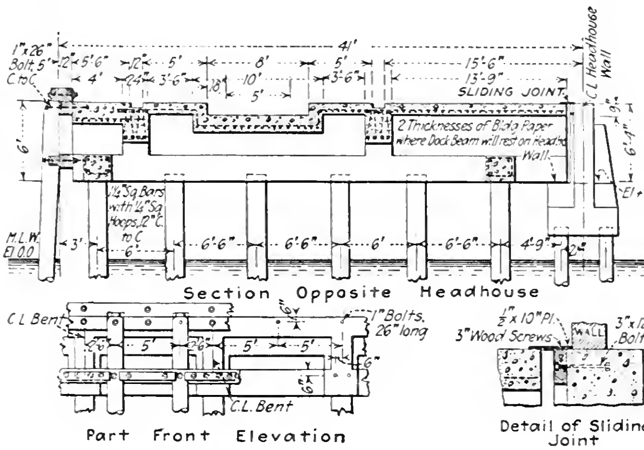
for a 10-ton gantry. Standard 80-lb. rails are used for the gantry tracks, and Russian rails 5 in. high with tie plates for the railroad tracks. Two 12 x 12-in. pine stringers are placed under each rail of the railroad track, and one 12 x 12-in. stringer under each gantry rail. Supporting this gantry stringer are three additional creosoted piles spaced between each bent, thus giving a pile every 2½ ft. under this stringer.

On top of these track stringers are laid 6 x 8-in. cross-ties spaced 16 in. on centers, and these ties also support the 6-in. floor in the neighborhood of the tracks. In places where no tracks occur the flooring is carried by 6 x 12-in. stringers 3 ft. on centers resting on a 6 x 8-in. timber spiked to the top of the cap.

Several heavy timbers are framed in on the face of the dock for stiffness, and a 12 x 12-in. bumping timber projects above the floor at the face of the dock and, in the open sections, in the rear also. White-oak fender piles are spaced on 10-ft. centers in front with an 8 x 12-in. fender cap and a line of 8 x 10-in. fender chocks.

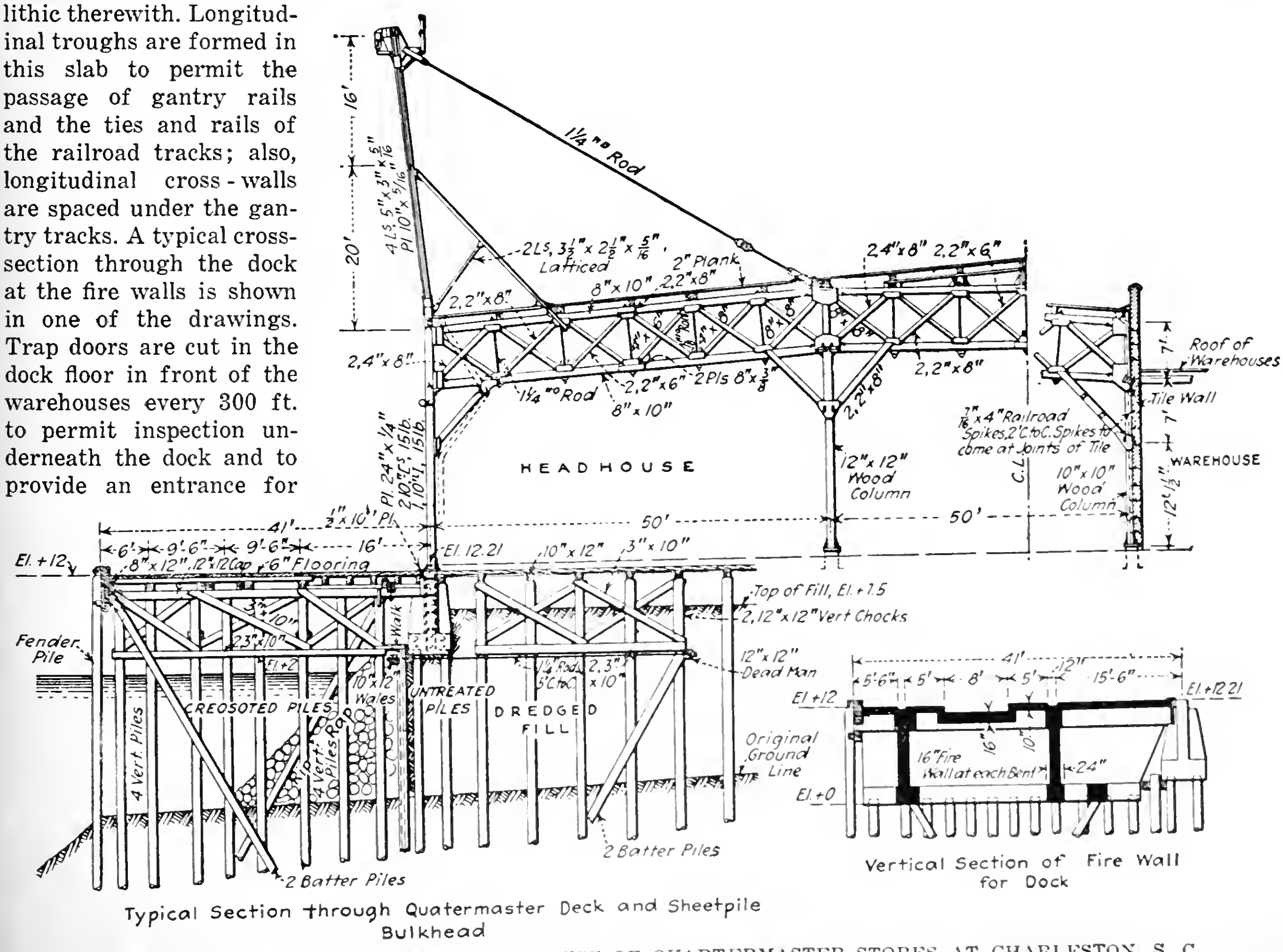
A 3-in. space is left between the rear of the dock and the front wall of the warehouses to allow for any possible movement of the dock when a ship is brought alongside. This slot is covered by a 10 x ½-in. steel plate.

The docks are divided into 300-ft. sections by double fire walls. The piles in two adjoining bents are cut off near low water, and a 16-in. concrete wall is built on each bent. The bottoms of the walls are at mean low water, and are tied together by longitudinal reinforced-concrete struts. A reinforced-concrete deck spans between the tops of the two walls and is monolithic therewith. Longitudinal troughs are formed in this slab to permit the passage of gantry rails and the ties and rails of the railroad tracks; also, longitudinal cross-walls are spaced under the gantry tracks. A typical cross-section through the dock at the fire walls is shown in one of the drawings. Trap doors are cut in the dock floor in front of the warehouses every 300 ft. to permit inspection underneath the dock and to provide an entrance for hose lines in case of fire. Standard types of mooring posts and cleats are spaced every 80 ft. along the outer edge of the dock. A group of dolphin piles was driven at the outshore corner at each end of each dock.



CONCRETE ALTERNATIVE DESIGN OF CHARLESTON DOCK WALL NOW BEING PLACED

When the armistice was signed and speed of construction became less vital, it was decided to use the concrete piles already cast to build 150 ft. of reinforced-concrete dock, in accordance with the first plan. These piles were 52 ft. long and 18 in. square, with beveled corners. The lower 2 ft. of length was tapered to a 6-in. square point. They were reinforced with four 1¼-in. square rods spaced 3 in. from the face of the pile to the center of the rod. The main rods were



DETAILS OF TIMBER DOCK AND HEADHOUSE OF QUARTERMASTER STORES AT CHARLESTON, S. C.

tied together every 12 in. by hoops made of ¼-in. steel. These hoops were spaced 4 in. for about 5 ft. at the head, and 3 ft. at the point of the pile. About 4 ft. from the head of the pile a short length of pipe 3 in. in diameter, was cast in the pile at right angles to the axis. This gave a convenient point to which to tie in handling the pile in the driver leads. The piles were cast on large platforms. Wooden forms were used for the piles, with a space of 9 in. between each set of forms, to facilitate stripping. When the concrete was sufficiently set these forms mere removed and were used again to form a pile on top of the previous one. In this way three tiers of piles were cast.

The piles are cut off at El. 6.5 with the pile reinforcing rods projecting 2 ft. about the cutoff, and a heavy concrete girder wall caps each bent of piles. This wall extends up to and is monolithic with a 9-in. reinforced-concrete floor-slab spanning between bents. Heavy girders are cast under the gantry rail, and a trough is left for the railroad track similar to that in the fire-wall construction. Two longitudinal struts brace the bottom of the bent caps, one strut near the front and one near the rear of the dock. A typical cross-section of this concrete dock is shown in one of the drawings.

After the armistice was signed, one of the ordnance pier sheds and the dock in front of it were abandoned; also a portion of the open dock between the quartermaster and the ordnance warehouses was omitted. All of the quartermaster warehouses and headhouses are built, however, together with about a half mile of dock in front of them; also 700 ft. of dock in front of the ordnance pier shed.

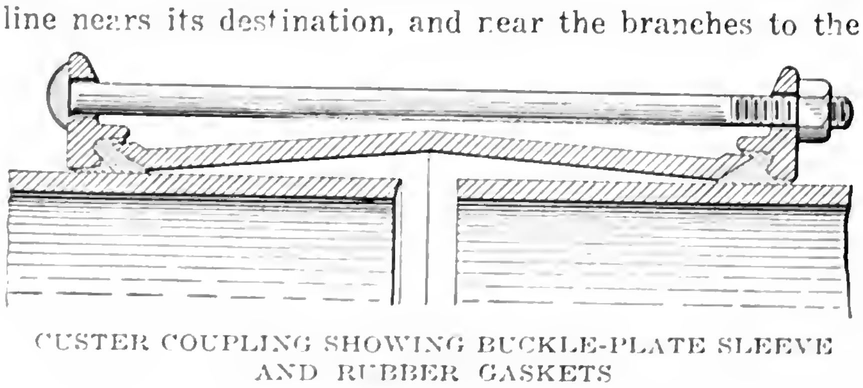
The total cost of this project will be approximately $17,000,000. The work was in charge of the engineering branch of the Construction Division of the Army, under the supervision of Col. Lincoln Bush, Lieut. Col. R. M. White, chief of the Port Terminal Section, and Lieut. Col. L. L. Calvert, supervising constructing quartermaster. Col. F. E. Lamphere was constructing quartermaster in charge of the work in the field. The Mason & Hanger Contracting Co. was the general contractor, and the Degnon Contracting Co. was the subcontractor on the ordnance magazines and part of the docks. The Atlantic, Gulf & Pacific Co. was the contractor for the dredging.

Constructs Largest Gas Line in the United States

Coke Plant Builds Gas Main 40 Inches in Diameter Laid Near Pittsburgh—Method of Construction and Joints Described

CONSTRUCTION of what is reported to be the largest gas line in the United States, and probably in the world, is now being completed for the Carnegie Natural Gas Co. The line has a maximum diameter of 40 in., is 11 miles long, has a daily capacity of 70,000,000 cu.ft., and is capable of sustaining a pressure of 200 lb. per square inch, but will actually work under a pressure of from 30 to 50 lb. It is being built to convey gas from the byproduct coke plant of the Clairton Coke Works to the Duquesne, Homestead, and Edgar Thomson steel mills near Pittsburgh. The joint used is of the Custer type, with rubber gaskets. The flexibility of this joint, due to its buckle-plate sleeve, is said to have made it much easier to obtain tight joints over this rough country, which required many vertical and horizontal curves. This feature also expedited the field work and made it possible to lay the pipe with inexperienced men and at a minimum cost.

Design and Location of Line—The pipe for this line is of the lock-bar type, with plain ends. The uniform thickness, for all sizes from 30 to 40 in., is ⅜ in. Three diameters of pipe are being used, as follows: There are 38,081 ft. of 40-in.; 12,381 ft. of 36-in. and 7881 ft. of 30-in. These reductions in size are made as the line nears its destination, and near the branches to the various manufacturing works. It was necessary to use riveted pipe in certain special sections for very sharp curves and for a riser which was required at a bridge.



CUSTER COUPLING SHOWING BUCKLE-PLATE SLEEVE AND RUBBER GASKETS

As the line passes through a hilly country, the vertical and horizontal curves are numerous; this required special beveling of the ends of the pipe so that they would fit tightly together. The grades and alignment were carefully worked out, and the pipe for curves were cut and match-marked for assembling. Where the curves are of large radius, the play allowed by the flexible joints used is sufficient to make the turn. The design of this coupling is shown in the sketch. The buckle-plate sleeve which abuts against the rubber gasket allows for an opening of from 1 in. to 1½ in. on the outside of curves, while still maintaining a gas-tight joint. By proper beveling a curve of 133-ft. radius was laid. To round this curve, which is shown in the illustration, six 17-ft. lengths, beveled 2¼ in. each end were used. The central angle of the curve is 44° 3 min. and the tangent length is 54 feet.

ROUNDING SHARP CURVE

Construction—Pipe was delivered at the site by rail, the standard length being 30 ft. It was loaded nine per car for 30-in., eight per car for 36-in., and five per car for 40-in. diameter. Delivery to the line was by teams, as it is has been found by experience that they cannot be equaled for this work, on account of the roughness of the country through which the lines generally run. The pipe can be loaded and unloaded by various means, but the general practice is to snub them down skids from the cars to the wagons, and from the wagons to the ground at the location. Accurate

TRENCH CUT BY EXCAVATOR —PIPE INSTALLED

placing is, of course, conducive to efficiency in laying, and this received particular attention. The pipes were distributed and strung out parallel to the line, as near as possible to the place they would finally occupy. However, where the line ran along a side hill, it was often necessary to lay them at right angles to the line to keep them from rolling. This caused extra expense in laying pipe.

Excavation—The nature of the soil along the line varies from heavy clay to hard rock. A large part of it is clay, and for such sections a specially designed trenching machine which digs a trench 54 in. wide is used. This width of trench will accommodate a 40-in. pipe. Where rock is encountered, a light revolving steam shovel of $\frac{3}{4}$-cu.yd. capacity, having a long dipper-handle is used. The trench is first drilled and blasted, and then cleaned out by means of the steam shovel. The general depth of the excavation runs from 6 to 8 ft., two feet of covering being considered advisable.

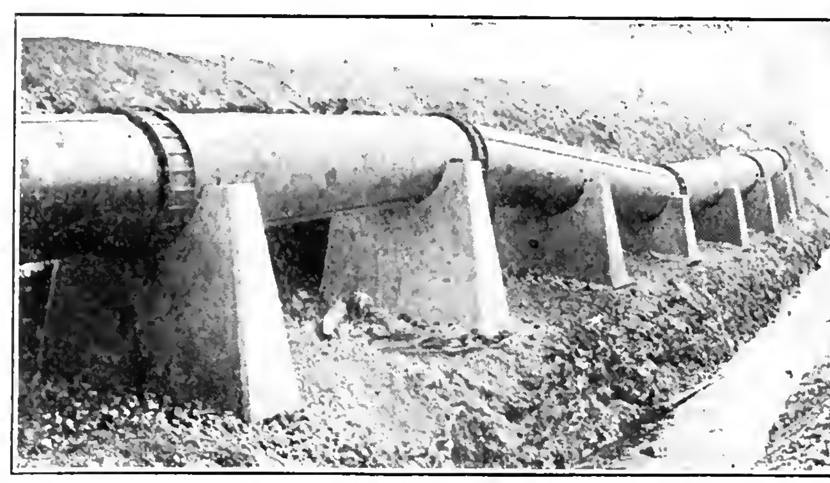
With the trenching machine 500 lin.ft. of trench, from 6 to 8 ft. deep, is excavated in 10 hours. The gang required for this work is an engineer, a fireman and 15 men. These are required to keep the buckets of the excavator from clogging, to keep the track clear for the track-laying tractive device, and to place planking where necessary. A view of the trench cut by the machine, with the pipe installed, is shown in the illustration. In some places, where the ground is unstable, it has been necessary to slope or sheet the sides of the trench.

Pipe Laying and Joining—After the delivery of the pipe, and upon the completion of the trench to the proper line and grade, pipe laying is accomplished by means of tripods supporting block and tackle operated by a winch, as shown in an illustration. After lowering the pipe into the trench and adjusting the joint, the back tripod is moved forward, while the forward tripod supports the end of the pipe until the insertion of the next length. In adjusting the joint the back ring is first put upon the pipe, and the rubber gasket, which fits snugly against the pipe, is snapped over it and pushed back to position in the ring groove. The buckle-plate sleeve is next inserted, after which the next length of pipe, with the forward ring and the rubber gasket already in place, is inserted in the sleeve. The ringbolts are now placed and the nuts tightened up temporarily. A $\frac{3}{8}$-in. clearance between the ends of the pipe is allowed for expansion. After temporary placing and tightening of the bolts, an auxiliary gang follows and completes this tightening, which presses the buckle-plate in against the rubber gasket, making an air-tight joint.

LOWERING THE PIPE WITH TRIPODS AND ADJUSTING THE JOINTS FOR TIGHTENING

One foreman and 30 to 35 men lay and completely connect up about 400 ft. of this gas-line per day, including an initial covering with about 1 ft. of earth. Inasmuch as there is no riveting, the work can all be done with ordinary labor under proper supervision.

As soon as a mile of pipe has been laid and the centers have been backfilled, it is subjected to what is known as a soap-and-water test. This consists of sealing the ends of the pipe and going over all field joints with soap and water, so that when the pipe is subjected to the required pressure of 50 lb. per square inch, soap bubbles will appear upon the surface, if there is leakage. The individual sections of pipe receive this test before leaving the shops. This is considered one of the severest tests that can be required of a gas line.



PIPE LAID UPON CONCRETE PIERS WITH 15-FOOT SPAN ALONG EMBANKMENT

Backfilling—Backfilling is accomplished by means of a dragline machine. With a gang of six men about 300 ft. per day is backfilled on the average. It is necessary to dress up the final surface by hand.

Work upon the 48,000-ft. line to the Duquesne and Edgar Thomson steel mills began Oct. 1, 1917, and was completed Aug. 31, 1918. The 12,000-ft. branch to the Homestead steel works is now being completed. The average gang employed upon the work has been 1000 men, who work in several gangs. In special cases the pipe was laid above ground on concrete piers with a span of about 15 ft., as shown in one of the illustrations. Being a gas line, it is unnecessary to keep it covered on account of frost.

The T. A. Gillespie Co., of New York is the contractor for the construction, and the lock-bar pipe is being furnished by the East Jersey Pipe Corporation.

Notes on the Design of a Single-Wall Cofferdam

Size and Location of Timber Wales and Braces and Size of Timber and Steel Sheeting Developed From Both Theoretic and Economic Considerations

By F. R. Sweeny
Engineer, The Foundation Co., Pittsburgh, Penn.

COFFERDAMS are too often built by rule-of-thumb methods, regardless of structural or economic requirements. The following analysis is offered as a practical and ready solution of the design of the most generally used type of cofferdam, the open pit in which the retained earth or water is held by vertical sheet-piles bearing against longitudinal wales and cross-braces. Such a coffer is shown in plan and cross-section in Fig. 1, which also gives the diagram of pressure,

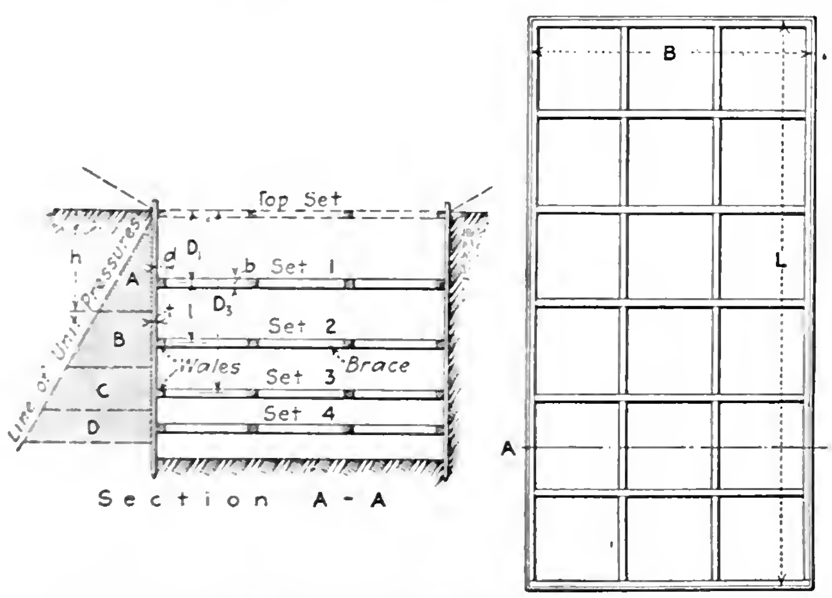


FIG. 1. PLAN SECTION AND OUTSIDE PRESSURE DIAGRAM OF SINGLE-WALL COFFERDAM

assuming that the horizontal unit pressure varies directly as the depth.

Let

w = Weight per cubic foot of material outside sheeting.

c = Ratio of horizontal to vertical pressures.

s = Span of wale in feet.

N = Number of rows of wales from surface (not counting top set).

D_1, D_2, D_N = Distance from surface to corresponding wale.

b = Width of wale as a beam.

d = Depth of wale as a beam.

l = Span of sheeting or distance between wales.

h = Depth from surface to any point.

W = Allowable load on wale of span s and section $b \times d$.

k = Safe unit stress in wale.

b' = Width of single sheeting.

In addition to the above assumptions, let areas A, B, C, and D be equal, which means that all wales are the same size. It follows from these assumptions that the top wale set will be theoretically of zero size, since it is supposed to carry no part of the load from area A. From practical considerations this set is always placed, but it will form no part of these discussions, since, by so doing, the conclusions will in no way be affected. This set is shown dotted.

The total load on N wales over one panel =

$$\frac{1}{2}wch^2s = NW \text{ or } N = \frac{wch^2s}{2W}$$

But since $W = \frac{kbd^2}{9s}$ then

$$N = \frac{4.5wch^2s^2}{kbd^2} \qquad (1)$$

$$h = \sqrt{\frac{kbd^2N}{4.5wcs^2}} \qquad (2)$$

Equating the moment of the total pressure area, to include N wales, to the sum of the moments of the wale reactions about the surface, we get the following expression,

$$NW \times \frac{2}{3}\sqrt{\frac{kbd^2N}{4.5wcs^2}} = WD_1 + WD_2 + \ldots + WD_N$$

Solving for D_N we get

$$D_N = \frac{2}{3}\sqrt{\frac{kbd^2N^3}{4.5wcs^2}} - (D_1 + D_2 + D_3 + \ldots + D_{(N-1)})$$

Substituting the value of $D_{(N-1)}$

$$D_N = 0.314\frac{d}{s}\sqrt{\frac{kb}{wc}}\left(\sqrt{N^3} - \sqrt{(N-1)^3}\right) \qquad (3)$$

Equation (3) expresses the law of wale spacing, but would be of little practical value to the engineer in this form, as it is too complex for ready calculation. We can reduce this, however, to a very handy diagram, Fig. 2, (see page 710) in which all the variables are taken care of except k, w and c. For the diagram some constant value is assigned to these variables and the cases in which they may differ from the values assigned are provided by means of a table of constants, which will be taken up later.

In the right-hand side of the diagram let the abscissas be N and the ordinates the depth D to the wale N. The third variable s is taken care of by constructing, in the left-hand diagram, a different vertical scale for each value of s. These scales will vary in length directly as the span, and so can be most easily laid off by drawing radial lines from the point of intersection of the surface line with the zero span line. Now solve the equation for s equal to 10 ft. for all values of N and timber sizes $b \times d$ and plot the curves as shown. The depths to the different wales will be found on the proper span line opposite the points where the vertical N lines intersect the wale curves.

For example, let us assume a cofferdam 25 ft. deep and 12 x 12-in. wales. The factors determining the wale size will be considered later. We will also assume a span length of 12 ft. Reading down the 12-ft. span line in the left-hand diagram opposite the successive points where the vertical "No. of wales" lines on the right intersect the 12 x 12-in. wale line, we get the following depths, 0, 5½, 9½, 12½, 15, 17, 18¾, 20⅓, 21¾, 23⅓, 24½.

It will be noticed in the diagram that the wales are numbered starting with the one at the surface. This would not be true in plotting from the formula, but for

practical reasons the numbers have been shifted to include this one.

Many cases will arise in which different values of k, w and c will be chosen. In order to meet these conditions a table of constants must be developed whereby the data as taken from the diagram may be modified to produce the correct results. The constant in Eq. (3) is represented by the expression

$$0.314\sqrt{\frac{k}{wc}}$$

Which for the diagram in Fig. 2 is

$$0.314\sqrt{\frac{1500}{62.5 \times 1}}$$

Therefore to obtain any other value for D_N with other values for k, w, and c, the expression will be

$$\frac{D_N \text{ (from diagram)}}{0.314\sqrt{\frac{1500}{62.5 \times 1}}} \times 0.314\sqrt{\frac{k}{wc}}$$

From which we get as the value of the constant by which we multiply the depths as taken from the diagram

$$\sqrt{\frac{k \times 62.5}{wc \times 1500}} \qquad (4)$$

The accompanying table is worked out for both level and surcharged conditions, the unit weights and constants c are taken from Peele's "Mining Engineers' Handbook," p. 2233. If we assume $k = 1000$ lb. per square inch and dry sand with level surface for the digging material, then the depths as found in the example previously worked out will be modified by multiplying by 1.24, giving the following depths, 0, 6.84, 11.78, 15.5, 16.61, 21.1, 23.3, and the next comes at the bottom, or 25.2.

Design of Sheeting—So far only the wales and struts have been considered, but as the pressure is transmitted to them through the sheeting, the relation between sheeting span to wale spacing must be determined and plotted on the diagram in order to determine the limiting thickness for each layout of wales.

From Fig. 2 the following relation holds:

$$\frac{whcl^2}{8} = \frac{kb't^2}{12 \times 6} \text{ or } t^2 = \frac{0.75wchl^2}{k} \qquad (5)$$

Let $l^2 = (D_{(N+1)} - D_N)^2$ and substituting the value of h from Eq. (2) into Eq. (5) and using Eq. (3)

$$s = \sqrt[3]{\frac{0.0349d^3}{t^2} \times \sqrt{\frac{b^3k}{wc}} \times \sqrt{N}\left[\sqrt{(N+1)^3} - 2\sqrt{N^3} + \sqrt{(N-1)^3}\right]^2} \qquad (6)$$

Solving this equation for the different values of t, bd and N with the same values for k, w and c as used for the wales, the sheeting lines can be plotted on the diagram (Fig. 2). These are shown at the left crossing the span lines.

It is important, at this point, to call attention to the fact that the sheeting thickness is determined by the span near the surface and *not at the bottom* as held by many. The reason for this becomes apparent from Fig. 2, whence it will be seen that, whereas the load on each wale and therefore each span of sheeting is constant, the span is greater at the surface—the bending moment being proportional to the span, in this case. Note that in Eq. (5) and (6) the sheeting spans l are not considered as continuous, this being in line with good practice, since it is difficult to tell very much about the strength of wooden sheeting after it has been driven the full depth of the cofferdam. In the case of steel sheeting, however, we can and do consider it continuous.

To make the diagram complete, lines have been added for Lackawanna steel sheeting, both for the $\frac{3}{8}$ x $12\frac{3}{4}$-in. straight web and $\frac{3}{8}$ x 14-in. arch web for 12 x 12-in. and 14 x 14-in. wales, the resisting moments of which have been taken from the manufacturer's catalog. It is interesting to note, by way of comparison, that, considering the wooden sheeting noncontinuous and the steel continuous, the straight web sheeting is approximately equivalent to 5-in. wooden sheeting and the arch web to something over 7 inches.

In determining the limiting sheeting thickness, in any case it must be borne in mind that this will be found in the diagram opposite the position of the wale, the minimum sheeting for the full depth being found opposite the second wale for reasons just stated; thus, the sheeting lines have been discontinued above this point.

In regard to the change in values of k, w and c as in the case of the wales, these functions bear the inverse relation to t that they bear to D, therefore the same constants will hold good, but, instead of multiplying, the thickness must be divided by them.

Economics of the Structure—In determining the value of the unit stress k, it is well to bear in mind that higher values than are used in permanent structures are permissible, since the matter of deflection is ordinarily of little moment, provided sufficient strength is developed, with a reasonable factor of safety. Thus, it is thought that, for ordinary uses, 1500 lb. is a good value.

The values of w and c are not so easily determined, being largely matters of mature judgment. In any event, it is important to look into the matter of possible saturation of the soil to the point where hydrostatic pressure will be developed and superimposed upon the earth pressure.

When we begin to look into the matter of the size and span of wales and braces, we see that quite a number of factors enter in, chief among which are (1) proper clearance for dredging and other work, (2) layout of the permanent structure within, (3) economic considerations.

Let us investigate, first of all, just when the most economical condition obtains and in connection therewith consider the other factors.

Nothing has been said, up to this point, about the size of braces, so it will be assumed that they are the same size as the wales, which is not theoretically correct, but the assumption suffices for this investigation, as will be seen further on.

From Fig. 1, the total ft. B.M. of timber =

$$\left[\frac{2LB}{s} + B + L\right]N\frac{bd}{12} + [L + B]2Ht$$

Substituting the value of N from Eq. 1

$$Ft.B.M. = \left[\left(\frac{2LB}{s} + B + L\right)\frac{0.375cwH^2s^2}{kd}\right] + [B + L]2Ht \qquad (7)$$

The expression in the first bracket represents the timber in the wales and braces and the second bracket the sheeting.

Our object now is to determine the conditions for minimum timber in Eq. 7. As will be seen, there are three variables s, d and t, and the last may be expressed in terms of the other two together with the breadth b.

The proper method of approach, from a mathematical point of view, would be to assume some values for b and d, differentiate BM. with regard to the span s, equate the result to zero and solve for s. The values so found will give us the most economical span for that particular value of b and d. Then assume s constant and do likewise for b and d. This procedure, however, leads into rather complex expressions, and so we will resort to graphical solution.

From Eq. 7 draw the curve for each size wale, assuming successive values for the span s. The values for the sheeting thickness will have to be taken from the diagram corresponding to the specific condition of span, etc. Such curves have been plotted in Fig. 3 for two different cofferdams of widely varying proportions of breadth B to length L, the first or upper set being almost square in plan, while the lower represents an elongated layout.

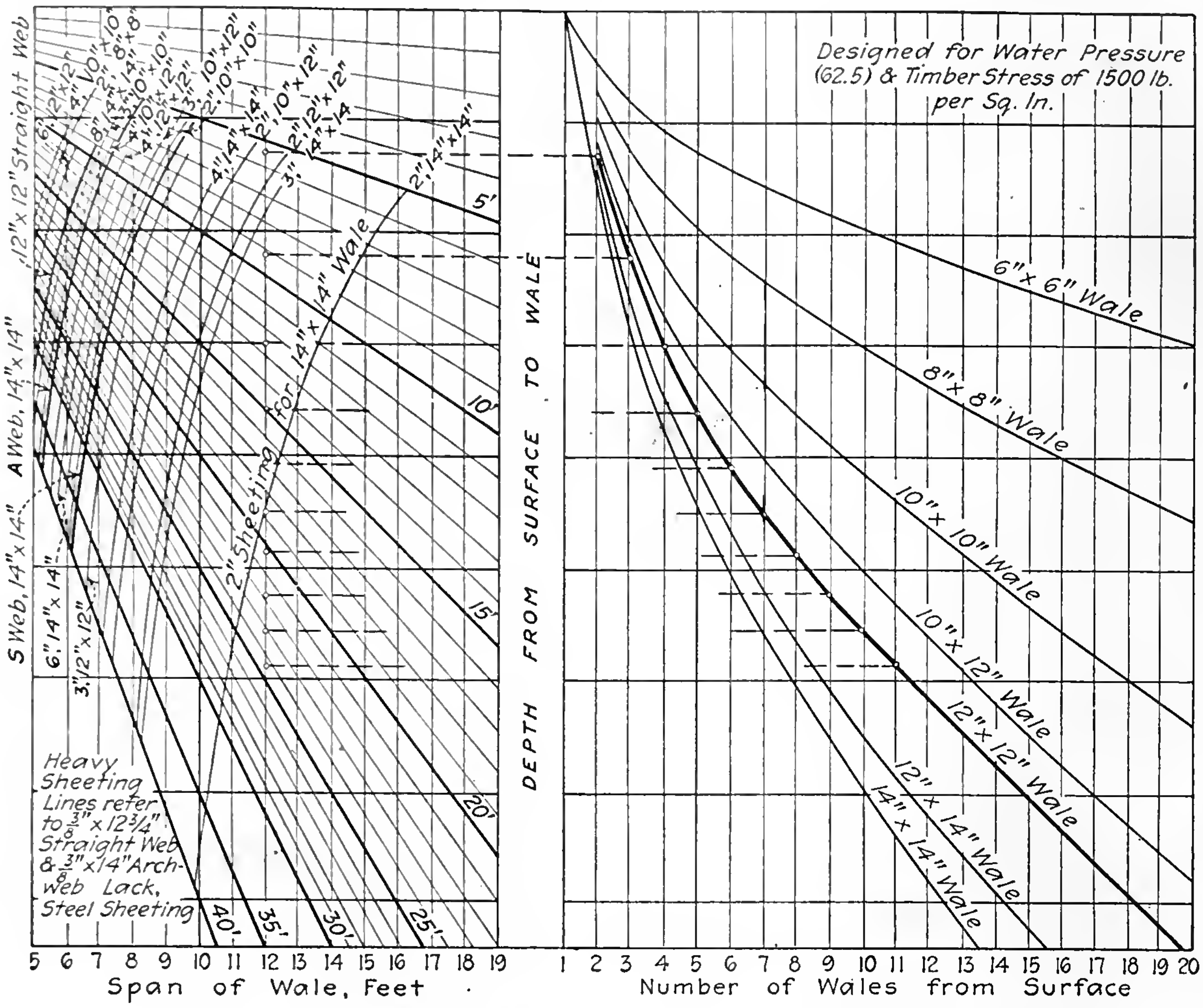


FIG. 2. DIAGRAM SHOWING WALE SPACING FOR COFFERDAM

The point of minimum timber is clearly shown for each case and forces the following conclusions: The quantity of timber varies, in general, with the size of wale and inversely as the span, the most economical span for each wale being roughly proportional to its size. The point of minimum timber varies very little for the two different sets of curves, comparing like wales. The necessity for maintaining the proper distance between braces for the dredging bucket and the handling of material fixes more or less exactly the span of the wale. This, in practice, is in the neighborhood of 10 ft., and for the most economical layout would call for a 12 x 12-in. wale.

It is sometimes expedient to arrange the bracing regardless of the above in order to meet certain construction conditions, the saving resulting from this offsetting the increased cost of timber. These conditions cannot be anticipated here other than to call attention to their possibility.

Where steel sheeting is used, we have rather different conditions. From the first part of Eq. (7), which expresses the quantity of timber in the wales and braces only, we see that the most economical condition obtains when the wale size is a maximum and the span a minimum. Thus, the proper solution would be to fix the minimum span permissible, taking into consideration the points heretofore brought out, and then select from the diagram the maximum wale size limited by the

MULTIPLY DEPTHS TO WALES AS FOUND IN DIAGRAM BY FOLLOWING CONSTANTS FOR THE CONDITIONS SHOWN

		Level Surface				Surcharged = ϕ			
	Unit		Fiber Stress				Fiber Stress		
Material	Wt.	C	1,000	1,500	2,000	C	1,000	1,500	2,000
Water	62.5	1.00	0.816	1.00	1.155	1.00	0.816	1.00	1.155
Clay, wet	130	0.59	0.736	0.902	1.04	0.97	0.574	0.704	0.81
Clay, damp	120	0.16	1.47	1.80	2.08	0.70	0.70	0.86	0.99
Clay, dry	110	0.41	0.955	1.175	1.36	0.91	0.643	0.79	0.91
Sand, wet	120	0.33	1.02	1.25	1.44	0.86	0.635	0.78	0.90
Sand, damp	110	0.21	1.34	1.645	1.90	0.76	0.705	0.865	1.00
Sand, dry	100	0.27	1.24	1.52	1.76	0.81	0.72	0.88	1.02
Loam, wet	110	0.33	1.07	1.31	1.51	0.86	0.66	0.81	0.935
Loam, damp	90	0.16	1.70	2.08	2.40	0.70	0.81	0.995	1.15
Loam, dry	80	0.21	1.57	1.92	2.22	0.76	0.823	1.01	1.165
Gravel, graded	120	0.21	1.28	1.575	1.82	0.76	0.675	0.828	0.956
Gravel, coarse	110	0.33	1.07	1.31	1.51	0.86	0.66	0.81	0.935
Alluvium	90	0.50	0.961	1.178	1.36	0.94	0.696	0.856	0.985
Coal, anthracite	52	0.40	1.41	1.73	1.35	0.90	0.945	1.16	1.34
Coal, bituminous	50	0.27	1.75	2.15	2.48	0.81	1.01	1.24	1.43
Wheat	50	0.37	1.50	1.84	2.12	0.88	0.97	1.19	1.375
Oats	28	0.37	2.01	2.46	2.84	0.88	1.30	1.59	1.84
Corn	44	0.37	1.60	1.96	2.26	0.88	1.04	1.27	1.47
Ashes	40	0.21	2.23	2.73	3.16	0.76	1.17	1.43	1.65

The constant C as used above is taken from Peele's "Mining Engineers' Handbook."

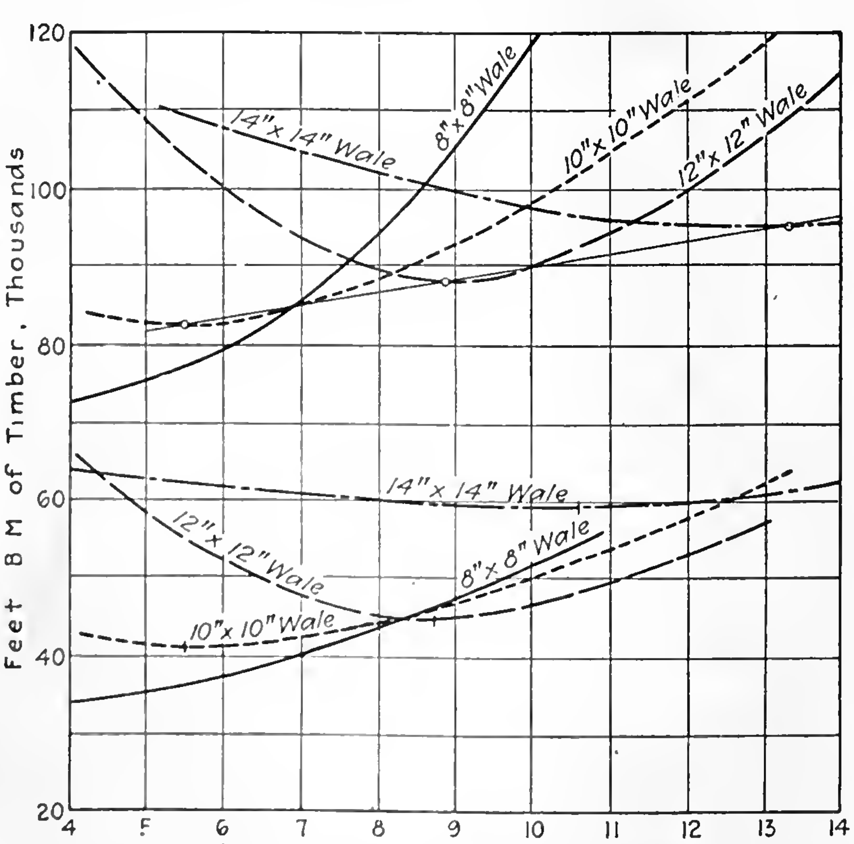


FIG. 3. CURVES SHOWING AMOUNT OF TIMBER REQUIRED FOR VARIABLE WALE CONDITIONS

sheeting. It is well to call attention to the fact that the sheeting thickness or strength will be fixed by the span between the first and second wales from the surface—not counting the one at the surface—and not the span from the surface to the first set. The reason for this is that the load upon the sheeting in the top span, as shown in Fig. 1, is just one-half that in the others; thus, the limiting size will be found in the diagram opposite the second wale, as stated before.

The size of the bracing is determined by practical considerations rather than theoretical. If we take the case of a 12 x 12-in. wale on a 10-ft. span, for the conditions in the diagram, we find that the allowable load on the wale will be 28,800 lb., which would call for about 40 sq.in. in the brace. This gives an absurdly small stick, and so, from the fact that the braces are subjected to heavy blows from one source or another, as well as from the necessity of providing sufficient area for end bearing of the wales and to satisfy numerous other construction requirements, it has been the custom to make the braces the same size as the wales or slightly smaller. This, however, does not affect the validity of our conclusions concerning economic conditions.

In conclusion, it should be pointed out that the foregoing results are based upon timber quantities and not upon the cost of the timber, the reason for this being obvious. We are here concerned with basic relations rather than local ones, which, when applied to concrete cases in connection with local conditions, will produce the most economical results for the general solution.

Blanket Lake Bottom To Stop Leaks From Water Reservoir

Dyke Also Built To Cut Off Bay From Which Loss Was Heaviest—Gage Observations Show Plan Successful

LEAKAGE from Bull Run Lake, which is a natural reservoir utilized for the water-supply of Portland, Ore., has been checked by blanketing the bottom and building a dyke to cut off a bay where much of the leakage was concentrated. There is no natural surface outlet or overflow, but the water passed out through an underground channel and emerged in the form of springs. A dam was built above this outlet to raise the water level. Leakage was discovered, however. through the boulders and shattered basaltic rock which appear to form the greater part of the lake bottom and the interstices of which have become filled with silt.

Clay containing some fine gravel is used for the blanketing, this material being obtained principally on the east side of the lake, about ½ mile from the work. It is transported on an improvised raft made of cedar logs, and equipped with a gasoline engine and propeller and a wooden 5-yd. hopper. The material is dumped from the raft in amounts depending upon the nature of the leaks. Where these occur among large boulders the blanket may have to be several feet in thickness, but where the bottom is of shattered rock a thickness of about a foot is usually sufficient.

The dyke is an earth fill, backed with large boulders on the outer slope. Material is deposited by means of skips run on wire cables and by the raft mentioned above, but after the fill nears the water surface it is finished by means of the skips alone. Care is exercised to deposit selected clay on the face of the embankment.

When the fill has been brought to the proper grade its inner face is riprapped to high-water level to prevent wash by wave action. Blanketing is carried out into the lake some distance beyond the toe of the dyke. No serious troubles have been encountered, the worst difficulty being found in obtaining suitable material for the dyke and for blanketing, as the formation is mostly loose rock and boulders, and a large quantity of waste material must be handled. All machinery and supplies for the work have to be hauled 20 miles in wagons from the nearest railway and then packed on horses for 11 miles over a mountain trail to the lake. The equipment, therefore, is necessarily light, and the work is more expensive than if it were accessible by wagon road.

To check the results of the work, observations were made by means of gages placed in the lake at various points, by the receding of the water in the bay outside the dyke, and by means of weirs at the points where Bull Run River emerges from the ground. As soon as the dyke was carried across this bay, where most of the leaks occurred, there was a noticeable decrease in the subsidence of the water in the lake as shown by the gages. There was also a marked decrease in the flow of the water over the weirs at points one mile and one and one-half miles from the lake. F. M. Randlett, engineer of the Bureau of Water-Works, who supplied the information here given, states that the larger part of the leakage is under control, although there are a few small and widely separated leaks that are to be located and stopped.

Control of Fires in Cinder Fills

Isolation appears to be the most satisfactory treatment of fires in cinder fills and culm banks. Such fires are a source of trouble on many railways using this material in fills for track and for building sites. According to report, the application of water usually has the effect of spreading the fire and even increasing its intensity, rather than extinguishing it. A method employed with success in many cases is to dig trenches to isolate the fire, which is then left to burn itself out. These trenches may be filled with clay or sand, while sand may be used also to bring the surface of the fill to grade as settlement occurs. One railway has had to dig out fires in cinder fills along its roadbed, using earth to replace the burning material. Trestles were burned on another road as the result of the practice of dumping cinders on the ends of the approach fills. Dumping at such places is now prohibited. On some roads, also, it is considered undesirable to use cinders as fills where buildings are to be erected, owing to the likelihood of trouble occurring from fires in the material.

Professional Organization in England

Abstract of an Analysis by Sidney and Beatrice Webb of the Motives, Methods and Results of Such Organization, Including That of Engineers

Many of the problems which are under active discussion among engineers in this country are keenly analyzed and discussed in the report from which the following abstract has been made. In many of its aspects the discussion covers with startling exactness the very conditions we find in this country, though the actual studies were on English professional organization. Among the topics touched upon are such pressing questions as division among professional societies, the strong centralized society versus the federation of societies, the cleavage between the leaders of the profession and the rank and file, professional responsibility to the community, the good points and the weaknesses of professional codes of ethics, and registration (or, as we call it here, licensing).

The report was made by Sidney and Beatrice Webb, the well-known English Socialist economists, for the Fabian Society, a Socialistic body, as a contribution to that organization's study of the control of industry. It appeared originally as a supplement to the "New Statesman," Apr. 21 and 28, 1917.

The full report takes up in separate chapters the professional organizations of lawyers, medical men, teachers, technicians (including engineers, architects, surveyors and chemists), of those engaged in literature and the fine arts, of those engaged in banking and various office activities, and of managers and superintendents. With this part of the report the following abstract does not deal. It does take up, however, the salient features of the two final chapters, which discuss the success, shortcomings and limitations of professional organization, and also the authors' conclusions.

The abstract is one largely made by Robert A. Cummings, consulting engineer of Pittsburgh, elaborated by additions from the original text.

Where italics are used in the abstract they are those of the editor of this journal.—EDITOR.

MOTIVES FOR ORGANIZATION

Three separate motives may be traced for the establishment of professional associations.

The first of these, and one which is usually placed in the forefront among the ostensible objects of the association, is the creative impulse—the intention and the wish to advance the knowledge and perfect the art of the vocation. This motive has not only resulted in the development of vigorous scientific societies but in genuine scientific work and intellectual comradeship. Moreover, the creative impulse is responsible for the professional code in one of its aspects, when it seeks to mark off the professional man from the profit-maker by a higher sense of honor, not only in his relations to fellow professionals, but also in those in which he stands to the community.

The second motive for professional association is that of fellowship among one's own kind, whether merely comradeship and social intercourse, or a willingness to befriend one's fellows; passing insensibly into an appreciation of the advantages of mutual assistance, and from that to mutual protection. The movement toward professional self-government is largely a development of this fellowship influence, which creates a desire to be judged or controlled by fellow members; that is, by persons who realize the conditions under which they work, and share their grievances and aspirations, rather than by persons with different social antecedents and outlook.

The third motive is the possessive impulse, the desire to secure for the members of the group all the remuneration and status which the community can be induced to accord for the performance of a particular service. The possessive impulse makes professional organization hostile to unqualified persons and even to those having a different technique. Obvious shortcomings of successful organization are the danger of an attempt to exact a higher remuneration or easier conditions of employment than are required to maintain the service in efficiency, and the objection to public regulation and to disciplinary inspection. The possessive impulse, however, is not always harmful. Without some protective development there is always a danger of any group being so crushed down as to be incapable of rendering its full service to the community. Without adequate security of a sufficient livelihood and a large measure of personal freedom in the execution of their tasks, neither the exercise of the creative impulse nor the maintenance of professional honor becomes possible.

The exercise of these three motives leads to a mutual development of each.

The professional mind is apt to be biased against new kinds of knowledge, against research which seems to lead into the domain of other vocations, and against innovations in technique which involve a change of outlook or a training different from that possessed by the existing practitioners. It is for this reason that we see arising "subject associations," confining themselves exclusively to the manifestations of the creative impulse; that is to say, the disinterested development of the science and art of the vocation; and protected against too much "professional egoism" by their inclusion not only of amateurs of the subject and men of other professions, but also of expert representatives of the "community of consumers." An instance of this is the Engineering Standards Committee.

CONDITIONS FAVORING GROWTH

It appears that the greatest reaction against vocational or professional organization was at the period when the functions of government were most limited. When state activity in a given line of service increases, we find corresponding professional organizations growing in membership and power. In fact, as the national and local governments have grown in scope and complexity of operations, they have been steadily making more and more use of, and therefore extending the influence and the power of, the professional organizations of brain workers, as a corrective to that development of bureaucracy which the collective control and conduct of public affairs inevitably necessitates.

Another set of circumstances has favored vocational organization. As long as industry is carried on by small

working masters, combining the functions of capitalist, undertaker, and business manager, and themselves using such scientific technique as was available, there was no professional organization. It was the growth of these business enterprises in size and complexity, and the consequent coming into existence of specialized classes of brain workers, divorced from participation in the profits, that led to the formation of the several professional associations. The rise of these associations in numerical strength and social power has been concurrent with the continual increase in the magnitude of the industrial enterprises with which their professional activities are concerned, and with the progressive elimination of the little working master.

Contributory to these two main causes of development is the continual elaboration and differentiation of professional technique. Without a sufficiently defined demarkation between the professional and the ordinary cultivated layman, no organization of a profession is possible. What happens is, first, the development of technique from its earliest germs and then the encouragement of the growth of technique by a professional organization.

Professional Ethics

Professional self-government has developed specialized rules of conduct. These rules can be classified under two heads, those relating to the conduct between professionals and those between professionals and the community.

The first set of rules forbids competition and criticism and prevents self-praise and advertisement. These rules discourage members of a profession from adopting unorthodox views and from associating with unqualified persons. They tend to good feeling and maintain a high standard of honor between professionals, but they may militate against innovations which make for progress, and they sometimes protect inefficiency and professional negligence.

In the most highly organized professions, an effort is made also to standardize the conduct of members of the profession toward the public. The most universal of these requirements is the distinction set up between what is permitted to a professional and what to a business man. According to the accepted canons of political economy, business men are permitted and even encouraged to compete with each other in price and quality, and to use the arts of advertisement to promote the sale of their wares. Moreover, they are assumed to make their profit by exploiting the labor of mind or body of their subordinates. They are also allowed or assumed to enter into secret understandings with other business men, with regard to sharing the profits of common undertakings. Above all, it is taken for granted that a business man will keep for his own profit any new invention or discovery that he makes, or of which he obtains control; and that he will attempt, whether by secrecy, by trademark, or by patent, to prevent anyone else from making use of it for the service of the public. All this is prohibited by professional ethics to the members of the most highly organized brain-working professions. The professional man is forbidden to take contracts in which the labor of other people is exploited for his own profit. He is always assumed to gain his livelihood solely by the use of his own faculties. He is prohibited from having any pecuniary interest, direct or indirect, in the materials, plants, processes or institutions which he recommends to his clients. So long as he is professionally engaged, he is required to think only of the advantage of his client and not of his own interest. In the higher ranges of professional ethics, he is expected to risk, and even to sacrifice, his health and his life in the performance of his professional duty, an expectation which never exists in business.

The weakest side of the ethics as elaborated by professional associations is the irresponsibility manifested with regard to the needs of the community. What the professional associations have always sought to protect is the interest of the practitioner, and the interest of the well-to-do client on whom he depends. This is true of all the learned professions, including engineers, who have been too eager to patent their own inventions to encourage their professional associations to concern themselves about how to make these inventions serviceable to the community.

If professional organization demands greater powers of government over the work of its members, and claims to decide how each profession shall be organized and conducted, it must give more attention to the requirements of the community as a whole, not merely for those persons who can pay the fees desired but for the whole population.

On the whole, the development of professional ethics has been one of the finest results of professional organization. But it has its dangerous aspects. It may be used to prevent the upgrowth of a new technique or a new method of organizing the profession in the public interest.

Militant Methods

All the devices by which trade unions attain their ends have been practiced by professional associations. For instance, there are restrictive devices requiring prolonged apprenticeship, limitation of the number of apprentices, the exclusion of women, the refusal to cooperate professionally with unlawful or recalcitrant practitioners, and the rejection of novel methods of performing the service which the public might desire.

So long as practitioners worked entirely for a succession of individual clients, the method of collective bargaining and the refusal to accept service under unfair employers were not open. As soon as professionals began to be employed at salaries, they took to collective bargaining and insisted upon a standard minimum of remuneration, refusing to accept employment, resorting to the boycott and even the strike. This is particularly true of the teachers and doctors, and in one or two cases their associations have been registered as trades unions. Professional associations have practiced militant action by resorting to political pressure, and this has become an important feature of the modern association.

Registration of Qualified Persons

In all brain-working vocations which have developed professional organizations there has arisen among the bulk of the practitioners a demand for statutory or otherwise authoritative registration of legally qualified practitioners. This demand has always been accompanied by insistence that the determination of this qualification, and, therefore, the keeping of the register, should be entrusted to an existing body of practitioners who consider themselves qualified. This identification of a register by legally qualified persons with professional self-government is, it is needless to say, neither logically nor practically necessary, and has, in

fact, often not accompanied statutory registration. In England today, where vocational organization is, on the whole, stronger than in any other country, the authoritative registration of legally qualified persons is nowhere accompanied by complete democratic vocational self-government. In many cases appointments to the governig body are made by "oligarchical corporations," such as the Colleges of Physicians and Surgeons.

The keeping of the register has resulted in prolonged controversy, the most remarkable feature of which has been not the divergence of interest between the vocation as a whole and the community as a whole, but the embittered quarrels over policy between the aristocracy and the rank and file of each profession. The agitations which have recently arisen for the statutory registration of architects and accountants, and, in a lesser degree, of engineers, are hampered by the internal dissensions within each of these vocations. The leading members of each profession see no advantage in a statutory register of qualified practitioners. What they prefer to seek are clauses in statutes and administrative orders compelling particular authorities to employ only the members of the dominant professional association. Moreover, even when the leaders of a profession give a perfunctory support to any movement for registration, they always insist that the authority controlling the register shall be predominantly made up, not of representatives of the rank and file of the profession, but of its superior grades.

The great institutions of engineers have latterly come to exercise great influence in favor of a monopoly for their own members in the appointment to important engineering posts, while during the war the recognition by the Government of these great institutions in the selection of men for commissions in the Army and places in munitions works is virtually handing over to members associates and students of these institutions the monopoly of certain grades of engineering. These indirect ways of establishing a register of persons qualified to hold remunerative posts of a public character may, in fact, be a more effective, because a more secret, way of securing for a certain group of persons a monopoly of employment. Even the growth of public opinion in favor of professional representation on royal commissions and departmental committees inevitably leads to the recognition of the membership of the principal professional association concerned as the only source from which representatives of the profession can be drawn.

Unit of Organization

In so far as professional association is based on the voluntary principle, the unit of organization seems strictly limited by the condition that all the persons to be included must have essentially identical interests on the main questions of policy. This is the fundamental cause of the variegated character of the voluntary associations of brain workers, which are always tending, with the increase in the size and diversity of the profession, to break up into new units corresponding to new group interests. It is to this cause that we ascribe the characteristic impermanence of voluntary organization among brain workers—the constant supersession of one association by another, and the perpetual shifting in relative importance of the different associations in the profession.

Nor is this tendency to a breaking up into separate societies, each pursuing its own policy, confined to differentiation of technique. We see it manifesting itself when some members of a profession, among whom are represented various types of technique, find themselves marked off from the bulk of their profession by some peculiarity of employment. The engineers working for local authorities, whether on drainage, electricity, bridges, road making, or the construction of buildings—not satisfied with the various specialized institutions of their profession—have united in a powerful organization of County and Municipal Engineers.

What determines the basis of these perpetual regroupings seems, therefore, to be not only the development of a common technique, but also the opportunity for social intercourse, the sense of a common interest, and especially the existence of common enemies, whether these are other sections of the same profession or a particular type of employer. Where a general organization includes within its scope divergent sections of one vocation, having mutually conflicting interests, differences of technique or different methods of remuneration and conditions of service, it tends either to become inert, or else to develop within itself separate associations or groups which act as caucuses pushing the divergent interests. These caucuses may end by making the association more of a battlefield than a platform for common action. Hence, one of the problems of professional organization is whether the greatest measure of common action can be obtained, where such diversity of interests exists, by *an amalgamated association* with common funds, a common policy, and a common government, or by *a loose federation of separate associations, delegating to the federal body only such powers as can be exercised with the consent of all the sections concerned.* Thus, for one or other reason, with every increase of professional organization in influence and membership, there seems to be—if the organization is on a voluntary basis—an increase in the number of separate associations, and an intensification of the diversity of their several policies.

What Is a Vocation?

When any demand is made for statutory powers of self-government, what are to be the outer limits of the vocation? Does the profession consist of all those who "habitually and for gain" coöperate in the rendering of the service or the provision of the commodity? Must we include all the indispensable contributors to the service, such as craftsmen, skilled and unskilled?

It is needless to say that no voluntary association coinciding with a vocation in this wide sense has ever arisen, or shows any sign of arising. Professional association if left to itself is always limited by the requirement for its membership of a common technique, practical opportunities for social intercourse, and a certain identity of pecuniary interest as against other classes. But when it is proposed to delegate to a profession any powers of government, the limits of the vocation to be subjected to these powers have necessarily to be defined.

Where statutory authority has been conferred, it has always been of wider scope than the membership of any one association. What has been conferred on professional association has been only the power to regulate the qualifications and conduct of certain grades of practitioners. The reason for this limitation of a unit is that the needs of a vocation can be properly understood and appreciated only by those habitually dealing with

its technique. Each service includes many techniques and a good deal of unspecialized work. *It is thus identity of training and technique, not coöperation in the service, which furnishes the boundaries of any statutory organization.*

Government of Professional Organization

Growth of self-goverment within a profession always brings about a more or less embittered dispute between the advocates of government by a select class and those of government by the rank and file. This dispute is largely responsible for the multiplication of voluntary organizations.

Is the aristocrat of the profession—the person who has enjoyed a longer and more extensive training than the ordinary practitioner, or who has developed a specialism involving a difference in technique, or who has acquired the hallmark of superior academic distinction—to be endowed with greater rights than the members of the profession having only the statutory minimum qualification? It is interesting to note that the limitation of government to a superior grade of the profession in choosing the governing council or in declaring the policy of the organization has been adopted by many of the principal voluntary organizations. Where an oligarchical constitution of this kind has not been adopted, there is a tendency for the superior grades of the profession either to abstain from joining, or at any rate from taking any active part in its affairs; or, on the other hand, for separate organizations of the superior grades to spring up either independently or within the main association, forming a powerful caucus for the promotion of sectional interest. When united action of the profession as a whole becomes indispensable, we see these various associations coming together in more or less permanent federation; and in such cases the rule is for the several associations to meet on equal terms, with equal representation, irrespective alike of gradations of rank or numerical membership—thus preserving the rights of the numerically smaller upper grades.

Whenever it is found necessary to bring in any statutory authority all these questions become acute. The main body of practitioners always desires to have the council elected by the profession as a whole, voting in equal geographical districts; but this procedure would involve the swamping, by the great numerical superiority of the rank and file, not only of the leaders of the profession, and, indeed, of the whole of the higher grades, but, what is no less important also of the various small minorities of specialists or practitioners of particular technique. There is thus a tug-of-war between the more select classes and the rank and file of the profession, the first using their political influence with the statesmen and the heads of the bureaucracy, by whom their professional superiority is appreciated, and the second appealing through the popular electorate to the members of Parliament. In the extremely important Engineering Standards Committee, which did not "come into the limelight," the influence of the superior grades has been paramount.

The question whether the professional organization shall be governed by the rank and file, or by the members of its superior grades is more important to the public than may at first sight appear. If the influence of the rank and file is decisive, the tendency is towards (1) maintaining only one ungraded qualification, so that there shall be no claims to superiority of status; (2) upholding a policy of "sharing out" the work, which leads to the objection to salaried service; (3) a preference for "rotation of office" or promotion by seniority; (4) keeping the qualification for public appointments low, so that they may be within the reach of all; (5) objecting to any requirement of a particular training, experience or academic attainment. On the other hand, in associations in which the influence of the superior grades is dominant we find (1) a desire for a graded profession, in which each grade has its own qualifications for entry; (2) a bias in favor of reducing the intellectual qualifications required for the lowest grade, in order to widen the gulf separating it from the higher grades; (3) a policy of restricting public appointments and honors of the profession exclusively to the members of the highest grade, irrespective of the special talents or special experience of exceptional members of the lower grades. It must not be taken for granted that either of these policies is necessarily good or bad. What is bad is that they are constantly being pressed heedless of the interest of the community which the profession has to serve.

Results of Professional Organization

The results of professional organization have been of a very mixed kind.

Effective organization, in the way of beneficial effects, raises the standard of professional honor, improves the education of its members, increases the opportunity for their professional training, disseminates improvements in professional technique, and promotes the scientific study of its subject matter. In all these ways professional organization has for its result an improvement of the service which the profession has to render the community; and it is not a matter for complaint if, coincidentally, there is also a raising of the status of the profession in public consideration, and even an increase in its aggregate emoluments and privileges.

There are, however, other results which are more invidious. Professional organization seems never to escape a tendency to exclusiveness. Whenever it controls or influences the entry into the profession, it tends through educational qualifications, apprenticeship and high fees, to confine the recruiting of the profession to the small social class which alone can afford for its children a long and expensive schooling of the conventional type. These onerous and restrictive conditions of entry are often justified by the importance of securing in the profession persons of cultivation and superior attainments.

No less serious is the influence of professional organization in refusing to recognize any but the science and art that were current in the generation that is passing away. This reluctance to admit the new knowledge or the new processes is seen at its worst when what is knocking at the door is some revolution which would shift the boundaries of the profession, transfer some of its service to another set of practitioners, or consign to the scrap heap some of the processes by which its members have gained a living.

Sphere of Professional Organization

Professional organization has shown itself to be of the greatest use to the community where it has been inspired by the creative impulse, with which the fellowship impulse is often associated. It is, in the main, to

the individual and collective activities of the existing body of practitioners—these activities being heightened by professional association—that the community owes most of the continuous advance in the science and art of a profession; because these practitioners alone enjoy that combination of knowledge, training, and daily opportunities for discovery upon which progress normally, although by no means invariably, depends.

Professional organization is, moreover, indispensable as a defensive force. Experience demonstrates that it is required for protection, alike of the individual practitioner against the economic oppression and lay tyranny to which he may otherwise be subjected, and of the profession itself against conditions and restrictions which would withhold from it the necessary means of training and improvement, deny to its rank-and-file members an appropriate standard of life, and prevent the most efficient service.

But professional organization has also an important part to play in the government both of the profession itself and of the service which it renders, and, therefore, in the government of the community. The very specialization of the professions renders it both difficult, and in the public interest undesirable, for the government of the professions to be carried on exclusively and autocratically by a lay authority, even if it represents the consumers, or by a bureaucracy trained only to administration.

On the other hand, it is undesirable to give to professional organization undivided control over the conditions of entry to the profession, the training required, the power of expulsion from a statutory register, the organization of the service, the terms of public employment, the technique to be encouraged or prescribed, and the treatment to be meted out to "unqualified practitioners." What is required is some sort of composite authority, such as the Engineering Standards Committee, in which there can be represented, not only the knowledge and desires of the profession, but also the interests of the consumers or users of the particular service, the larger and more enduring interests of the state, and even the knowledge and desires of other professions which may be indirectly concerned. The first function of professional organization is to supply duly authorized representatives of the profession to such composite authority.

The second function of professional organization in connection with the government of its service, and the most important of all, is one which has so far scarcely been claimed by professional associations. This is the function of independent, authoritative criticism of the government of the state, alike in its central and in its local administration, and of responsible advice, both to the legislature and the executive on matters in which the profession has special competence. One of the gravest drawbacks of the bureaucratic administration which is involved in all enterprise on a large scale is the immunity from expert criticism which is now secured by official secretiveness and departmental discipline, and the practical monopoly of access to the mind of the minister or governing committee possessed by the departmental chiefs. We know of no effective organ of criticism except that which might be afforded by professional organization.

Perhaps the most important of all of the aspects of this criticism and advice which it is the duty of professional organization to supply to the state is one which has hitherto been entirely neglected. It should be a matter of professional honor for the collective organization of each profession to see to it, *not merely that its members are well qualified and properly remunerated, but also that the service of the profession is supplied in adequate quantity for the needs of the community, not only the rich but also the poor.*

The Unsolved Problem

The most intractable problem of professional organization, and one for which this report offers no complete solution, is how to discover, in each profession and in each branch of a profession, the most effective unit of organization, and the most appropriate method of formulating a general will, alike as an organ of expression and criticism, and as an instrument for supplying representatives to composite authorities. The simple solution of asking all the registered or recognized practitioners to elect a council representing the entire profession has two capital drawbacks. It submerges all the expert specialists, and all the newer and smaller sections, in the undistinguished mass of the rank and file pursuing the old routine. Moreover, even when provision is made for enabling these minorities to have a share in any pronouncements of the council, the result is blurred and ineffective; in the compromise between the different elements the specialization of knowledge and intensity of emotional experience, or just what is most valuable in vocational association, is inevitably lost.

Finally, the characteristic impermanence of professional associations, which results naturally from the constant shiftings of a progressive technique and a changing social environment, makes it difficult, without an objectionable stereotyping of that which is in its nature variable, to base upon these voluntary associations any formally constituted professional council which is intended to be permanent. *The only inference we can draw is that the constitution of any professional council, whether statutory or voluntary, must necessarily be complicated, ought always to be elastic, and will need to be perpetually revised.* A solution may perhaps be found in an elaboration of what may be called "stratified democracy," in which the affairs of each grade or special section are dealt with separately by that grade or section, with an independent and uncensored right of expression, as well as by the profession as a whole.

Status of Government Motor-Vehicle Equipment

Delivered and uncancelled contracts for motor vehicles of all types for the Government Army service covered 254,626 units, by recent report. Of these 223,871 have been delivered and 30,755 are still under contract. Motor trucks of all kinds total 115,137, of which 96,551 have been delivered and 18,586 are still under contract. Motor cars, ambulances, motorcycles, trailers and bicycles to the number of 139,489 have been contracted for; 127,320 have been delivered and 12,169 are still to be delivered. These figures do not include 4847 Ordnance Department trailers which were purchased. Of the total number of motor vehicles, 126,111 are overseas, while 97,760, which number includes those still under contract, are in the United States. It is reported that large numbers of these trucks will be transferred to the Postoffice Department for the transportation of mail and parcel-post matter.

Long-Distance Motor-Truck Haulage Costs in Ohio

Routes Between Akron, Youngstown and Cleveland Investigated—Present Rates Too Low—Operate for 52 Cents per Truck Mile

An investigation made of one of the long-distance motor-trucking companies, operating between Akron, Cleveland and Youngstown and covering a 12-months' period, has recently been completed by Melvin W. Boyle for the Packard Motor Car Co. The results of the investigation show that freight rates which have heretofore been charged are much too low—not giving a reasonable profit to the truck operator. The cost of running a 3½-ton truck averaged \$28.89 per day when covering an average distance of 55 miles, or about 52c. per mile. The investigation was made to determine what rates should be charged, as indicated by the actual cost of doing business. The following is an abstract from the report covering the investigation:

Freight shipments between Cleveland and Akron were found to be much greater than those between Cleveland and Youngstown. The amount hauled between the former places was 80% of the total. However, the cost per mile on the haulage of the 20% transported between Cleveland and Youngstown showed the same cost per mile. The investigation covered a company operating twelve 3½-ton trucks. The amount of freight from Cleveland to Akron was just about double that from Akron to Cleveland; the average loads being 8500 and 4300 lb., respectively. Thus, the trucks generally ran one way only half loaded. If this could be remedied the indicated rate would be cut considerably.

One of the largest factors tending to increase the cost of operation was found to be the condition of the roads. Breaks in the surfacing requiring detours, failure to remove snow, etc., all caused costs to jump. At times it took trucks from two to three days to make a return trip between Cleveland and Akron. Trucks were blocked in the snow, requiring gangs of men to dig them out, and often an extra truck had to be sent to assist. After every heavy snowstorm the trucks had to break their own way, not only being delayed thereby but having excessive repair charges due to the wear and tear. The extra expenses for drivers, gangs of men, etc., mounted when bad conditions were encountered. During the spring months the road was impassable in many stretches, which required long detours over poor roads in which deep ruts and holes were formed, often causing breakage of springs, injury to differentials and other damage.

Mileage Figured

The average number of miles covered per truck per day was 55, or 16,500 miles per year of 300 days. This mileage allows for truck repairing, overhauling, time lost in loading and unloading, and various other delays. Thus, although the actual speed in operation was much greater, the average was cut down by this loss of time. The development of the pneumatic tire will undoubtedly increase mileage and thereby lower the cost; however, this tire has not yet been put on the market for the larger trucks, and cannot be an immediate remedy.

Referring to the accompanying table, some of the items need explanation. Item 5, driver's expense, covers meals and room rent when out of town. Item 10 covers the expense of a repair gang which is necessary in long-distance motor trucking. This gang must consist of men competent to repair trucks, and it must be ready to work night or day when trucks are broken down. The records show that two mechanics were necessary to keep 12 trucks moving. Item 11 covers one complete overhauling per truck per year, which has also been found necessary. Item 13 covers warehouse charges, salaries, office expense, traveling expenses, etc., for the three cities on the route.

OPERATING COST FOR LONG-DISTANCE TRUCKING, BASED ON 55 MILES PER DAY AND 300 DAYS PER YEAR

Item	Cost Per Year	Cost Per Day	Cost Per Mile
1. Interest on \$5,000 at 6% on depreciated value	\$180.00	\$0.60	\$0.0109
2. Insurance, complete protection	450.00	1.50	.0272
3. Depreciation at 20% per year	1,000.00	3.33	.06
4. Driver at \$5.00 per day	1,500.00	5.00	.0909
5. Driver's expense	300.00	1.00	.018
6. Helper, part time	100.00	.33	.006
7. Gasoline, 3.2 miles per gallon at 25c.	1,288.65	4.29	.0781
8. Lubricants, 78 miles per gallon at 58c. and 10c. per day for grease, etc	155.10	.51	.0094
9. Tires, 36 x 5, dual rears at \$448.00, less 10%	952.05	3.17	.0577
10. Repair men, 1 at \$1,900 per year; 1 at 1,500 per year; \$3,400 ÷ 12 trucks.	283.33	.94	.0171
11. Repairs—Overhaul	600.00	2.00	.0363
12. Garage	225.00	.75	.0136
13. Overhead, \$1,600 per year each truck	1,600.00	5.33	.0969
Totals	\$8,634.13	28.75	\$0.5221
14. Claims ½%	43.17	.14	.0026
Complete total	\$8,677.30	\$28.89	\$0.5247

Computation of Necessary Freight Rates

In a trip from Akron to Cleveland and return the distance covered averaged 100 miles. This was due to a certain mileage covered in each city, in delivery and pick-up. Using the cost per mile as shown in the table, the cost per trip would be \$52.47. The average tonnage, as stated before, was one-half load up and a full load back, or an efficiency of 75%. On a basis of 8500 lb. for a full load, the costs and the indicated freight rates are as follows for various efficiencies:

For 75% efficiency, the combined load would be 12,750 lb., transported at a cost of \$52.47, or \$0.4115 per hundredweight. With a profit of 20%, the indicated freight rate would be \$0.4938.

At 83% efficiency or two-thirds loaded one way and a full load the other way, the combined load would be 14,168 lb., or an average cost per hundredweight of \$0.37, which with a profit of 20% added would give an indicated freight rate of \$0.444.

With a 100% efficiency, or a combined load of 17,000 lb., the indicated freight rate per hundredweight would be \$0.369. The records showed practically no difference in operation cost for loaded and empty trucks.

Present rates are far below these indicated rates, principally because the operators had to make a tentative rate until the limiting costs had been determined. Furthermore, the established trucking companies are put at a disadvantage by the man owning a single truck who is willing to use it for a day or two in good weather to keep his truck busy. To run a legitimate trucking business, the operator must work summer and winter and in all kinds of weather, and if manufacturers want this service they must pick a dependable concern and pay a profit; otherwise, the trucking companies will have to go out of business.

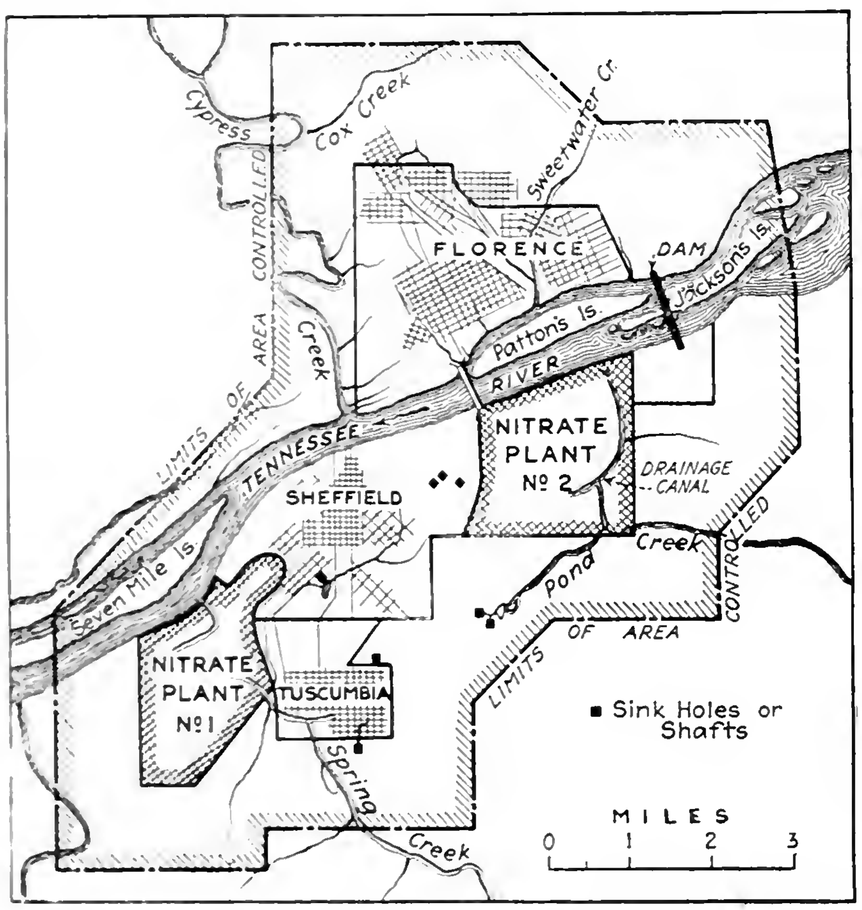
It may be interesting to know that of at least 20 companies, many small and a few of good size, which have operated between Akron and Cleveland, there are only two still in business which have operated over one year.

Malaria Control at Nitrate Plant

Mosquito Eradication by Clearing, Drainage and Oiling Water Surfaces Reduces Disease 95 Per Cent in Alabama District

By W. G. Stromquist
Sanitary Engineer, United States Public Health Service, Florence, Ala.

To safeguard the health and increase the efficiency of the 20,000 employees building the two nitrate plants at Sheffield, Ala., the United States Public Health Service in March, 1918, by request of the Alabama State Board of Health, organized the Muscle Shoals sanitary district, including the nitrate plants, the construction camp of the Tennessee River dam and the cities of Florence, Sheffield and Tuscumbia. Malaria being prevalent and the plants drawing a large proportion of labor from malarial sections, measures for control of this disease were an important feature of the activities. An area of approximately 60 square miles was included in districts where the mosquito-eradication work was done.



MOSQUITO EXTERMINATION DISTRICT INCLUDES CITIES AND NITRATE PLANTS

North of the Tennessee River the topography is hilly, with level bottom lands along the river. Except for sloughs in the bottoms, the drainage is good. The larger islands contain swampy areas. A high bluff cut by steep and narrow gullies borders the south bank, beyond which the land is level to rolling. A number of drainage areas have no surface outlet, so that there are many ponds. In general, the soil is loam and clay overlying limestone, which outcrops in many places. Sink holes in the limestone region provide outlets for the surface water of some of the isolated drainage areas.

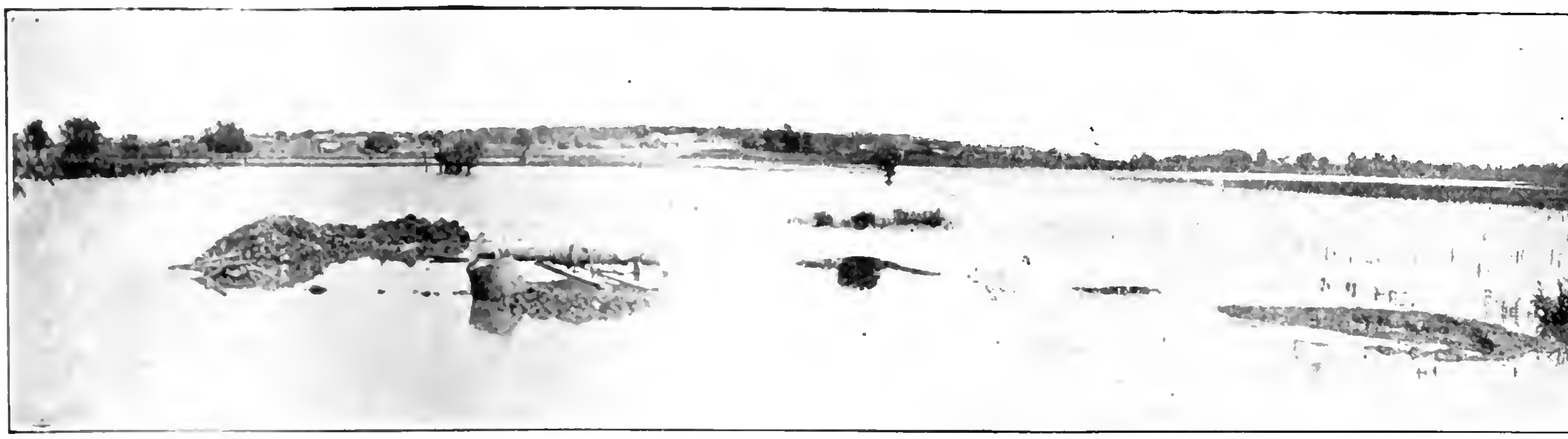
As malaria-carrying mosquitoes may fly one mile from their breeding places, all water surfaces within that distance of the area to be protected were considered a menace. A hurried survey determined the five most important problems, which are shown by the map: The Pond Creek area; Spring Creek; sloughs on Patton's Island and in Florence; sloughs in the river bottoms west of Cypress Creek, and, finally, a large number of ponds.

Drainage was the prominent feature of the work, in order to eliminate breeding places. Ditches were dug or improved, new channels cut and old channels cleared of brush and drift, all this being supplemented by oiling. Some of the heaviest work was on Patton's Island. Conditions there before and after drainage are shown in the accompanying views. A canal built to carry waste water from Plant 2 to the river provides drainage for a swampy area, and a lateral from this intercepts part of the flow of Pond Creek. Vertical drainage by natural sink holes and vertical shafts was a feature of the work. Two sink holes forming the only natural outlet of Pond Creek were enlarged, a timber crib 10 ft. square and 30 ft. deep being sunk in one of these. A 40-acre pond near the business section of Sheffield was drained by a shaft 40 ft. deep, with results shown in two of the views, printed on the next page.

Approximately 30 miles of streams were cleared, 12 miles of new ditches dug and 12 miles of old ditches improved. Ditches require frequent attention, to prevent obstruction by vegetation and drift. Very little maintenance was done last season, however, owing to the greater necessity of completing the drainage work, but as the season was unusually dry there were no ill effects.

Mosquito breeding was controlled in all water surfaces by oiling with a 1:2 mixture of black oil and kerosene. The oil was delivered in barrels and distributed so as to be readily accessible for the oilers, who carried 5-gal. knapsack sprayers. Each man cov-

CONDITIONS ON PATTON'S ISLAND BEFORE AND AFTER MOSQUITO WORK
This slough is within mosquito flight distance of Nitrate Plant 2 and Florence.



A POND OF MORE THAN 40 ACRES AT SHEFFIELD, ALABAMA, WAS DRAINED BY 41-FOOT VERTICAL SHAFT INDICATED BY WINDLASS

This pond covered "city lots" near business center of city. Conditions before and after drainage are shown by the two views.

ered a district of 5 to 6 square miles. Drip cans used on the smaller streams were 5-gal. galvanized cans with a ¼-in. air cock near the bottom. These were placed in boxes and suspended about 5 ft. above the water, being adjusted to drop 15 to 20 drops per minute. This treatment was supplemented by spraying.

Medical students were employed to inspect the oiling and to look for mosquito breeding, each inspector covering two or three oiling districts. Numbered signs at ponds and along streams and ditches facilitated the daily reports of oilers and inspectors. Oilers reported all ponds visited, and whether oiled or found dry. Inspectors reported as follows: Oiled, needs oil, or dry; mosquito larvæ present or not found. In general, oiling and inspection were done once a week. About 55 miles of streams and ditches and 300 ponds were oiled, using 14,500 gallons.

Labor shortage was one difficulty. With an eight-hour day as a basis the men worked 10 hours, receiving time and a half for overtime. At first laborers were paid 25c. per hour, which was soon increased to 30c. and then to 35c. near the end of the season. Foremen were paid $5.50 and $6.60 per day. High wages and a poor grade of labor greatly increased the cost. On the drainage work, from three to eight gangs were maintained throughout the season. These varied from six to 30 men, according to the nature of the work, but in general it was found best to have 12 to 15 men in each gang. The fact that some of the foremen were familiar with local conditions and took personal interest in the work was an important factor in its success.

Five medical students were employed as oiling inspectors from about June 1 to early in September. An engineering student made surveys and kept cost records. A maximum of nine laborers were used as oilers. The maximum force was 140 men. Federal funds bore the expense of supervision, labor, the purchase and upkeep of two trucks, gasoline and oil for the trucks and for cars used in supervision of the work. Funds appropriated by the two counties and the three cities were used to buy tools and other equipment.

Cost records were kept, with actual man-hours, the foremen making daily progress reports. The cost of drainage and maintenance work was divided into labor, foreman, transportation and incidentals. The cost of oiling included labor, inspection, transportation and oil. The transportation charges consisted of the truck drivers' wages. The total cost was approximately $60,000. With 50 square miles controlled, exclusive of

COST OF MOSQUITO ELIMINATION, PER SQUARE MILE

Supervision	$80
Labor:	
Drainage	800
Maintenance	25
Oiling (including inspection)	100
Transportation:	
Cost and upkeep of trucks and automobiles	85
Tools and supplies	60
Oil	50
Total	$1200

the plant reservations, the cost per square mile was $1200, distributed approximately as shown in the accompanying table. With the most difficult and expensive work completed, and the probability of lower wages, it is thought that the mosquito breeding could be controlled during the coming season at about one-third the cost for the first season. It is expected that the local authorities will appropriate funds and that supervision will be maintained by the United States Public Health Service.

Malaria has been reduced 90 to 95%, according to local physicians, but there are no records of the number of cases in previous years. The absence of mosquitoes is a subject of favorable comment by residents.

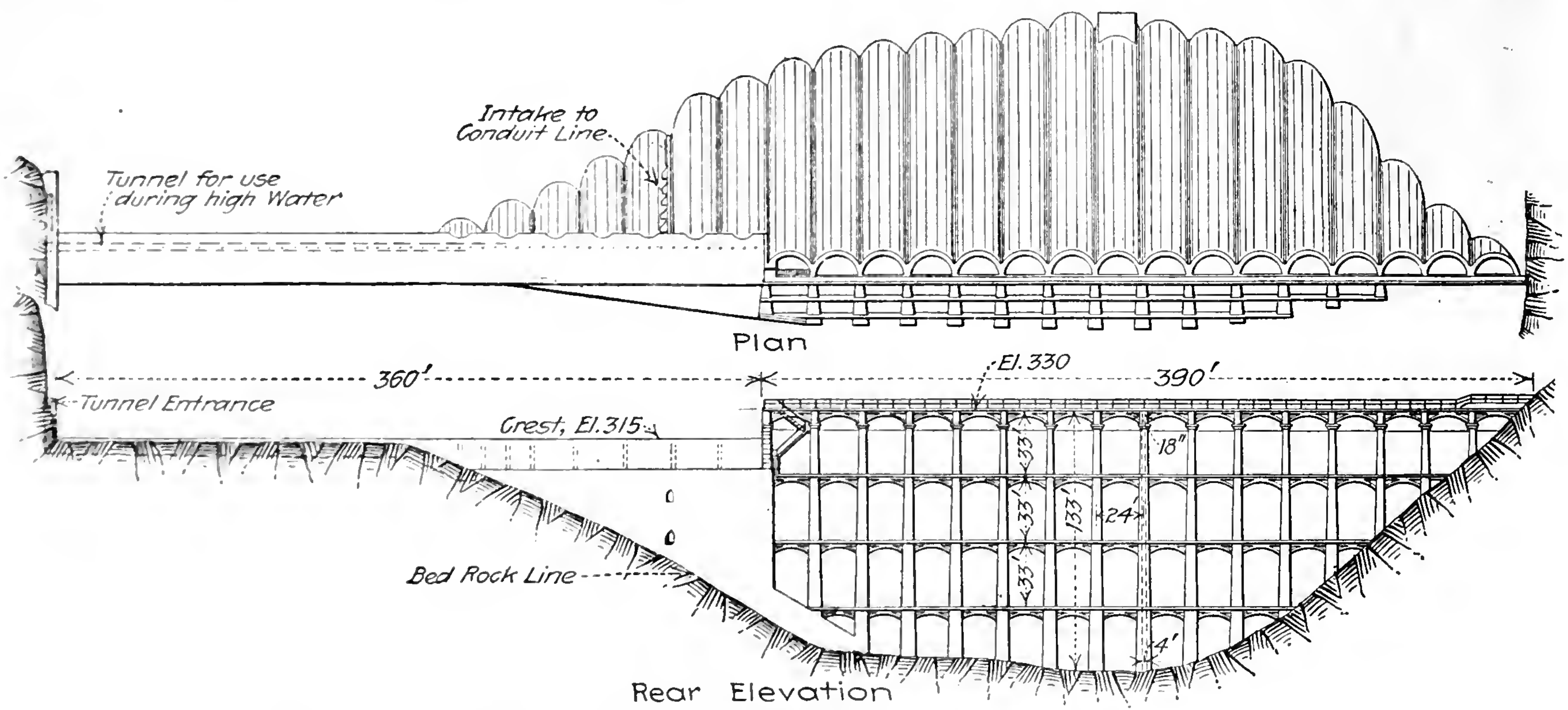
The mosquito-eradication work in this and other dis-

tricts has been under the supervision of J. A. A. Le Prince, senior sanitary engineer. R. E. Tarbett, sanitary engineer, organized the work in the Muscle Shoals sanitary district. The general activities were organized by Surgeon L. L. Lumsden, with Assistant Surgeon H. S. Mustard, and later Assistant Surgeon Thomas Parran, Jr., as medical officer in charge. The writer was in immediate charge of the mosquito-eradication work, assisted by H. R. Fullerton, assistant sanitary engineer.

Record Height Concrete Multiple-Arch Dam Completed

Dam Forming Lake Hodges in Irrigation District Near San Diego Is 136 Feet from Crest to Low Point in Valley

A MULTIPLE-ARCH reinforced-concrete dam just completed by the San Dieguito Mutual Water Co. in southern California has an overall height of 136 ft., which makes it the highest structure of this type on record. It is located on the San Dieguito River about 30 miles from San Diego, and will have a storage capacity of 38,000 acre-ft., which is to be used for irrigating lands in the valley below.



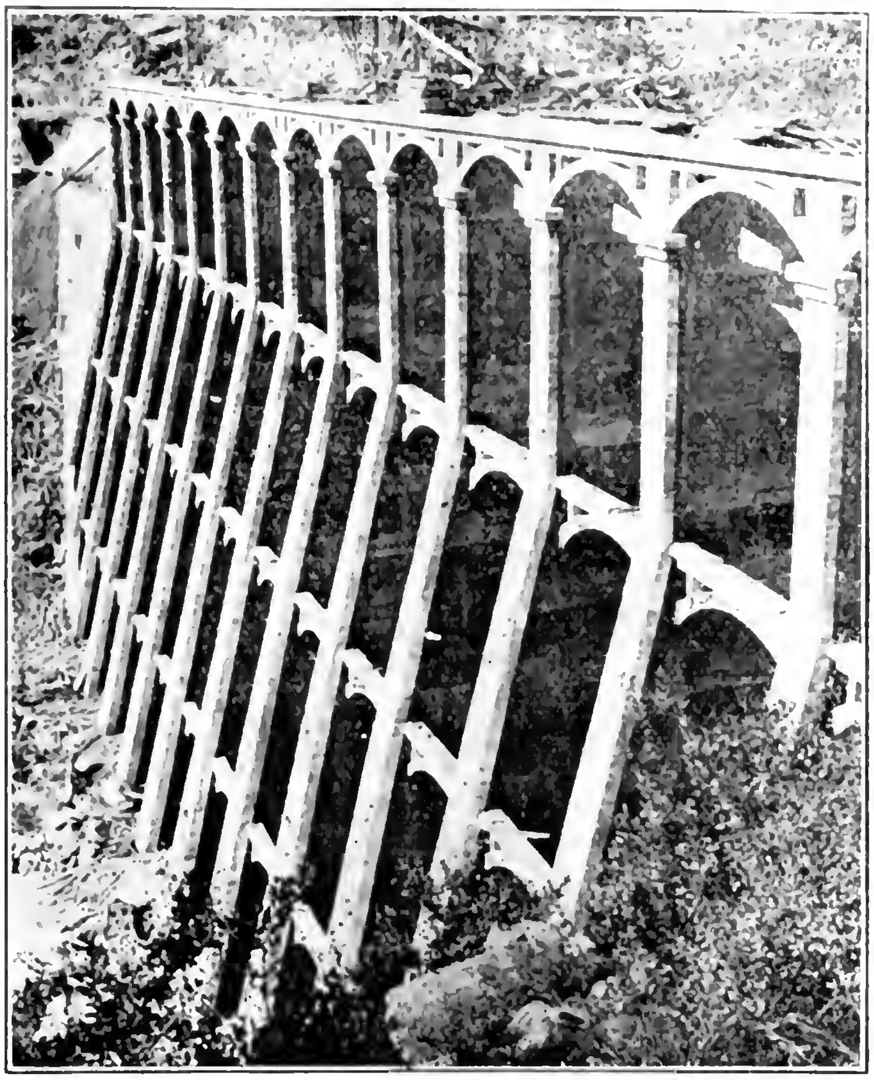
LAKE HODGES DAM FOR SAN DIEGUITO MUTUAL WATER COMPANY, CALIFORNIA

The length of the concrete structure across the gorge is 558 ft., the balance of 192 ft. being a wide bench at the north end of the dam excavated in the solid rock in order to provide a spillway of 70,000 sec.-ft. capacity. This capacity was required by the State Engineer's office, as the maximum stream flow on record at this point is 72,100 sec.-ft. The total length of the spillway provided is 360 ft., of which 192 ft. is excavated from the mountain side, and 168 ft. is in the form of a rollway over the top of the concrete structure at its north abutment. The storage capacity in the 15-ft. rise between the spillway level and the top of the dam would be 38,000 acre-feet; that is, equal to the net capacity below spillway level. In order to avoid obstructing the spillway with piers supporting an overhead bridge, access to the valves under the dam is maintained during high water by means of 4 x 6½-ft. concrete-lined tunnel built under the spillway for a distance of 192 ft., connecting at this point with a series of concrete foot bridges extending under the dam through the buttresses and from which the blowoff and service gates can be reached.

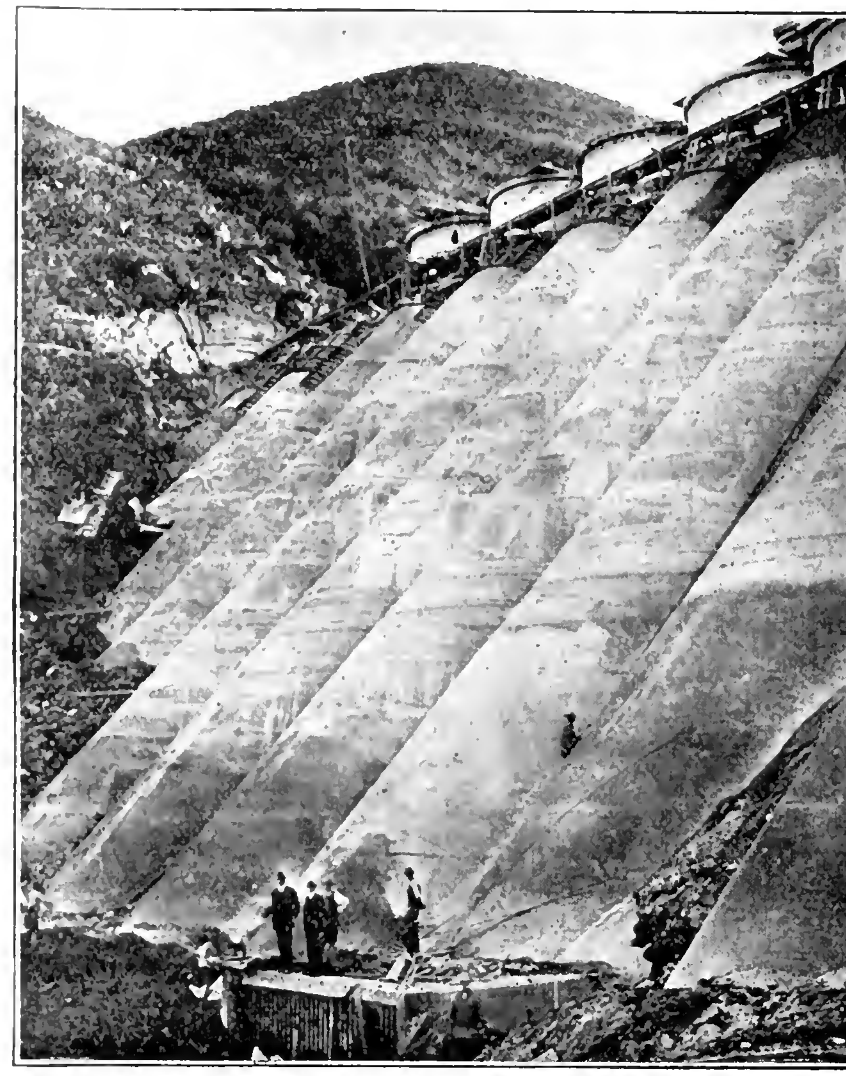
During low-water periods, operators have access by a more convenient entry, through the downstream face of the spillway, into the chamber where the valves admitting the water to the irrigation conduit are located. These consist of six 20-in. outlet gates set so as to draw water off at 10-ft. lifts. Each gate has its screen and connecting pipe to the conduit, which through the structure and beyond, is a heavily reinforced-concrete tube tied to the buttress at one side and laid on bedrock throughout. There are also four 24-in. blowoff valves at the lowest point of the dam. The latter are reached from a suspended concrete stairway running down from one of the concrete footwalks mentioned before.

The buttresses, which rest on bedrock, have no reinforcement except where arches, strut-beams and foot walks are tied in. They are spaced 24 ft. on centers and vary in thickness from 4 ft. at the bottom of the tallest buttress to 1½ ft. at a point 47 ft. below the top of the structure, and above this point this thickness is maintained. Each buttress has a showing face 2 ft. thick and increasing in width from 4 ft. at the top to 8 ft. at the bottom.

The arches vary in thickness from 2 ft. 7¼ in. at the lowest point to 1 ft. at a point 50 ft. below the top of the dam, and maintain this thickness of 1 ft. to the crest, the extreme crest, however, being stiffened by means of a coping 2½ ft. wide by 1 ft. deep. The crown slope of the arches is 45°. The radius of the extrados of the slanting arches is 13 ft. 10¼ in., and the radius of the intrados is variable. The reinforcement is shown on the drawing.

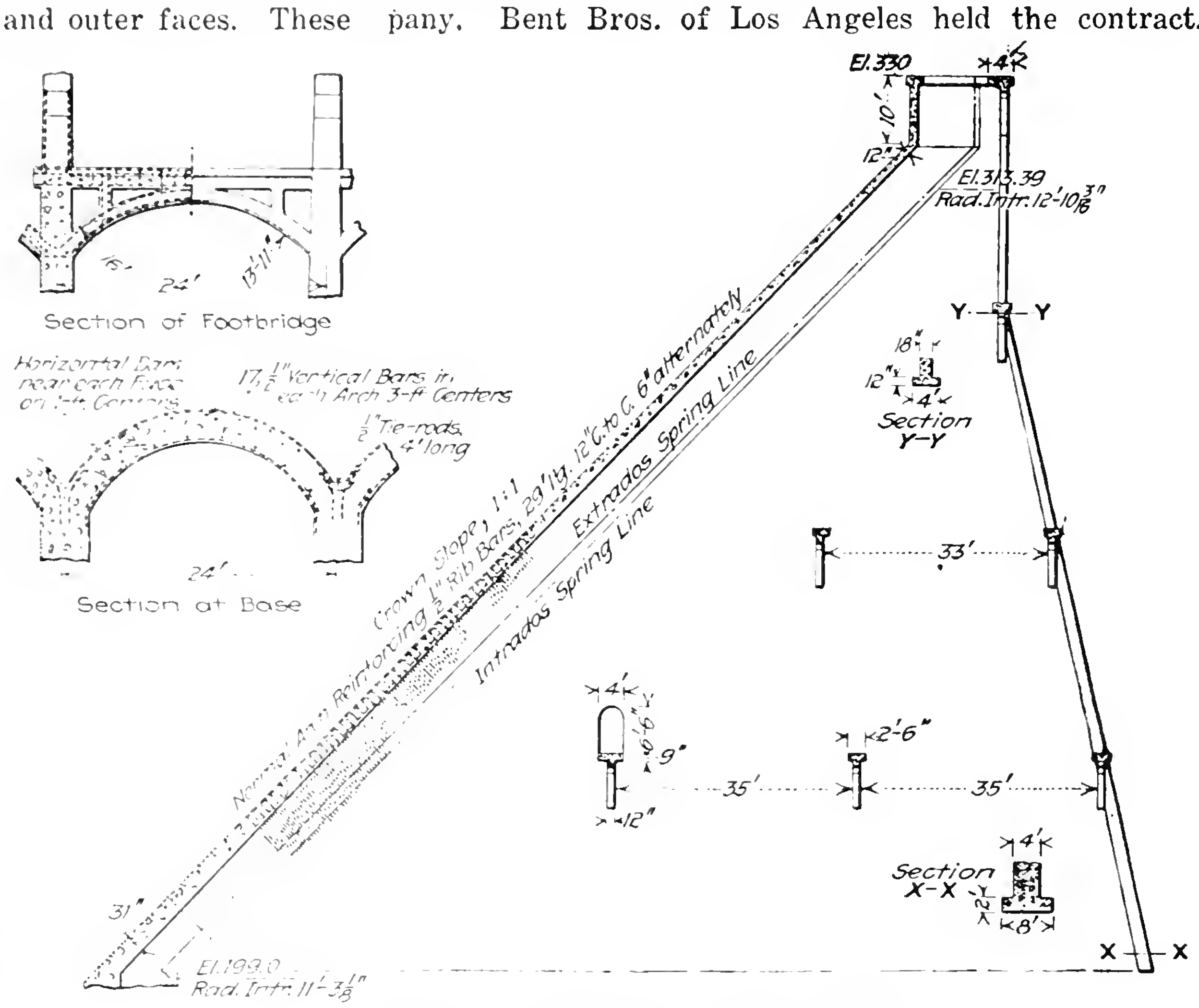


DOWNSTREAM FACE OF HIGHEST MULTIPLE-ARCH DAM HAS ARCHITECTURAL PRETENSION



UPSTREAM FACE OF MULTIPLE ARCHES ARE FINISHED WITH THE CEMENT GUN

The greater part of the reinforcing steel is composed of ½-in. deformed bars. Part of the reinforcing in the spillway roll top and in the strut beams is of ¼-in. deformed bars. In the arches the ½-in. bars are spaced 12 in. on centers on both inner and outer faces. These reinforcing bars are so alternated that the vertical space between bars in the two faces does not exceed 6 in. The arches are also reinforced with vertical rods 2 ft. on centers alternately near inner and outer faces thus giving vertical reinforcement 12 in. on centers. All steel was kept 2½ in. from the surfaces. The concrete mix in the arches was 1 : 2 : 4. The cement gun was used for putting a finishing coat on the upstream face, and has given a very satisfactory finish. The 50-ft. head of water thus far stored behind the dam did not cause any leakage through the structure. During February, 1918, a sudden flood passed through the partly finished dam over an arch that had been left about 25 ft. below the tops of the other arches. The low arch was overtopped to a depth of about 20 ft., the flow falling between the two buttresses for several days without damage. The dam was designed by John S. Eastwood, who served as consulting engineer for the company. E. A. Case was the chief engineer in charge of construction for the water company. Bent Bros. of Los Angeles held the contract.



DETAILS OF THE LAKE HODGES DAM

How Should a Federal Department of Public Works Be Organized?

Need for Clear Determination of What Bureaus Should Be Included, and How Personnel Should Be Protected and Built Up

By Charles Whiting Baker
Consulting Editor, "Engineering News-Record"

A NATIONAL convention of engineers has been called by the Engineering Council to meet in Chicago, Apr. 23-25, to formulate plans for the organization of a Federal Department of Public Works and for a campaign that will secure its creation by Congress.

That the engineering profession is undertaking a very large and difficult task, anyone who realizes the huge inertia which retards all Governmental action will agree. Even on matters of great public importance, to which there is no opposition, it is often very difficult to obtain action by Congress. If the project for a Federal Department of Public Works is to have any chance of success, it must be presented in such form that a powerful body of public sentiment can be enlisted in its support and that opposition will be aroused from as few sources as possible.

For more than forty years there has been discussion in the engineering profession as to the desirability of a Federal Department of Public Works, manned by a permanent body of civilian engineers. Seldom, however, has the discussion included the details of how such a Government department should be organized.

It is evident that if the profession desires now to carry this important reform to success, these detail questions must receive careful study. If a delegation of engineers were to appear before committees of Congress, merely to recommend that a Department of Public Works should be created, they would be assailed at once by questions: What would be the field of such a department? Which present bureaus should it take over? Would this change mean adding a new member to the Cabinet? How will the proposition affect the urgent demands which are being made by other influential interests for changes in the Federal Government organization?

The engineering profession, if it is to succeed in its ambitious task, must be prepared to answer all these and similar questions, and give convincing reasons for its answers. In the coming convention such questions as these are to be threshed out. In preparation for the discussion there, the Engineering Council has sent a prospectus to each engineering society invited to participate, in which various questions are stated, and the society is urged to consider and vote upon them.

Such general discussion by engineers is highly desirable; for, if this great reform is to be carried through engineers all over the country must be able to inform and arouse public opinion in its support.

Care is needed at the outset in defining the field which the proposed department should cover. In earlier discussions of the question it was urged that such a department should take over all the engineering work carried on by the Government. Today, however, engineering is a much more comprehensive term than it was a quarter century ago. A large part of the work done by both the Navy Department and the War Department—the construction of ships, docks, fortifications, ordnance—is engineering work of a very high order; but no one would advocate transferring such military functions to a Department of Public Works.

Again, there is a strong movement, backed by the executive heads of the railway companies, for the organization of a Federal Department of Transportation. If created, such a department would probably take over the functions of the Interstate Commerce Commission, and such other supervision over the railways as the Government may continue to exercise; the Government work in merchant shipbuilding and ship operation; perhaps also the Bureau of Navigation and the Steamboat Inspection Service, now under the Department of Commerce.

A great deal of this work is engineering work, and the Department of Transportation, if organized, should be largely conducted by engineers; but none of these functions seems properly included in a Department of Public Works. Furthermore, those promoting the establishment of a Department of Public Works may well enlist the coöperation of the influential interests backing the proposed Department of Transportation. It may be easier to bring about the systematic reorganization of the Government's business which the establishment of these two departments would involve, than to establish either department separately.

The proper field for the proposed Department of Public Works appears to be the Federal Government's operations in civil engineering construction together with the functions of those scientific bureaus which are chiefly carried on by engineers and whose work is chiefly useful as a foundation for engineering work.

In the prospectus of the Chicago conference there is given the following list of engineering bureaus scattered through various departments, with a request for an opinion as to whether each should or should not be included in the proposed Department of Public Works:

- Treasury Department:
  - Public Health Service
  - Supervising Architect
- Department of War:
  - Public Buildings and Grounds
  - Construction Division of the Army
  - Rivers and Harbors
  - Mississippi River Commission
  - California Débris Commission
- Department of the Interior:
  - General Land Office
  - Indian Affairs
  - Geological Survey
  - Reclamation Service
  - Bureau of Mines
  - National Park Service
  - Alaskan Engineering Commission
- Department of Agriculture:
  - Forest Service
  - Weather Bureau
  - Public Roads
- Department of Commerce:
  - Bureau of Standards
  - Bureau of Lighthouses
  - Coast and Geodetic Survey
- Unattached Functions:
  - The Panama Canal

That the sanitary engineers who carry on the Public Health Service, and the architects and engineers who construct public buildings, should be under an engineering department rather than the Treasury is too obvious to need argument, and the transfer of these bureaus should arise little opposition.

When it comes to the transfer to the new department of the river and harbor and other civil engineering work now carried on under the War Department by the Army engineers, no such easy success is likely. The arguments for the transfer of these works from military engineers to civil have often been presented and are familiar to most engineers. As was pointed out in discussing the question in *Engineering News-Record* of Feb. 20, p. 359, one of the strongest of these arguments is that river and harbor work, under the nominal control of the Corps of Engineers—though the policy is dictated by Congress—has become a national disgrace. This is so well known that public support should be readily enlisted in favor of the transfer of this work to the control of civilian engineers organized under a Cabinet officer who would have the authority and initiative to plan and carry out public works for the national welfare instead of merely distributing Federal expenditures in certain Congressional districts.

In the discussion of this question among engineers, first place has often been given to the position of the engineers in Government service. In pushing the reform before the public, first place must be given to the national benefit which will result from the substitution of intelligent planning by able engineers in carrying out all classes of Federal works, in place of the haphazard spending of money that has hitherto prevailed.

At the close of a war in which engineering has played so large a part, the public will look with greater favor than ever before on the proposition that the Army engineers should devote their time to military engineering work in the interest of national preparedness. To keep them busy on civil engineering work, as has been done hitherto, inevitably results in neglect of their own proper duties.

Bureaus Under Agriculture, Commerce and the Interior Departments

Of the three bureaus in the Department of Agriculture above noted, the one destined to be most important in the future is probably the Bureau of Public Roads. Already it has supervision over the heavy expenditure of the Federal Government in aid of state road construction; and much more extensive work on the nation's highways is probable. Little argument is needed to demonstrate that this should be under a Department of Public Works rather than Agriculture.

A valid reason for the inclusion of the Forest Service in the proposed department is its jurisdiction over the work of water-power development which is in prospect. It will be recalled that the Federal water-power bill, which came so near passage in the late Congress and for which success is expected in the coming session, created a Water-Power Commission made up of the Secretaries of the Interior and Agriculture Departments and of War, because the bureaus concerned with water-power were scattered through these three departments. If these bureaus are brought together in a Department of Public Works, the need for such a cumbrous administrative organization will disappear.

Perhaps the Agricultural Department will seek to retain the Weather Bureau; but its relation to the engineer's work for flood control, water-supply and irrigation is close enough to ground an argument for its inclusion in the Public Works Department.

Of the three bureaus under the Commerce Department listed above, the building of lighthouses and the work of the Coast and Geodetic Survey would surely be generally recognized as civil engineering functions. As for the Bureau of Standards, its work is so largely carried on by engineers and for engineers that the proper place for it would seem to be in the department which will be presumably the engineering department of the Government.

Under the Interior Department, seven bureaus are listed above for possible transfer to the Department of Public Works. In answer to the objection that this would practically destroy the Department, leaving it only patents, pensions and education, the National Service Committee of the Engineering Council has made the interesting suggestion that the Department of Public Works could most easily be started by merely changing the name of the Interior Department, the latter a name which has no longer any significance. This would obviate also the creation of a new Cabinet office.

Of the seven bureaus in the Interior Department listed above, the Reclamation Service of course belongs in a Department of Public Works and so does the work of building the Alaskan railroads. The Geological Survey should be under the same head as the Coast and Geodetic Survey, and as the Bureau of Mines. The care of the national parks should be in the same department as the care of the national forest reserves. The Land Office and the Indian Bureau have such close relations with the other bureaus just named that they should be retained.

Organization of Department

Turning now to the organization of the proposed department: The profession will surely agree that the engineers in such a department should be given a permanent status. These men, on whose independent judgment the conduct of the department will depend, must be safeguarded from dismissal through political or personal influence. If the Government's work is to be carried on with economy and efficiency, unprejudiced engineering judgment is a first essential. Some reasonable tenure of position for engineers in the department is necessary for this reason, and it is also necessary in order that engineers of the requisite ability and character may be obtained. If engineers must exert political influence to obtain positions in the service and hold them after obtaining them, there is little chance that the Government would be able to secure for its great tasks such engineers as have built up the railway systems of the country or created its great industrial establishments.

Hardly less essential in planning the personnel of the proposed department is provision for regular promotion and for retirement on partial pay on reaching a certain age limit on becoming disabled in the service. It is hardly to be exected that Congress can be persuaded to increase the salaries for technical and professional men in the service of the Government to the scale common in private business. There is a fair prospect, however, that Congress will, eventually, in view of the urgent necessities of the departments at Washington,

provide a retiring allowance for Government employees at a certain age limit. With secure provision for old age or disability, men will be better content to work at the low scale of salaries common in the Government service.

It may be argued that such a corps of civilian engineers as is here proposed, with a fixed tenure of office, definite provision for promotion and retiring allowances on reaching the age limit, would to some extent duplicate the organization of the present Corps of Engineers. It has, nevertheless, great advantages over that organization in its freedom from military control and military methods. It would be recruited, also, from men trained in the engineering schools and probably also by some years in the school of practical experience, instead of being brought into the work fresh from West Point.

It needs only a glance, too, at the varied kinds of work which this great department would have to execute to see how necessary in such an organization would be engineers of a great variety of experience, experts in their respective fields. It is only by enlisting the service of such men that the Government can hope to have its great works carried out efficiently.

But, in carrying out any great reform, it is well not to attempt too much at the start. Fundamental though the internal organization of such a department may seem to be to its success, those who have planned the Chicago conference give warning of difficulties in the way. The various bureaus which it is proposed to bring together in that new department each have their own organizations, methods, and personnel which have been built up through a course of years, and to a considerable extent are covered by special laws. If it were attempted now to make a sweeping reorganization of these bureaus, as well as transfer them to a new department, strong opposition would certainly be encountered. Moreover, the bill to create the new department would have to be a very long and complex statute repealing a large number of existing laws and enacting other provisions in their place. It is easy to foresee that such a law would be carried through Congress with great difficulty, if at all.

If the proposed Department of Public Works is to become a reality, therefore, the wisest plan would appear to be merely to bring together intact such bureaus as manifestly belong under such a department, with practically no change in their present organization and personnel. The working out of the relations between these bureaus and of the general organization of the department could be left for the future.

Upkeep High on Disconnected Road System

MAINTENANCE of the 700 miles of state-aid roads of Illinois is difficult and expensive, because the system is so disconnected. The longest continuous stretch of improved road is 15 miles, and the average length is less than two miles. About 300 miles are earth road and the remainder are principally of brick and concrete. The costs per year per mile, including work on the shoulders and ditches, average: Brick, \$56.56; concrete, \$81.45; earth, \$102.20; gravel, \$162.20; macadam, \$564.20 (including surface oiling). Maintenance work on brick and concrete paving consists mainly in filling cracks and building up the earth shoulders; on macadam paving it is mainly surface treatment, while on earth and gravel roads it consists of dragging and filling depressions with new material. In addition, there are the cutting of weeds, the clearing of ditches and the dressing of the shoulders. Where the gang system of maintenance is used, each gang, composed of two to five men in charge of a foreman, takes care of the work in from 10 to 15 counties and has about 75 miles of road under its charge.

The equipment used consists of a small motor truck, heating kettles and the necessary tools and accessories. Only in Vermilion County has the patrol system been introduced, this being made practicable by the fact that there are 90 miles of hard road, the greatest mileage in any one county.

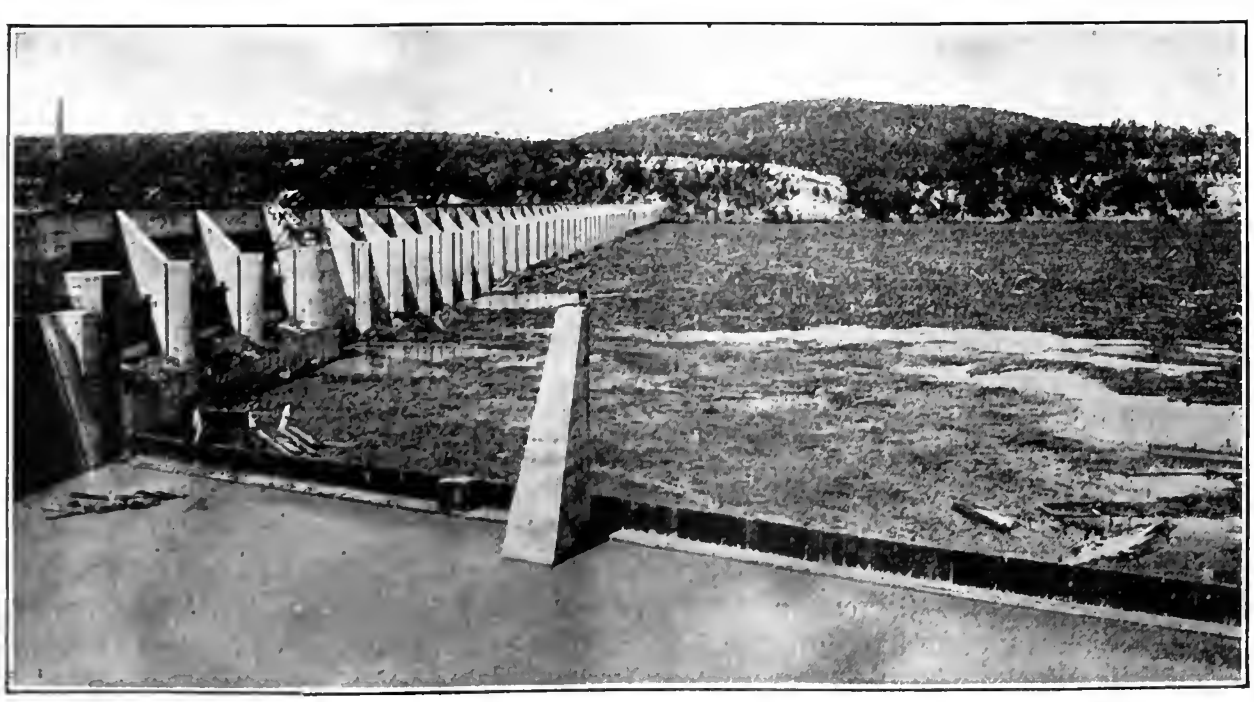
Drift on the Colorado River Held Back by Austin Dam

Passes Over the Rounded Top of Old Dam, But Is Caught by the Present Structure—All Sorts and Sizes of Débris

BY T. U. TAYLOR
University of Texas, Austin

ENGINEERS unacquainted with the Colorado River, Texas, do not appreciate the seriousness of the drift problem in its relation to the Austin dam. The accompanying view, showing drift conditions in the spring of the year, will help them understand what has to be contended with, besides emphasizing the importance of designing a dam to meet local conditions.

The drainage area above the dam at Austin, Tex., is 37,000 square miles. There is an immense amount of drift that comes down the Colorado River, and this



NEW AUSTIN DAM CATCHES VAST QUANTITIES OF DRIFT

drift will be stopped by, passed over or around any dam across the stream.

During the existence of the old dam the drift passed over the rounded crest with no practical difficulty. In 1911, when the City of Austin was considering the present style of dam, it was warned of the futility of depending on it to pass the drift. This warning was ignored, and the contract was let for an open-work dam with a crest in the new part at El. 51 ft., with gates 14 ft. high between buttresses which were supposed to raise the water to El. 65 ft. above the toe of the old dam. There were 28 of these gates, and the first drift flood that came after they were installed destroyed 24 of them and clogged up the gateways with drift.

The accompanying view was taken by the writer when the lake level was 54 ft. above the toe of the dam. It was taken from the east end of the dam, looking toward the west. From the lone buttress or pier in the foreground to the west bluff is practically 1200 ft. The small patches of water seen in the foreground are the result of pulling drift out of the east gate sections. The drift ranges in size from mere trash to logs 3 ft. in diameter, and 60 ft. long.

It should be remarked that there is another dam at Marble Falls, about 120 miles, by river, above the Austin dam, and that the Marble Falls dam partially obstructs the channel and stops considerable drift.

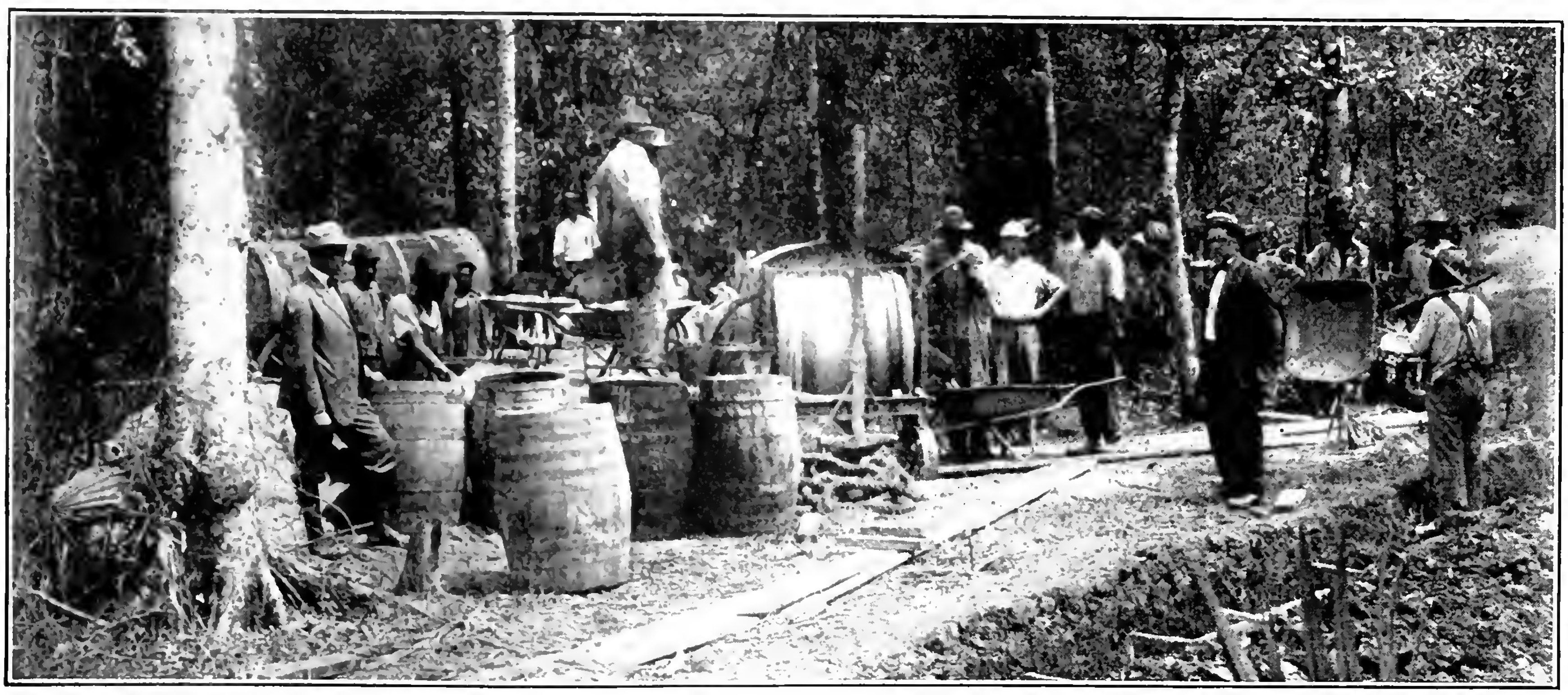
Planning Work Expedites Casing of Pipe Line With Concrete

In Repairing Oil Line Different Foremen Directed Materials Supply, Plant Repairs and Principal Construction Operations

PLANT mobility and precise scheduling of operations have enabled the construction forces of the Standard Oil Co. to obtain notable speed in casing a steel pipe line with concrete. Working 131 men in a gang, 280 miles of 8-in. line in Louisiana have been concreted at an average speed of one-third mile per gang per day. The gangs were divided into crews under foremen and subforemen, and each crew performed a specified set of operations in step with the other crews. Easily shifted tent camps kept the gangs close to their work. All equipment was portable, and certain units less movable than the others were provided in duplicate, so that one unit could be moved ahead and set up ready for work while the other unit was busy on the preceding section. Materials delivery was timed exactly with the work.

Corrosion of the six-year-old oil pipe line between Ida, La., and North Baton Rouge, La., made concrete casing necessary. The terrain traversed by the line is generally low and flat, with a large percentage of marsh land and swamps and some rolling hills. Chlorine salts and other acidulated solutions in the soil had pitted the pipe; in places the pitting was severe. The work to be done involved more than simply placing a concrete casing. It was necessary to uncover the lines, hoist and hold the pipe above the trench bottom, pound, scrape, brush and otherwise clean the pipe, and then to lower and encase the pipe and backfill the trench. All these operations had, moreover, to be performed while the pipe was carrying oil under pressures of from 100 to 600 pounds.

At times one superintendent directed the field operations of as many as four gangs. Each gang consisted of 125 laborers and six foremen. The laborers were apportioned about as follows: Forty men uncovering, handling and backfilling pipe line; 20 men cleaning pipe; 50 men concreting; 10 men handling materials and equipment, and five utility men. Subdivision of the duties of the foremen was carefully planned. There were two materials foremen, three ditching foremen and two concreting foremen, each having a set schedule.



CONCRETE WAS WHEELED FIFTY FEET EACH WAY FROM LOCATION OF THE MIXER

The direction of materials supply was kept separate from the direction of construction operations. A materials foreman, generally one for every two gangs, designated the distribution points, investigated roads, and routed and placed materials and supplies along the work. On the work an assistant foreman, one for each gang, directed the unloading, looked after the housing of cement and the salvage of cement sacks, and saw generally that all things were done which were necessary

PIPE-LINE CREW SHIFTING HORSES AND SETTING FORMS

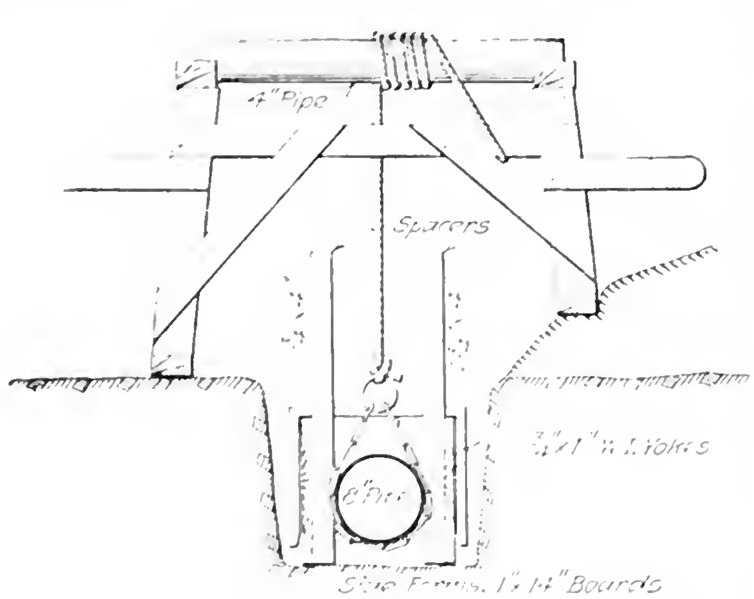
to keep the construction foremen promptly supplied with materials, supplies and equipment.

The transportation of materials was somewhat simplified by the fact that the pipe-line work paralleled railways to a considerable degree. Sand, cement, lumber and equipment were shipped by railway in carload lots to stations nearest the work, and from these points were hauled to and distributed along the work by teams. Water-supply was a more complex task. The amount of water required for concrete mixing and for drinking and cooking was quite large. This water was hauled in tank wagons from convenient bayous, creeks and wells from which it was pumped by portable diaphragm pumps. Horizontal, galvanized-iron, 5- and 10-bbl. tanks were used, the larger or the smaller being employed according to the character of the roads. Cross baffle plates in the tanks prevented the surge of the water when the roads were rough. The tank wagons discharged into barrels located were the water was wanted.

The preparation of the pipe line for the concreting operations was in charge of a general foreman and two assistant foremen. The general foreman directed the operations of uncovering and of raising and lowering the pipe. One assistant supervised the pipe cleaning and the other directed the backfilling and the finishing up of work of various kinds.

After being uncovered, from 200 to 300 ft. of pipe at a time was hoisted by means of windlass horses to a height which permitted the leveling of the trench bottom and the thorough cleaning of the pipe. When cleaned, the pipe was lowered to a position 2 in. above the trench bottom, and concreting was begun.

Cement mortar, nominally of 1:3 mixture, was used for the casing. However, the purpose was to insure a mixture in which the volume of cement was always great enough to fill the sand voids, so the nominal proportions were changed whenever tests, which were constantly made, indicated material variation in the void contents of the sand. Experience has shown this mixture to be practically waterproof. The thickness of the casing was 2 in. under the pipe bottom, 1¾ in. on each side, and 1 in. over the top, which was shaped to a flat crown. No bottom forms were used except where the bottom was boggy or where there was a small water crossing. This practice greatly reduced the amount of lumber left in the trench. The side forms were 1 x 14 in. x 16-ft. boards, cleated across at the middle and at each end to prevent splitting. They were set on edge on the trench bottom and were held in position by wrought-iron clamps spaced about 4 ft., and by timber spacers which blocked them away from the pipe. This arrangement, as shown by the drawing, insured the proper thickness of covering and the exact centering of the



WINDLASS HORSES HELD PIPE LINE SUSPENDED WHILE BEING CONCRETED

INCASED PIPE LEFT IN FORMS OVER NIGHT TO HARDEN

pipe in the forms. The butt joints in the side forms were banked outside with clay to prevent leakage of mortar.

The concrete was machine-mixed and was placed with wheelbarrows having side spouts to facilitate pouring into forms. Stock piles were placed at every tenth joint of the pipe line, or 100 ft. apart, so that the maximum wheelbarrow haul of concrete was 50 ft. ahead and 50 ft. to the rear. Wheel-mounted, $\frac{1}{2}$-cu.yd., power-driven mixers were used. They were hauled by four-mule teams. Two mixers were provided for each gang, one being in use while the other was being hauled ahead and set up ready for use as the work advanced.

Concrete was placed with the pipe suspended, as shown by the sketch. Careful puddling was necessary to fill solidly under the pipe, but otherwise the work presented no special difficulties. When a 100-ft. length of pipe had been concreted and the corresponding length ahead had been suspended in position for concreting, the slings holding the concreted length were released, letting the pipe "float" in the green concrete. No squeezing up or settlement of the concrete resulted from this procedure. The holes left by removing the slings and spacers were filled, and each morning the side forms were removed from the previous day's work.

A construction foreman and a machinery foreman directed the concreting operations. All work of lining up the steel pipe, moving and placing forms and mixing and placing concrete was in charge of the construction foreman. His assistant attended to the upkeep and repairs of mixers, motors and other equipment, and saw to the shifting and setting up of the extra mixer.

All construction was under the direction of the pipeline department of the Standard Oil Co. of Louisiana. Information for this article was furnished by F. Ray McGrew, assistant superintendent.

Piecework Faster Than Day Labor On Hand Excavation

Greater Yardage per Man Recorded in California on Both Road and Irrigation Work—Station Gangs Used on Piecework

By Everett N. Bryan

Chief Engineer, Waterford Irrigation District, Waterford, Calif.

YARDAGE output per man in excavating for road construction in California was 10.9 cu.yd. and 14.3 cu.yd. by piecework, compared with 6.8 cu.yd. and 10.9 cu.yd. by force account. On excavation for irrigation structures, the piecework output per man was 7.2 cu.yd., as compared with a best record of 6.3 cu.yd. by force account. In both comparisons the conditions favored more rapid excavation on the force-account jobs.

The road excavation amounted to 59,027 cu.yd. of loam, "dobe" and cemented gravel, containing in places large percentages of loose rock. Loosening by blasting was necessary to get the best results. All excavation was pick and shovel work, and the material was loaded into cars.

The force-account excavation amounted to 12,283 cu.yd. One cut of 9000 cu.yd. had a maximum depth of 25 ft. This was handled by driving a center drift at the bottom and trapping as much as possible of the mate-bottom and trapping as much as possible of the material into cars. The excavation in the smaller cuts was shoveled. Competent foremen were in charge in all cases. The average output, including drilling, blasting, drifting, mucking, transporting and dumping was 6.8 cu.yd. per man per day. Counting labor in drifting and mucking alone, the output per man per day was 10.9 cubic yards.

Nine station gangs excavated the remaining 46,744 cu.yd. Part of the material was trapped into cars in center drifts at the bottoms of the deeper excavations, part was trapped into cars beneath lean-to platforms against the faces of the excavation, but the larger part was shoveled directly into the cars. Generally, the conditions were not so favorable to rapid progress as they were in the 12,280 cu.yd. of excavation that was done by force account.

The output per man per day for the nine gangs was, however, 10.9 cu.yd., including all operations, and 14.3 cu.yd., including only labor in drifting and mucking.

In excavating for irrigation structures the force-account operations were divided into two parts. About 1339 cu.yd. of excavation was for 28 canal structures and was contained in pits not over 30 in. wide, which were shallow enough to be dug without reshoveling. There was some hardpan in the pit bottoms and the top soil had to be loosened by picking. Very little blasting was necessary. The average output was 3.94 cu.yd. per man per day. The second part of the force-account excavation consisted of trenches for five inverted siphons, and amounted to 1019 cu.yd. The material was not inconvenient to handle, there being very little cemented gravel requiring blasting. The output was 6.3 cu.yd. per man per day.

Piecework Contracts for Trenching Siphons

On another part of the work piecework contracts were let for the trenching for three more inverted siphons. The excavation amounted to 2469 cu.yd., of which 2218 cu.yd. were in one trench $4\frac{1}{2}$ ft. wide and averaging $5\frac{1}{2}$ ft. deep. The other two trenches were of smaller cross-section, the smallest one being 2.25 ft. wide and averaging 3.2 ft. in depth. The smallest trench was very hard at one end and required blasting; the middle-sized trench was handled entirely without powder, and the largest trench required the use of powder throughout. An average of 0.69 lb. of powder per cubic yard was used, and the bottom was carefully trimmed with picks to leave a smooth surface on which to lay the concrete pipe. The average progress per man per day, including drilling, shooting, picking, shoveling, and forge work, was 7.8 cubic yards.

In some cases it is not practicable to compensate an entire gang on a piece-rate basis, but it is often possible to engage one or more of the men to undertake the work on such a basis, if the employer will pay wages to the other men and deduct the cost thereof from the total sum earned by the gang. This plan is applicable to many lines of work where the total cost is not sufficient to justify an attempt to let contracts in the usual way. The work requires less watching than when done by day labor, and is generally accomplished with greater satisfaction to both employer and employee.

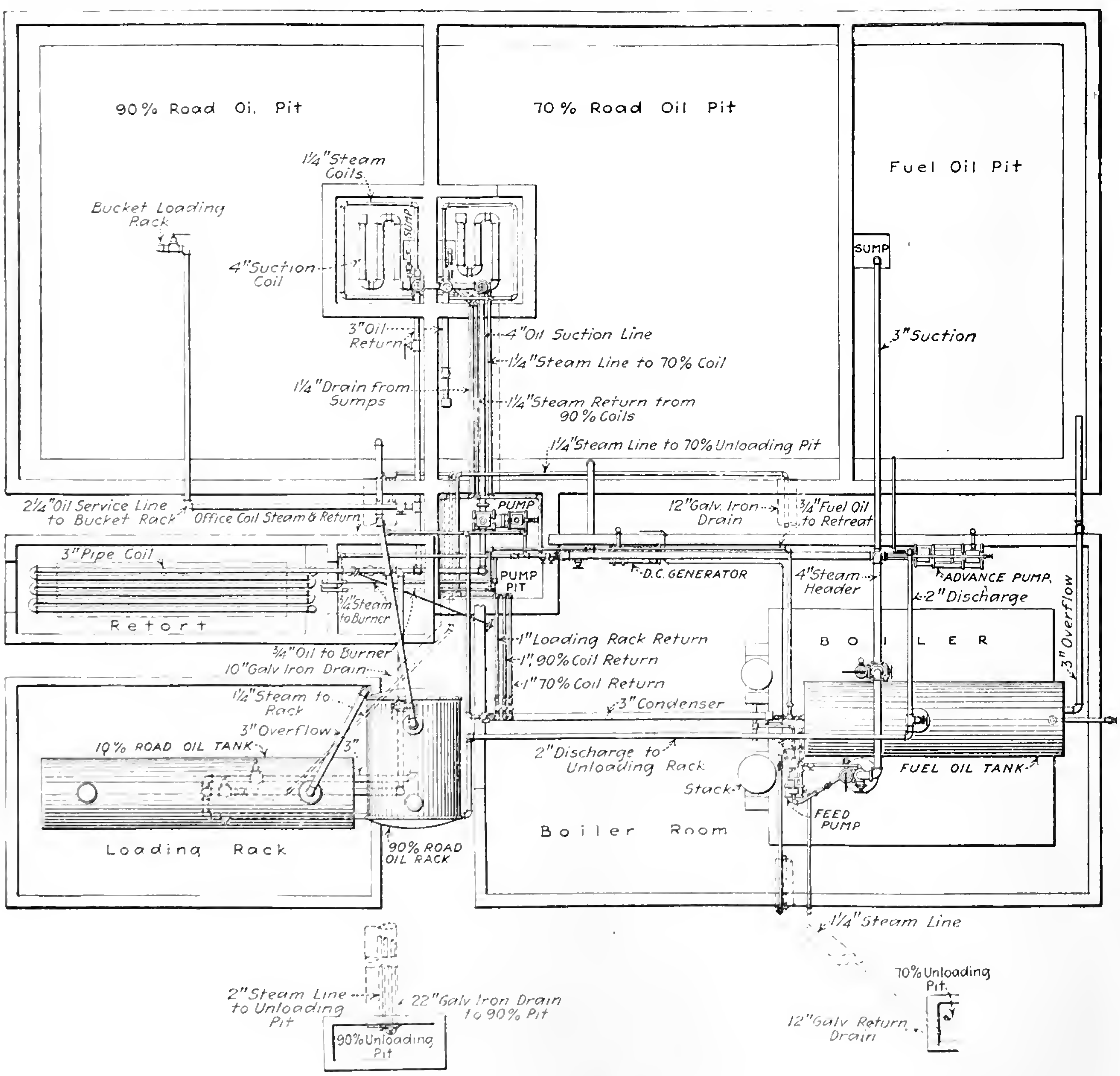
Road-Oil Heating Plant of Los Angeles County

Road Department Builds Plant from Old Equipment in Stock—Installation Saves County $20 per 1000-Gallon Tank

By E. Earl Glass
Monrovia, Calif.

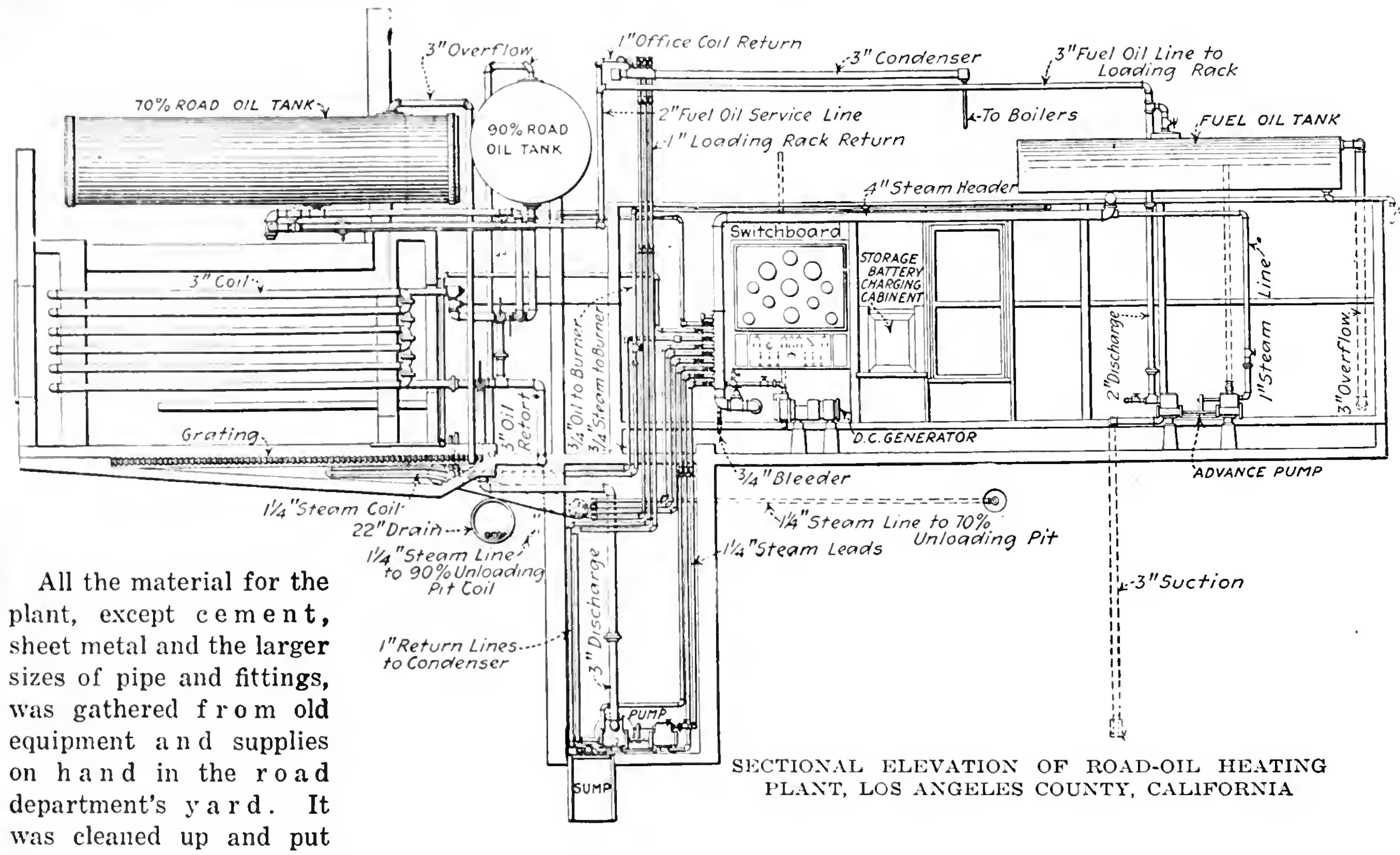
A ROAD-OIL heating plant built from old equipment in the stock of the Los Angeles County road department has been very successful. A saving of $16.66 in delivery and of $1.32 in heating and loading per 1000-gal. tank, as compared with the rates of private companies, has been effected by the installation. The cost per barrel-mile of spreading on the road has been reduced from 3.5c. to 1.68c.—a net saving of 1.82c. From 8000 to 10,000 gal. of oil per day, depending upon its gravity, can be handled, and when operating at capacity the cost averages $1.35 per 1000 gallons.

Large quantities of natural asphalt oil are used in the construction of roads in California, and the county officials found they could effect a considerable saving by handling the oil themselves. The new plant was located, centrally, in the eastern part of the county, at the Baldwin Park warehouse, which is distant 25 miles from the old source of supply. A 20-mile delivery trip, on the average, for each tank of oil used in the district, was thus eliminated. Since the private companies charge 3½c. per barrel-mile (one-way charge) for delivering and spreading, the road department saves $16.66 on each 1000-gal. tank of oil. A further saving is also effected in delivering and spreading, as shown by actual operations. A county truck can average 66 miles per eight-hour day, or 33 miles one way. With a truck driver at $4 per day, a truck helper at $3.50 per day, gasoline and oil at $2.50 per day and interest, depreciation and repair at $3 per day, this gives a total of $13 per eight-hour day, or 1.68c. per barrel-mile, as compared with the commercial rate of 3½ cents.



PLAN

ROAD-OIL HEATING PLANT BUILT FROM EQUIPMENT IN STOCK AT A COST OF $6000



SECTIONAL ELEVATION OF ROAD-OIL HEATING PLANT, LOS ANGELES COUNTY, CALIFORNIA

All the material for the plant, except cement, sheet metal and the larger sizes of pipe and fittings, was gathered from old equipment and supplies on hand in the road department's yard. It was cleaned up and put in good order, so that the finished plant does not show its origin in either performance or appearance. Plans and elevation are shown in the accompanying drawings.

Excavation for the pits required the removal of about 1500 cu.yd. of clean gravel, which was used to level the warehouse ground, the select gravel being used as a natural aggregate for the concrete of the pit floor and walls. The plant has three oil compartments in the storage pit, two of three-car capacity for the heavy 90% and medium 70% oils, and one of two-car capacity for fuel oil. They are filled by gravity, from railroad tank cars, through 22-in., 12-in. and 6-in. drains, running from the three unloading pits, which are situated between the rails on the siding and are spaced 45 ft. on centers. A flowing temperature is maintained in the two large drains and their track pits by means of the steam-pipe coils with which they are fitted. The track pits are 2 x 6 x 2½ ft. deep, with 6-in. concrete walls and floors.

At normal temperature, the 90% oil has about the consistency of slightly warm tar, while the 70% oil is somewhat more fluid. The former is used for the construction of bituminous macadam roads, for the wearing coat on concrete highways and for all patching and repairs on these roads. The 70% oil is used almost exclusively by the road foremen for the construction and repair of the oiled-earth roads, which include most of the secondary roads in southern California.

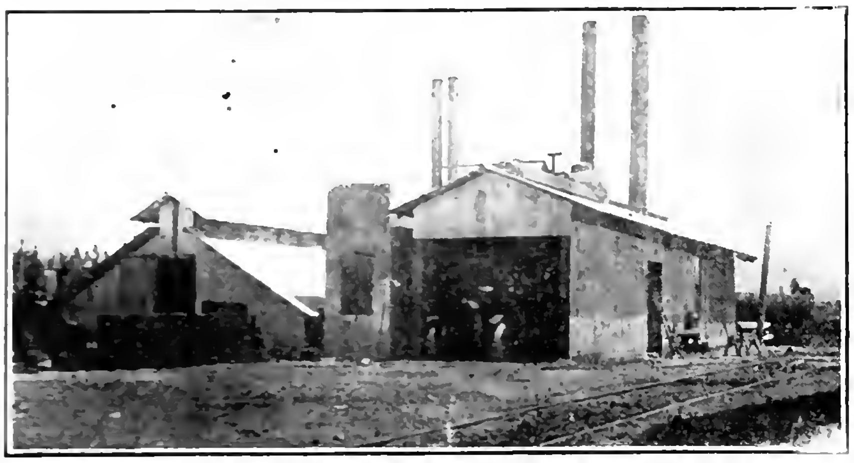
A 12,000-gal. car of the heavy oil is unloaded in seven to ten hours, depending on the time which has elapsed since the car was loaded hot. Two hours' time is required to empty a car of 70% oil. Steam for the car coils, track pits and drains is furnished by two boilers of 35 and 50 hp., the 13-way manifold on the steam header being made in the warehouse shop with an acetylene welding outfit. The boilers also supply steam for operating the pumps, oil burners, heating pit coils and heating system for the warehouse office. Either boiler is capable of running the plant at capacity. Compressed air from the warehouse is used to start the oil burners under the boilers. A 1-kw. steam-turbine direct-current generator unit supplies the current for charging the storage batteries for the trucks and automobiles. A drop-leg condenser automatically returns the condensed steam to the boilers.

A sawdust mixture was used successfully for covering the steampipes, but was not suitable for the oil lines, as it takes fire at high temperatures. In making this mixture 2 lb. of wheat starch and 1 lb. of rye starch were cooked to make 5 gal. of paste, and enough sawdust was stirred in to make 10 gal. of mixture. This was spread on canvas strips and wound on the pipe, and then heated to dryness by turning on the steam. When a coat of boiler paint is applied, this treatment gives good results and a fair appearance.

The retort is entirely inclosed by a 6-in. concrete fire wall, carried well above the surrounding buildings and kept out of contact with the brickwork of the retort by a thin plaster of mud, to allow for expansion of the brick. The firebox is lined with firebrick and heated by an oil burner. The 3-in. retort coil has 430 sq. ft. of heating surface, and all the return fittings are readily accessible for the removal of burned pipes. The coil pipes, 2 in. in diameter, extend through pipe sleeves in the end walls of the firebox into the return chamber, and the coil supports are kept fully air-cooled, resisting the high temperatures by passing through 4-in. casings extending through both side walls.

The loading room has a floor of 2 x 4-in. pine grating over a shallow concrete pit which drains through a coil-heated pipe to the 70% compartment. The delivery trucks back upon this rack and are loaded from above through a universal nozzle. Any one of the three grades of oil may be drawn from its overhead storage tank by

the operation of one of the three valves on the service lines at the nozzle. The entrance to the loading rack is closed by a roller door made by nailing narrow Oregon pine ceiling to three pieces of canvas belt. The oil pit is roofed and the other buildings are sided with galvanized sheet metal. The illustration shows a truck loading in the shed.



LOADING TRUCKS AT ROAD-OIL HEATING PLANT

In operation the asphalt oil is admitted to the 5 x 6-ft. cell, and rises to the depth of 6 ft. This cell has the capacity of a 1000-gal. truck. The 1¼-in. pipe steam coils raise this from normal temperature to 150° F. in about one hour. It is now fluid and is raised through the retort to its overhead tank by the duplex steam pump in the pit below the boiler room. The 4-in. suction pipes in the heating pits are jointed and balanced, so that the hot oil may be drawn from the surface. The efficiency of the heating pits is being further increased by the laying of flat steam coils on their floors.

A 1-in. metallic hose is connected to the line between the 90% pit and the retort and is used to fill 4-gal. steel buckets with heavy oil. Highway maintenance crews use these to carry patching oil on their tool trucks. As more than 200 of these buckets are used each day, this method is much more effective than carrying the buckets from a fixed filling pipe, as was done in the past. All oil pipes drain back when not in use to prevent setting of the asphaltic oil in the cold pipes. Each of the overhead storage tanks is fitted with an overflow pipe returning to its proper pit.

Fuel oil (27 gravity) is pumped directly from its pit to the 550-gal. supply tank over the boilers, whence it flows to the burners of the retort and boilers and to the service nozzle over the loading rack. This oil is delivered to the county road rollers, steam shovels and piledrivers by truck tanks or trailer tenders.

Oil temperatures are indicated by an electric pyrometer, calibrated from 0 to 800° F. Five thermo-couples are fixed at the following points: One in each heating pit, one in each road oil tank and one in the retort coil. These lead through a selective switch to the indicator. Regulation of the circulation of the oil through the retort, and thereby of the temperature of the road oil, is controlled by a gate valve which is operated from the switchboard by an extension stem and hand wheel. This gives a practically centralized control of the plant and makes one-man operation possible. The cost of operation is $7.50 for fuel, lubricant and water, and $4.50 for the operator, or $12 per eight-hour day. Ten 1000-gal. tanks of 70% oil at 300° F. or eight 1000-gal. tanks of 90% oil at 350° F., can be loaded in eight hours.

The full capacity of the plant will seldom be called upon, but an average of five truckloads per day may be expected. This will give a cost of about $2.25 each, for heating and loading. The cost of the plant was about $6000. It is being operated under the supervision of F. H. Joyner, county road commissioner.

Inclined Railway to Deliver Materials on Hetch Hetchy Project

DELIVERING materials and equipment to the Early intake portal of the 18-mile tunnel on the Hetch Hetchy water-supply project required special consideration because the intake is in a narrow cañon about 1700 ft. below the Hetch Hetchy Railroad. The method decided upon was the use of an inclined tramway 3000 ft. long with a maximum incline of 70%. This tramway was built in 1917.

1700-FOOT INCLINE TO EARLY INTAKE PORTAL

To prevent creeping anchorages were put in as close together as the outcropping of rock afforded suitable foundation. These anchorages consisted each of an extra large tie, usually a 14 x 14-in. timber, cut as long as necessary to develop the strength of the anchorage. Where the rails crossed these anchor ties the flanges were notched so that the spikes could prevent creeping of the rails over the tie. Twenty-pound rails were used.

No measurements have been made of the lengthening that has occurred in this rail line since it was installed a year and a half ago, but the resident engineer asserts this has amounted to as much as 6 or 8 in. An interesting point is that the resultant movement is downward, whether caused by contraction or expansion.

When the incline is ready for operation a 25-hp. electric winch will handle the cars. In the meantime, the only access to the bottom of the cañon is by means of a wagon road built on a uniform 10% grade, and about 3½ miles long.

Midway in the line (near the top of the accompanying view) there is a turnout. Three rails instead of two were used on the incline to insure against derailments at the turnout, which, experience proves, are of frequent occurrence where only two rails are used.

This work is being carried out by the City of San Francisco under the direction of M. M. O'Shaughnessy, city engineer.

More Water Laboratories in Kansas

Water-works managers in a number of the smaller Kansas cities are fitting up small chemical and bacterial laboratories. The practice is being promoted by the State Board of Health, which will supplement the work of these small laboratories by more extensive analyses made periodically in its main laboratory.

Water Consumption Cut More Than Half at Newark, Ohio

Contract for Water-Waste Survey Reduced Underground Leakage and Located Illegal Use of Water

BY F. H. WARING
Assistant Engineer, Ohio State Department of Health, Columbus, Ohio

WATER-WASTE surveys cut waste and consumption at Newark, Ohio, more than half, or from 131 to 61.5 gal., in 1918. Much of the excessive consumption was due to the illegal use of water, and much to underground leakage. The curtailment was effected by professional water savers, working under contracts in coöperation with the city water department.

The population of Newark in 1918 was estimated at 30,000. The water-supply is pumped from infiltration systems in the bed of the north fork of the Licking River, supplemented from the river direct. Liquid chlorine disinfection is used. Up to Mar. 1, 1918, the city water-works was conducted under the immediate supervision of the director of public service, J. Edward Wilson, who then appointed Taylor Kussmaul superintendent. The latter had been engineer at the pumping station and later assistant in the office of the water-works department.

The water consumption at Newark averaged about 3,000,000 gal. a day for the four-year period up to January, 1917. Subsequent steady increase in water consumption took place, until in the spring and summer of 1918 it had reached the estimated figure of 4,100,000 gal. per day. On Mar. 1, 1918, 6700 of the 7000 services were metered.

In attempting to account for water consumed, the superintendent observed: (1) That the water consumption estimate of 137 gal. per capita was excessive for a city of the size and character of Newark; (2) that he could account for but a small percentage of the total water consumed by checking up the 96% of services that were metered; (3) that an average daily pumpage of over 4,000,000 gal. placed a burden on the pumping station which would soon have to be met by the installation of a new pump at a considerable expense to the city. It was the superintendent's purpose, therefore, to find out if the purchase of such an additional pump was necessary.

On July 1, 1918, every service had been metered, and still the large quantity of water consumed was unaccounted for. On Aug. 1 a water-waste survey company was employed to make a survey of the distributing system. At the suggestion of the superintendent the employment of the comapny was not made generally public.

CONTRACT FOR WASTE SURVEY MADE

The survey experts contracted to test (1) the existing pumps; (2) all meters larger than 3 in. (3) the distribution system, for underground leakage. It was agreed that the leaks, as located, would be repaired and that tests would be made at industrial plants to detect any illegal use of water.

The company furnished one engineer and three pitometers; the city furnished shelter boxes for the instruments, a foreman and three laborers for line work, necessary transportation and incidentals. The company guaranteed to save the cost of the survey to the city by accounting for and stopping leakage of water which would be figured for one year at 3c. per 1000 gal. The city agreed to pay one-third of the contract price when the guarantee was fulfilled, one-third when the field work was completed, and one-third when the report was filed and accepted. The contract price to the city under the above conditions was $2600. It is estimated that the city incurred expenses connected with the survey amounting to $2600 more.

Pump tests indicated slippage as high as 14½% when the pumps were drawing water direct from the Licking River. Repairs were made and the second test indicated 10% slippage. Further repairs were undertaken, but the exact amount of slippage then prevailing was not determined before the survey was finished. Having installed measurement devices for the total quantity of water pumped, the average daily consumption in August was found to be 120 gal. per capita. This figure was far in excess of what it should be for a totally metered city of 30,000.

The city was then divided into districts, and the water consumed in each district was measured for a 24-hour period. If comparison of the day and night rates showed the latter to be a high proportion, indicating waste, the district was subdivided and the same 24-hour study was made. In this way leakages were narrowed down and located, and the necessary repairs were made at once.

ILLEGAL USE OF NEARLY 1,000,000 GALLONS FOUND

In the course of the survey the experts located an illegal use of water by the American Bottle Co. amounting to about 895,000 gal. per day. This water was being taken through an unauthorized connection to a fire line which entered the property from a 12-in. city main. The connection was uncovered and photographs of it were obtained. The company disclaimed any knowledge of the connection, although water had been drawn through it regularly for cooling purposes in its factory. This and other evidence enabled the city to bring charges against the bottle company. A bill for $49,000, estimated to cover the amount due the city for 1918, was rendered. On refusal to pay the bill the city threatened to shut off the bottle company's entire supply, and the company brought suit to enjoin the city from carrying out its threat. The company offered to settle for $6700, representing that the evidence at hand proved only the definite illegal use for a short time preceding the survey. The trial court sustained the company and gave the city judgment for $6700. The city has taken the case to a higher court.

During August, after the shut-off of the illegal connection at the American Bottle Co., the average daily quantity of water accounted for by the meters from which revenue is received amounted to 909,700 gal. Other consumption was: Flat-rate services for commercial use, 379,000 gal daily; public watering troughs, 99,000; hydrant leakage, which could be stopped after repairs had been made, amounted to 82,000 gal. A total of 1,469,700 gal. a day was accounted for.

At this time a remeasurement showed that 1,845,000 gal. was being pumped to the city. Of the difference, amounting to 375,300 gal., 243,000 gal. was attributed to unavoidable leakage, or 3000 gal. per mile for the 81 miles of main in the city. The remainder, 132,300 gal., was assumed to be consumption by the city building and fire houses and the city hospital. The second as-

sumption was thought to be too low, but, nevertheless, showed forcibly the fact that the main leakage had been reduced to a minimum.

Recapitulation of the average daily consumption shows the following comparative totals:

	Gallons
Before the survey	3,932,000
After the survey	1,845,000
Decrease	2,087,000
Leakage located and stopped	552,000
American Bottle Co. illegal use stopped	895,000
Decrease unaccounted for	640,000

Of the decrease unaccounted for, about 140,000 gal. were attributed to two leaks that were subsequently discovered and repaired by the city on the supply main, leaving 500,000 gal. unaccounted for.

It is felt by the survey experts and by the city officials engaged on the work that this item represents a large consumer taking water illegally from the mains, but whose connection could not be located following the exposure of the American Bottle Co. In other words, the large consumer became aware that investigations were being made and discontinued taking this amount of water just before the survey was finished.

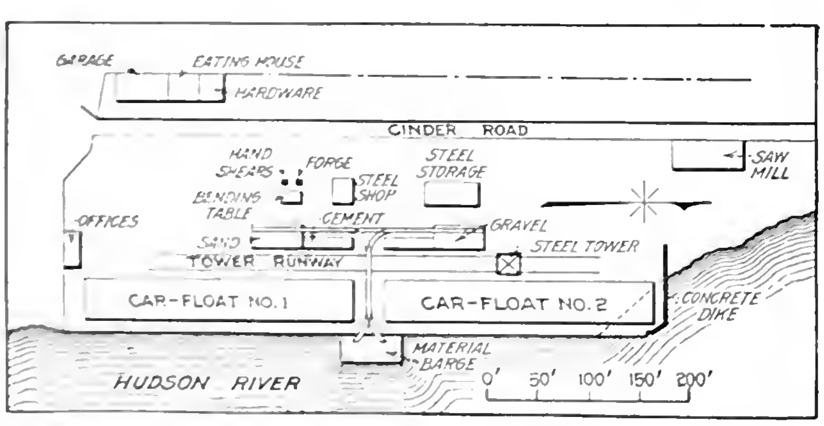
The water-waste survey at Newark revealed the fact that before the survey the average daily per capita consumption amounted to about 131 gal. After the survey, and after leakages had been repaired and illegal use of water stopped, the per capita consumption fell to 61.5 gal. The leakage amounted to 23.1 gal. and the illegal use to 29.8 gal.; unaccounted for but stopped, and thought to be additional illegal use of water, 16.6 gal. per capita. In other words, the City of Newark has accomplished a reduction in water used, and for which previously no revenue had been derived, corresponding to 53% of the total water pumped before the survey. It is needless to add that an additional pump was therefore found to be unnecessary. Furthermore, the plans of the city for a filtration plant will be considerably modified by the accurate data on water consumption obtained. The water-works department is now upon a sound financial basis.

Hudson River Shipyard Layout To Build Concrete Car Floats

Concrete Placed for 1600-Ton Vessels From Stiffleg Chute Tower—Will Launch Sideways From Jacked-Up Ways

By H. W. Eldridge
Engineer, Technical Department, Atlas Portland Cement Company, New York

CONCRETE car floats, having a finished weight of approximately 1600 tons, which makes them the largest concrete towboats now under construction, are being built in a yard specially designed for them, at Athens, N. Y., on the Hudson River, about 120 miles above New York City. Distinctive features of the yard are the launching method and the provision for

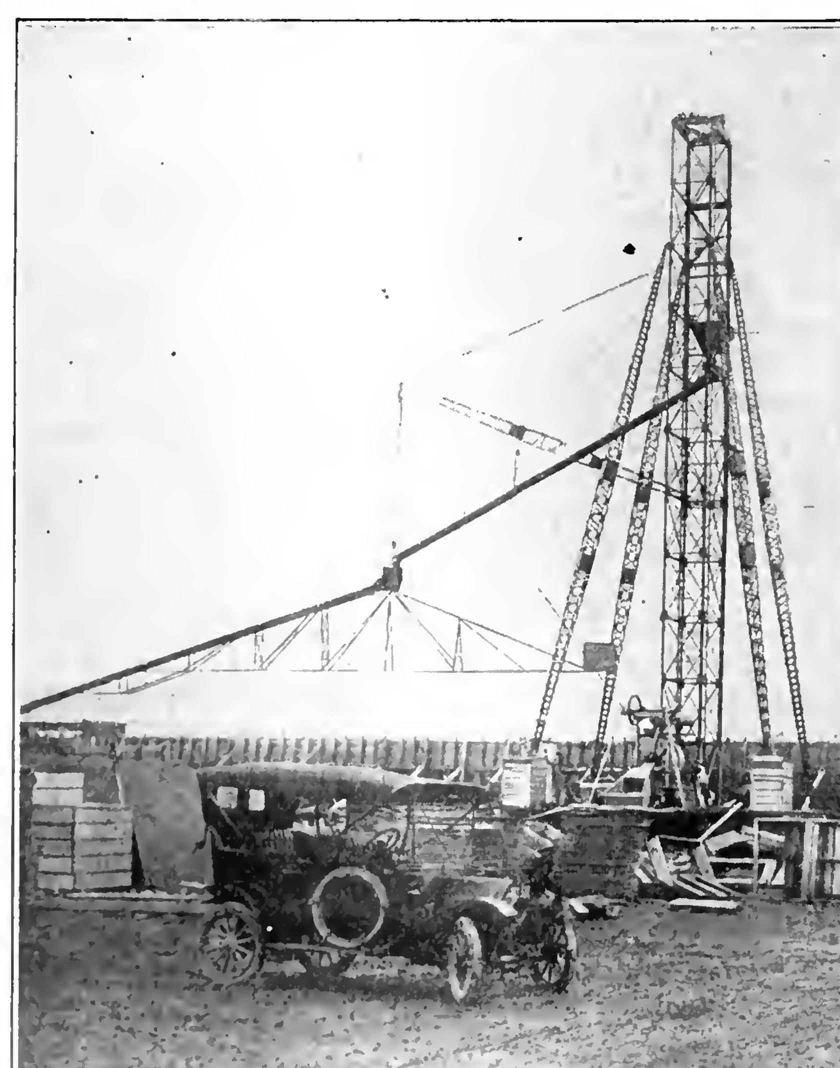


CONCRETE SHIPYARD AT ATHENS, N. Y., WHERE CAR FLOATS ARE BEING BUILT

concreting from a stiffleg tower with chute which will control half of the long boat at one set-up and which can be moved on rollers to control the other half. Six of the floats are being built at this yard for the Embarkation Division of the War Department.

The boats are each 265.9 ft. long, of 38 ft. 2 in. beam, and are 11 ft. 3 in. deep. They are of the general form common to wood and steel floats and provide for three lines of standard-gage railroad track with a capacity of seventeen 50-ton loaded cars. Provision is made at the yards to build two of these floats at a time on side-launching ways and to command the concreting operations from a tower running on tracks paralleling the ways. Details of the layout are shown in one of the drawings.

The river at this point has a depth of 25 ft. and a tidal range of 5 ft. The construction materials are



TOWER CHUTE HAS NO GUYS AND IS MOVED ON ROLLERS UNDER PLATFORM

delivered by barge to a trestle running into the yard between the car floats and the cement sheds and extending the full length of the concreting yard. This trestle supports a 24-in.-gage industrial track. The rise and fall of the tide are taken care of by a hinged joint in the trestle 30 ft. from the end. The material is loaded into 1½-yd. industrial dump cars which are hauled on

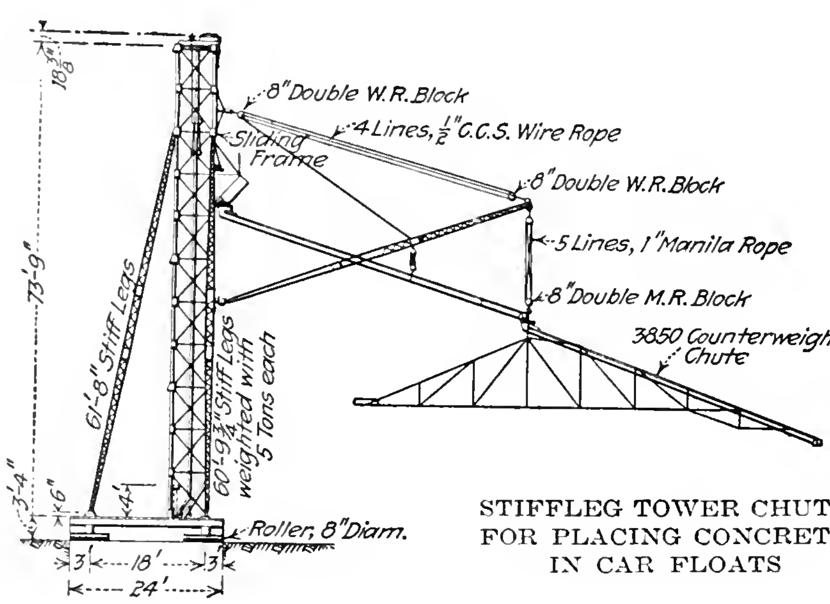
SEVENTEEN-CAR CONCRETE FLOAT ON WAYS JUST BEFORE LAUNCHING

the trestle by a line running through a snatch block to a motor truck on the ground alongside.

The remainder of the yard comprises a modern sawmill 28 x 72 ft. in plan, a steel storage yard, a steel fabricating building 20 x 24 ft., bending tables, forge and shears. A power punch is being used for the spacing angles detailed to hold the reinforcement. The remaining buildings are the garage, eating house, hardware store and small tool shack and the office building.

The concrete aggregates are graded Hudson River gravel, and are being delivered by barge from a point south of Newburgh, on the river, and the cement is delivered from Hudson, N. Y., directly opposite Athens.

The plan for handling the concrete was worked out by the engineers of the shipbuilding company and the Insley Manufacturing Co. A steel tower 80 ft. high with a ⅝-yd. mixer and chutes having a radius of 114 ft. are mounted on a specially designed platform. The tower was made portable by the use of a timber runway and 22 hardwood rollers 6 ft. long and 8 in. in diameter. The details of this steel tower are shown in one of the drawings. From one set-up of the tower it is possible to place concrete a total distance of 196 ft. It is, therefore, necessary to make only two tower set-ups for the concreting of each car float. The 50-hp. motor which furnishes power for the operation of the elevator bucket and concrete mixer is also used for moving the tower, by using a cable fastened to an anchor post or deadman. The tower and chutes are thus a complete portable unit. No guy wires are necessary, as the entire plant is perfectly balanced. There are four stifflegs fastened to the corners of the tower at a point about 10 ft. below the top, and to the tower foundation. The two on the side of the tower, opposite the chutes and boom, are weighted down each with a 5-ton sand box, which is sufficient to resist the overturning moment. The tower is very rigid, and no

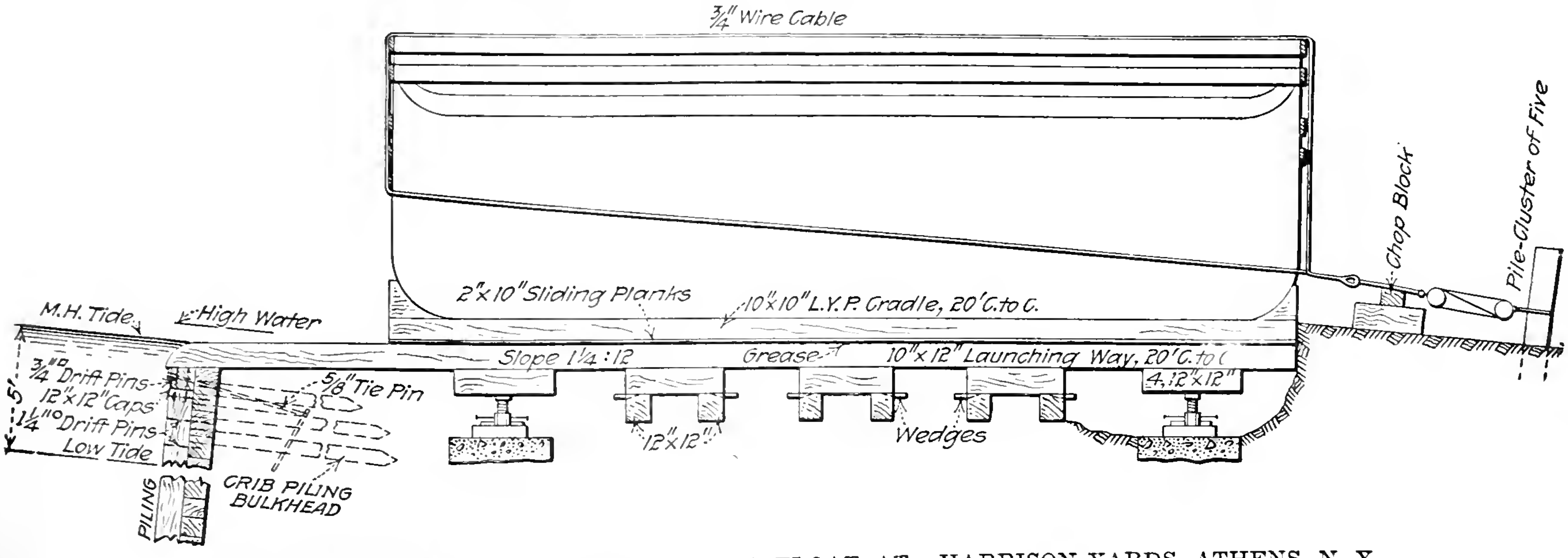


STIFFLEG TOWER CHUTE FOR PLACING CONCRETE IN CAR FLOATS

trouble has been experienced in maintaining the elevator bucket in true alignment.

The chutes consist of one 50-ft. boom chute and one 50-ft. counter-weight chute, and extension chutes. A complete electric lighting system has been installed.

Continuous placing of concrete is required for this work, and the tower is accomplishing this wonderfully well. The side forms for one of the floats have a total



LAUNCHING DETAILS OF CONCRETE CAR FLOAT AT HARRISON YARDS, ATHENS, N. Y.

distance of about 610 lin.ft. To place the concrete continuously, a complete circuit of this distance must be made before the initial set of the concrete already placed has been obtained. This is being done, and readily demonstrates the flexibility of the plant.

In preparing the site for the construction and launching ways the ground is evenly graded on a slope of $1\frac{1}{4}$-in. to 1 ft. Timbers made up of 12 x 12-in. logs slabbed on two sides are placed on 6-ft. centers on this grade with the top face flush with the ground level. During construction the entire weight of the vessel is supported by these timbers. Two launching timbers and a series of jacks are then placed at intervals of 20 ft. The jacks are supported by a concrete footing and capped by a 12 x 12-in. block 4 ft. long. The two 10 x 12-in. launching timbers are supported by two jacks and at the water end by the bulkhead piling, and also by 12 x 12-in. blocking and wedges between the jacks. The two 10 x 10-in. timbers which make the saddle are yellow pine. It was impossible to, secure hardwood timbers, and therefore, as it was necessary to obtain a hardwood finish to the underside of the saddle timbers, two 2 x 10-in. hardwood planks are used for this purpose.

When the vessel is ready for launching a $\frac{3}{4}$-in. steel cable is to be passed around the ends, as shown in a drawing, and anchored to a cluster of five piles. When the forms are being built, provisions are being made for removal above the saddle timbers. This part of the form is to be first stripped and the saddle timbers placed. The jacks are then to be started, raising gradually and uniformly over the entire length, thus transferring the weight of the vessel from the timber ways to the launching timbers. As the vessel is jacked the remainder of the forms are stripped and removed. The 12 x 12-in. blocking is wedged up as the jacking progressses, so that the weight is evenly distributed. This performance continues until the desired slope has been obtained. The lines are then simultaneously cut at the chop blocks, and the vessel starts down the ways. It is expected to launch at a slope of 4 ft. and at the high stage of the river. The launching design was made by William Jones, chief engineer of the company.

The contract is being executed by the Louis B. Harrison Shipyards, Inc., of 141 Broadway, New York City, under the direction and supervision of the Embarkation Division of the War Department. Mr. Jones, the chief engineer, is in responsible charge of the yard, and the War Department is represented by G. E. P. Bradley.

One vessel is ready for launching, and a second one has forms in place and steel installed and is practically ready for the placing of concrete.

Ohio Uses Cost-Plus-Lump-Sum Contract for Highway Maintenance

DURING the past year a modified form of the cost-plus-lump-sum contract has been used for resurfacing work by the Bureau of Maintenance and Repair of the Ohio State Highway Department. The new form is reported to have worked well, having encouraged the contractors to prosecute the work actively. Under the modified plan the state furnished all materials, thus relieving the contractor of the risk of rising prices.

The following example illustrates the form of procedure. The work was the reconstruction of a bituminous macadam top on an old macadam road. Selected contractors were asked to bid on the items given in the accompanying tabulation, which also gives the accepted bid prices. All labor, teams and equipment not specified in the contract were provided and paid for by the department.

In planning this contract, the objects sought were: Reduction of risk to the contractor; inducement to the contractor to push the work, and assurance that the contractor would do good work. By taking unit bids on items which are more or less uncertain, the contractor's risk is reduced. Also, since the state buys and furnishes all materials, the contractor is relieved of all risk of price advances and of delays in obtaining materials. Active prosecution of work is encouraged by the fact that the contractor's equipment and personal time are tied up until the job is finished. Finally, the contractor is assured a reasonable profit, though he has no chance of making one that is unusually large.

Maintenance work is directed in the field by patrolmen, foremen and superintendents. These men work under the supervision of a resident engineer, representing the county. The resident engineers work under the direction of division or maintenance engineers, who have charge of several counties each and who are responsible to the deputy highway commissioner.

Clinton Cowen is state highway commissioner of Ohio, and A. H. Hinkle is deputy highway commissioner in charge of the bureau of maintenance and repair.

SCHEDULE OF BIDS ON OHIO COST-PLUS-LUMP-SUM CONTRACT FOR ROAD RECONSTRUCTION

Approximate Estimated Quantity	Item	Contractor's Bid	Total
90 days	1 10-ton road roller	$6 40	$576
Lump sum	1 heavy road grader	100.00	100
Lump sum	1 contractor's plow	30 00	30
Lump sum	1 harrow	25 00	25
Lump sum	1 tank wagon	100 00	100
Lump sum	1 stone unloader	250 00	250
Lump sum	6 slip scrapers	8.00	48
Lump sum	3 wheel scrapers	30 00	90
1,000 days	Teams with dump wagon (not including driver)	4.50	4,500
Lump sum	All picks, shovels and other small tools	150 00	150
Lump sum	Moving outfit on job	200 00	200
200 days	Foremen (2)	4 00	800
Lump sum	General supervision*	1,400 00	1,400
Totals			$8,269

*Contractor must be on the work at least half the time.

Prohibition and Water Revenues at Cincinnati

Based on information supplied by the Water-Works Department, William F. Von Hoene, comptroller of Cincinnati, estimates that the loss in water-works revenues that will follow putting prohibition into effect will exceed $100,000. It is stated that in 1915 Cincinnati breweries used 65,611,000 cu.ft. of water; distilleries, 8,993,500 cu.ft.; manufacturers of accessories, 5,956,400 cu.ft. This makes a total of 80,560,900 cu.ft., said to be the normal yearly water consumption for these industries. The value of this water in terms of revenue is placed at $80,561. In addition, it is estimated that each of the 850 saloons in Cincinnati paid an average of $30 a year for water, making $25,500 and thus bringing the total loss up to a little over $100,000. This is gross loss. No allowance is included for water consumed in substituted manufacturing plants or by tenants for the quarters previously used for saloons.

Tamped Concrete Specified For Illinois Roads

Requirements Controlling Quality of Workmanship Made More Rigid—Increase in Machine Operations Encouraged

CONCRETE so dry that it must be compacted by tamping is specified for 1919 state-aid road work in Illinois. Machine tamping is encouraged, but is not required. Other new clauses tighten up the requirements for quality of construction, but they call for no radical changes in plant and methods previously employed. An outline of the new provisions which are of most significance to the contractor follows:

Consistency is rigidly defined. Broadly, it is to be "such that a conical pile of the concrete having a 45° slope will neither tend to flatten nor to run at the edges." It is to be such that the concrete will require "considerable tamping." It is required that precision of consistency be established by the following test: "A cylinder 6 in. in diameter and 12 in. in length shall be filled with concrete which shall be tamped until all voids are filled and a slight film of mortar appears on the surface. The cylinder shall then be removed and the vertical settlement or slump of the concrete noted. This settlement shall not exceed 2 in. when the mechanical finishing machine is to be used and shall not exceed 4 in. when the finishing is to be done by other methods permitted in the specifications."

Concrete is to be deposited the full depth of the slab and across the road in successive batches and then "it shall be leveled off and tamped mechanically with a machine approved by the engineers, until all voids are removed and the concrete is thoroughly compacted. The mechanical tamper shall go over each area of the pavement at least five times and at such intervals as will give the desired result." Hand tamping may be substituted for machine tamping, "providing at least four men are engaged at the exclusive work of tamping."

When machine tamping is employed the surface will be finished by two beltings, one given just after tamping and another just before initial set occurs. If hand-tamped, the slab is to be rolled once across and back and then a move forward of one-half the width of the roller, and then it is to be belted as with machine tamping. Specifications for belts and rollers and for their operation are the same as they have been previously.

Special Preparation of Subgrade

Special preparation of the subgrade is required for concrete roads. "The rolling and thorough compaction of the subgrade shall extend for a width of at least 12 in. beyond the edges of the pavement, and no backfill of any material excepting concrete will be permitted when re-rolling." In detail the accuracy of subgrade is to be determined as follows: "Immediately before any concrete is placed upon the subgrade it shall be tested for elevation by the use of a templet riding on the side forms behind the mixer. In the lower edge of the templet there shall be driven nails 6 in. apart and to such depths that their heads will just come to the true position of the subgrade when the templet is riding on the forms. Testing the elevation of the subgrade shall be done by moving the templet back and forth on the forms. On those areas of the subgrade found to be too high by as much as ⅛ in., additional excavation shall be made until the required depth is reached, and the excavated material shall be deposited on the shoulders. Those areas below the true elevation shall be filled with concrete making an integral part of the slab proper; all expense for this extra concrete including both labor and material shall be borne by the contractor."

Minor changes affecting equipment or construction methods are: Hauling over subgrade for greater distances than 500 ft. is prohibited. When tamping machines are used the side forms must be steel. Removal of side forms after 12 hours is permitted. Mixers shall be equipped with automatic locks or time-recording devices which will prevent emptying until the batch has been mixed for the minimum time required.

Except as noted, requirements for concrete construction remain substantially as in previous specifications. Clifford Older is chief engineer, Division of Highways, Department of Public Works and Buildings, Springfield, Ill.

New Illinois Road Specifications Work No Hardships on Contractors

By Clifford Older
Chief Highway Engineer, Division of Highways, Springfield, Ill.

ABSOLUTELY no reason exists why contractors should be alarmed over the new provisions in the specifications which have just been issued by the Division of Highways of Illinois, for concrete roads.

There will be no difficulty whatever in handling in the ordinary contractor's mixer concrete of the consistency specified, except that possibly chutes may be found unsatisfactory for distributing the material. Several of the best contractors last season placed, without any trouble, concrete of a consistency only slightly wetter than is now specified. The present mixer equipment owned by contractors will handle this concrete as economically as heretofore, except possibly in the case of mixers equipped with chutes. Except as to chutes, no mixer equipment that is in good condition and that has heretofore been acceptable will need to be scrapped.

Mechanical subgraders will not be required, nor is it anticipated that they will be needed. The new specifications for subgrading merely emphasize a little more strongly the results we have heretofore expected to secure. The only additional provision is that backfilling with loose material of any kind will not be permitted after the final rolling. This means that where depressions or ruts occur in the subgrade the high places must be cut off and the low places filled with concrete. This will work no hardship on any contractor who uses reasonable care in the preparation of the subgrade and avoids rutting or cutting it up by hauling long distances over it, after the rolling is completed.

Machine tampers are not required, although they are encouraged. Hand tamping is permitted. However, there are mechanical tampers on the market which, there is every reason to believe, will spread, tamp and finish concrete of the consistency required with less labor than has been heretofore used. The use of such a machine in St. Clair County, Illinois, resulted, without question, in a saving in cost to the contractor. At the same time, better results were secured, since the concrete could be laid without an excess of water. The machine cost about $1200, and would finish three or four times as much road in a day as the mixer could handle and only one man was needed to operate it.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Old Impact Formula Preferred

Sir—I have read very carefully your editorial of Mar. 6, p. 454, on railway-bridge impact allowances, and I beg to say that I am in thorough accord with your criticism of the proposed new impact formula. An impact formula, to be of any value, should cover other things beside impacts, especially in articulated structures where members do not always take equal stress and there are other minor defects which impair the accuracy of any calculations which can be made. These defects generally appear in the lighter members near the center of the bridge and the old impact formulas take care of these parts to a certain extent, but they are not taken care of by the new formulas. I regard the old formula as a practical one and it has demonstrated its sufficiency by long use.

The new formula, although it is the result of many tests, will not give us the results which our experience justifies us in believing more satisfactory. The new formula would make no distinction between the impacts for a single-track and a double-track bridge—or a four-track bridge, for that matter—but the old formula takes care of this in a satisfactory manner. On the whole I regard the results of the tests made by Professor Turneaure as a satisfactory check on the formula which has been used in this country for a long time, rather than something new to be introduced into our specifications.

J. E. GREINER,
Consulting Engineer.

Baltimore, Md.

Compensation in Minor Engineering Positions

Sir—I dislike very much to attempt to measure verbal swords with an engineer of the eminence of John M. Goodell, but it seems to me that that gentleman, in his letter in *Engineering News-Record* of Mar. 6, 1919, p. 482, is laboring under two misapprehensions. The first is that the salaries now paid in engineering work are in any way commensurate with present wage and salary scales in other occupations, and the second, that limiting the education of men engaged in the minor engineering occupations, such as surveying and drafting, would make them satisfied with their present salaries.

As to the first, it would be obvious to everyone that the general level of wages has risen so enormously in recent years that all people on paid salaries have suffered a decrease in income none the less real because it is measured in purchasing power and not in dollars. In all occupations, where the individual is employed by others, and where the requirements of the job partake of the mental rather than of the manual, there have been no salary increases in recent years which are in any manner proportional to the great increases in the wages of manual laborers and artisans. It is from such conditions that the engineer is suffering today, and he feels it all the more keenly because he is thrown into such close contact with people of the manual-labor class.

There are undoubtedly many engineers in minor positions who are not capable of rising above their present limitations. But it does not follow that they should not, under present economic conditions, receive any increase in salary. The rise in the wages of manual laborers and artisans has not, in general, been due to any increase in their skill or to any greater value or quantity of the work produced by them. It has been due to the coercive power of organized labor in times of public stress. It is fairly easy in a manual trade to establish arbitrary scales of wages, and to insist, through the power of organization, that these scales be paid, but the man who performs his work primarily by his own individual ability, initiative and education is not so organized, and by the nature of his work cannot use the coercive power of organization to increase his salary. Such increases as he gets are usually due to an actual increase in the value of the work done by him, and have but slight reference to changes in the cost of living.

As to the second misapprehension, I know of no surer way to increase the wages of transitmen and draftsmen than to limit their education to that which might be obtained in a mere trade school. For, if the transitman or draftsman were possessed only of such education and ability that he had no opportunity or aspiration of attaining to a higher engineering position, it is certain that he would, in due course, become a labor union man, and use the power of union labor to secure a greatly increased wage for himself. Surely the transitman's or draftsman's manual skill is at least as great as that of the carpenter or the bricklayer, and the work which he accomplishes is at least of as great a value. Why should he not, therefore, receive as high a wage? The main reason why he does not is because he feels that he has a certain amount of ability and education which may in the future enable him to rise to a position requiring real engineering knowledge, and it is that hope and expectation that lead him to reject the simpler and surer method of wage increase through organization, coercion and strikes.

The "under dog" in engineering today is not, as Mr. Goodell asserts, kicking at his salary because he thinks that he should receive more money simply because he has an expensive education. He is kicking because other men, who have no special education, and are doing work requiring no greater manual skill and not so much mental ability as his own work calls for, can now afford to sport limousines on their recently greatly increased wages, while the purchasing power of his own salary has become less and less. He knows that the value of his services has not decreased, and that the value of the artisan's services has not increased. He knows that if his services were worth more than the skilled laborer's ten years ago they are still worth just as much more. He knows that something is wrong, and that he is made to suffer, through no fault of his own, in the general readjustment of economic conditions. Therefore, when he goes to his employer and as one man to another, without threat or intimidation, asks for a raise in salary, the employer should be the first to recognize these conditions. Yet, because this same employer is himself suffering from economic conditions, and perhaps has been forced to pay higher wages to his manually skilled employees, he often adopts the

"penny wise and pound foolish" policy of refusing the request because he is not forced to grant it.

It might be expected that where the employer is himself an engineer he would be the more ready to recognize the value of the services of his subordinate engineers. Yet how many of your readers are familiar with that type of employing engineer, perhaps a member of the Am. Soc. C. E., who, when approached by a subordinate for a raise, regales him with stories of how, when he was young, he worked for $50 or $60 a month on difficult and responsible work, and believes that all engineers should go through the same mill. To the suggestion that $50 or $60 a month in those days was as good as $100 a month today he turns a deaf ear.

There are, however, some employing engineers who are beginning to see the light, and who realize that the profession can never be maintained upon a high plane by the practice of paying lower wages to subordinate engineers than to mechanics, and some of the more enlightened of these men have associated themselves with other engineers, some of them representatives of the "under dogs," in an earnest endeavor to raise the whole scale of engineering salaries to a plane more nearly representative of present economic conditions. I refer to the American Association of Engineers, which is the only national organization of engineers that concerns itself with the bettering of the economic condition of the technical engineer, and seeks to do this through methods compatible with the dignity of a useful and learned profession. I hope that ere long all engineers will see the light. If not, the future of the profession is dark indeed.

Washington, D. C. KENNETH P. ARMSTRONG.

Boston Engineers' Trade Union Dinner

Sir—What is perhaps a significant sign of the times is furnished by a dinner of Boston engineers, held at the City Club on Mar. 25. The dinner was given by the Civil Engineers' Association of Boston and was its third annual banquet. This organization is made up of men working for the City of Boston and the State of Massachusetts, and is affiliated with the American Federation of Labor. Also present at the dinner were the members of the Civil Engineers' and Inspectors' Union No. 16,347, which is likewise affiliated with the American Federation of Labor, but is made up of men working for private employers. A number of men engaged in private engineering practice were among the guests. One of the after-dinner speakers was Maj. Gen. Clarence R. Edwards, who described the work of the Army engineers of the 26th Division.

The keynote of a number of the other speeches was advocacy of the organization of professional as well as trade workers to protect the rights of the individual. The president of the association said that while some members had resigned as a result of the association becoming affiliated with the American Federation of Labor, a much larger number had been induced through this move to join the association.

The dinner was certainly an enthusiastic one, and showed that those present looked forward with confidence to an increase in their salaries as a result of their alliance with the American Federation of Labor. It appeared that benefit to engineers had already been gained by the support of the federation before the State Civil Service Commission. It seemed to be the general opinion of those present that no question of professional ethics is involved by affiliation with organized labor and that this is not in conflict with the objects of the professional engineering societies. These societies, it was held, had concerned themselves essentially with the scientific and intellectual needs of the profession rather than with the business welfare of their members. Some speakers pointed out that legal and medical associations do not hesitate to take action to protect the business interests of their members.

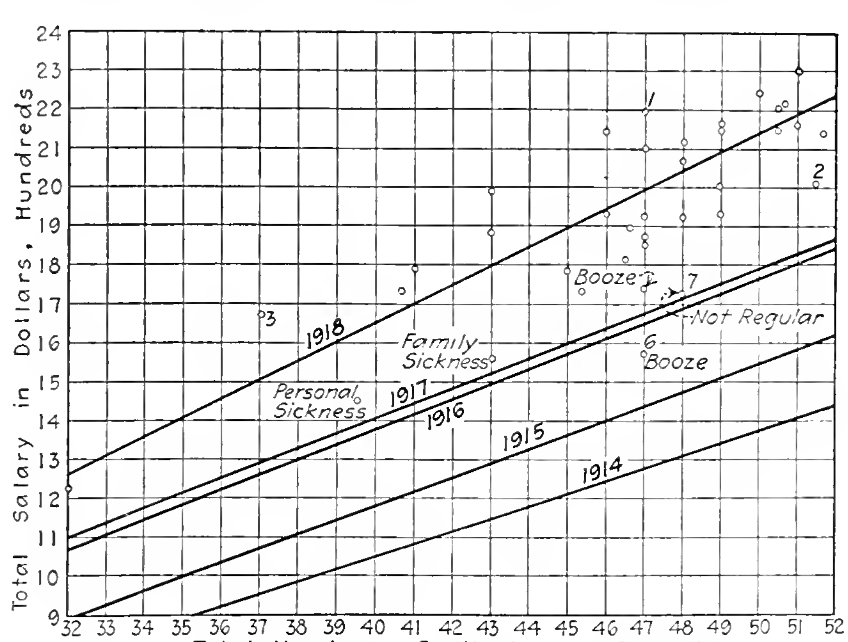
Whatever opinions one may hold for or against the trade-unionizing of the engineering profession, it is well for all of us to face fairly and understandingly the conditions that confront us today. This public dinner and the prevalent sentiment which it voiced seems to reveal a condition more widespread than many engineers realize. OBSERVER.

Boston, Mass.

What Carpenters Earn with One Contractor

Sir—With the present agitation for higher wages in the building trades, due to increased cost of living, a study of actual earnings by carpenters in the New England district during the year 1918 gives interesting results.

In a recent War Labor Board hearing in New York City Dr. William F. Ogburn, statistician for the board, stated that "budgets arrived at scientifically, based on the actual expenditures of over 600 families, consisting of five members, father, mother and three children, two of whom were of school age" would amount, at the present time, to $1500 for the "bare sustenance level," $1800 for the "minimum comfort level" and approximately $2100 for the "security and citizenship level." He further stated that in his opinion the smallest in-



CURVES SHOW ACTUAL EARNINGS OF CARPENTERS EMPLOYED BY ONE LARGE CORPORATION

Average curves for each year are based on actual earnings of a number of men for that year, the small circles showing earnings in year 1918. Wages were as follows:

1914, 50c. per hour to June 1; 55c. per hour remainder of year; 10-hour day, straight time for overtime.
1915, 55c. per hour whole year; 10-hour day, straight time for over time.
1916, 55c. per hour to June 1; 60c. per hour remainder of year; 10-hour day, straight time for overtime.
1917, 60c. per hour to June 1; 65c. per hour remainder of year; 10-hour day, straight time for overtime to Sept. 13, then 8-hour day, 1½ time or double time for overtime.
1918, 65c. per hour to June 1; 70c. to Sept. 1, 75c. remainder of year; 8-hour day; 1½ time or double time for overtime.

come on which such a family with present living costs could live and enjoy health and comfort was $1800.

The attached chart shows the average earnings for a group of approximately forty carpenters employed by our company over a period of five years. For example, a carpenter working at the rates and hours noted, if on the payroll for 52 weeks or the entire year, should have earned the following amounts: In 1914, $1440; 1915, $1620; 1916, $1845; 1917, $1870; 1918, $2240.

How did the men whose actual 1918 earnings are represented by the circles fare during that year? Our employment records show that for this group of men the average family included mother, father and one and one-half children. Using the minimum comfort budget of $1800 as a basis, and allowing $250 per child, the budget for this family calls for $1375 per year. The father, however, on an average had to spend about six months of the year away from home to get work. This would add, over normal expenses, approximately $10 per week, or $260 for the six months. The family budget then becomes $1635 for the year. Referring to the chart, we see our "average-family" carpenter would have received that amount in 39.5 weeks. We also see that every man in the group with the exception of three received well over this amount.

Why did some of the men earn so much more than others?

Referring to the chart again, specific cases are interesting.

No. 1. A very steady man; quit his out-of-town job the minute overtime was cut out. Had he worked five weeks longer, and rounded out the year, he would have received $2360 for his year's work.

No. 2. The star worker of the group. For the years 1914-1917, inclusive, his earnings ranged from $50 to $150 above the average. During 1918 he did not care to work Sundays and took a day off now and then. He was satisfied and reported to the writer he had saved "about $500." His family consists of himself and wife.

No. 3. A widower with four children. He is an "overtime chaser"; "works for any company having overtime work." He left at the end of the thirty-seventh week and went to a shipyard building wooden ships. His reported earnings for the remaining portion of the year would indicate that he received at least $2500 for his year's work.

Nos. 4 and 5. Owing to personal and family sickness these men cannot leave Boston and must therefore take what work comes along in that city.

Nos. 6 and 7. One of our foremen reported that two of his men were going "to the dogs." One "boozed," the other had a habit of leaving on Friday night and showing up for work Tuesday morning. The wage record seems to prove that the foreman is correct.

Earnings for 1919 will probably not approach those of 1918 by a considerable amount. The building trades at the present time are flat, thus causing considerable unemployment. Prospective builders are waiting for a drop in material and labor prices. Owners who have started building insist there shall be no overtime; the "straight" eight-hour day and not the "basic" eight-hour day shall prevail. Labor leaders demand a 44-hour week (in Boston the 40-hour week is already in effect in a few of the trades); they insist there shall be no reduction in rates; in fact, owing to the constantly increased cost of living (?), there seems to be a universal demand for greatly increased hourly rates.

The wage situation in the building trades certainly warrants a close study. Unless all parties concerned "lay their cards on the table, face up," and *coöperate,* the coming summer will have a deluge of squabbles, with consequent strikes.

O. R. RIETSCHLIN,
Employment Manager, Aberthaw Construction Company,
Boston, Mass.

The Pioneer National Society to Adopt the Cleveland Plan

Sir—May I call the attention of your readers to an oversight that occurred in *Engineering News-Record* of Mar. 6, 1919, pp. 454 and 495? The first national society to adopt the Cleveland plan of joint membership was not the American Society of Mechanical Engineers, in 1919, but the American Association of Engineers, in 1918.

Joint membership is not a panacea; it is but one step toward closer relations among all engineers. The next step might by the adoption of this plan, as modified by experience, by all the national societies in unison and in addition requiring, as recommended by the Intersociety Relations Committee of the Cleveland Engineering Society, and as approved by the American Association of Engineers and the Association of Ohio Technical Societies, that applicants for membership in national societies shall show as a prerequsite for membership that they are members of an accredited local society.

C. E. DRAYER,
Secretary, American Association of Engineers.
Chicago.

Why Not Engineers for Federal Rural Health-Protective Work?

Sir—I have noted the comments of H. C. Hodgkins, in *Engineering News-Record,* Mar. 13, p. 535, on the above-named subject. Having been employed by the United States Public Health Service, I am familiar with its attitude toward the sanitary engineers employed on public-health work, such as drainage for "mosquito eradication." I can say from experience that such engineers have been allowed very little responsibility. While this may be due to the nature of the work given them and to the reputed lack of executive ability among engineers, there is no question that the medical officers in charge are jealous of their position and authority and prone to consider as an instrusion the exercise of authority by any nonmedical officer.

The opinion has been widely held that only medical men are fitted to supervise matters of public health. This fallacy has long ago been dispelled, for there is a large and growing number of nonmedical, though specially trained, health officers who are making their influence felt, to the discomfiture perhaps of the medical profession. My attitude has always been that the sanitary engineer is the proper person to direct public-health work as the problems are primarily engineering problems and the medical phases are, largely, purely incidental. This view is gradually gaining ground, I believe. Efforts have been made in the Public Health Service to obtain for the sanitary engineers wider

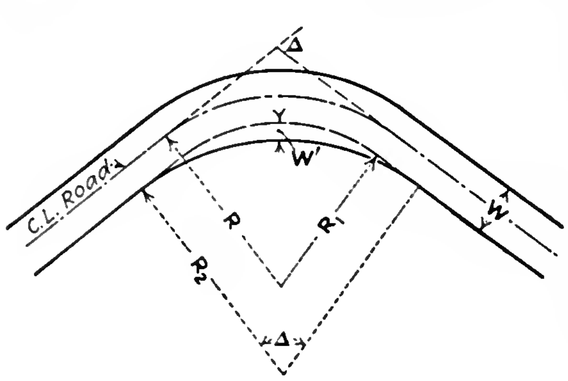
responsibility and higher standing, but all efforts have been vetoed, due to the predominance of medical men in the service. As a result, the medical officers have been giving more time to engineering problems, such as labor questions, pay rolls, and field drainage details, than to the duties for which they are fitted. In my own experience, I found that the medical officer in charge of my station was more interested in the wages paid my laborers than in the health of the laborers themselves, for while he was interfering with the field work one of the workmen was ill for three weeks with spinal meningitis, a communicable disease. In another case, the medical officer spent a large part of his valuable time in writing out checks to cover a large payroll for labor on work which was under the supervision of the sanitary engineer.

The sanitary engineer has charge generally of important phases of sanitation and general public-health work, and he should have responsibility in keeping with the nature of the work performed. Engineers must take the stand that they are as important factors in respect to the public welfare as doctors of medicine—they surely are as high-grade men, on the average.

E. G. SHEIBLEY,
Hydraulic and Sanitary Engineer.
Riverside, Calif.

To Compute Added Area on Highway Curves

Sir—The following simplified formula for computing the extra area in pavement due to widening at curves may be of some interest to highway engineers. In all cases which I have met, slide-rule computation is accurate to tenths of a square yard, and may be used to save time.



With the notation shown on the diagram, it can be shown:

$$R_1 = R - W/2$$

$$R_2 = R_1 + \frac{W'}{exscc\ \Delta/2}$$

Area added $= (R_2^2 - R_1^2)\ (tan\ \Delta/2 - \Delta/2\ radians)$

W. W. CRAWFORD,
Division No. 1, Wisconsin Highway Commission.
Madison, Wis.

The Duluth Way of Meeting Cost of Water-Main Extensions

Sir—The two editorial notes in your issue of Mar. 20, "Meeting the Cost of Water-Main Extensions" and "Assessment of Benefits Deserves More Attention," lead me to send you a copy of a paper on the general subject that I wrote a few years ago (see *Jour.* Am. W. W. Assoc., December, 1915, p. 612).

The criticisms in your articles are to the point and are vital. Since the adoption of our method of making extensions in Duluth there has been but little criticism, with no attempts to change the system. If the extension is designed to boom real estate the plan throws the burden upon the property. If bona-fide consumers exist or build along the line of the extension afterward, the property is gradually relieved, so that eventually the consumers pay for the entire expense of the service.

Under this method no vacant property escapes where contributions are necessary in order to evade a losing proposition so far as the Water Department is concerned.

D. A. REED,
Manager Water and Light Department.
Duluth, Minn.

[Under the Duluth plan, 8% of the first cost of a 6-in. water main is charged annually against abutting property, for 15 years, on the basis of 5% interest and 3% sinking fund, or the charge may be paid in one installment, at 25% discount. Against this charge is credited one-half of the water revenue paid by the occupant of any premises. The other half is allowed for operating expense. Vacant property bears the entire 8%. The charge is based on frontage, with no debit for the second side of a corner lot. The same plan is followed for gas (the city owning the gas works) except that a 4-in. main is the base and only one-third the gas rates paid are credited against the charge.

Strictly speaking, this is not an assessment for benefit, but rather a uniform and, so far as appears, an arbitrary annual charge in lieu of rates for 15 years, with a penalty for letting property remain vacant. It is virtually a guarantee of 8% on the cost of a minimum-sized main, but the guarantee terminates in 15 years, regardless of how few water consumers there may be on the street. It is much fairer than the apparently common practice of letting one or a few willing persons bear the entire guarantee of revenue, or even put up the entire first cost of an extension, with no means of compelling other property owners to do more than pay ordinary water rents when they become consumers.—EDITOR.]

Colorado River Flood Control by Storage Promising

Sir—Mr. LaRue's article in *Engineering News-Record* of Mar. 6, 1919, p. 456, on the control of the Colorado River by storage offers a promising solution to a situation growing more precarious every year.

Here is a river which menaces the most intensively productive region in the world, the Imperial Valley. Head-water storage on the Colorado will have its full effect in flood prevention in this valley, a thousand miles below the source of floods and the reservoirs proposed to prevent them. This situation, then, is unique, in problems of flood control by storage, in that herein is contained every promise of ultimate success. Examine the figures given for the 1917 flood and imagine what would have happened if the Grand River peak had been delayed a week. The Yuma peak instead of 143,000 sec.-ft. might have reached 165,000, and the levees might have been overtopped at all points.

Immunity from flood damage in the lower Colorado hangs by too slender a thread not to begin at once a comprehensive study of the possibilities of permanently removing this menace by storage. The data which Mr. LaRue points out as necessary cost an altogether insignificant sum, considering the important purposes they will serve. The study should be begun without further delay.

J. C. STEVENS.
Portland, Ore.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

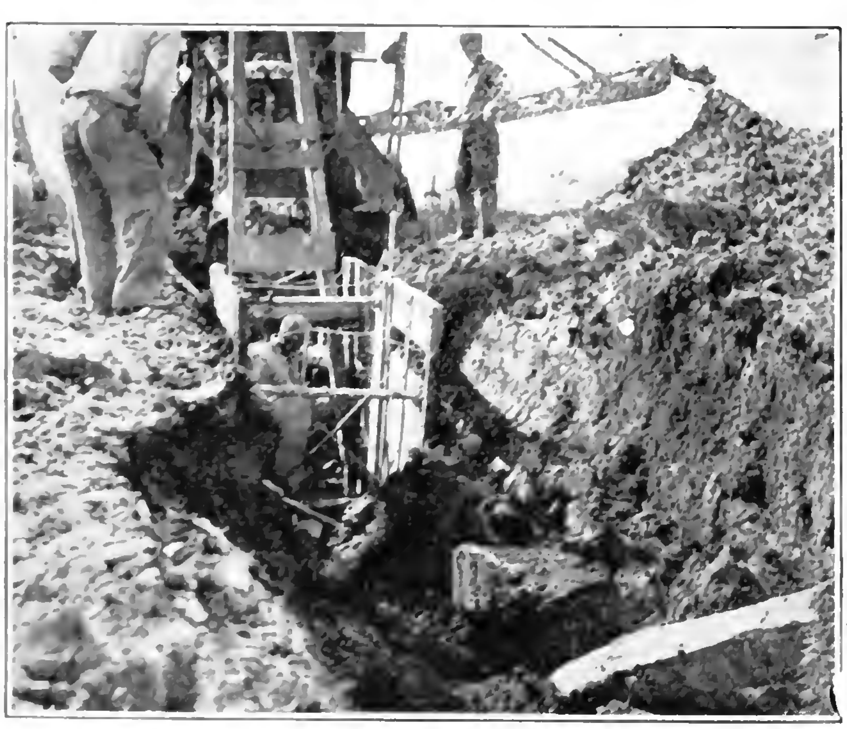
Trailer Shield Holds Sides of Caving Ditches in Pipe Laying

BY MEANS of a cage or shield pulled by the trench excavator and protecting the pipe-laying operations, drain pipe for a large system of tile drains was successfully laid without sheeting the badly caving ditches. Ordinary methods of handling caving ditches permitted a daily progress of only 50 ft. With the shield, a progress of 425 ft. per day was made under the worst conditions of spring work, and later in the season, when water was less troublesome, the daily progress was from 700 ft. to 1500 ft. of pipe laid. Two men working inside the shield laid the tile.

Other Articles in This Issue of Interest to Contractors:

The work was located near Garden Prairie, Ill., where soil conditions were very difficult. The top soil was a black gumbo about 3 ft. deep. Below the gumbo were 4 ft. of joint clay, very rotten and crumbly in texture, and below the joint clay there was from 1 to 4 ft. of fine sand and water. The sand was so fine that it was carried by the water from under the trench sides, causing them to cave in, until the trench was often 40 ft. wide at the top.

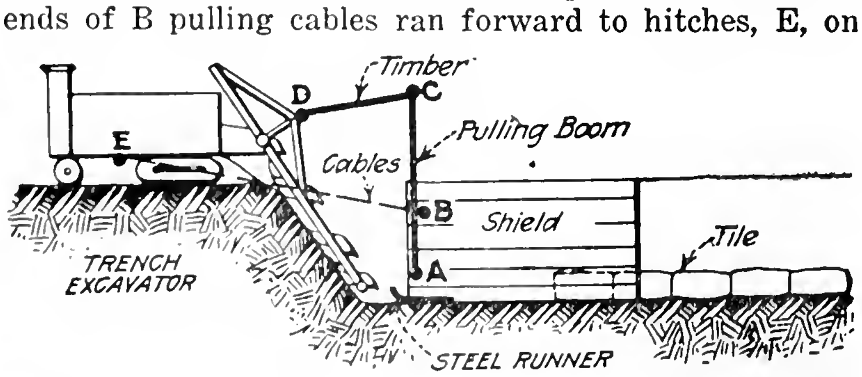
Tight sheeting was first used by the contractor and it was fairly successful in holding the banks, but its cost was prohibitive at the price for which the contract was taken. Sand boxes and various other methods commonly employed for controlling sand and water were tried, without success. Finally the contractor adopted the method of spading the sides of the ditch down into the excavator buckets until no more dirt would fall in. This method was very slow, the average daily progress being 50 ft. per day. The contractor was unable financially to continue the work and it was recontracted.



SHIELD PROTECTS PIPE LAYING OPERATIONS IN CAVING DITCH

Construction was resumed in the spring with an outfit consisting of a trench excavator, a power backfiller, a large power-driven diaphragm pump and a trench shield devised by the new contractor. At the beginning of the work the soil conditions could hardly have been worse; the spring rains had soaked the earth and the water level was the top of the ground. The shield met these conditions successfully. The accompanying view shows it in operation.

The success of the shield in operation was due wholly to the pulling method employed. Structurally the shield consisted of two side panels held apart by screw braces and held together against the braces by horizontal and diagonal turnbuckle ties. Between the sides, at the front end, stood a vertical mast or pulling boom. From the pin, C, at the boom top two timbers extended forward to the boom, D, of the trench excavator. The bottom of the pulling boom was set on a pulling bar, A, whose ends set into the side panels and which extended across the shield. The bar, A, could be raised or lowered, but ordinarily such a change was not necessary. At B another pulling bar extended across the shield, and its ends passed through the side panels. From the ends of B pulling cables ran forward to hitches, E, on the trench excavator. The bar, B, could be quickly shifted up and down with respect to the height of the shield and, being behind the boom, AC, it pulled against the boom. This method of hitching the shield to the excavator involves a care in adjustment which is not indicated in the diagram and upon attention to which, the contractor states, much of the success of operation depends. The shield weighed about 1500 pounds.



METHOD OF HITCHING SHIELD TO TRENCH EXCAVATOR

In the operation of the shield, two men worked between the sides of the shield with short-handled shovels, one man working in the front end cleaning up the bottom of the trench and aiding the second man, or the pipe layer, in making a perfect grade. This combination gave excellent results, and only very seldom was the machine stopped to wait for the pipe men, who were able to lay two tiles within the sides of the shield at one time.

The most serious obstacle encountered by the contractor was water. Heavy rains fell every few days, and the water at all times was so high in the pipe that had been laid that the pump was constantly used to keep the trench dry; nevertheless, the work went forward with a daily average of 425 lin.ft. Later in the year, after the rainy season was over and the pump was no longer needed, daily runs of 700 to 1500 ft. of pipe laid were frequently made.

The adaptability of the shield to any width or depth of trench was one of the main features. To change the width of the shield the screw jacks were run in or out, and the width of the shield was changed accordingly. At the time when the length of the screw jacks was altered, it was necessary to alter the turnbuckles. To alter the height of the shield to fit a trench of greater depth, it was necessary to add horizontal members. There were limits, however, to the practical depths and widths at which this device could be operated. The shallower the ditch, the easier it was to operate the shield. However, it could be operated with success down to depths of 10 ft. and out to widths necessary to fit a 60-in. trench.

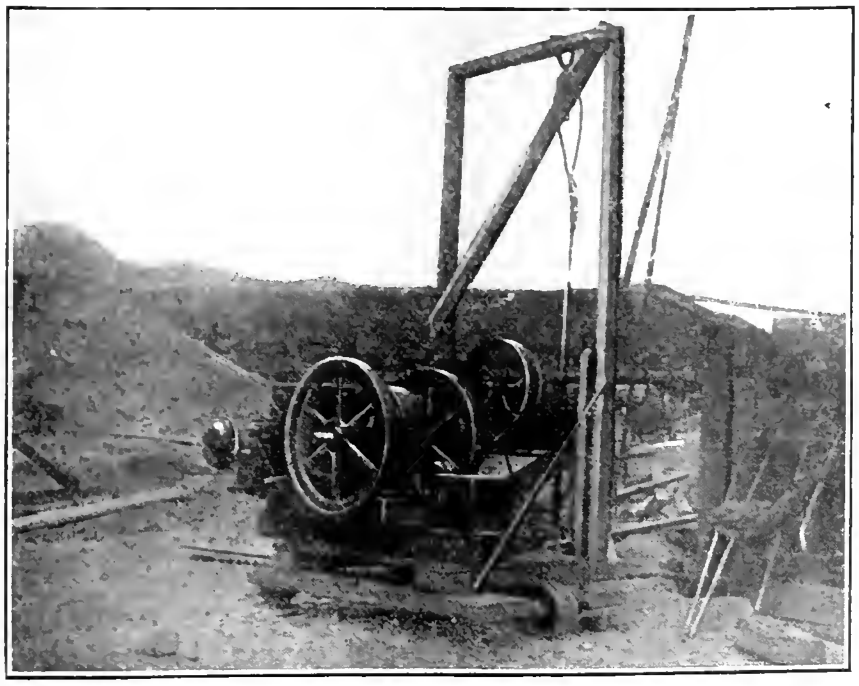
The contractor for the work was Monroe Farrer, of 4045 W. Van Buren St., Chicago, Ill., who designed the shield and perfected its operation.

Portable Home-Made Gasoline Drill

By C. M. Young

Engineering Experiment Station, University of Illinois, Urbana, Ill.

The accompanying illustration shows a portable outfit consisting of an auger drill, driven by a gasoline engine, which has been successfully used in boring vertical holes through soft surface ground and soft shale. It was developed by a subcontractor for boring holes in blasting the excavation for a building. The shale to be drilled is 3½ ft. thick, not hard but somewhat gritty. While the apparatus was intended for vertical holes, there is no reason why the drill should not be turned in any direction.



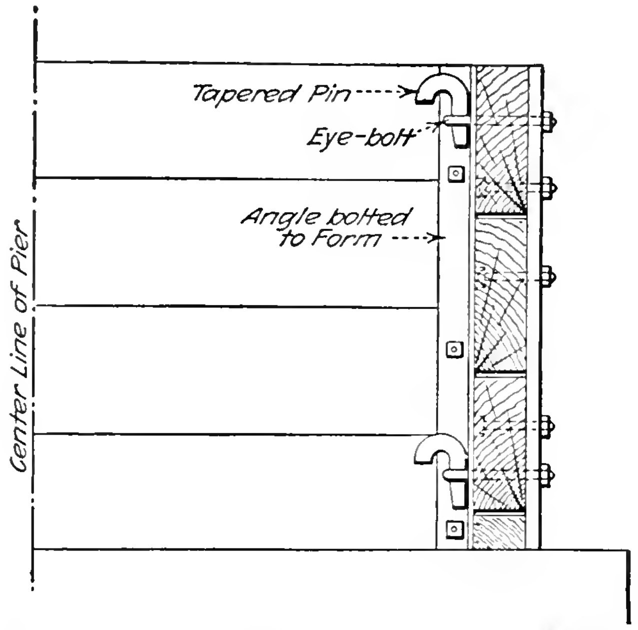
AUGER DRILL DRIVEN BY GASOLINE ENGINE BORING VERTICAL HOLES THROUGH SOFT SHALE

The outfit consists of the ordinary bit and chuck used in coal mining, a gasoline engine, and suitable belting and reducing gears. The engine is of 4 hp. and is belted to a shaft which carries the beveled gear for driving the drill. The speed of the drill is about 150 revolutions per minute.

The drill is fed downward by a rope fastened at one end, passing over a sheave wheel at the top of the drill rod and down to a hand winch. It is raised by a rope hooked to the end of the rod and passing over a pulley at the top of the frame. A 2-in. bit is used, and the machine is drilling 100 holes per day through the 3½ ft. of shale. The average time for drilling one hole, including one change of bit but not the moving of the machine, is 3¼ min. In surface soil of average hardness the drill has been put down 2½ ft. in 5 sec. The whole outfit is mounted on a frame carried on three rollers and is pulled from hole to hole by hand. Only one man is needed to run it and move it. The gasoline consumption is one gallon for eight hours of steady work.

Device Simplifies Footing Form Removal

The arrangement shown in the accompanying picture is in successful use by William G. Cooper, contractor, on his footings for the Gravesend Ave. elevated line in Brooklyn. These forms are used many times over, and the simplicity with which they may be assembled and stripped adds greatly to their life. To each end of the two cross-forms is bolted an angle which has been punched to allow an eye-bolt to pass through it at two or more places. These eye-bolts are a part of the longitudinal forms, and are spaced to match the holes in the angles. The two forms are held together by tapered pins with hooks at the top. Hammering on the top of the bend drives them snugly into place during assembly, while a few taps on the lower end of the hook loosens them as easily. Edward Murphy is superintendent and Charles Mannel is engineer for the contractor.



SIMPLE HOOKED PINS FOR PIER FORMS MAKE FOR RAPID REMOVAL

NEWS OF THE WEEK

New York, April 10, 1919

Railroad Wage Board Gives Engineers Hearing

Three Days Devoted to Pleas That Technical Engineers on Railroads Be Given Uniform and Higher Pay

Much sooner than expected, the Railroad Board of Wages and Working Conditions, on Mar. 31, Apr. 1 and 2 gave the technical engineers a hearing and a chance to present the schedule adopted at the National Conference of Railroad Engineers held Mar. 17 in Chicago, under the auspices of the American Association of Engineers.

Marshall O. Leighton, chairman of the National Service Committee of the Engineering Council, arranged for the meeting and the board sent an invitation to the American Association of Engineers to appear at the same time, an arrangement which suited both organizations. After Mr. Leighton opened the meeting Francis Lee Stuart, consulting engineer, New York, representing the Engineering Council, pointed out the need and justice of increasing salaries. While in sympathy, he was not in touch with the details, and turned the question for proofs over to the American Association of Engineers. C. E. Drayer, secretary of the latter organization, presented documentary evidence of the representative character of the railroad conference in Chicago, which he held represented the 40,000 engineers in subordinate positions, and submitted the following memorandum:

"We urge the classification and standardization of conditions and salaries for railroad professional engineers in the classes under consideration. Two illustrations are mentioned for the purpose of making plain the need. From questionnaires recently sent out, the American Association of Engineers finds that three roads are paying instrumentmen $105 a month, while several other instrumentmen on the Pennsylvania R.R. are doing resident engineers' work, consisting of the construction of an engine terminal, and are receiving instrumentmen's pay.

"The benefits to be derived from classification and standardization are: (1) Elimination of the discrimination that exists between engineers in railroad service; (2) it will permit readjustment of salaries and working conditions on a definite and sound basis.

"It is admitted by all that there should be certain definite relations in pay among men who are doing the same kind of work; that there should be certain standards whereby a man who is qualified to perform a certain kind of work, and does it, should receive a certain pay. We find on the different roads, from 1200 questionnaires sent out and received last week from some 60 different roads, that men doing precisely the same kind of work are being paid salaries differing by large percentages.

"The following principles should govern in classification and standardization of positions and salaries: (1) Standard and distinctive details of all positions having similar conditions and working requirements; (2) definitions of duties and responsibilities of each position; (3) definitions of classifications and requirements of each position; (4) placing of positions into classification according to the character of duties and according to responsibility and division of work; (5) positions of the same kind, made distinctive according to duties and responsibilities, should carry the same rate of pay."

(*Concluded on page* 745)

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

The Federal director of the United States Employment Service in New York State announces the receipt of a letter from J. P. Morgan & Co., in which $100,000 is offered for the purpose of continuing the work of the service up to July 1 of this year. The Professional and Special Section in New York will therefore be continued, but will be located at the main office, 469 Fifth Ave., New York City.

St. Louis $23,000,000 Bond Issue

A commission appointed by the mayor of St. Louis has listed the items which it considers should be covered by the proposed bond issue of $23,384,000, this being the amount the city can issue without exceeding its bonding limit. The tentative list is as follows: River des Pères channel, $10,495,000; sewers, $3,420,000; parks and playgrounds, $2,850,000; grade crossings and viaducts (city's share), $1,034,000; extension of municipal dock, $1,000,000; municipal belt railway, $1,000,000; connection between the municipal railway and tracks on the municipal bridge over the Mississippi, $1,000,000; municipal auditorium, $1,000,000; street openings and widenings (city's share), $750,000; municipal farm, $400,000; fire houses and equipment, $200,000; industrial farm, $150,000; jail extension, $85,000.

New Jersey Passes Tunnel and Bridge Bills

Bills authorizing the construction of a vehicle tunnel under the Hudson River at New York, and a street bridge over the Delaware River at Philadelphia, have been passed by the New Jersey legislature and are before Governor Edge for approval. Preparations have already been made to provide an appropriation of $1,000,000 as New Jersey's initial contribution to the Hudson River tunnel. Until 1922 money for this work will have to come from the state's surplus fund, but in 1922 a direct tax can be levied, under a new constitutional provision.

Free Service to Soldiers

A number of employment agents in Chicago, handling principally railroad labor, have addressed a letter to the Federal managers of the railroads having termini in Chicago, offering their services without charge in finding employment for returned soldiers.

Detroit and Duluth Vote Against Buying Street Railways

Municipal purchase of street railways was voted down at both Detroit and Duluth Apr. 7, the popular vote being 63,382 against and 59,479 for at Detroit and 8886 against and 4902 for at Duluth. The proposed purchase price of the United Railway lines at Detroit was $31,500,000.

Votes for Municipal Ownership

Municipal purchase of the water, gas, electric-light and power plants of Superior, Wis., was indorsed by a large majority popular vote Apr. 7.

War Department Has Locomotives and Cranes For Sale

Announcement has just been made that $45,000,000 worth of locomotives and cranes is for sale by the Director and cranes are for sale by the Director General of Military Railways, whose office is at 6th and B Sts., N. W., Washington, D. C.

The equipment to be sold is material which was built for shipment overseas, and for the most part is in crates at Atlantic seaboard ports of this country. It includes 22 locomotive cranes of capacities from 10 to 50 tons, 34 raised pier locomotive cranes of capacities of 10 and 15 tons, 20 railway track piledrivers, 6 two-boom cast gantry cranes, 212 standard-gage Baldwin locomotives, and three 36-in. gage dinkey locomotives, a great number of cars of the box, gondola and dump-car types, hoisting engines, railway rails, generator sets, steel searchlight equipment and automobile trailers.

The cranes, as stated, are all packed for export and are available for immediate shipment. The cabs of the cranes are built with French clearances for bridges and tunnels, considerably lower than those in this country. The cranes, however, are standard in their engine and working parts.

New York Port Treaty Postponed

After a number of hearings on the desirability of the immediate adoption of the interstate treaty governing the joint control of the port of New York, it has been decided that the proposed treaty will not be submitted to the two legislatures at the current session. This decision was reached by the interstate commission after it became evident that the city government of New York is opposed to the port treaty as it now stands.

Both states have promised funds to continue the commission's studies, and it is reported that a definite, comprehensive plan for port development will be submitted next year. This is in accordance with the vote of the Board of Estimate of New York City to withhold approval of the treaty until after such a comprehensive plan had been prepared.

Large Hydraulic Turbines Ordered

Orders have been placed with the Westinghouse Co. for two 45,000-kva. vertical water-wheel generators of 12,000 volts, three-phase, 25 cycles, for the Queenston development of the Hydro-Electric Power Commission of Canada. These will be the largest hydraulic turbines yet built.

Cleveland Clearwater Basin Case Hearings Concluded

Testimony before the master appointed by the court in the suit of the City of Cleveland against the Walsh Construction Co., on account of the reconstruction of the clearwater basin at the West Side filtration plant, has been concluded. The issues involved are a claim of the contractor against the city for unpaid balance, and a claim of the city against the contractor for damages on account of the necessity for reconstructing the basin by jacketing it with reinforced concrete. Robert Hoffmann, city engineer, was appointed master by the court to take testimony and report on the facts involved; it is likely that his report will be rendered soon.

Conflict Over Bids on Cost-Plus Contract for Viaduct

Bids received by Kansas City, Mo., for the construction of the 23rd St. viaduct on plans and specifications providing for a profit-sharing form of cost-plus bidding have led to a political conflict which is delaying the award of a contract. The Board of Public Works declared the A. S. Hecker Co. of Cleveland the lowest and best bidder, but the City Council refused to confirm the award of the contract. A local bidder was only a fraction of 1% higher. Ostensibly the opposition of the council majority is directed against the cost-plus form of bidding; it is claimed that the city is not adequately protected against excessive cost. Engineers familiar with the situation say, however, that the political organization opposes the award of the contract to an outside contractor.

Under the contract as drawn by Harrington, Howard & Ash, consulting engineers for the city on the viaduct, the bidders fixed an estimate of cost plus contractor's fee; if the cost exceeds the bid estimate the contractor will have to pay half the excess, but in all events he receives a minimum fee of $15,000, his bid fee, while if the cost is below his estimate the city and the contractor divide equally. The Hecker bid on this basis was $716,000, including a fee of $50,000.

Strong sentiment has developed in the city over the refusal of the council to approve the award of the contract. The Kansas City Engineers' Club on Mar. 31 held an open discussion on the subject of the viaduct contract in which a representative of the local bidder whose bid was next above that of the Hecker Co. received opportunity to present his side of the case. As a result of the hearing, the club passed resolutions affirming the imperative need of building the viaduct at the earliest possible moment, demanding that the city have open competition on all municipal construction work and accord outside bidders the same treatment as local bidders, and approving the profit-sharing cost-plus form of contract as used for the 23rd St. viaduct.

This is a radical departure from the principle which the club has followed in the past of not concerning itself with civic affairs, although in technical matters the club has been progressive and active. Local engineers have expressed great satisfaction with the club's action and believe that it will develop the organization into a more forceful one, and one of greater influence on public questions.

Allegheny Bridges Ordered Raised by Secretary Baker

In spite of strong opposition from the Pittsburgh council and from citizens of the city, Secretary of War Baker signed Mar. 31 an order requiring that the bridges over the Allegheny River at Pittsburgh be raised immediately. Work upon these raising operations was suspended during the war, and is now to be resumed upon the same terms as previously ordered. The county will have the same time limits as originally prescribed.

This action was taken as the result of a recommendation by the Rivers and Harbors Committee of the Pittsburgh Chamber of Commerce—although opposed by the Municipal Affairs Committee of the chamber—the final vote of the chamber as a whole resulting in favor of the adoption of the Rivers and Harbors Committee request. The original order was dated Mar. 23, 1917, at which time eight bridges were to be raised. Of these, one has burned down, the Pennsylvania R.R. bridge has been raised, and the owner of another is raising and rebuilding it voluntarily. The order, therefore, requires the county commissioners to proceed with the raising of five bridges immediately.

Pennsylvania Gets Early Start On Road Bond Issue Construction

In order to get an early start on construction under the new bond issue, the Pennsylvania State Highway Department, of which W. D. Uhler is chief engineer, has announced the appointment of the 15 engineers who will be in charge of the various districts into which the state is divided. A number of changes have been made in the personnel of the various districts. The engineer in charge, the district number, and headquarters are as follows:

District No. 1. D. C. Stackpole, Bellefonte.
" " 2. C. W. Hardt, Harrisburg.
" " 3. A. S. Clay, Bloomsburg.
" " 4. H. W. Claybaugh, Franklin.
" " 5. W. R. Wolfinger, Allentown.
" " 6. C. W. Erismah, York.
" " 7. W. F. Cressman, Philadelphia.
" " 8. W. O. Bennett, Du Bois.
" " 9. W. S. Hammacher, Chambersburg.
" " 10. J. S. Ritchey, Wellsboro.
" " 11. C. S. Lemon, Hollidaysburg.
" " 12. W. H. Bircher, Scranton.
" " 13. C. E. Myers, Pittsburgh.
" " 14. W. D. Myers, Washington.
" " 15. F. E. Winter, Warren.

Would Improve State Health Work in Texas

Recommendations for increasing the efficiency of state health work in Texas have been made to Governor Hobby by a special commission representing 11 state-wide organizations. It includes Charles Saville of the State Council of Defense. The commission advises that members of the State Board of Health serve for six-year terms, and that one member "be an experienced sanitary engineer"; that bureaus of sanitary engineering, communicable diseases, rural sanitation, child hygiene,

public health nursing, laboratories, and health instruction, each under "an experienced director," be created; that the state be divided into eight or more sanitary districts, each in charge of a full-time district officer; that fitness and not politics govern in filling positions; and that adequate health appropriations be made and reasonable salaries paid. Texas now spends only 5c. per capita for health protection, the special commission states.

Industrial Relations Discussed at Joint Meeting in Chicago

Safety engineering, scientific selection of workmen, and the inauguration of works councils of employers and workmen, have demonstrated excellent results at the works of the International Harvester Co., as told in an address before a joint meeting of the Western Society of Engineers and the Chicago Sections of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers by A. H. Young, manager of the industrial relations department of the company. He stated that by safety methods accidental deaths of employees had been reduced to 7 per year, from 47 to 56 per year.

The old haphazard methods of employing men had given way to the centralized employment office, where the applicant's qualifications are carefully appraised. It now takes 3 to 3½ days to hire a man, compared with 3 min. by the old practice. By the new method the employee is made to feel that he is a real part of the organization, hired to do the particular job for which he is best adapted. Moving pictures instruct him how his work is to be done. He is also instructed specifically by the foreman, and is warned of the various dangers connected with the work.

An interesting experiment is the new arrangement which the company now has by which all matters of mutual interest are passed on by a works council, of which 50% are employees and the other half are representatives of the employer, such as superintendents. This council determines the policy and the management carries it out. In this way the men are educated in the problems of management, they see and understand the difficulties, and have already shown signs of being fair and reasonable in the problems they have had a part in solving.

Yellow Fever Eradication Work to Be Continued

Resumption of the work of the Yellow Fever Commission, interrupted by the war, is announced in a Rockefeller Foundation circular (61 Broadway, New York City). The work will be continued under Dr. William C. Gorgas, who was recently retired as surgeon general, U. S. A. Dr. Gorgas will soon sail for Central and South America, from the countries of which it is expected that yellow fever can be eradicated.

Engineers Club Reports on Cement Prices

Committee of Duluth Society Recommends That Further Study Be Left to Labor Department

Some weeks ago the Duluth Engineers' Club appointed a committee, with Lyonel Ayres as chairman, to report on the reasonableness of the prices for portland cement. The committee's report, verbatim, is given below:

The following are the prices of portland cement net f.o.b. Duluth, from 1913 to 1919:

1913	$1.55
1914	1.50
1915	1.41
1916	1.56
1917	1.91
1918	2.01
1919	2.20

This range of prices shows an increase in 1919 of 56% over 1915 price.

From data obtained from the Universal Portland Cement Co., they contend that the cause of the increase in cost of production in 1918 over 1915 is approximately as follows:

Labor	127%
Fuel	115%
Mill overhead	110%
Packing and loading	167%
General expense	49%
Care of empty sacks	62%

Quoting further from their statement, the increase on certain classes of skilled labor ran as high as 146 per cent.

In comparison with other commodities used in construction work, we find that there have been the following increases:

Gravel	36.40%
Sand	56.25%
Crushed rock	50.00%
Brick	23.10%
Lumber	70.50%
Labor	100.00%
Teams	60.00%

These figures were obtained from records in the engineer's office of the City of Duluth.

In this regard we quote from bulletin of Mar. 4, 1919, issued by the United States Department of Labor Information and Educational Service, as follows:

"At the close of the war the index number of building materials, not including steel, had risen only 61% over the pre-war prices of 1913, while the index number for commodities, exclusive of building materials, have risen 113%. The average increase of wages in the construction industrial in 41 leading cities from 1914 to 1918 was only 28.5%, as against the rise of 94% in commodities."

From the foregoing data it would appear that the increased price of cement has not been proportionately greater than the average increase on other building materials.

Your committee with the time allotted has not attempted to go into a study or investigation of the cost of cement production. Furthermore, we do not believe that a production cost can be determined during the present chaotic industrial conditions without the full coöperation of the manufacturers. Likewise, we do not believe this society is in position to delve into the trade secrets of any business organization so long as there are other means for such investigation.

If the club decide to investigate further into the cost of production, we would respectfully recommend that they refer the matter for full investigation to the United States Department of Labor who are investigating the various conditions that would enter into a revival of the building activities.

Erie Mill Creek Work to Proceed

Active prosecution of the Mill Creek flood-protection work at Erie, Penn., where a concrete conduit is being built to carry the flow of the creek through the city, is about to be started. A report on the urgency of resuming construction was made last week by the superintendent of streets. The approval of the mayor and of civic bodies supported the proposal, and the City Council voted to carry the project through at once. A bond issue of $600,000 is needed to complete the work, which, with a balance of $400,000, should suffice to carry the project through. At present the conduit is completed to 19th St.; the work to be undertaken comprises two contract sections, one extending north from 19th St. to 9th St., and the other thence north to the Pittsburgh & Erie culvert.

New Secretary for Federal Trade Commission

Following the recent resignation of Leonidas L. Bracken, who has left the Federal Trade Commission to resume the practice of law, J. P. Yoder was appointed secretary. Mr. Yoder left the commission in February, 1918, being commissioned a captain in the Army Sanitary Corps. He has recently returned from service in France.

Prior to his former connection with the commission, Mr. Yoder was manager of the Washington bureau of one of the large press associations.

Research Council Gets Funds

The Rockefeller Foundation is to appropriate $500,000 to promote fundamental research in physics and chemistry, the money to be used to support research fellowships over a period of five years and to be administered by the National Research Council. It has announced that the board named by the council to control the work consists of H. A. Bumstead, Simon Flexner, G. E. Hale, E. P. Kohler, R. A. McMillikan, A. A. Noyes and W. D. Bancroft.

Platform Collapses at Ship Launching

At least four men were killed in an accident that marred the launching of the steel vessel "Waukau" at the yard of the Merchant Shipbuilding Corporation, Harriman, Penn., Mar. 31. Workmen crowded on a patrol walk passing behind the stern of the ship next to the "Waukau," and a few minutes before the launching the walk broke down, throwing a score or more of persons into the water.

Hearing on Engineers' Pay

(*Concluded from page* 742)

Willard Beahan, chairman of the conference, spoke on the increased cost of living, which he estimated to be fully 50%, while the engineer's salary in his opinion had not advanced more than 30%, but from a point long out of line with normal increases. Then for two days W. C. Bolin, chairman of the subcommittee which gathered the data for the original schedule, presented the concrete case for those positions which the board considered within its jurisdiction: Tapeman, rodman, instrumentman, tracer, junior draftsman, draftsman, leading draftsman or designer and engineer inspectors. Higher positions having supervisory duties are handled by the regional directors. As a matter of record, however, the board asked that the whole schedule be filed. Into the record was read part of the article on "Pay and Position of Engineers in Railway Service," by C. W. Baker, in *Engineering News-Record* of Jan. 30, 1919, p. 228, and also the calculation of the cost of an engineering education, with the deduction that an engineer should receive at least $75 per month more than a skilled mechanic in order to produce and educate for the world's service another engineer.

Normally, the board will require 60 days to investigate the question and get in reports from the regional directors, after which it will take 30 days in which to prepare a report. It may be said that the board seemed to listen to the pleas with friendly interest.

Oregon Reclamation Bills Go To Referendum Vote

Subject to referendum approval, the Oregon legislature has passed a number of bills providing for or facilitating irrigation and other reclamation work. Some $2,000,000 for reclamation and $500,000 for land settlement are included. It is hoped that the reclamation fund will be spent in coöperation with the Federal Government on a dollar-for-dollar basis. One of the measures submitted to popular approval is a constitutional amendment providing for a state guarantee of irrigation and district bonds for five years after the date of issue. Various amendments to the irrigation and drainage district laws are included in the program. The drainage district law is made to conform more closely than before to the irrigation-district law. P. A. Cupper, Salem, is state engineer of Oregon.

Bequests to Terre Haute and to Rose Polytechnic Institute

A trust fund of $100,000 to improve the sewerage system of Terre Haute, Ind., and a gift of $100,000 to buy land for a city park are among the bequests of the late William S. Rea, a wholesale grocer of Terre Haute. To Rose Polytechnic Institute, Terre Haute, $100,000 was given besides a trust fund of $50,000 to afford aid to worthy students.

One-Third Engineer Officers Discharged

On Mar. 20, 1919, 31% of the engineer officers in the United States Army had been discharged. The total number of engineer officers on Nov. 11, 1918, was 10,302. Of these 3,244 are now out of the service. The corresponding figures for other branches of the service are as follows:

Branch	On Duty Nov. 11	Discharged Nov. 11-Mar. 20	Percentage Discharged
Ordnance	5,925	2,811	47
Quartermaster	10,122	4,626	46
Infantry	85,373	39,126	46

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File Application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

United States.—Expert patent investigator, $1800 to $2400 per year, and technical patent expert, $2400 to $3600 per year, May 20.

United States.—Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

United States.—Statistician, Department of Interior, $1800 per year, May 13. Apply for Form 2118.

United States.—Junior recreational engineer, Forest Service, Denver, Colo., $1800 to $2400 per year, May 6. Apply for Form 2118.

United States.—Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

United States.—Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 10-14, Buffalo, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston, Mass.; June 27-28, Atlantic City, N. J.

Engineering Societies

The Colorado Association of Members of the American Society of Civil Engineers and the Denver Section of the American Institute of Electrical Engineers held a joint meeting at the Denver Athletic Club, Apr. 9, in honor of Lieut.-Col. H. S. Crocker, supervisor of the work on the Army supply base at Brooklyn, N. Y. The work on the base was described by Colonel Crocker, who illustrated his address with lantern slides.

The Brooklyn Engineers' Club will hold a meeting Apr. 10 at which Maj. Robert Starr Allyn, U. S. A., will read a paper on "Artillery Preparation and Service with the 57th Regiment, C. A. C., near Verdun."

The Montreal Branch of The Engineering Institute of Canada will be addressed, at the meeting Apr. 17 by Phelps Johnson, G. H. Duggan and George F. Porter, who will speak on the Quebec Bridge.

The Engineers' Club of Philadelphia will be addressed by Morris L. Cooke on "The Participation of Engineers in Public Affairs," at the weekly luncheon Apr. 15.

The American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Chemical Society, the Pacific Northwest Society of Engineers, the American Institute of Mining Engineers, and the Associated Engineering Societies of Seattle were represented at a joint meeting held in Seattle Mar. 27 at which Calvin W. Rice discussed problems which engineers face in matters of society organization. After the talks by Mr. Rice and by representatives of each of the societies, there was a general discussion of the best plan for carrying out further organization of engineering societies in Seattle, to the end that centralization and closer coöperation might be secured.

The Engineers' Club of San Francisco at a dinner Apr. 3 had as a guest of honor Dr. W. F. Durand, who told of his personal experiences in France. Dr. Durand's headquarters were in Paris.

The New York Chapter of the American Association of Engineers will be

addressed at the meeting of Apr. 10 by Maj. C. R. Hulsart, Corps of Engineers, American Expeditionary Forces, who will speak on "The Engineers on the Hindenburg Line."

The Rochester (N. Y.) Society of Technical Draftsmen will be addressed Apr. 24 by Allan S. Crocker on "Power Plants," with particular reference to layouts, fuel saving, machine valuation and power-plant inventory assessment.

The Indiana Sanitary and Water Supply Association's annual meeting to be held in Indianapolis Apr. 9 and 10, as mentioned in these pages last week, will include the reading of papers on finance, rates, legislation, wells, water treatment, fire prevention, meters and war experiences. As a new law requires a regular analysis of waters offered for sale in Indiana, a model laboratory is to be exhibited. The United States Public Health Service has detailed one of its traveling laboratories to assist in creating interest in water purification and regularity of analysis.

The Western Society of Engineers held a meeting Mar. 31, devoted to a discussion of public affairs, to which members of all technical societies in Chicago were invited. First-hand information from the engineers' standpoint was presented on the state constitutional convention, deep waterways, better city administration, city planning, housing and zoning, proposed legislation on the Public Utilities Commission, licensing of engineers, and good roads. The discussion was led by James J. Barbour, state senator; B. H. Peck, electrical engineer, Public Utilities Commission of Illinois, and Douglas Southerland, secretary of the Civic Federation.

The Iowa Section of the American Water-Works Association will hold its fourth annual meeting at the State University of Iowa, Iowa City, Apr. 16-17. J. H. Dunlap, of the State University, is acting secretary-treasurer of the section.

The Washington Chapter of the American Association of Engineers has elected the following officers: President, Harry Stevens; vice-presidents, A. Y. Ross and Clegge Thomas; secretary, E. L. Howard, Bureau of Yards and Docks, Navy Department; treasurer, O. M. Sutherland.

The Kansas City Chapter of the American Association of Engineers has elected the following officers: Chairman, J. E. Jacoby; vice-chairman, W. B. Cost; secretary, C. N. Clarke, and treasurer, S. M. Bate.

The Detroit Engineering Society was addressed Apr. 4 by William B. Stout, chief engineer, United Aircraft Engineering Corporation, New York, who spoke on the "Commercialization of Aircraft," discussing various types of machines for different service, air routes of travel, wireless control, and the necessity for municipal air harbors. The annual meeting of the society will be held Apr. 19.

Personal Notes

COL. PETER JUNKERSFELD, who recently received his discharge from the Army, has resigned his position as assistant to the vice-president of the Commonwealth Edison Co., Chicago, to become engineering manager for Stone & Webster, with office in Boston, Mass. He has been with the former company and its predecessors for over 23 years, beginning as assistant to the mechanical engineer and rising to be electrical engineer and finally assistant to the vice-president, who is in charge of the operating, contract, construction and electrical departments. As a reserve major he was called into service in June, 1917, and in a few months was assigned to the Cantonment Division, which later became the Construction Division of the Army. He received his commission as colonel a few months later. A portrait and a brief biography of Colonel Junkersfeld were published in *Engineering News-Record* of Jan. 23, 1919, pp. 208 and 209.

MAJ. F. P. ADAMS, city engineer of Chatham, Ont., who went overseas with the 186th Battalion, has returned to Canada and resumed his duties.

W. W. HUFF, who recently left the Army service, has opened an office as consulting civil engineer at 605 Gumbel Building, Kansas City, Mo. Mr. Huff was constructing quartermaster in the Construction Division of the Army and was stationed at several points on the Atlantic coast. Before enlisting in the Army he was engaged in practice as consulting structural engineer.

GRUPE & WALTERS will open offices at 204 Bee Building, Omaha, Neb., as consulting engineers in paving, sewers, water-works, electric-light plants, municipal ice plants and heating layouts. Mr. Grupe has been engineer in charge of work at Florence Field, Omaha, Neb.

MAJ. JAMES MCGREGOR, of Halifax, N. S., resident engineer of the Halifax Ocean Terminals, has returned after two years' service in the 3rd Battalion of Canadian railway troops.

C. S. OGILVIE, formerly assistant engineer of the Grand Trunk Ry., at Belleville, Ont., who enlisted with the 13th Royal Highlanders and was a prisoner in Germany for over three years, has been appointed assistant engineer for the Ottawa division, Grand Trunk Ry, in succession to H. Mowat.

A. A. SCHENCK, engineer of maintenance, western lines of the Chicago & Northwestern R.R., with headquarters in Omaha, Neb., was recently appointed assistant to the chief engineer, with jurisdiction over the lines west of the Missouri River. His offices are in Omaha.

A. J. TURNER, consulting engineer, Seattle, has been appointed engineer of the Columbia Basin Commission, to take full charge of the preliminary survey which the commission is to make before the actual work of reclamation is undertaken.

RUDOLPH E. LEE, T. A. MACEWAN and A. R. TURNBULL have become associated under the firm name of Lee, MacEwan and Turnbull, architects and engineers, Charlotte, N. C.

I. F. STERN, who since February, 1918, served with the United States Shipping Board, Emergency Fleet Corporation, as consulting engineer in the Division of Wood Ship Construction, has resigned from the service and reopened his office in the Old Colony Building, Chicago, for private practice.

R. S. BONSIB, formerly in the service of the United States Shipping Board, Emergency Fleet Corporation, has been appointed chief of the Division of Safety Engineering of the Working Conditions Service, Department of Labor.

GUSTAV RASMUS, consulting engineer, Denver, has been appointed chief of the Industrial Bureau of that city, succeeding George A. Levy, resigned.

J. B. LIPPINCOTT has returned to Los Angeles and has opened offices in the Central Building for the practice of engineering, after having been in Government service in charge of the Housing Corporation's work at Neville Island, Pittsburgh. Associated with Mr. Lippincott will be Kenneth Q. Volk and E. A. Rowe, recently discharged from the Construction Division of the Army, where they held commissions as first lieutenants.

CAPT. S. J. GARGES, Construction Division, U. S. A., construction officer, Elizabethport Proving Grounds, has received his discharge from the service and has become associated with the Franklin Contracting Co., New York City.

R. M. HUBBARD has been appointed chairman of the Texas State Highway Commission, succeeding Curtis Hancock, resigned, as noted elsewhere.

THOMAS F. GIBSON, advisory engineer in charge of reinforced-concrete construction for the Construction Division, U. S. A., has received his discharge from the service and has returned to the employ of the Corrugated Bar Co., Buffalo, as district engineer, with headquarters in Kansas City, Mo.

CURTIS HANCOCK, chairman, Texas State Highway Commission, has resigned and will devote his entire time to private business.

JAMES POSEY, consulting engineer, Baltimore, who has been engaged in war work, has reopened offices in

the Fidelity Building, with branches in New York and Washington. Associated with him is George W. Gail, Jr.

C. V. HANSEN, chief engineer, St. John Levee and Drainage District of Missouri, has been appointed highway engineer of New Madrid County.

WILLIS E. AYRES and GARNER W. MILLER have become associated under the firm name of Ayres & Miller, consulting engineers, Memphis, Tenn., specializing in road, drainage and flood-protection work.

CAPT. CHARLES B. SPENCER, Ordnance Department, U. S. A., who recently arrived from France, has received his discharge from the service and has returned to his work with the Underpinning & Foundation Co., New York City.

ELMER O. FIPPIN, professor of soil technology, Cornell University, is to become director of the Agricultural Bureau of the Lime Association at the close of the present collegiate year.

DAVID A. SEALEY, assistant engineer with the Public Service Commission, New York City, and for the past six years engineering assistant to the engineer of subway construction, has resigned from the organization and has joined the staff of the Truscon Steel Co., Youngstown, Ohio.

N. A. GILMAN has resigned as city engineer of Yakima, Wash.

H. A. SEWELL, HANS STRAALSUND and C. W. STRAIGHT have formed the Interstate Engineering & Construction Co. at Newport, Wash., to specialize in timber and reinforced-concrete structures.

A. K. GAULT has been appointed division engineer of the eastern division of the western lines of the Chicago & Northwestern R.R. and the Missouri Valley & Blair Bridge, with headquarters in Omaha, Neb.

WALTER SHEPARD, consulting engineer of the Boston & Albany R.R., with headquarters in Boston, on Mar. 1 was retired under the pension rules of the company. He served 44 years in the engineering department of the railroad. Mr. Shepard was born Mar. 1, 1849, at Dorchester, Mass., and was graduated in 1870 from Harvard University and in 1872 from the Massachusetts Institute of Technology. In June, 1872, he began his railway work with the Boston & Albany R.R. as an engineer's assistant. For a few years he was out of railway work, until in March, 1875, he returned to the service of the road. In April, 1882, he became division engineer, and in December, 1886, was promoted to the position of assistant chief engineer. From November, 1891, until May, 1908, he served as chief engineer of the road, and since that time he has been consulting engineer.

ORLANDO H. FRICK recently became district engineer of the middle district of the Chicago, Milwaukee & St. Paul R.R., with headquarters in Milwaukee.

M. K. BARNUM, assistant to the general superintendent, maintenance of equipment, Baltimore & Ohio R.R., with office in Baltimore, has been appointed mechanical engineer for the corporation.

HAROLD R. MILES, assistant engineer on the Canadian Pacific Ry., with headquarters in Montreal, has been promoted to division engineer with headquarters at Winnipeg. Mr. Miles was born at Lethbridge, Alberta, in 1879, and entered railway service in March, 1899, with the Washington County Railway Co. in Maine. The following year he was employed by the Algoma Central on location work and in 1901 he entered the service of the Canadian Pacific as assistant engineer on maintenance, with headquarters at North Bay, Ont. Later he became resident engineer of maintenance on the Lake Superior division, remaining there until July 1, 1915, when he was transferred to Montreal as assistant engineer. More recently he has been division engineer, with headquarters at Lethbridge.

W. S. GEARHART has resigned as state highway engineer of Kansas. Captain Gearhart went to Kansas from the Illinois Highway Department and established a similar department at the Kansas Agricultural College. When the Kansas State Highway Commission was created, Mr. Gearhart became state highway engineer. Last year he received a leave of absence from the state service to enter the Army engineer corps.

W. T. MAIN has been appointed division engineer of the Black Hills division of the Chicago & Northwestern R.R. and the Wyoming & Northwestern R.R., with headquarters at Chadron, Neb.

H. K. YORSTON, until recently division engineer of the Canadian Pacific Ry. at Winnipeg, has been appointed locating engineer of the Canadian Pacific, Western Lines. He is succeeded at Winnipeg by Harold R. Miles, as noted elsewhere.

OBITUARY

ALLEN T. FRASER, of Winnipeg, chief engineer of the Canadian National Rys., was killed by a snowslide near Mount Robson in the Yellow Head Pass through the Rocky Mountains, Mar. 31. The train on which Mr. Fraser was proceeding west was stopped by the slide. Mr. Fraser and a section crew went to make an examination when another mass of snow and rock came down, burying the party. The section hands were dug out alive, but badly injured. Mr. Fraser was 46 years of age and had been in the service of the Canadian Northern Ry. for many years. He was formerly district engineer of that line, at Edmonton, but in January last was promoted to the position of chief engineer of the western division with headquarters at Winnipeg.

GEORGE H. GARDEN, formerly resident in Montreal, died recently at Rouses Point, N. Y., aged 70. He was born at Woodstock, N. B., and had been all his life engaged in engineering. At the age of 20 he was appointed assistant engineer on the location of the Intercolonial Ry. and was subsequently in charge of part of the location on the Crow's Nest Pass division of the Canadian Pacific Ry. Mr. Garden afterward became chief engineer of the Alberta Ry. & Coal Co. at Lethbridge, Alta., leaving that position in 1901 to practice his profession in the East. He retired in 1914, his last work being the location of a large section of the Canadian Pacific Ry. Montreal-Toronto (lake shore) line. Mr. Garden was a member of the Engineering Club of Montreal and the Engineering Institute of Canada.

A. C. WALKER, civil engineer of Blacksburg, Va., died in that city Mar. 21 at the age of 69. A large part of Mr. Walker's life was spent in railroad location work, among which was that of the Carlisle, Clinchfield & Ohio R.R. line across the Blue Ridge Mountains. He was educated at the United States Military Academy.

OWEN BRAINARD, consulting engineer and architect, New York, died in that city Apr. 2. He was 54 years old. After attending public and private schools, he engaged in machine-shop work for two years at Haddam, Conn., and Philadelphia, and in 1887 became associated with his father in the construction of buildings and general contracting in Middlesex County, Connecticut. Continuing in contracting and architectural work, he became general superintendent and manager of the firm of Carrere & Hastings, architects, New York City, of which he became a member in 1901. In 1907 Mr. Brainard opened his own offices as a consulting engineer and architect in New York City. During his association with Carrere & Hastings he had assisted in the design of the New York Public Library, the Senate and House office buildings in Washington, the extension of the United States Capitol, and the Yale memorial buildings. His later work has been the design of the New Theater, New York City, now the Century, and the industrial villages of the United States Steel Corporation.

J. E. JOHNSON, JR., mining and consulting engineer, New York City, died Apr. 4 as the result of an automobile accident. He was a director of the American Institute of Mining and Metallurgical Engineers.

National Foreign Trade Convention To Be Held in Chicago

Announcement has been made of the sixth National Foreign Trade Convention, which will be held in Chicago Apr. 24-26, inclusive. The session Apr. 24 will deal with America's need of foreign trade, while that on the 26th will be devoted to a discussion of the American merchant marine. A variety of subjects connected with the post-war problems of foreign trade will be presented Apr. 25. Among the subjects and speakers will be: "America's Financial Equipment for Foreign Trade," by Fred I. Kent, vice-president of the Bankers' Trust Co.; "The Interest of Labor in Foreign Trade," by Hugh Frayne of the War Industries Board; "The Element of Labor Costs in American Exports," by William Pigott, president of the Seattle Car & Foundry Co.; "The Effect of Increased Productive Capacity Upon Our Foreign Trade," by Edward Prizer, president of the Vacuum Oil Co., and "The Future of Our Foreign Trade," by Edward N. Hurley, chairman of the United States Shipping Board.

Other speakers will be William S. Culbertson, of the Tariff Commission; John M. Parker, president of the Mississippi Valley Association; J. W. Hook, president of the Allied Machinery Co., of New York; James A. Farrell, chairman of the National Foreign Trade Council, and Breckinridge Long, third assistant secretary of state.

Present Claims on Cancelled War Contracts by May 15

Benedict Crowell, assistant secretary of war, has given notice that contractors desiring to adjust cancelled war contracts through the machinery set up by the War Department must present their claims prior to May 15. He stated that nearly half the claims involved had not yet been formally presented. The inconvenience caused by this delay was stated by Mr. Crowell as follows:

"This failure on the part of contractors is occasioning the department embarrassment. The organization which is handling this matter is essentially civilian in character and composed of men who remain in this work only at a very great sacrifice and at the urgent request of the department. I do not feel that I can continue indefinitely to impose that hardship, and have determined that all contractors who desire to avail themselves of the existing organization for the settlement of their claims must present them prior to May 15, 1919."

Cement Price Is Lowered Throughout Country

There has been a general decline in the price of cement, amounting to from 5c. to 15c. net, 65c. to 75c. gross. The charge for sacks has been decreased 40c., or from $1 per bbl. to 60c. A statement of the situation is to be issued by the cement manufacturers Apr. 10.

Ditcher Arranged to Cut Close to Obstructions

A new mechanical ditcher, designed to cut trenches close to buildings, curbs, pole lines and other obstructions, has been designed by the Pawling & Harnischfeger Co. The machine, which is shown in the accompanying illustration, has corduroy grip tractions, and will cut a trench from 15 to 24 in. wide to a maximum depth of four feet.

Three changes of speed are made available by sliding gears without changing sprockets, so that quick changes can be made to suit the character of the material being excavated. By means of two sizes of chain sprockets a total of six speeds can be obtained, ranging in geometrical progression from about 1.5 to 5 ft. per minute.

DITCHER IN OPERATION NEAR WALL

Although the standard width of cut is 15 in., adjustable side clearance cutters enable the machine to dig 24 in. The corduroy grip tractions are of unequal width, a 19-in. width being used under the cutting side to take up the extra weight, while 15-in. width is used on the other side. Power is furnished by a 25-hp., four-cylinder vertical engine of the tractor type, arranged for burning kerosene, gasoline, or motor spirits. The various dimensions are: Width over all, 10 ft. 7 in.; length over all, 25 ft. 9 in.; height 9 ft. 7½ in.; total weight 19,500 pounds.

Business Notes

The Allied Machinery Co. of America announces the removal of its main offices in New York to 51 Chambers St., where it will occupy the entire eighth floor. This company is a subsidiary of the American International Corporation.

The Chicago Pneumatic Tool Co. announces the discontinuance of its office at Wichita, Kan., and the establishment of an office and warehouse at Eldorado, Kan. A new office has also been opened at Tulsa, Okla., at 313 Richards Building, with warehouses at 102 North Cheyenne St. It is thought that this arrangement will better serve the territories concerned.

The American International Steel Corporation announces that Lieut. Col. Merrill G. Baker has been appointed president of the company, effective Apr. 1, 1919. Colonel Baker was formerly assistant general manager of sales for the Cambria Steel Co., but has been in the Ordnance Department since shortly after America entered the war. He succeeds the late Edward M. Hager, who died over a year ago, since which time Morris Metcalf, vice-president, has been in charge of the business. Mr. Metcalf will remain in his old position. The American International Steel Corporation is a subsidiary of the American International Corporation and is engaged in the exportation of steel products and railway equipment.

The Bucyrus Co. has opened offices in Minneapolis, from which point it is intended to serve the Northwest district to and including Nebraska.

The Ideal Engine Co., of Lansing, Mich., manufacturer of power equipment, announces that it has added H. H. Lucas to its sales force. Before joining the United States Navy, Mr. Lucas was with the Lansing Co. Mr. Lucas will take up his duties early in April, after his discharge from service.

Trade Publications

"Checking Thermocouple Pyrometers" is the subject of bulletin No. 867-B, issued by the Leeds & Northrup Co., Philadelphia, Penn. This is an 8 x 10½-in. 23-p. pamphlet covering heat-measuring apparatus and is illustrated with half tones and line cuts.

The Quigley Furnace Specialties Co., 26 Cortlandt St., New York, N. Y., has issued bulletin No. 11, covering the preparation, distribution, and burning of powdered fuel, using the company's air transport system. The bulletin is 8½ x 11 in.; has 15 pages, and is profusely illustrated.

The Page Steel & Wire Co., of 30 Church St., New York City, has just issued a 4 x 6½-in., 60-pp. pamphlet, which deals with Armco iron rods and wire for oxyacetylene and electric welding.

"Absolute Permissive Block-System Circuits" is the title of a new bulletin issued by the General Railway Signal Co., of Rochester, N. Y. The booklet consists of 16 pp. 6 x 9 in. in size, and is illustrated with half tones of signaling apparatus. It contains an insert of seven pages of block-system circuits.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 NEW YORK, THURSDAY, APRIL 17, 1919 Number 16

Modern Methods Applied To Group House Building

BUILDING a dwelling or a series of dwellings was raised during the war from a mechanic's job to an engineering operation. The designs for the numerous towns for the war workers involved little that was new. But the construction, turned over to contractors accustomed to handling large projects, was rushed through with methods and economies unknown in house building heretofore. Some of these methods are well illustrated in the article on another page describing the Cradock development. The effectiveness of machinery in place of men for such work cannot be questioned, although relative cost figures are not here available. Particularly to be noted for use where small amounts of concrete have to be placed over a large area is the system of central concrete mixing with distribution in tractor-drawn carts.

Governmental Buying of Construction Material

CLAUSES in contracts providing for the purchase and delivery to highway contractors of all materials, thus relieving them of the hazard of price changes, have had many advocates in the past, particularly during the war. Such a plan, operated in Outagamie County, Wisconsin, was described in *Engineering News-Record* of Feb. 6, 1919, p. 289. The advantages of this procedure to the contractor are obvious. Besides the relief from the risks already referred to, there is released for use that part of the contractors' capital usually tied up in delivered materials. Responsibility for quality also rests with those who let the contracts, and, where large amounts of work are under way, the authorities, by controlling shipments and changing routings on the indications of daily reports, can deliver the right amount of material at all times, thus eliminating delays and demurrage charges. The advantages to the state or county may not be so apparent, but the adoption of the custom would no doubt reduce the cost of the finished road. An added incentive at the present time lies in the fact that lower freight rates are offered by the Railroad Administration on materials bought by Federal, state, county, municipal and township governments. Considering these conditions, it would appear that now is a good time to try the system of Governmental buying.

Engineering Council and the Nonmember Societies

WHAT relations should the Engineering Council have with the national, state and local engineering societies which are not represented in it? It is announced that the delegates from engineering societies who have been invited by the council to meet in Chicago April 23-25 to confer on plans for a Federal Department of Public Works will, on the third day of the conference, have an opportunity to discuss the above question. At present the council has 25 members, representing the national societies of civil, mining, mechanical, electrical and testing engineers. The combined membership of these five societies is about 40,000, or an everage of 1600 members per representative. It will be necessary to take into consideration these facts, in discussing any plans for direct representation of the smaller societies on the council. What is needed is confidence on the part of engineers that the council is endeavoring to act for the interest of the engineering profession as a whole and not merely for the more successful and conservative portion of the profession which is active in the national societies. Unless the council is sympathetic with all classes of the profession and all sections of the country, its mission is bound to be relatively narrow. Such recent acts of the council as the broad invitation to all engineering societies to join in the movement for a public-works department, and this frank request for practical suggestions as to how the council may coöperate with all engineering organizations, will in themselves help to increase the needed confidence.

Navigation Improvement Under the Ohio Conservancy Law

A NEW application of the Ohio conservancy law, proposed by the city and county authorities of Cleveland, is under court test. Straightening of the Cuyahoga River where it winds along the bottom of its valley through the city is urgently necessary for the general commercial benefit of the city; it will improve navigation and thereby make dock property more accessible, will give far better utilization of the bottom lands for commercial purposes, will simplify railroad and freight distribution problems, will facilitate bridge and viaduct construction across river and valley, and, incidentally, will do something in the way of reducing the liability of floods in the bottoms. This is a new field of service for the conservancy law, which was drafted in the interests of flood protection as needed on the Miami and Scioto Rivers. However, the wording of the law specifically makes it applicable to broader purposes, and unless unforeseen objections are encountered the court may well find in its favor and decree the organization of a district. The fact is that river straightening at Cleveland is beset by many difficulties from the administrative viewpoint, and assessment of the costs upon the property directly benefited seems the only logical way to deal with the work on a justifiable basis of expenditure. There are unquestionably, many and sound objections to the creation of local improvement districts of this

character. Administered under the Ohio law, they are controlled without proportionate representation of the population assessed for the improvement. Objections of this character are sure to receive proper consideration in the court hearing, and the decision, by showing whether they prevail over the advantages obtainable in the Cleveland case, will represent a measurable advance in the processes of handling large public enterprises along rivers.

One Township Employs Effective Road Publicity

TOWNSHIP highway work is often not appreciated for lack of proper publicity. If the officials make reports they are pigeonholed and forgotten unless brought out only as a matter of political expediency. It is all the more refreshing, therefore, to receive the eight-page report of the highway commissioner, H. H. Sherer, of New Trier township, just north of Chicago. Everything is noted, from the formation of an advisory board (made up of two lawyers, two architects, a banker, an engineer and a drainage expert) to the daily cost sheet of road-drainage work. The report shows what the budget taught, what was the necessity of developing a nearby gravel pit for repair work in place of the ordinarily used but more expensive crushed stone, how the road drag at $7.50 per day replaced a grader at $15 and was found to be the tool really needed because of excessive crowning, how a patrol system was established, and how the prospective ditch work uncovered the fact that surveys and dedicatory plats for many of the traveled roads did not exist. A map showing all the roads and drainage work done is included in the report, which was printed and sent to every citizen. Only $18,348 was spent, but if every township would make as good an account of its expenditures, there would be less criticism because of the millions wasted by local authorities.

Narrow-Gage Railways Proposed in England

NARROW-GAGE railways in this country are relics of the past, but in England the exigencies of war and reconstruction are forcing them into engineering notice. Improved transportation is held there to be one of the immediate necessities. Strange as it may seem to an American, there are still many productive areas in England, isolated from the centers of consumption, which must be tied into the transportation net of the country if immediately increased production is to be realized. In France, and ready to go to France, when the war ended, was material for hundreds of miles of the light railways which had been developed so effectively in the zone of communications. These, it is urged, can now be put down in the remote districts of England by the experts who built similar ones in France, without the complicated legal and parliamentary procedure required to put through a standard-gage line and at much lower first cost and operating expense than either main-line railways or highways. The recrudescence of the almost forgotten narrow-gage will be watched with all the more interest now, on account of the growing claims of the highway and motor truck as a freight feeder. In this country the tendency has clearly been toward a larger and more effective use of highway transportation. Its recommendation is the very great flexibility of its vehicle—the motor car or the motor truck—and that advantage will be the great one against which the narrow-gage will have to contend if it is to receive attention.

Making Geological Survey Maps More Popular

STUDIES looking to the popularization of Geological Survey maps are being made by the cartographers of the survey in order that persons who are unable to read contour maps may find at least some of the future sheets issued by this bureau of service to them. It has been found that by shading contour maps the topography can be shown so clearly that even bright boys are able to read them readily. The studies now in progress are for the purpose of determining the best method of shading. The use of hachures involves so much time and requires so much highly skilled drafting and engraving to produce really satisfactory results that it is not available for such work. Attention is, therefore, being focused on tinting as a means of portraying the relief, and some very encouraging results have been obtained. The relative elevations of flat surfaces are indicated by flat tints, darkest for the lowest plains, while the hills and mountains are shaded in accordance with the shadows which would exist when the light comes from a direction somewhat north of west. The time spent in surveying a region like the Yellowstone or Yosemite Park and preparing the standard contour maps from the results of these surveys is considerable, and if a little more time spent in tinting the maps will make them useful to the general public, which demands large numbers of maps of our scenic districts, a useful public service will be rendered.

A Gasoline Tax On Motor Vehicles

HIGHWAY engineers are repeatedly raising the question as to the method by which motor trucks shall be made to pay a just share of the cost of building and maintaining highways. Comparison is often made with the economics of railway transportation, in which the shipper bears not merely the cost of operating the moving equipment but also a proper share of the cost of constructing and maintaining the track. In various states an attempt is made, by a graduation of motor fees, to charge back to the motor-truck user a proper proportion of the wear that the transportation of his goods causes to the pavement. Necessarily, these fees cannot be directly proportional to the use made of the road. Of two trucks of the same weight and capacity, paying the same yearly motor-vehicle tax, one may average only five miles a day and the other 30, the latter obviously causing six times as much wear on the highway as the less-used truck. To secure an equitable method of charging, it has been proposed to levy a tax on the gasoline consumed by motor vehicles. While there is some variation in fuel consumption between different makes of vehicles having the same carrying capacity, it is in general true that the fuel consumption is in direct proportion to the load and speed. At least, it is a closer measure of highway wear than anything we have found to date. Obviously, objections can be found to any form of tax. One of the apparent weaknesses of the gasoline tax is that a given capacity of vehicle carrying a certain load will produce more serious damage with hard-rubber tires than with pneumatic tires, and, again, still more serious damage if steel tires are

used. This difficulty for the present is a relatively negligible factor. In other words, practically all of the motor-truck traffic today is carried upon solid-rubber tires. If, in the future, the pneumatic tire becomes the standard for motor trucks of large capacity, some modification of the tax may be necessary, but, all things considered, the gasoline tax has much to commend it.

Danger Ahead for American Society for Testing Materials

IN THE establishment of a new organization to deal with shape and quality standards of constructional materials, discussed in these columns last week, the American Society for Testing Materials has an intensely personal interest. For other societies, as the Civil Engineers, the Engineering Standards Committee movement is only a minor incident. For the American Society for Testing Materials it is a life-and-death matter.

No development in technical society life during the past twenty years is more noteworthy than the rise and fruitful service of the American Society for Testing Materials. Steadily and in purposeful manner it has worked for efficiency, improved quality and economy in the production of engineering materials, through the study of tests and the drafting of standard acceptance specifications. Its future has seemed as bright as its past. The society's vitality was rooted in its serious purpose, its independence, and the authority which it acquired by virtue of the strong working spirit and conscientious coöperation of its members. When it becomes a secondary organization, subordinate in both initiative and achievement, as it must under the working plans of the Engineering Standards Committee, the wellsprings of this vitality would inevitably be dried. The society could no longer hope to be a center of such spontaneous energy and enthusiasm as its members have hitherto brought to its work.

To the members of the society as well as to that large circle of technical and industrial men outside the society who have been aided by its work, the situation now existing is, we believe, of immediate and most urgent concern. The profound loss which would be suffered through paralysis and decay of the society can hardly be made up or overbalanced by gains through the activities of the Engineering Standards Committee. Members of the society, and especially participants in its committee work, will never believe that the society's methods can successfully be duplicated by a far-away mechanism of nontechnical direction, such as is now to be set into action.

The governing body of the society has participated in the Engineering Standards Committee movement from the outset, and the society is at present represented upon that committee. Doubtless those who direct the society's policy have believed that its position of supremacy in the field of quality specifications would not be harmed by a coöperative agreement with other societies. But can supremacy and subordination be brought into harmony? Can the society's position of unquestioned authority in the field of materials, won through the most sincere and conscientious labors, be retained if that final authority is yielded up to another body? We believe that it can be neither retained nor transferred, but will be lost.

It is a noteworthy fact that the man who more than others had inspired the spirit and created the methods of the society, the late Prof. Edgar Marburg, was very apprehensive of the influence of the Engineering Standards Committee movement upon the society, and opposed the plan of participating. No man knew better than he the difficulties inherent in intersociety coöperation, commonly called joint-committee work; no one had been more successful in directing such work, and no one better knew that technical as well as personal disagreements are bound to enter, regardless of the source. He did not fear the success of the Engineering Standards Committee, we feel sure; what he feared was its failure. He was of generous nature, and perhaps he would not have opposed the formation of a body that could do the work of the society if it would do it better. But he was too clearseeing a man and too strong a leader to look with favor on a plan that might submerge his own society without assuring that its work would continue.

Now that the committee is in a period of reorganization, new opportunity is afforded to consider the broad questions at issue. We urge upon the council of the American Society for Testing Materials that it review its prior decision to participate in the Engineering Standards movement; and we repeat that the matter is one of vigor or paralysis, of life or death, to the society and to the cause which it represents.

Distributed Versus Centralized Passenger Terminals

WITH the growth of our cities the question of passenger terminals is one of repeated occurrence. The long drawn out discussions at Chicago and Cleveland are but the counterpart of what is being heard in dozens of cities in different parts of the country. The problems there may not be as acute, but as the number of cities of very large population increases there are sure to arise elsewhere situations just as difficult and provocative of as much discussion.

Usually, the discussion comes down to a dispute between the railroad and the representatives of the public. The railroad company faces large expense in the building of elaborate terminals in congested cities, while the public, seeking merely its own convenience, desires to dictate the location, and sometimes the character, of the terminal.

In all cases the argument revolves about the possibility of building another huge terminal, and the advantages and possibilities of the "distributed" type never come up for consideration. By "distributed" type is meant a shuttle service running into the congested sections from a terminal placed well outside of the city, such a shuttle road to have in town a number of stations similar to those of elevated and subway lines. It proposes, instead of a huge terminal putting on the railroads the terrific overhead of high property costs and an elaborate building, the substitution of a system relatively inexpensive and tending to give the people of the city a service far excelling the possibilities of the centralized terminal.

"Arrant nonsense," will be the immediate comment of many whose thoughts have never strayed beyond the huge terminal idea. But is it arrant nonsense?

Consider, for example, the Manhattan Transfer scheme of the Pennsylvania R.R. at New York. One can go from lower New York, from any Hudson and Manhattan tunnel station on Sixth Ave., from Hoboken, from Newark, from Harrison, from four points in Jersey

City, to Manhattan Transfer, and there wait for and board his train. The passenger need never see the Pennsylvania Terminal in New York City; he buys his ticket in any one of half a dozen places and checks his baggage at the same time. The passenger entering New York City, on the other hand, can terminate his journey at that one of the fifteen Hudson and Manhattan stations in the metropolitan district which best suits his convenience.

Moreover, the ferry systems of the various railroads terminating on the west bank of the Hudson River, opposite New York City, furnish another example of the distributed type of terminal. Land on the west bank of the Hudson is relatively expensive, yet not so expensive as that upon Manhattan Island itself. From each of these terminals radiates a number of ferry lines, dropping the passengers at points most convenient for them. Looking about, we can find other instances where the distributed terminal idea has been used to a minor extent. In Cleveland, Pittsburgh and Chicago there are stations in the outlying sections where goodly numbers of passengers board and leave through trains, while at Chicago the Elgin, Aurora & Chicago R.R., instead of having a downtown terminal, uses the Metropolitan Elevated Railroad Co.'s line and thus is able to distribute its passengers at any point on that extensive system.

Objections can be raised as the various difficulties involved in the distributed type are considered. What about waiting rooms, baggage, boarding trains which leave late at night, etc.? The answers to most of the objections can be found by a study of the Manhattan Transfer scheme of the Pennsylvania—although, manifestly, there, with a central terminal in addition to the distributed system, the full development of a distributed system has not been attained.

A distributed scheme may sound like "arrant nonsense" to those who blindly wrap themselves in tradition, but, from the standpoints of convenience and good business policy, it must give pause to those who defend as an alternative the $50,000,000 (and more) terminal, inconvenient because of its immensity, burdensome to the railroad as an investment, albeit monumental and creditable to a city which bears none of the cost, save to relieve later the inevitable street and transit congestion.

Some New Ideas in Concrete Proportioning

PROPORTIONING concrete by volume is so firmly established that to many the method of designing a concrete mixture proposed by Professor Abrams, as outlined in an article on another page, may seem unduly complicated. It is true that the machinery of the method requires some rather involved explaining, but the method itself is simple enough and the theory back of it rational. That theory is that concrete strength and wear depend on optimum plasticity, which may be brought about by varying the three ingredients—cement, aggregate and water. The studies on which the method is based emphasize, first, the importance of water, and, second, the effect of the grading of the aggregate on the amount of either water or cement. Since cement is the more expensive of the two, the design of a concrete mixture resolves itself into the determination for any given aggregate of the proper amount of water with the minimum amount of cement. This is good economy, because on any job the aggregate is the variable, to which the cement and water can most readily be adjusted for the best possible concrete.

In particularizing the water-content problem in concrete, Professor Abrams has done a service to all concrete users. The subject is not new. The dry concrete of the late '90s was based on sound enough theory, which was forgotten or discarded in the rapid growth in the use of reinforced concrete, with its impeding steel. Four or five years ago the wet pendulum began swinging too far, and students of concrete commenced to sound the dangers of the overwet mix. Professor Abrams more than any other investigator has pinned impressions down with facts. Very definitely he has shown the quantitative as well as the qualitative rôle of water in concrete.

In his theory of aggregate grading he, too, is treading on familiar ground, only he has gone further than previous investigators. In place of the Fuller grading curve, which was supposed to give an aggregate of maximum strength-making properties, he substitutes an area which any number of curves may satisfy, and—what is crucial—indicates that any such area of sieve-grading curves has its own water or cement content to produce a concrete of given strength. This has wide application, because aggregate rarely occurs according to any required analysis.

It is evident, however, that the insistence on a proper water content is the most important feature of Professor Abrams' work. One may disagree with his fineness modulus theory or ask for more confirmation thereof, and still accept the principle of the optimum water-cement ratio. There is plenty of evidence that too much water is dangerous, but the trouble is that the rank and file of concrete workers do not yet appreciate it. The subject has been hammered and hammered for the past two years and needs more hammering. The general rule, "Use the smallest amount of mixing water that will produce a workable concrete," should be cast in bright letters on every concrete mixer in the country, and the men who tend that mixer taught what the words mean in the very concrete they are placing.

Engineers must translate into better concrete such work as the Lewis Institute laboratory is doing. They must disabuse the concrete workmen and foremen of their present idea that such studies as this one are what Professor Talbot at a recent convention referred to as "artists' stuff." They must emphasize and advertise the fact that concrete is not a casual composition but a delicately balanced mixture responsive to every variation in its content or method of manufacture.

And these same engineers should not forget that, highly scientific as is the designing theory advanced by Professor Abrams, at bottom its operation depends on practical experience and visual expertness. Throughout the discussion the importance of "workability" is emphasized. Just what is an optimum workability? On nearly every concrete job expert opinion differs. The added pint of water which takes away exactly so many pounds of compressive strength may make the difference between success and failure in getting the concrete out of the mixer. The extra plasticity which perfect design forbids may be necessary to insure complete covering of close-knit reinforcement. This by no means detracts from the desirability of so exact a design of the mix, but it does indicate—what, of course, is true of all engineering—that the finished engineer is the one who can apply to the elegance of the laboratory and of the study the solid experience of years of practical observation.

Labor-Saving Machinery Used in Building Houses

Tractors Drag Plows and Also Haul Concrete Carts From Central Mixing Plant to All Parts of Extended Job—Lumber Pre-Sawed to Standard Sizes in Mill on Works

By Samuel H. Lea
Assistant Engineer, Cradock Housing Development, Portsmouth, Va.

CRAWLER TRACTORS HAUL MIXED CONCRETE AS FAR AS 1750 FEET ON UNITED STATES HOUSING DEVELOPMENT

LABOR was the element hardest to get in the construction of the United States housing project at Cradock, Va., which was started last summer, to provide homes for workers in the nearby Norfolk Navy Yard. For that reason a special effort was made to utilize all possible labor-saving devices and machinery, so that the men who could be obtained would be employed most effectively. This application of machinery extended from the unloading of material to the digging of the service trenches, but its most novel manifestation was the extensive use of the small tractor of the track-laying or "crawler" type to haul concrete from the central concreting plant and to do all manner of odd jobs of haulage around the works.

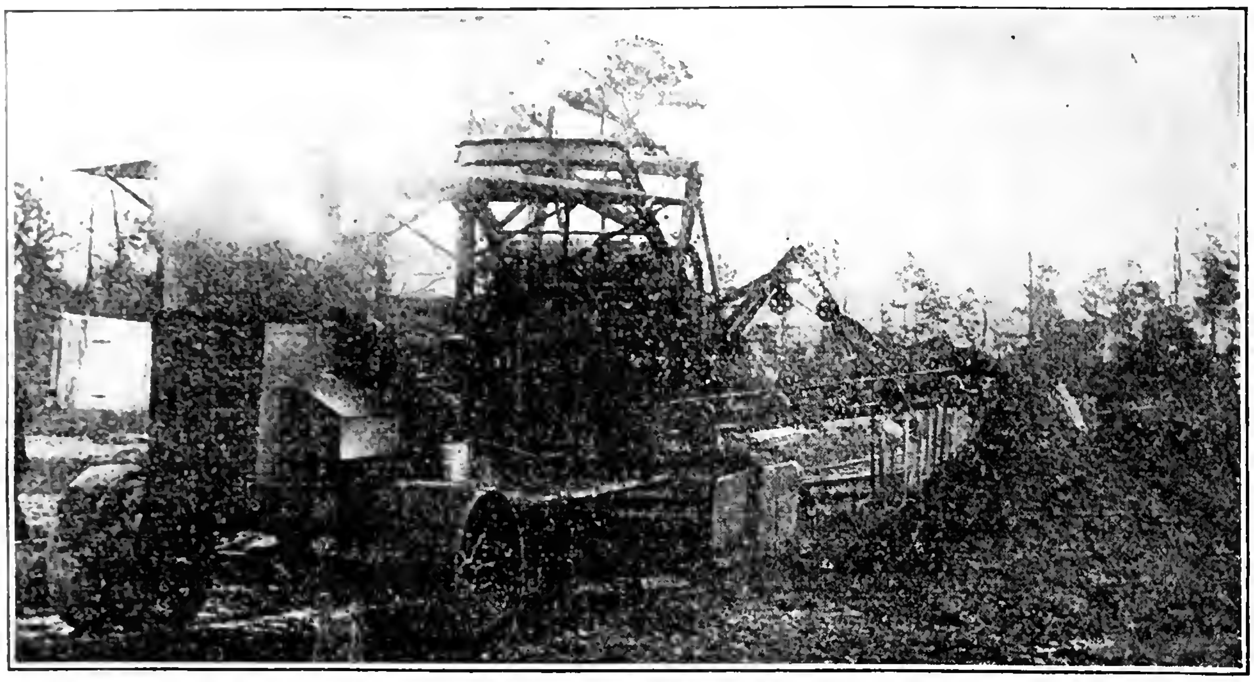
The original plans at Cradock contemplated sufficient houses for 5000 persons. After the armistice was signed it was decided to build 662 houses, including seven apartment buildings and 93 portable houses. All of these houses, together with the streets, roads, pavements and public-service appurtenances, had to be built on virgin ground on a site of about 400 acres adjacent to the Virginian R.R. and the Portsmouth-Gilmerton trolley line. In addition to the permanent housing buildings, there were many temporary buildings, such as bungalows and mess halls for the administrative force, barracks, kitchens, mess halls and canteens for the laborers, sawmills, storage buildings and hospitals.

THREE TRAILER LOADS OF LUMBER BEING HAULED BY A SMALL TRACTOR

Convenience of transportation in the site was facilitated by the location of the main-line railway. A loop track from the Virginian R.R. extends through the project for 2.6 miles, including sidings and spurs. Material brought in could be run around this loop and discharged at convenient places, from which it was delivered to the job by trucks, tractors and horse-drawn wagons. Temporary roads were built to take care of this traffic, and preliminary surfacing was also placed on the permanent roads. About 4000 cu.yd. of road metal, comprising slag and stream and pit-run gravel, was used for surfacing the main thoroughfares through the project. Most of the temporary roads, made at an early period upon the natural surface, were of gravel or slag, forming a solid bed during the rainy period. They were located outside of the regular roadway, to be out of the way of grading operations, sewers and water lines.

On streets where the utilities had been installed and where settlement of the trenches was anticipated, the roadways were graded to subgrade, and the permanent paving was delayed. Where concrete pavement is to be constructed the roadway was excavated to a depth of 6 in. below subgrade. A layer of furnace slag was placed in the excavation and rolled until the surface was even with the subgrade. This temporary pavement is used for traffic and serves as a sub-base for the later concrete pavement.

One of the first applications of labor-saving methods was in the unloading of the lumber. Freight cars loaded with lumber were switched on a spur track, and



TRENCHING MACHINE AT CRADOCK DEVELOPMENT AT WORK DIGGING SEWERS

collapsible platforms were erected, one against either side of the car door. These platforms were made of 2 x 4-in. lumber about the width of a lumber truck, with the floor a few inches higher than the truck floor. A truckload of lumber unloaded from the car to each platform projected about 3 ft. beyond the end of the platform. The lumber truck had flat floors with rollers of 3-in. iron pipe extending across the floor at intervals of about 3 ft. These rollers were embedded so as to leave their tops about 1 in. above the floor. In loading, the truck was backed under the projecting end of the pile of lumber which covered the nearest floor roller; the truck was moved back until the lumber was fully loaded; the platform collapsed during the operation and fell to the ground, to be rebuilt for the next load, leaving the lumber load on the track. The side of the car held the lumber in place while the truck was backing under. When the truck loaded with lumber reached its destination, it was stopped at the required place, and was then started suddenly and moved forward a few feet, which caused the load to shift backward a short distance. The operation was repeated a few times and the truck was out from under the load ready for another trip.

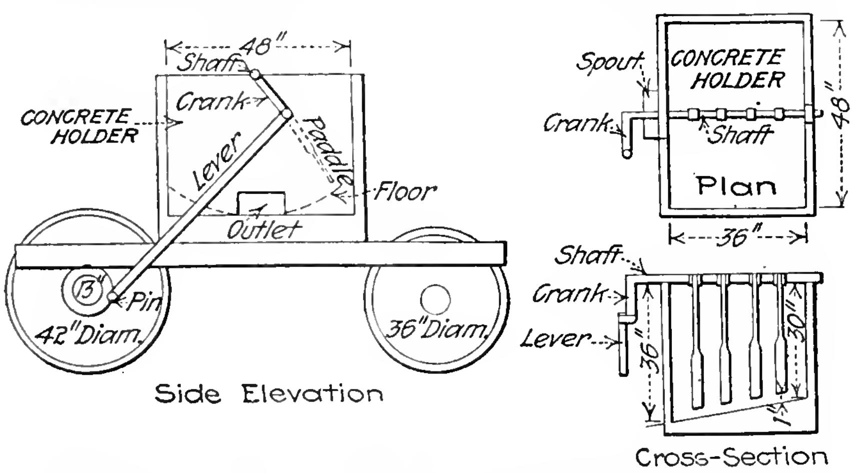
In getting the material around the job, the tractors which are seen in the views were useful. One view shows trucks with three loads of lumber. Such a train would make an average speed of six miles an hour along the temporary roads at the project. The same tractors were used for moving freight cars along the railroad track during the early part of the work before a locomotive was available. A log chain 10 or 12 ft. long was used for coupling the car to the tractor, which traveled close beside the track. One loaded freight car or two empties constituted a load. In one case a 10 x 12-ft. shack mounted on 6 x 8-in. skids was carried several hundred yards by three tractors traveling tandem.

The same tractors were used in clearing up the project before the construction started. They pulled down and removed small trees and stumps and, as shown in one of the views, were used to drag plows. Trees up to 3 in. in diameter were first cut around the roots, and a log chain was attached to the trunk several feet from the ground. The other end of the chain was hooked to a tractor which pulled down the tree and dragged it away. In plowing, the tractor was attached to the plow by a long chain.

Pre-sawed material was used in all the buildings, which were of frame throughout. The sawmill was equipped with swing saws which could be turned to any required angle for making square or mitered cuts of framing lumber and for the interior and exterior trim of the buildings.

From four to six pieces would be sawed at the same time. Pieces of lumber ready for use were passed from the saws through the mill door onto the truck or trailer. Each machine saw was driven by an independent electric motor. The mill supplied material for framing and for trim for from 10 to 15 houses per day.

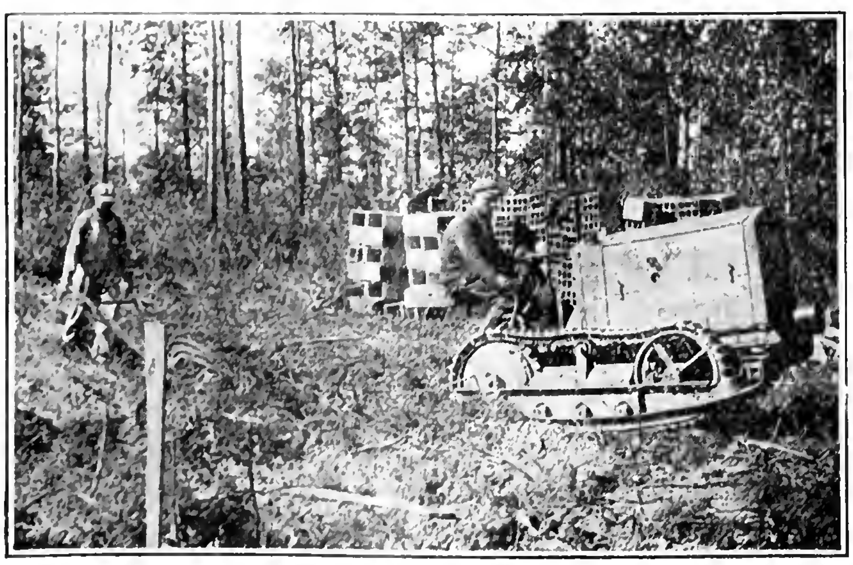
Concrete for the foundations of the buildings and for such other uses as were required was made at a central mixing plant and hauled to the place in special carts by



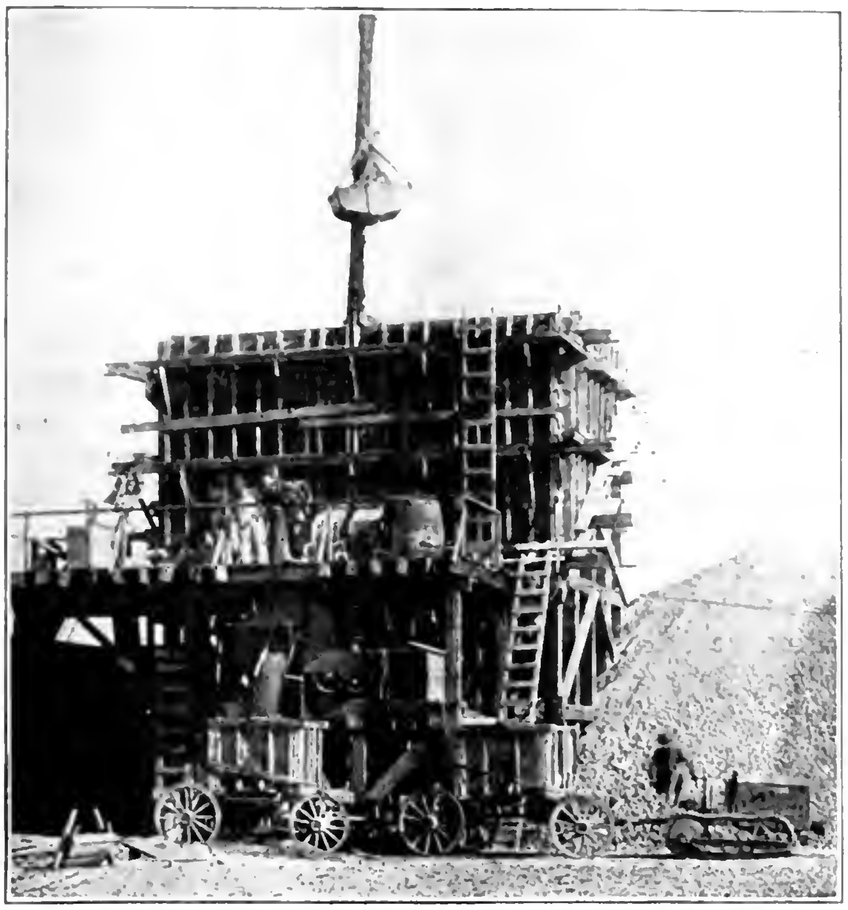
DETAILS OF CART IN WHICH CONCRETE IS CARRIED TO WORK

the same tractors. These carts, a drawing of which is seen above, have interior paddles which agitate the concrete during transportation and keep it in shape for use when delivered. The mixer, which is electrically driven, is upon an elevated platform, the concrete being discharged by gravity into the wagon.

The aggregates are taken from open-top freight cars

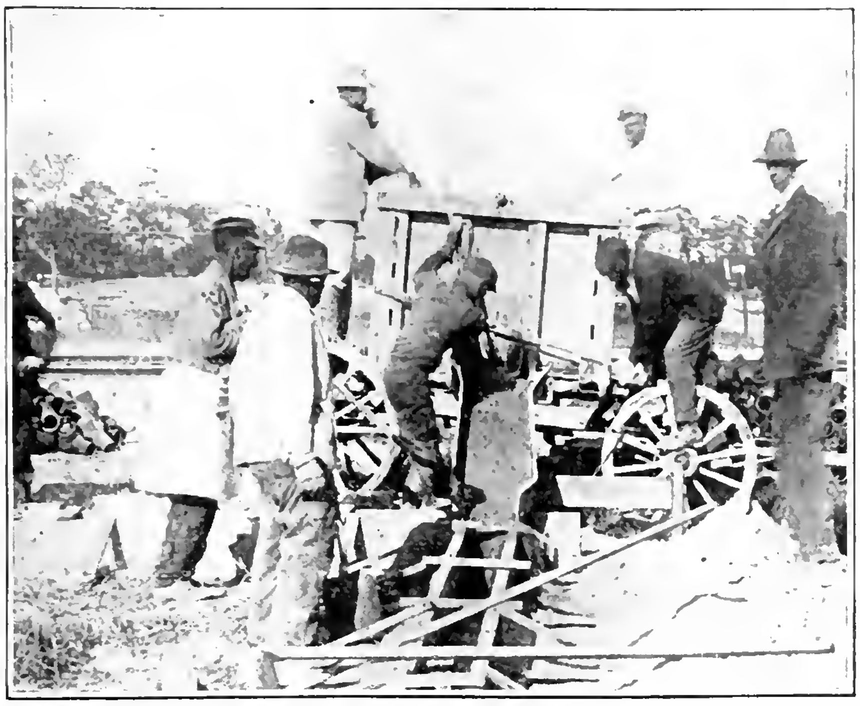


PLOWING FOR A HOUSING DEVELOPMENT WITH A TRACTOR FOR A MULE



TRACTOR-DRAWN CONCRETE CARTS BEING FILLED AT CENTRAL MIXING STATION

in a clamshell bucket operated by a steam derrick, and are deposited in bins above the mixer or in nearby stock-piles. Cement is carried from the adjacent storage room to the mixer platform by an electrically operated endless chain elevator. The loaded concrete wagons are hauled one or two at a time to place by the tractors, and the concrete is deposited through a small chute, shown in one of the views. The concrete is kept stirring during the trip by the agitator, which is operated by



DISCHARGING CONCRETE FROM A WAGON INTO HOUSE FOOTING THROUGH A CHUTE

a lever attached to one of the rear wheels of the wagon. A 1¼-in. round iron shaft across the wagon top is mounted on trunnions near the end. Four iron paddles, ⅜ x 2 in., are attached to the shaft and extend vertically to within about 1 in. of the sloping wagon bottom. The shaft is connected to a collar on the outer end of the hub. As the wagon moves the wheel revolves and operates the lever, which moves the four iron paddles back and forth through the concrete. On the long runs a distance of 1750 ft. was traveled, making a total of 3500 ft. for the round trip, which required 10 minutes. This included time taken for loading and placing the concrete after mixing.

Trenches for sewers and water mains were dug both by hand and machine. The deeper trenches were mostly excavated by hand, because the sides would cave so quickly behind the machine that the sheeting could not be placed and secured. This rapid caving was caused by the vibration of the heavy machine on the soft ground. At depths of from 4 to 7 ft., however, the machine was successfully operated, and a good-sized gang was kept busy laying pipe behind it.

Roadway grading was done with an elevating grader drawn by 16 horses. The excavated material is loaded into bottom dumping wagons and hauled to low places for filling. Only short runs can be made without turning, so conditions were not particularly favorable for this method of grading.

The average day's work is 225 cu.yd. of earth in cuts from 4 to 12 in. in depth, and the cost is about $1 per cubic yard of earth removed.

The Cradock development was in charge of the United States Housing Corporation. George B. Post & Sons, of New York, prepared the general architectural plans

ELEVATING GRADER PULLED BY SIXTEEN HORSES MAKING NEW STREETS

for the project. Hill & Ferguson, of New York, were the supervising engineers until Jan. 1, 1919, when G. C. & A. E. Wheeler, of New York, took over that end of the work. The Hegeman-Harris Co., Inc., of New York, is the general contractor; and William Wooley is works superintendent.

Water Treatment Saves Lives and Money

Reduction in the annual typhoid death rate of 54 per 100,000 at Columbus, Ohio, due to the introduction of a purified water-supply, means a financial saving of $1,188,000 for 2.2 years. This estimate was given by Prof. C. W. Fould, of Ohio State University, in a paper read before the Engineers' Club of Columbus, and was based on Mr. Whipple's estimate of $10,000 loss to a community for each death by typhoid. A total yearly saving per household (five persons) is made up of $3 saving on soap, $17 on plumbing and $15 in doctor's bills, funeral expenses and loss of time. Thus, for each household there is an average annual saving of $35 due to the purifying and softening of the city water.

Engineering Civic Federation

Proposed Organization of Engineering Societies Based Upon Our Political System of Representation

By W. L. Saunders
Past President, American Institute of Mining Engineers

THE engineers' symposium held in the auditorium of the Engineering Societies' Building in New York City, Mar. 26, 1919, brings prominently before us the question whether or not citizens of the United States, engaged in engineering and other scientific pursuits, are willing to organize for the purpose of using the influence of technical men in civic affairs. The speeches and the discussions showed clearly that there is something wrong with the present situation, that a great opportunity now exists for the engineer to render real service to the community.

Dr. Ricketts, in an address to the Engineering Association of the Princeton Club, said: "We vote, but we do not really serve our community, state and county. We have been so absorbed in advancing the industries with which we have been connected that we have failed to exercise our proper influence in behalf of the community. We have established splendid engineering schools where graduates are given superior technical training, but are not inspired by the true spirit of service to the commonwealth."

In order to crystallize this subject into a practical plan, it would seem that the first thing to do is to get together on fundamentals. There is much confusion and some difference of opinion as to whether this movement should be one of coöperation among engineering societies or whether it should take the line of an independent organization of engineers and scientific men, federating citizens of technical thought and training into a broad, nation-wide organization, planned in accordance with American ideals and to meet the conditions that exist in a democratic form of government.

Objects of Associations

Engineering associations, national and local, are usually organized and directed for the purpose of advancing engineering knowledge and for the maintenance of high professional standards. Such organizations are of the greatest value and importance to the profession, but their very nature tends toward concentration upon purely technical lines and to separation from civic and social duties. The highly trained civil engineer naturally considers that he is a better judge of things involving civil engineering than is any other type of engineer. He also considers his judgment superior to that of one of his juniors. If a question is before a legislative body, involving civil engineering, he would not look favorably upon a proposition to consider his vote as only equal to that of other men in the profession. He would naturally, and reasonably, favor submitting the question to a body of civil engineers.

The conclusion from this premise leads to permitting the engineering societies to take separate action in public questions. The unfortunate part of this, however, is that it is neither wise nor effective. It does not conform to the American system of government. Such a system is fundamentally one where the man in the street has an equal vote with the man in the counting house, even on a banking question, and experience has shown over and over again that legislative bodies are not influenced by banking associations when banking questions are before them. This may not be right, but it is a fact. It was shown recently in the case of the Federal Reserve act, which was opposed by the bankers and which is now generally approved.

Let me illustrate this point in another way: Let us suppose a project to be before a county board, a state legislature, or any governing body, involving the construction of either a bridge across or a tunnel under a stream. The civil engineer would perhaps be more interested in a bridge, the mining engineer in a tunnel. The question might appeal to the governing body on lines of general public interest; matters of finance may come in, so that a decision rendered on broad grounds should have its influences reach out to lines of general technical and commercial knowledge.

An association of technical men without special predominance in any branch of engineering is not only likely to do more effective work, but its influence would be broader. There may be but a few civil engineers in

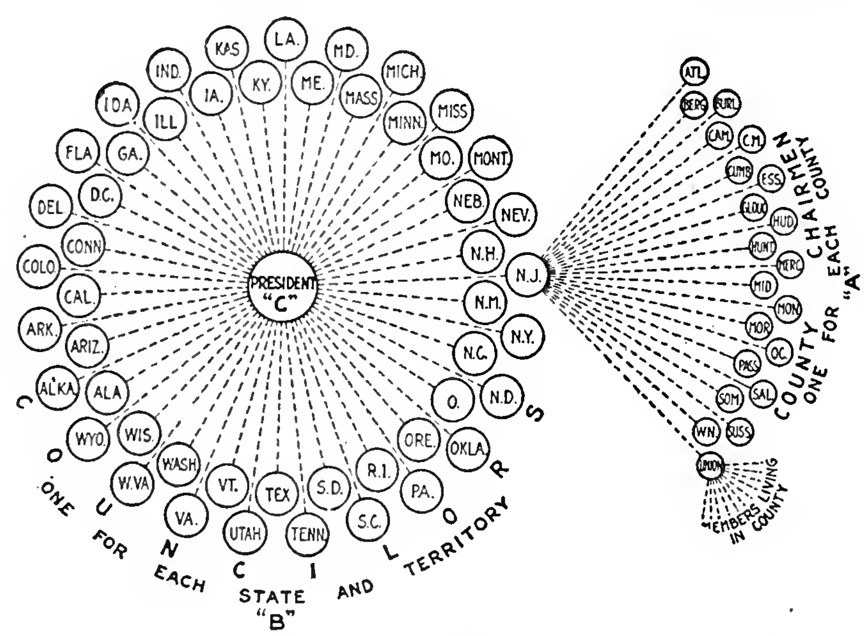


CHART OF PROPOSED SCHEME OF REPRESENTATION

A. *A County Chairman* for each county in each state and territory, elected by the majority vote of members who are legal voters in the county.

B. *A Councilor* for each state and territory, elected by the majority vote of the county chairmen in each state and territory.

C. *A President* elected for two years by the majority vote of the councilors.

A Governing Council to consist of the president and the councilors, who shall conduct all the affairs of the organization and who may vote by letter ballot.

Each county may express through a referendum in the county, the opinion of the county only on any question, but the opinion of the organization can only be expressed through a referendum vote of all the members of the Engineering Civic Federation.

that particular county or state, and this small group, acting in a community, would not be likely to have as much effect upon the governing body as the more widely distributed influence of a large number of engineers who might actually have been reasoned to their position by the superior intelligence of the small body of civil engineers. This would be specially so if the right and strength of the matter were on the side of this small group.

Engineering Societies Not Effective

The first reason why engineering societies are not likely to be effective as such in public matters is that, *their chief function being technical, they are now engaged and should continue to devote their time and energies, from the president down, to the advancement of scientific knowledge, and that if they attempt to divert those energies to public questions they are likely to do less in this fundamental line, which in itself is*

of the greatest importance. Furthermore, a departure from their true province to one which borders on politics will threaten to disrupt the organization.

It is proposed to organize an Engineering Civic Federation on practically the same basis as that on which the Chamber of Commerce of the United States has been established to represent business. Business men have their manufacturers' associations, their bankers' clubs, their trade associations, reaching into many lines of activity. They federate under the national chamber, an organization which is geographically widely distributed, the membership of which comprises all lines of business from the head of a large corporation down to the corner grocer. When this national chamber speaks it is with the voice of business, uninfluenced by personal considerations. It is the popular expression of the American business world. Why not have such an expression from the engineering world? If we make the attempt let us make it on a broad and not a narrow scale. Let us follow American systems.

The proposed Engineering Civic Federation is based in principle upon the national political organizations of the country. All members living in any county of any state elect a county chairman. The several county chairmen in each state by majority vote elect a councilor; the several councilors by majority vote elect a president. There is complete autonomy in each county, in each state and in the nation. Subjects relating to county interest only should be considered by the county members only, questions of state interest by state members only, and national questions by the entire organization. The opinion of the organization on public questions should be expressed only through a referendum.

It is proposed to elect Gen. George W. Goethals president. He is retired from the Army and is now in civic life. Here we have a man of international reputation, a great executive, through whom a membership at $1 or $2 each per annum of from 75,000 to 100,000 technical men might be enlisted for service. The possibilities of such an organization can scarcely be overestimated. Annual meetings might be held in Washington, D. C.; state meetings more frequently in each state, and county members might get together at any time. There should be no jealousy excited among the various engineering and scientific societies by such an organization as this. *It does not encroach upon their province. On the contrary, it draws a clear line of distinction between maintaining high professional standards and federating technical men for public service.*

The engineer has no one but himself to blame because his influence is so much less than that of the lawyer. He has been too modest. He looks upon engineering as too serious a thing, he hides his light beneath a bushel, he is too fond of avoiding the mire of politics, giving too little consideration to the fact that politics enters into every part of our life, and that if there is a mire there it is because the men who are best fitted to clean it up do not go in. We have a part to play—now let us play it. The problems of civilization are daily becoming more and more technical. The United States is the greatest industrial nation of the world. It is the engineer who has built up this industry. The men who have built it up are best fitted to conduct it, for engineering today is the art of organizing and directing men and of unfolding and utilizing the works of nature for the benefit of the human race.

Public Works Department Would Spend Over $125,000,000 Annually

The accompanying table shows the annual disbursements for four years of some of the principal bureaus of the Federal Government which it is proposed to bring together under control of a Federal Department of Public Works. (See *Engineering News-Record* of Apr. 10, 1919, p. 722.) The figures for the expenditures for 1918 are not yet available, but an increase of great importance is the appropriation for

ANNUAL DISBURSEMENTS BY FEDERAL GOVERNMENT BUREAUS CHIEFLY ENGAGED IN ENGINEERING WORK

	1914	1915	1916	1917
Treasury Department				
Public Health Service	$2,264,676	$2,767,820	$2,839,017	$3,045,598
Supervising Architect	15,969,970	19,953,643	16,621,567	17,878,023
War Department				
Public Buildings and Grounds	427,097	404,166	408,801	411,189
Rivers and Harbors	49,921,592	46,833,914	32,450,301	30,487,599
Interior Department				
Geological Survey	1,368,544	1,361,842	1,378,641	1,342,279
Reclamation Service	7,709,350	12,091,685	5,891,614	4,993,732
Bureau of Mines	660,509	710,307	681,681	815,156
Alaskan Engineering Commission	....	2,000,000*	8,647,620*	....
Department of Commerce				
Bureau of Standards	595,469	634,303	790,169	784,693
Bureau of Lighthouses	5,731,075	5,607,966	5,722,146	5,861,511
Coast and Geodetic Survey	999,375	1,095,301	1,178,860	1,229,288
Department of Agriculture				
Bureau of Public Roads	225,282	267,241	442,843	503,325
Weather Bureau	1,548,936	1,348,087	1,324,627	1,406,070
Forest Service	3,201,718	3,580,508	3,286,086	2,913,744
Panama Canal	34,826,941	9,187,042	17,503,728	19,262,793
Totals	125,450,534	125,843,825	99,167,701	90,935,00[illegible]

* Appropriations.

Federal aid to state road construction, expended under direction of the Bureau of Public Roads. The appropriation for the coming year for this purpose is $100,000,000.

If the above rate were to continue, the total expenditures of the proposed Department of Public Works would probably be in the neighborhood of $250,000,000—a greater amount than was disbursed by any department of the Government prior to the war.

Compression Tests Show Effect of Silt

Results of compression tests of portland cement mortars and concrete containing various percentages of silt, made by A. C. Alvarez and J. R. Shields, are published in a bulletin issued by the University of California, Berkeley, Cal.

In discussing the results of the recent tests, the authors offer explanations of the observed fact that in general the strength of all mortars decreased with increase in percentage of silt; but up to 10% of silt this decrease in strength averaged only about 4.5%; the decrease in strength jumped to an average of 15% for the addition of 14% of silt. The strength of 1 : 2 : 4 concrete increased when silt was added; the more so the greater the percentage of silt, 14% increasing the strength about 15%. The leaner the mixture, the greater is the percentage of silt which may be added with beneficial results.

It is concluded from the results of the tests that neither the injury to mortar nor the benefit to concrete due to the presence of 14% of silt is great. Such an amount of silt would be valuable to make mortar or concrete less permeable to water. The word silt refers to very fine, inert particles of durable minerals that have no chemical action on portland cement

How to Design Concrete Mixtures

Proper Proportions Can Be Determined for Different Kinds of Material—New Theories Regarding Aggregate Grading Advanced by D. A. Abrams as Result of Tests

PROPORTIONING concrete on an arbitrary volumetric ratio of the elements is a practice of long standing. Probably 90% of the concrete made today is specified to be a 1:2:4 mix, regardless of the material that makes the concrete. But for some years past a number of experimenters have been studying the make-up of concrete in the hope of discovering some more rational method of proportioning which will take into account the properties of the aggregate and the strength to be desired. Prominent among such investigators is Prof. Duff A. Abrams of the Structural Materials Research Laboratory of the Lewis Institute, Chicago. In the past three years this laboratory has made some 50,000 tests in the study of proper proportioning, as a result of which Professor Abrams has deduced a rational theory which permits the design of a concrete mixture from the particular aggregate available. His theories were advanced in a paper read before the Portland Cement Association in December, 1918, and have now been issued as Bulletin 1 of the Structural Materials Research Laboratory of the Lewis Institute. They are so important, however, that they are given in considerable detail in this article.

Experience has shown that the ordinary volumetric proportioning is far from satisfactory. The Chicago experiments further showed that other methods advanced are subject to serious limitations. They found, for instance, that the maximum strength of concrete does not depend on either an aggregate of maximum density or a concrete of maximum density, and that the methods which have been suggested for proportioning concrete by straight sieve analysis of aggregate are based on an erroneous theory. Furthermore, the tests emphasized what has been the growing impression in the past few years that proper attention has not been given to the water content of a concrete mixture. As noted in Professor Abrams' paper in *Engineering News-Record* of May 2, 1918, p. 873, the tests show that very small variations in water content produce more important variations in the strength and other properties of concrete ~~and~~ that similar changes in other ingredients.

Fundamentally, the main principles of Professor Abrams' theory are as follows: (1) With given concrete materials and conditions of test, the quantity of mixing water used determines the strength of concrete so long as the mix is of a workable plasticity; (2) a measurement of aggregate grading on a sieve, giving rise to a function known as the "fineness modulus" of the aggregate, is of the greatest importance in proportioning a mixture.

As corollaries to these main principles, it is stated that the aggregate grading which produces the strongest concrete is not that giving the maximum density—that is, the lowest voids. A grading coarser than that giving maximum density is necessary for highest concrete strength. The shape of the particle and the quality of the aggregate have less influence on concrete strength than has been hitherto reported. There is an intimate relation between the grading of the aggregate and the quantity of water required to produce a workable concrete.

The effect of water on the mix was shown in the article in *Engineering News-Record* of May 2, 1918. Tests represented by the diagram in Fig. 1 demonstrate that so long as the mix is workable, compressive strength of the concrete is a function of the ratio of the volume of water to the volume of cement in the batch—that is, the formula $S = A/B^x$ is generally applicable, where S is the compressive strength of the concrete, x is the ratio of the volume of water to the volume of cement, and A and B are constants whose values depend on the quality of the cement used, the age of the concrete, curing conditions, etc. For the tests in question this formula becomes $S = 14{,}000/7^x$.

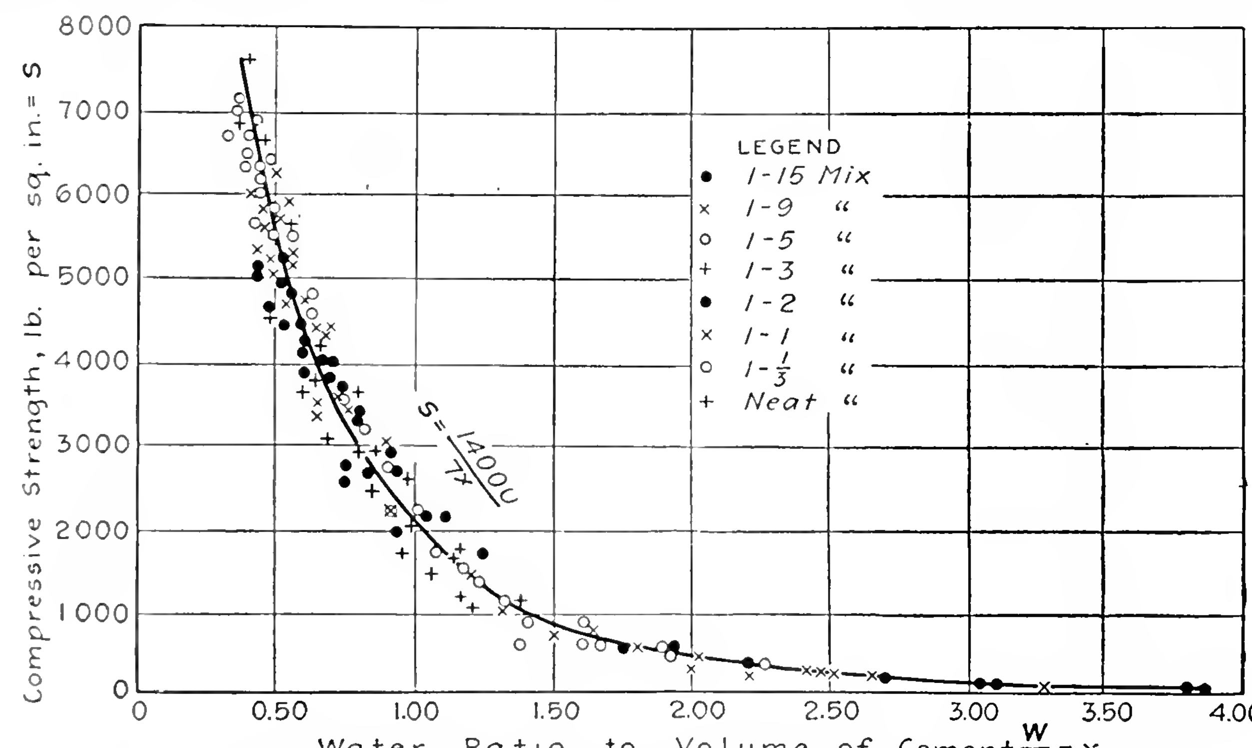


FIG. 1. RELATION BETWEEN CONCRETE STRENGTH AND WATER CONTENT
Twenty-eight-day compression tests on 6 x 12-inch cylinders.

The strength of the concrete responds to changes in water regardless of the reason for these changes. The water ratio may be changed, due to any of the following causes: (1) Change in mix (cement content); (2) change in size or grading of aggregate; (3) change in relative consistency; (4) any combination of 1 to 3. It should not be concluded that the tests indicate that lean mixtures can be substituted for richer ones without limit. The limitation is the necessity of using sufficient water to secure a workable mix. Therefore, according to Professor Abrams, the problem of designing concrete mixes resolves itself into the following: To produce a workable concrete which has a given water ratio, using a minimum quantity of cement, or the converse,

to produce a workable concrete with a minimum water ratio using a given quantity of cement. The method of securing the best grading of aggregate and the use of the driest concrete which is workable are thus seen to be only devices which enable the accomplishment of the above mentioned results.

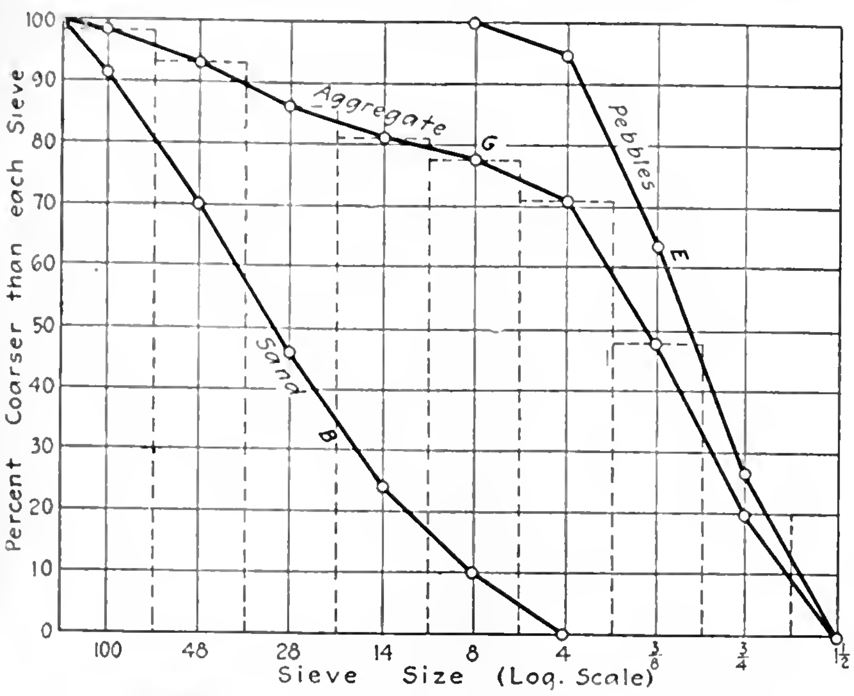


FIG. 2. METHOD OF PLOTTING SIEVE ANALYSIS OF AGGREGATES

Sieve analysis curves for aggregates B, E and G in Table 1.

TABLE I. METHOD OF CALCULATING FINENESS MODULUS OF AGGREGATES

Sieves commonly known as the Tyler standard sieves; each sieve has a clear opening just double that of the preceding one.

The sieve analysis may be expressed in terms of volume or weight.

The fineness modulus of an aggregate is the sum of the percentages given by the sieve analysis, divided by 100.

	Size of Square Opening		Sieve Analysis of Aggregates Per Cent. of Sample Coarser Than a Given Sieve						
			Sand			Pebbles			Concrete
Sieve Size	In.	Mm.	Fine (A)	Medium (B)	Coarse (C)	Fine (D)	Medium (E)	Coarse (F)	Aggregate (G)*
100-mesh.....	0.0058	0.147	82	91	97	100	100	100	98
48-mesh.....	0.0116	0.295	52	70	81	100	100	100	92
28-mesh.....	0.0232	0.59	20	46	63	100	100	100	86
14-mesh.....	0.046	1.17	0	24	44	100	100	100	81
8-mesh.....	0.093	2.36	0	10	25	100	100	100	78
4-mesh.....	0.185	4.70	0	0	0	86	95	100	71
⅜-in.........	0.37	9.4	0	0	0	51	66	86	49
¾-in.........	0.75	18.8	0	0	0	9	25	50	19
1½-in.........	1.5	38.1	0	0	0	0	0	0	0
Fineness Modulus.........			1.54	2.41	3.10	6.46	6.86	7.36	5.74

* Concrete aggregate "G" is made up of 25% of sand "B" mixed with 75% of pebbles "E." Equivalent gradings would be secured by mixing 33% sand "B" with 67% coarse pebbles "F"; 28% "A" with 72% "F," etc. The proportion coarser than a given sieve is made up by the addition of these percentages of the corresponding size of the constituent materials.

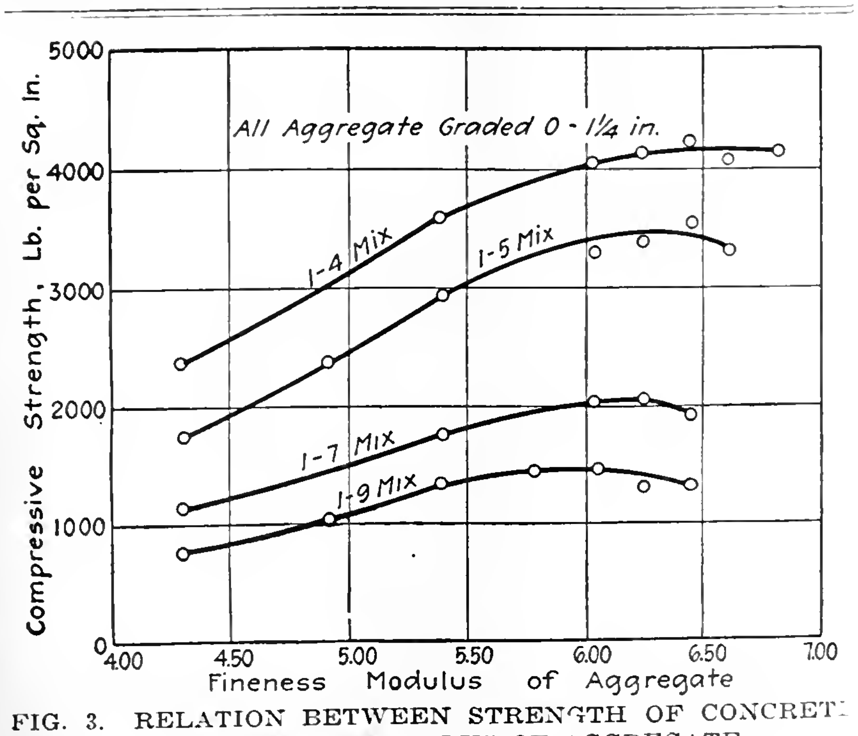


FIG. 3. RELATION BETWEEN STRENGTH OF CONCRETE AND FINENESS MODULUS OF AGGREGATE FOR DIFFERENT MIXES

In further investigation of the aggregate, the function called the "fineness modulus" was set up. In brief, this modulus is the sum of the percentages of the aggregate in a certain type of sieve analysis divided by 100. The sieve analysis is determined by using the following sieves from the Tyler standard series: 100, 48, 28, 14, 8, 4, ⅜-in., ¾-in., and 1½-in. These sieves are made of square-mesh wire cloth. Each sieve has a clear opening just double the width of the preceding one. The exact dimensions of the sieves and the method of determining the fineness modulus are found in Table I. It will be noted that the sieve analysis is expressed in terms of the percentages of the material by volume or weight *coarser* than each sieve. A well graded torpedo sand up to No. 4 sieve will give a fineness modulus of about 3; a coarse aggregate graded 4-1½ in. will give a fineness modulus of about 7; a mixture of the above materials in proper proportions for a 1: 4 mix will have a fineness modulus of about 5.80. A fine sand such as drift sand may have a fineness modulus as low as 1.50.

In explaining the use of the fineness modulus, Professor Abrams continues as follows:

There is an intimate relation between the sieve analysis curve for the aggregate and the fineness modulus; in fact, the fineness modulus permits the proper interpretation of the sieve analysis of an aggregate. If the sieve analysis of an aggregate is platted in the manner indicated in Fig. 2, that is, using the per cent coarser than a given sieve as ordinate, and the sieve size (platted to logarithmic scale) as abscissa, the fineness modulus of the aggregate is measured by the area below the sieve analysis curve. The dotted rectangles for aggregate "G" show how this result is secured. Each elemental rectangle is the fineness modulus of the material of that particular size. The fineness modulus of the graded aggregate is then the summation of these elemental areas. Any other sieve analysis curve which will give the same total area corresponds to the same fineness modulus and will require the same quantity of water to produce a mix of the same plasticity and gives concrete of the same strength, so long as it is not too coarse for the quantity of cement used.

Fineness Modulus Strength Relation for Concrete

Many separate series of tests have shown that for a given plastic condition of concrete and the same mix there is an intimate relation between the fineness modulus of the aggregate and the strength and other properties of the concrete. We have seen that the reason for this result is found in the fact that the fineness modulus simply reflects the changes in water-ratio necessary to produce a given plastic condition.

Figs. 3 and 4 give the results of certain compression tests which bring out the relation between the strength of the concrete and the fineness modulus of the aggregate. It

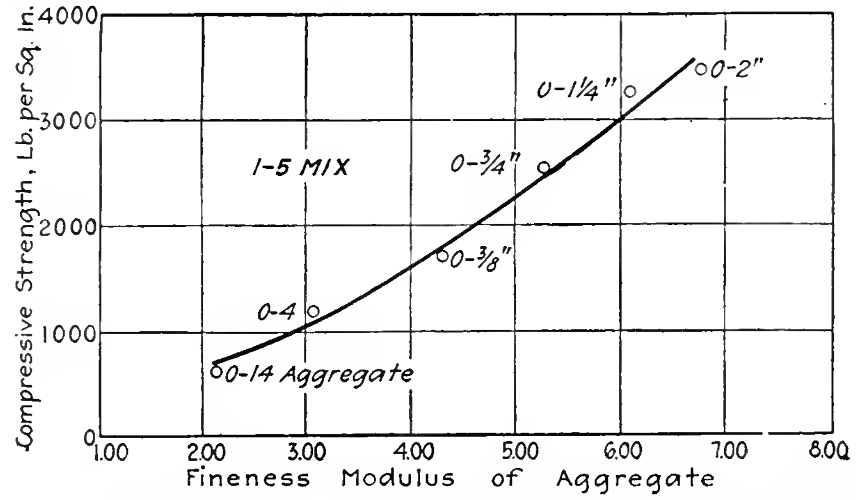


FIG. 4. RELATION BETWEEN STRENGTH OF CONCRETE AND FINENESS MODULUS FOR DIFFERENT SIZES

will be noted from Fig. 3 that a separate curve may be drawn for each mix. In each case there is a steady increase in the compressive strength of the concrete as the fineness modulus of the aggregate increases, until a certain value is reached which corresponds to a maximum point. It will be noted also that this maximum point corresponds to higher and higher values of fineness modulus as the quantity of cement in the mix is increased. In other words, the maximum strength comes at a fineness modulus of about 5.80 for the 1 : 9 mix and about 6.40 for the 1 : 4 mix. In these tests the different values of the fineness modulus were secured by using a preponderance of the coarser sizes, but in all cases maintaining the same limiting size, that is, 1¼ inches.

In Fig. 4 is found a similar relation between the strength and the fineness modulus, except that no maximum point is found. This condition arises from the fact that the maximum size of the aggregate is increasing without changing the type of the sieve analysis curve, consequently the fineness modulus strength curve continues to rise indefinitely. The height to which the curve rises is limited only by the maximum size of aggregate which may be used. It is important to note that there is no conflict between the indications of Figs. 3 and 4.

A given value for the fineness modulus of an aggregate can be secured with any combination of percentages in the sieve analysis which gives the same total; consequently, an infinite variety of gradings may be found which give aggregate of the same concrete strength. Table II gives the

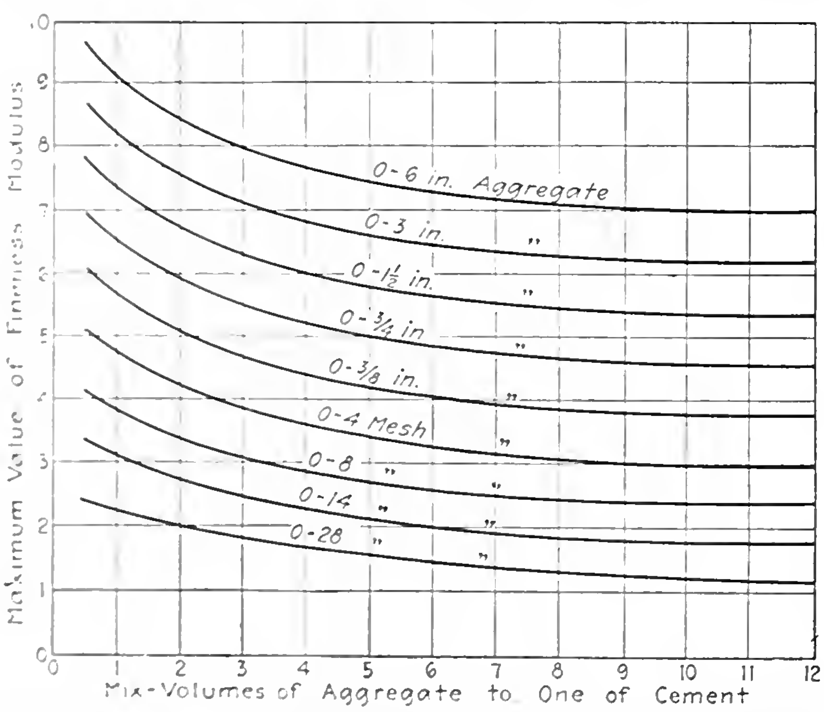


FIG. 5. MAXIMUM PERMISSIBLE VALUES OF FINENESS MODULUS OF AGGREGATE

Graphical representation of Table III. Based on sand and pebble aggregate.

TABLE II. EFFECT OF GRADING OF AGGREGATES ON THE STRENGTH OF CONCRETE

Compression tests of 6 by 12-in. concrete cylinders. Mix 1:5 by volume; age at test, 28 days; stored in damp sand; tested damp.
Aggregates—sand and pebbles from Elgin, Ill. Aggregates were screened to different sizes and recombined to conform to predetermined sieve analyses.
Same quantity of water was used in all specimens of a given consistency. The 110% consistency contains 10% more water than the 100%
Each value in the strength tests the average from 5 tests made on different days

Ref. No.	Sieve Analysis of Aggregate Per Cent. Coarser than Each Sieve: 100	48	28	14	8	4	⅜	¾	1¼	1½	2	Fineness Modulus of Aggregate	Surface Area of Aggregate Sq.In.: Per Lb. of Aggregate	Per G. of Cement	Compressive Strength of Concrete at 28 Days (Lb. per Sq.In.): 100% Consistency	110% Consistency
40	99	98	95	90	81	68	49	24	0	..	..	6.04	602	8.8	3,300	2,890
259	99	98	96	92	84	67	46	22	0	..	..	6.04	569	8.2	2,950	2,650
260	98	97	93	88	80	67	52	29	0	..	..	6.04	764	11.4	3,120	2,760
261	97	94	91	85	77	67	58	35	0	..	..	6.04	999	15.2	3,140	2,790
262	95	92	87	82	75	67	67	39	0	..	..	6.04	1,292	20.1	3,100	2,800
263	95	90	84	78	73	67	62	55	0	..	..	6.04	1,451	23.0	2,830	2,740
264	95	89	82	75	67	67	67	62	0	..	..	6.04	1,565	25.2	2,680	2,580
265	100	97	91	79	72	67	58	40	0	..	..	6.04	761	11.9	3,070	2,690
266	100	97	93	88	83	67	50	27	7	0	..	6.04	616	9.0	3,080	2,790
267	99	97	94	86	77	67	47	27	16	..	0	6.04	709	10.5	3,150	2,710
268	98	95	90	83	83	83	50	22	0	..	..	6.04	834	12.6	3,080	2,500
269	98	94	90	86	83	80	55	18	0	..	..	6.04	898	13.3	3,050	2,550
270	96	90	80	80	80	80	60	39	0	..	..	6.04	1,391	21.5	2,970	2,550
271	100	96	92	87	81	75	50	23	0	..	..	6.04	672	10.0	2,930	2,710
272	95	91	87	82	77	73	59	40	0	..	..	6.04	1,315	20.2	3,000	2,580
273	99	95	88	80	76	73	61	32	0	..	..	6.04	911	13.9	2,950	2,740
274	90	85	81	78	75	73	66	56	0	..	..	6.04	1,992	31.3	2,680	2,440
275	100	93	82	73	73	73	63	47	0	..	..	6.04	1,076	16.7	2,820	2,620
276	100	100	100	92	81	60	45	26	0	..	..	6.04	390	5.6	3,040	2,780
277	100	98	95	90	80	60	50	31	0	..	..	6.04	557	8.3	2,900	2,770
278	100	99	96	92	84	55	50	28	0	..	..	6.04	483	7.0	2,940	2,750
279	100	99	96	91	80	50	50	38	0	..	..	6.04	514	7.6	3,080	2,750
280	98	84	84	84	84	57	57	57	0	..	..	6.04	1,276	19.7	3,000	2,780
281	99	98	91	86	80	76	38	38	0	..	..	6.04	701	10.4	2,940	2,700
282	99	98	91	86	80	76	46	30	0	..	..	6.04	697	10.2	3,020	2,660
283	99	98	91	86	80	76	61	15	0	..	..	6.04	689	10.1	2,930	2,670
284	99	98	91	85	80	76	67	8	0	..	..	6.04	685	9.9	2,970	2,630
Average												6.04	904	13.8	2,990	2,690
Minimum value												....	390	5.6	2,680	2,440
Maximum value												....	1,992	31.3	3,300	2,890
Mean variation from average—per cent												....	34.4	37.2	3.41	3.04

results of groups of tests which bring out the wide variation which may be made in the grading of aggregate without producing any essential variation in the concrete strength. Twenty-seven different gradings of the same aggregate were made up. These gradings covered the widest possible range, but they had one property in common; that is, a fineness modulus of 6.04. All specimens were mixed with the same quantity of cement and water. Separate sets of specimens were made of two different consistencies.

Table II also furnishes some interesting data on the surface-area method of proportioning aggregates. It is seen that there is the widest variation in the surface area of the aggregate without any appreciable difference in the concrete strength. Our studies have shown that surface area is not a satisfactory basis for proportioning aggregates.

On the basis of the water ratio theory and of the

TABLE III MAXIMUM PERMISSIBLE VALUES OF FINENESS MODULUS OF AGGREGATES

Mix Cem.-Agg.	Size of Aggregate: 0-28	0-14	0-8	0-4	0-3*	0-⅜	0-½*	0-¾	0-1 in.*	0-1½	0-2½*	0-3 in.	0-4½*	0-6 in.
1-12	1.20	1.80	2.40	2.95	3.35	3.80	4.20	4.60	5.00	5.35	5.75	6.20	6.60	7.00
1-9	1.30	1.85	2.45	3.05	3.45	3.85	4.25	4.65	5.00	5.40	5.80	6.25	6.65	7.05
1-7	1.40	1.95	2.55	3.20	3.55	3.95	4.35	4.75	5.15	5.55	5.95	6.40	6.80	7.20
1-6	1.50	2.05	2.65	3.30	3.65	4.05	4.45	4.85	5.25	5.65	6.05	6.50	6.90	7.30
1-5	1.60	2.15	2.75	3.45	3.80	4.20	4.60	5.00	5.40	5.80	6.20	6.60	7.00	7.45
1-4	1.70	2.30	2.90	3.60	4.00	4.40	4.80	5.20	5.60	6.00	6.40	6.85	7.25	7.65
1-3	1.85	2.50	3.10	3.90	4.30	4.70	5.10	5.50	5.90	6.30	6.70	7.15	7.55	8.00
1-2	2.00	2.70	3.40	4.20	4.60	5.05	5.45	5.90	6.30	6.70	7.10	7.55	7.95	8.40
1-1	2.25	3.00	3.80	4.75	5.25	5.60	6.05	6.50	6.90	7.35	7.75	8.20	8.65	9.10

* Considered as "half-size" sieves, not used in computing fineness modulus.

For mixes other than those given in the table, use the values for the next leaner mix.

For maximum sizes of aggregate other than those given in the table, use the values for the next smaller size.

Fine aggregate includes all material finer than No. 4 sieve; coarse aggregate includes all material coarser than the No. 4 sieve. Mortar is a mixture of cement, water and fine aggregate.

This table is based on the requirements for sand-and-pebble or gravel aggregate composed of approximately spherical particles, in ordinary uses of concrete in reinforced-concrete structures. For other materials and in other classes of work the maximum permissible values of fineness modulus for an aggregate of a given size is subject to the following corrections:

(1) If crushed stone or slag is used as coarse aggregate, reduce values in table by 0.25. For crushed material consisting of unusually flat or elongated particles reduce values by 0.40.

(2) For pebbles consisting of flat particles, reduce values by 0.25.

(3) If stone screenings are used as fine aggregate, reduce values by 0.25.

(4) For the top course in concrete roads, reduce the values by 0.25. If finishing is done by mechanical means, this reduction need not be made.

(5) In work of massive proportions, such that the smallest dimension is larger than 10 times the maximum size of the coarse aggregate, additions may be made to the values in the table as follows: for ¾-in. aggregate 0.10; for 1½-in. 0.20; for 3-in. 0.30; for 6-in. 0.40.

Sand with fineness modulus lower than 1.50 is undesirable as a fine aggregate in ordinary concrete mixes. Natural sands of such fineness are seldom found.

Sand or screenings used for fine aggregate in concrete must not have a higher fineness modulus than that permitted for mortars of the same mix.

Crushed stone mixed with both fine sand and coarser pebbles requires no reduction in fineness modulus provided the quantity of crushed stone is less than 30% of the total volume of the aggregate.

TABLE IV. EXAMPLE OF INFLUENCE OF QUANTITY OF MIXING WATER ON THE STRENGTH OF CONCRETE

Water in a 1-Bag Batch: Gallons	Water in a 1-Bag Batch: Water-Ratio (x)	Relative Consistency Per Cent.	Compressive Strength of Concrete at 28 Days: Lb. per Sq In. (S)	Compressive Strength of Concrete at 28 Days: Relative Strength Per Cent.
5.75	0 77	100	2,770	100
6 0	0 80	104	2,600	94
6.25	0 84	109	2,400	87
6.5	0 87	113	2,250	81
7 0	0 94	122	1,950	70
7.5	1 01	131	1,670	60
8.0	1 07	139	1,470	53
9.0	1 21	157	1,100	40
10.0	1.34	174	830	30
12.0	1 60	208	480	17
15.0	2.00	260	200	7

Values calculated from equation

$$S = \frac{A}{B^x} = \frac{14{,}000}{8.2^x}$$

Where S = compressive strength of concrete (lb. per square inch); x = water ratio (an exponent)

A and B are constants whose values depend on quantity of cement and other conditions of the test. The values given for A and B are based on 28-day tests of 1:4 mix, pebble aggregate graded 0-1¼-in., fineness modulus 5.75.

The water-ratio is equivalent to the cubic feet of water to 1 sack (1 cu. ft) of cement.

The strength values are solely for comparative purposes in showing the influence of changing the water content.

fineness modulus, as noted above, Professor Abrams' method of proportioning is then outlined as follows:

1. Knowing the compressive strength required of the concrete, determine by reference to Fig. 1 the maximum water-ratio which may be used. In general, some allowance must be made for the high strengths in laboratory tests. In other words, a water-ratio somewhat lower than that given for the required strength in Fig. 1 should be used. For convenience in the subsequent steps we shall deal with concrete strength instead of water-ratio (as in Fig. 6), although it should be understood that it is the water-ratio which fixes the strength so long as we have a plastic mix.

2. Make sieve analysis of fine and coarse aggregate, using Tyler standard sieves. Express sieve analysis in terms of percentages of material by weight (or separate volumes) *coarser than* each of the standard sieves.

3. Compute fineness modulus of each aggregate by adding the percentages found in (2), and dividing by 100.

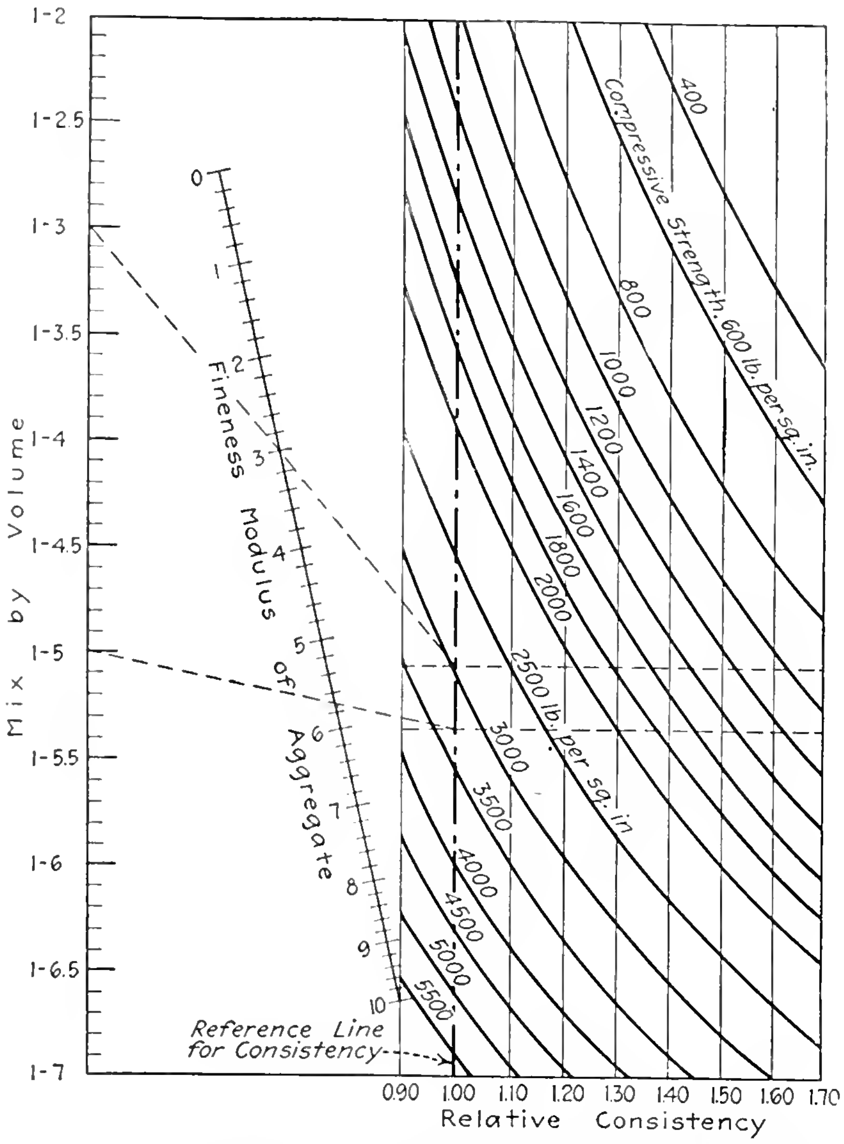


FIG. 6. DIAGRAM FOR DESIGN OF CONCRETE MIXTURES

Chart is based on compression tests of 6 x 12-inch cylinders at 28 days. Cement used gave strengths in 1:3 standard sand mortar, as follows:

Age	Lb. per Square Inch
7 days	1900
28 days	3200
3 mo.	4200
1 year	4300

TABLE V. QUANTITY OF MIXING WATER REQUIRED FOR CONCRETE

Mix Cem.-Agg. by Volume	Gallons of Water per Sack of Cement Using Aggregates of Different Fineness Moduli: 1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00
	Relative Consistency — (R) = 1.00											
1-12	23.5	21.4	19.5	17.8	16.4	15.2	13.9	12.9	12.0	11.1	10.4	9.8
1-9	18.1	16.7	15.2	14.0	12.9	12.0	11.0	10.2	9.6	9.0	8.4	7.9
1-7	14.7	13.5	12.3	11.4	10.6	9.9	9.1	8.6	8.0	7.6	7.2	6.7
1-6	13.0	12.0	11.0	10.2	9.5	8.9	8.3	7.7	7.3	6.8	6.5	6.2
1-5	11.2	10.4	9.5	8.9	8.3	7.8	7.3	6.9	6.4	6.1	5.8	5.5
1-4	9.5	8.9	8.2	7.7	7.2	6.8	6.3	6.0	5.7	5.4	5.2	5.0
1-3	7.8	7.2	6.7	6.3	6.0	5.7	5.4	5.1	4.9	4.6	4.5	4.3
1-2	6.0	5.7	5.4	5.1	4.9	4.7	4.5	4.3	4.1	4.0	3.9	3.8
1-1	4.3	4.1	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.2	3.1
	Relative Consistency — (R) = 1.10											
1-12	25.8	23.6	21.4	19.6	18.1	16.7	15.3	14.2	13.2	12.2	11.4	10.8
1-9	19.9	18.4	16.7	15.4	14.2	13.2	12.1	11.2	10.6	9.9	9.2	8.7
1-7	16.2	14.9	13.5	12.5	11.7	10.9	10.0	9.5	8.8	8.4	7.9	7.4
1-6	14.3	13.2	12.1	11.2	10.5	9.8	9.1	8.5	8.0	7.5	7.2	6.8
1-5	12.3	11.4	10.5	9.8	9.1	8.6	8.0	7.6	7.0	6.7	6.4	6.1
1-4	10.5	9.8	9.0	8.5	7.9	7.5	6.9	6.6	6.3	5.9	5.7	5.5
1-3	8.6	7.9	7.4	6.9	6.6	6.3	5.9	5.6	5.4	5.1	5.0	4.7
1-2	6.6	6.3	5.9	5.6	5.4	5.2	5.0	4.7	4.5	4.4	4.3	4.2
1-1	4.7	4.5	4.3	4.2	4.1	4.0	3.9	3.7	3.6	3.5	3.5	3.4
	Relative Consistency — (R) = 1.25											
1-12	29.4	26.8	24.4	22.2	20.5	19.0	17.4	16.1	15.0	13.9	13.0	12.3
1-9	22.6	20.9	19.0	17.5	16.1	15.0	13.8	12.7	12.0	11.2	10.5	9.9
1-7	18.4	16.9	15.4	14.3	13.2	12.4	11.4	10.7	10.0	9.5	9.0	8.4
1-6	16.3	15.0	13.8	12.8	11.9	11.1	10.4	9.6	9.1	8.5	8.1	7.7
1-5	14.0	13.0	11.9	11.1	10.4	9.8	9.1	8.6	8.0	7.6	7.2	6.9
1-4	11.9	11.1	10.2	9.6	9.0	8.5	7.9	7.5	7.1	6.8	6.5	6.2
1-3	9.8	9.0	8.4	7.9	7.5	7.1	6.8	6.4	6.1	5.8	5.6	5.4
1-2	7.5	7.1	6.8	6.4	6.1	5.9	5.6	5.4	5.1	5.0	4.9	4.8
1-1	5.4	5.1	4.9	4.8	4.6	4.5	4.4	4.3	4.1	4.0	4.0	3.9

Calculated by Formula 4 in text.

In this table ($a - c$) is assumed as 0.02. This value may be used for ordinary limestones and pebbles. For crushed trap and granite it is somewhat high. It is too high in any case where the aggregate is saturated with water.

A relative consistency of 1.00 (normal consistency) requires the use of such a quantity of mixing water as will cause a slump of ½ to 1 in. in a freshly molded 6 by 12-in. cylinder of about 1:4 mix upon withdrawing the form by a steady, upward pull. This consistency is somewhat dry for most concrete work, but can be used where light tamping is practicable.

A relative consistency of 1.10 (10% more water than required for normal consistency) represents about the driest concrete which can be satisfactorily used in concrete road construction. Under the conditions mentioned above, this consistency will give a slump of about 5 to 6 inches.

A relative consistency of 1.25 represents about the wettest consistency which should be used in reinforced concrete building construction. Under the conditions mentioned above, this consistency will give a slump of about 8 to 9 inches.

For mixes and fineness moduli, other than those given in the table, approximate values may be determined by interpolation. For specific cases use the formula.

4. Determine the "maximum size" of aggregate by applying the following rules: If more than 20% of aggregate is coarser than any sieve the maximum size shall be taken as the next larger sieve in the standard set; if between 11 and 20% is coarser than any sieve, the maximum size shall be the next larger "half-sieve"; if less than 10% is coarser than certain sieves, the smallest of these sieve sizes shall be considered the maximum size.

5. From Table III determine the maximum value of fineness modulus which may be used for the mix, kind and size of aggregate, and the work under consideration. (The values in Table III are platted in Fig. 5.)

6. Compute the percentages of fine and coarse aggregates required to produce the fineness modulus desired for the final aggregate mixture by applying the formula:

$$p = 100\,\frac{A - C}{A - B} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where p = percentage of fine aggregate in total mixture.
A = fineness modulus of coarse aggregate.
B = fineness modulus of final aggregate mixture.
C = fineness modulus of fine aggregate.

Fig. 7 may be used for solving Eq. (3), and for making comparisons of the effect of certain changes in proportions

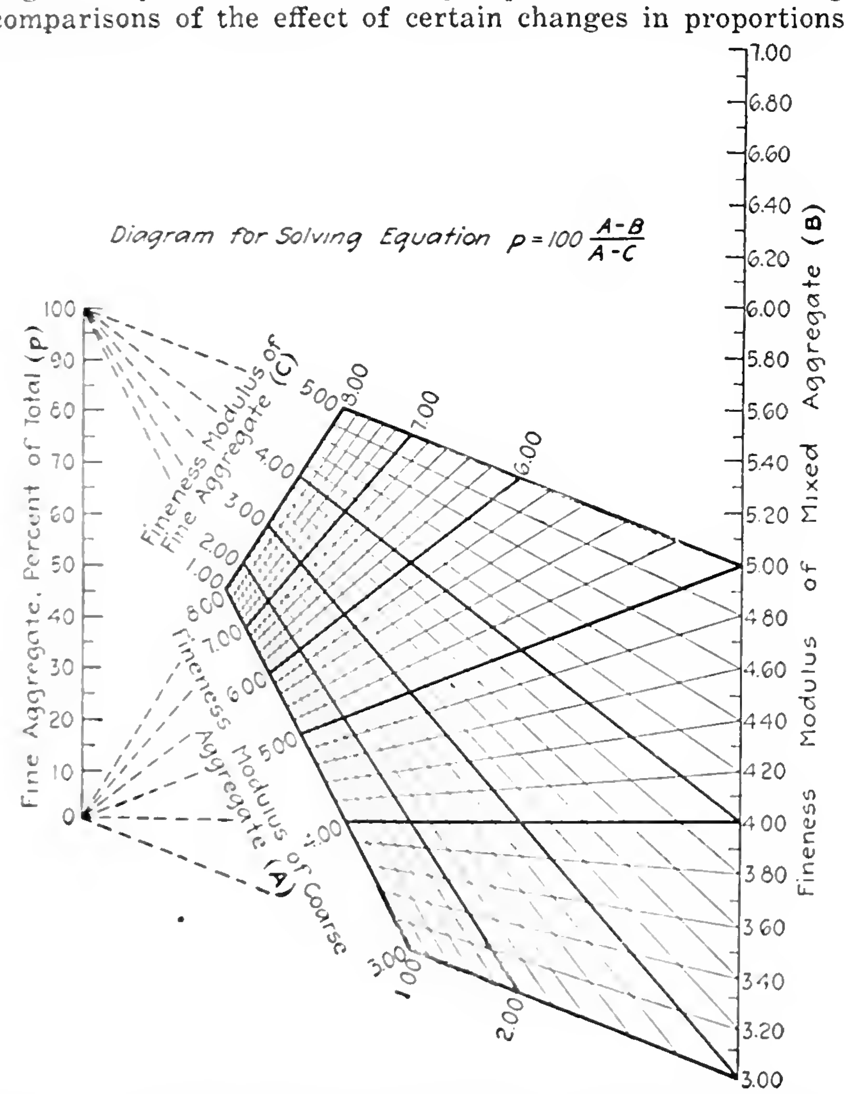


FIG. 7. DIAGRAM FOR DETERMINING QUANTITY OF SAND REQUIRED IN CONCRETE MIXES

of fine and coarse aggregates. The distinction between fine and coarse aggregate is solely for convenience in securing a uniform grading; the division may be made at any desired point.

7. With the estimated mix, fineness modulus and consistency enter Fig. 6 and determine the strength of concrete produced by the combination. If the strength shown by the diagram is not that required, the necessary readjustment may be made by changing the mix, consistency or size and grading of the aggregates.

The quantity of water required can be determined from Eq. (4) below, or approximately from Table V.

It must be understood that the values in Fig. 6 were determined from compression tests of 6 x 12-in. cylinders stored for 28 days in a damp place. The values obtained on the work will depend on such factors as the consistency of the concrete, quality of the cement, methods of mixing, handling, placing the concrete, etc., and on age and curing conditions. Strength values higher than given for relative consistency of 1.10 should seldom be considered in designing, since it is only in exceptional cases that a consistency drier than this can be satisfactorily placed. For wetter concrete much lower strengths must be considered.

Because of the important influence of the quantity of water in the concrete it is desirable to have a sound basis for proportioning the water. The quantity of water necessary for given proportions and conditions may be determined by the following formula:

$$x = R\left[\frac{3}{2}p + \left(\frac{.30}{1.26^{m}} + a - c\right)n\right] \ldots\ldots\ldots (4)$$

where

x = water required—ratio to volume of cement in batch (water-ratio).

R = Relative consistency of concrete, or "workability factor." Normal consistency (relative consistency = 1.00) requires the use of such a quantity of mixing water as will cause a slump of ½ to 1 in. in a freshly molded 6 x 12-in. cylinder of about 1:4 mix upon withdrawing the form by a steady, upward pull. A relative consistency of 1.10 requires the use of 10% more water and under the above conditions will give a slump of about 5 to 6 inches.

p = Normal consistency of cement, ratio by weight.

m = Fineness modulus of aggregate (an exponent).

n = Volumes of mixed aggregate to one of cement.

a = Absorption of aggregate, ratio of water absorbed to volume of aggregate. (Determined after immersion in water for three hours. Average values for crushed limestone and pebbles may be assumed as 0.02; porous sandstones may reach 0.08; very light and porous aggregate may reach 0.25.)

c = Moisture contained in aggregate, ratio of water contained to volume of aggregate. (Assume as zero for room-dry aggregate.)

This formula takes account of all the factors which affect the quantity of water required in a concrete mixture. These factors may be classified as follows:

1. "Workability" factor, or the relative consistency of the concrete. This is dictated by the kind of work being done; concrete must be more plastic (which generally means a wetter consistency) in reinforced-concrete building construction than is necessary in mass work. The term (R) in the equation takes care of this factor. (R) may vary from, say, 0.90 for a dry concrete to 2.00 or higher for very wet mixes.

2. Cement factor, which is made up of two parts: the *quality* of cement so far as normal consistency is concerned (p); the *quantity* of cement in the mix (n).

3. The aggregate factor. This includes the three terms within the parenthesis in Eq. (4). The first term, involving (m), takes account of the size and grading; the second (a) the absorption, and the third (c) the water contained in the aggregate.

While Eq. (4) represents the true water relation, it is somewhat complicated by the fact that the fineness modulus (m) appears as an exponent. The equation can be expressed in a simpler form as follows:

$$x = R\left[\frac{3}{2}p + \left(0.22 - \frac{m}{42} + a - c\right)n\right] \ldots\ldots (5)$$

This equation gives values for ordinary ranges of mix and grading of aggregate which are sensibly the same as given by Eq. (4).

Since a maximum practicable value of fineness modulus is found for each size of aggregate and mix, it is necessary to place certain limits on the value which may be used for proportioning materials for concrete mixes. Table III gives limits which will be found practicable. Subsequent experience may dictate certain modifications in the details.

The purpose of Table III is to avoid the attempt to secure an aggregate grading which is too coarse for its maximum size and for the amount of cement used. It is also useful in prohibiting attempts to use sands which are too coarse for best results in concrete mixtures. For instance, it would be found from this table that the use of a sand of

the nature of standard Ottawa sand is not permitted except in mixes 1:2 or richer.

The curves in Fig. 5 are platted directly from the values given for the standard sieves in Table III.

Fig. 6 is a nomographic chart for the design of concrete mixes. This chart takes account of the following four factors: (1) The mix (cement content); (2) the relative consistency; (3) the grading of aggregate (fineness modulus); (4) the compressive strength of concrete.

Given any three of these factors, the chart enables us to solve for the fourth. This chart is, of course, based on the results of certain tests. For practical application these values must generally be reduced by certain factors, which will depend on the judgment of the designer. In order to furnish some basis for comparison, compression tests of 1:3 standard sand mortars from the cement used in these tests are given.

Suppose we consider the case of concrete for road construction. This is generally specified as a 1:1½:3 or a 1:2:3 mix, with aggregate graded up to 1½ in. These mixes are about the same as what have been termed a 1:4 mix, the exact equivalent depending on the particular size and grading of the fine and coarse aggregate. Assume that gravel aggregate will be used, graded to 1½ in. Table III shows that we may use a fineness modulus as high as 6.00 — .25 = 5.75. Knowing the sieve analysis and fineness modulus of both sizes of aggregate, apply the formula or Fig. 7 to determine the proportions of each aggregate which must be mixed to secure this value. Assume that the concrete will be mixed to a relative consistency of 1.10, which is of such plasticity as will give a slump of 5 to 6 in. in the test described above. Place a straightedge in Fig. 6 on mix 1:4 and fineness modulus 5.75, and mark the point where it crosses the reference line for consistency; from this point project the line horizontally (as indicated in other examples) to relative consistency 1.10. It will be seen that this gives a compressive strength of 3,400 lb. per square inch at 28 days.

The effect of using other mixes, gradings or consistencies on the strength can be seen at once from the diagram. For instance, if the water were increased to a relative consistency of 1.25 (not nearly so wet as is frequently seen in road work) the strength will be reduced to 2,700 lb. per square inch—a reduction of over 20%. If the mix were changed to 1:4½ and other factors the same as in the first example, the strength would be 3200 lb. per square inch. We should have to change the mix to as lean as 1:5¼ in order to secure the same reduction in strength as was found above for a change from 1.10 to 1.25 consistency.

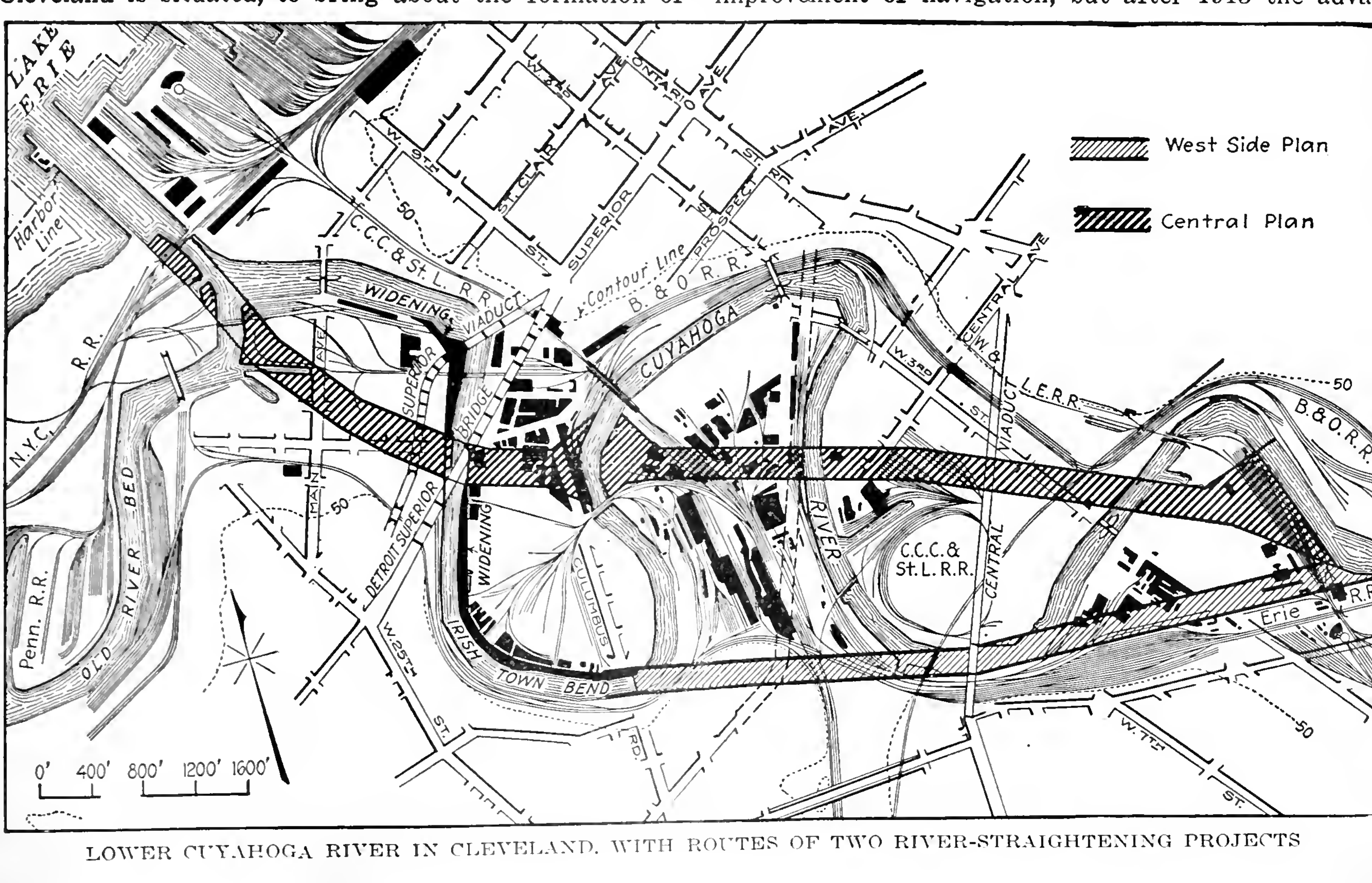
By using the wetter of the two consistencies we secure concrete of the same strength as if we had used one-third less cement and the drier mix. In other words, increasing the mixing water 13% causes the same reduction in strength as if we should omit 33% of the cement. This example shows the reason for emphasizing the importance of proper control of mixing water in concrete.

Eq. (4) and (5) show the elements which make up the water-requirements of a concrete mix. Table V gives the quantity of water required for certain mixes and values of fineness modulus. Quantities are given in terms of gallons per sack of cement. In this table the net absorption (that is, the quantity of water taken up by the aggregate in addition to that already contained) is assumed as 0.02 (2% by volume).

New River-Straightening Movement at Cleveland

Conservancy District Proposed — Choice Between Central and West Channels Affected by Union Station Scheme

STEPS have been taken by the county commissioners of Cuyahoga County, Ohio, in which the City of Cleveland is situated, to bring about the formation of a conservancy district under the Ohio conservancy law, in order to carry out the work of straightening the Cuyahoga River. A court hearing on the commissioners' petition that such a district be formed will be held Apr. 18. In 1913 the river flooded the valley bottom land sufficiently to do damage estimated variously up to $3,000,000. Numerous plans for straightening the river had been proposed before that time and others were developed subsequently, the object being improvement of navigation, but after 1913 the advan-



LOWER CUYAHOGA RIVER IN CLEVELAND, WITH ROUTES OF TWO RIVER-STRAIGHTENING PROJECTS

tage of straightening with a view to reduction of floods by increasing the channel capacity was also taken into account. As indicated on the sketch map herewith, the sharp bends of the river windings form a serious obstacle to navigation, their effect being made more serious by various low-level bridges, and at the same time they reduce the flow capacity.

A new factor was injected into the case two years ago by the vote of the people of the county appropriating money for a viaduct connecting Lorain Ave. on the west side with Huron Road on the east. As the referendum vote has been interpreted, a practically straight alignment of the viaduct between the ends of the two streets must be maintained, and this involves an unfavorable relation to the river. Doubt as to whether the construction of the bridge on this location is advisable while the river remains in its present condition led to delay in preparation of plans and initiation of work on the structure, and ultimately brought about the petition to the county court for the formation of a conservancy district.

Of the straightening projects now considered favorably, the two principal ones are those indicated on the map. The central one was worked out in 1916 and 1917 by a committee composed of E. B. Thomas, consulting engineer, W. A. Stinchcomb, county engineer, Robert Hoffmann, city engineer, and Maj. P. S. Bond, United States Engineer Officer. It is perhaps the most radical of the projects devised. Since it was prepared with the coöperation of a representative of the Engineer Corps, it has commonly been called the Federal plan.

A considerable amount of local sentiment, however, favors the west side plan, also shown on the map. This is composed of two sections, the northerly part being locally known as Plan No. 2, which is favored by the City Planning Commission, while the southerly extension is called the Mahoning Ave. cut. North of the Plan No. 2 channel a certain amount of river widening would be done to make the channel more easily navigable at the bends and to increase its flow capacity.

Believe One or Other of Plans Proposed Will Be Adopted

If a conservancy district is organized its studies would necessarily be general and not be limited to the two here shown. Cleveland engineers familiar with the river problem are, however, of the opinion that one or the other of the plans shown will almost necessarily be selected. The cost of the two projects was estimated something over two years ago at about $7,000,000 for the central channel and a trifle less than $5,000,000 for the west side channel as shown.

Until the formulation of the new union station project last autumn, which involves removal and relocation of many of the railway tracks and yards in the Cuyahoga valley, a serious obstacle to the realization of the west side channel scheme was the existence of important yards on or adjacent to the location of the channel. It is believed that with the removal of these yards through their replacement by yards in other parts of the city, in connection with the union station project (now planned to combine all roads in a passenger station on the public square and to rearrange freight facilities), the chief objections to the west side channel are removed, and its advantages in affecting a minimum of industrial property are held to be an important argument in its favor.

Operation Cost, Municipal Asphalt Plant of the District of Columbia

ITEMIZED costs for the operation of the District of Columbia municipal asphalt plant are contained in a report by the engineer department for the year which ended June 30, 1918. The plant output for the year was 185,952 cu.ft. of material, consisting of 151,152 cu.ft. of old-material mixture, 22,056 cu.ft. of asphaltic concrete mixture, and 12,744 cu.ft. of topping mixture. The plant was operated for 214 days with an average daily output of 869 cubic feet.

Hauling by motor truck was introduced during the year for hauling the hot mixture, and was found to be both economical and advantageous. About 90% of the hot haul is being done by trucks at the present time, replacing the horse-drawn carts and wagons.

MUNICIPAL ASPHALT PLANT COSTS AT WASHINGTON, D. C.

Based on 1 Cu.Ft. of Mixture

Old-Material Mixture		
Material cost:		
Old material, 0.6 cu.ft., at $1.05 per cubic yard		$0.0233
Sand, 0.34 cu.ft. at $1.43 per cubic yard		.0180
Limestone dust, 2.1 lb. at $3.63 per ton		.0038
Asphaltic cement, 4.12 lb. at $19.10 per ton		.0393
Total cost of material per cubic foot		$0.0844
Manufacturing and placing cost:		
Plant labor	$0.0593	
Hot haul	.0498	
Street laying	.1974	
Maintenance of plant and tools	.0188	
Supervision	.0432	
Total		$0.3685
Total cost per cubic foot		.4529
Asphaltic Concrete Mixture		
Material cost:		
Screenings, 0.5 cu.ft., at $1.30 per ton		.0331
Sand, 0.5 cu.ft., at $1.43 per cubic yard		.0265
Limestone dust, 4.2 lb., at $3.63 per ton		.0076
Asphaltic cement, 9.16 lb., at $19.10 per ton		.0875
Total cost of material		$0.1547
Manufacturing and placing cost		.3685
Total cost per cubic foot		$0.5232
Topping Mixture		
Material cost:		
Sand, 1.0 cu.ft., at $1.43 per cubic yard		$0.0530
Limestone dust, 4.2 lb., at $3.63 per ton		.0076
Asphaltic cement, 9.16 lb., at $19.10 per ton		.0875
Total cost of material		$0.1481
Manufacturing and placing cost		.3685
Total cost per cubic foot		$0.5166

A summary of the costs of material, operation, hauling, laying, maintenance and supervision is given in the table. The cost of minor repairs to sheet-asphalt pavements during the year averaged 1.7c. per square yard on a yardage of 3,064,706. The average costs for the past 10 years have been as follows: 1908, 3.8c.; 1909, 2.3c.; 1910, 2.6c.; 1911, 2.2c.; 1912, 2.4c.; 1913, 2c.; 1914, 1.9c.; 1915, 1.9c.; 1916, 1.8c.; 1917, 1.5c. The municipal asphalt plant began operations in 1912.

Heaviest Rapid Transit in New York City

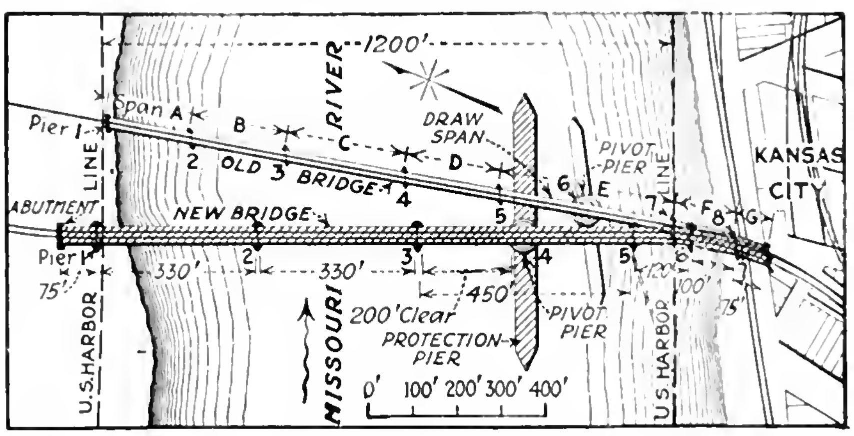
Record-breaking traffic on the New York rapid-transit lines occurred on Mar. 24 and 25, due to military reviews held in New York and Brooklyn. On Mar. 24, 1,824,735 passengers were carried on the subways of Manhattan Borough, and 1,332,607 passengers on the elevated lines of the same borough, making a total of 3,157,342. On Mar. 25 the corresponding figures were 1,753,772, 1,122,894 and 2,876,666. The latter figure is in excess of any previous record up to the day before. An unusually heavy traffic was also carried on the Brooklyn elevated lines, a few of these showing record-breaking figures.

Dismantle Bridge Spans Carefully for Use Elsewhere

Old Missouri Bridge of Burlington Railroad Is Removed—Drawspan Tied to Pivot Pier While End Panels Are Cut Off

REMOVAL of the old Missouri River bridge of the Chicago, Burlington & Quincy R. R., in 1916-17, was complicated by partial overlapping of the new bridge—which necessitated alterations under traffic—and by the requirement that the work should be done with such care as to permit re-erecting the spans at other sites. High water made it desirable to omit falsework at some points and compelled its omission at two spans. In dismantling the drawspan, cables anchored to the floor system held the span balanced on the pivot pier while corresponding members were removed simultaneously from opposite ends of the span.

This work followed the construction of a new bridge



LOCATION OF OLD AND NEW BRIDGES AT KANSAS CITY

partly alongside and partly on the same location, the old and new bridges forming a V, with the point on the south shore. At this point the approach is practically fixed, as it lies along a steep bluff with a high retaining wall protecting the tracks and through a cut on a heavy reverse curve. This made the center lines nearly identical for about 150 feet.

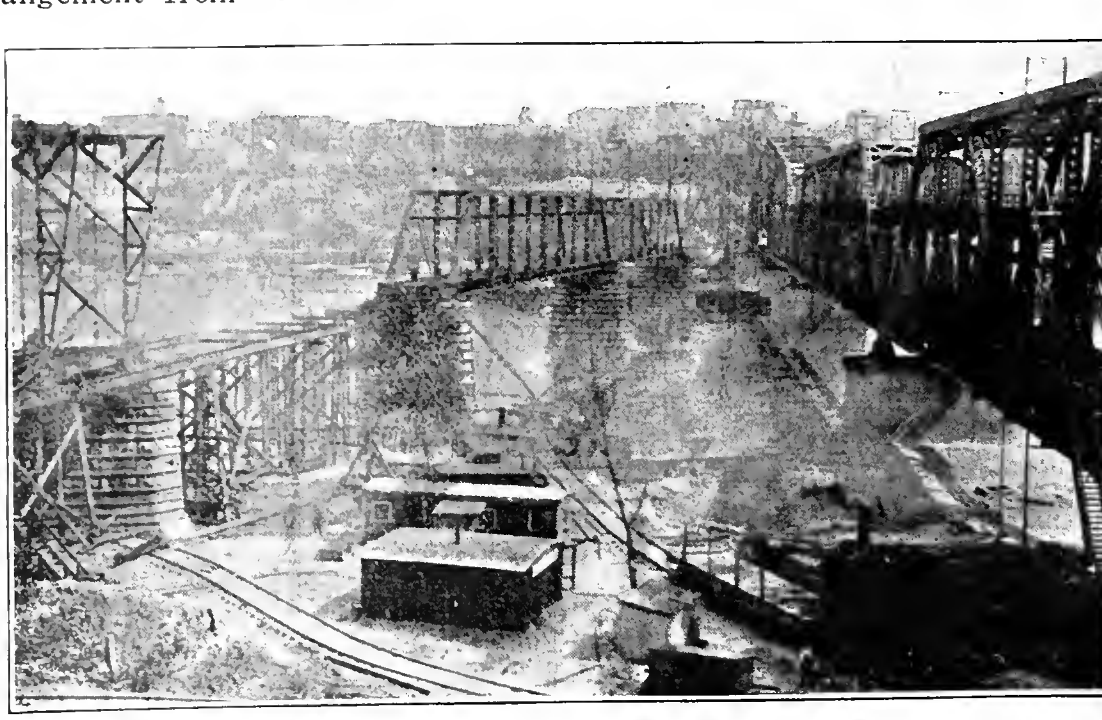
The old structure was known as the Hannibal bridge, having been built by the Hannibal & St. Joseph R.R. in 1867-69. Its original Howe trusses had been replaced at various times by steel spans. The arrangement from north and south was as follows: Four through truss spans of 177 ft., 200 ft., 250 ft. and 199 ft.; through truss swing span of 363 ft.; through truss span of 130 ft., through girder span of 69 ft. Dismantling the two south spans under traffic was necessary from the fact that they interfered with the new bridge. The other five spans were removed after traffic had been transferred to the new bridge. The relative positions of the old and the new bridges are shown by the plan. For the 69-ft. girder span, falsework was built downstream to permit rolling it out, which was done by a hoisting engine mounted on a flat-car on a track which passes under the bridge, the engine operating two sets of triple-blocks with $1\frac{1}{2}$-in. manila cables. The falsework was extended upstream to carry the new girder span, which was pulled into position in the same way.

The use of pile falsework was not advisable for the removal of the 130-ft. truss span, because of loose rock and shale dumped beneath the span, and of the danger from high water. Two heavy frame bents set on the concrete footing of the new pier No. 6 supported four 75-ft. deck girders, whose outer ends were carried on a timber grillage on a limestone ledge near pier No. 7. The bents were anchored to the shaft of the pier by dowels, and were high enough to allow for a 20-ft. rise in the river. Frame bents on the girders were placed under the panel points, and falsework stringers and blocking were placed on these.

As the old span extended about 40 ft. over new pier No. 6, a set of old 44-ft. girders was set between new pier No. 6 and old pier No. 7, to serve as falsework during the wrecking of the span and also to carry the traffic as long as the old bridge was in service. The old single track was connected at the south end of the draw with the outbound track on the new double-track through girder span which was then in place. This gave a dead-end spur on which the derrick car stood while taking down the old trusses and loading the members onto flat-cars placed behind it. From the crane boom was hung the ram with which the truss pins were driven out.

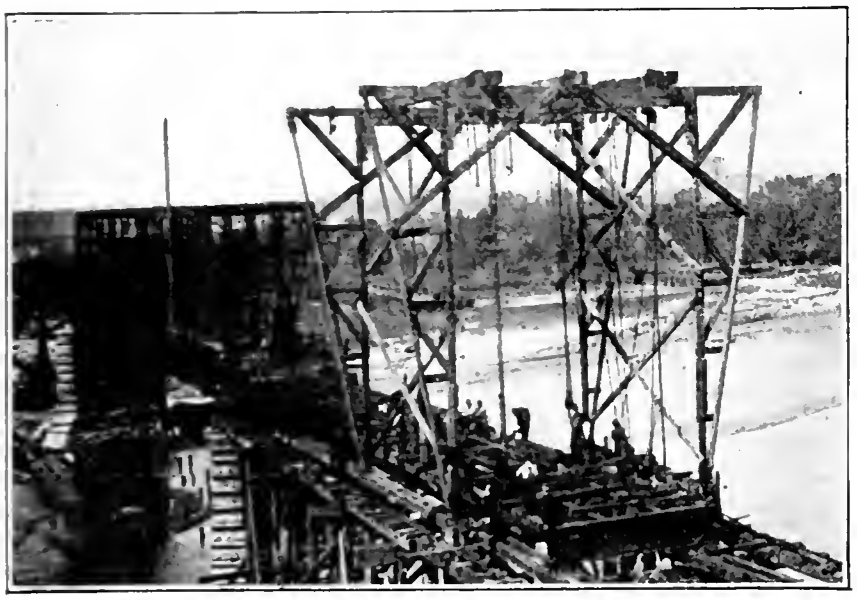
Removal of the old drawspan was the first proceeding as soon as the new structure had been opened to traffic, for until it was partly removed it was impossible to place the 120-ft. deck girders between the new piers Nos. 5 and 6, and to complete the double track. The use of falsework was dispensed with as a matter of economy and to avoid danger from high water. Four lines of $\frac{7}{8}$-in. cable were run at about 45° from the floor-beam of the second panel point on each side of the center panel and anchored to the pivot pier. In the dismantling, similar pieces were removed from each end at the same time, keeping the span balanced on the pier by means of the cables.

By blocking up on the downstream protection crib of the new pivot pier, and using this pier as falsework, the crane from the north end was run out on the second



MIDDLE SPANS WERE LEFT UNTIL THE LAST ON ACCOUNT OF HIGH WATER—AT THE RIGHT IS THE NEW BRIDGE

panel of the old draw. Five panels were removed by this crane and three by a crane on the south end. For this work 60-ton erecting cranes were used, fitted with 75-ft. booms. They loaded the steel on flat-cars placed behind them. The north crane stood on the old span D. The south crane worked from the outbound track, standing on the 44-ft. falsework girders between the old



TRAVELER IS USED FOR REMOVING TRUSS SPANS

pier No. 7 and the new pier No. 6. The remaining panels were removed by a 100-ft. steel boom rigged to a post of the new span and operated by a hoisting engine anchored on the outbound track, which had not been put in service at that time.

For removal of the fixed spans north of the draw, it had been intended to drive falsework and remove them in order, beginning at the draw, thus using the old track connection to handle the material. A rapid rise in the river, however, washed out several bents driven under span D, and the contractor decided to wait until all danger of spring high water was over. As this would have seriously delayed removal of the old piers, the railway company assumed part of the additional cost of removing spans C and D, and the contractors agreed to remove spans A and B at once.

A light overhead traveler was built on the job and erected on falsework placed under span B, this being outside the main current and in little danger from high water. While this span was being dismantled, frame bents were erected under span A, using five yellow-pine piles as posts in each bent. The same traveler removed this span and loaded the material on cars. This work had released piers 1 and 2 for wrecking, and as the river was still too high to permit driving piles in the channel, the removal of spans C and D was left until early in the fall of 1917.

Falsework piles were 70- to 80-ft. yellow-pine sticks. Those for span D were driven by a steam hammer in leads erected on a barge, while those for span C, where the water was only about 1 ft. deep, were driven by the same hammer in leads suspended from the top laterals. As the material was removed by the traveler it was run on a push-car to the north end of span C and loaded into cars by a stiffleg derrick set up on short piles and having an 80-ft. stick for a boom. The heaviest sections were end posts weighing about 3¾ tons.

Piles under span D were pulled by a triple block on a short boom rigged up on the barge. Those under span C, in an exposed sand bar, were pulled by a hoisting engine on the ground using a triple block hung from a gin-pole. This consisted of a 60-ft. pile with its lower end set on a short stringer and the top held by guys. The stringer was skidded from bent to bent.

Care in removing the spans was required by the contract, as the bridge department of the railroad intends to erect all the spans over other streams. It even specified the drilling out of rivets if necessary to prevent injury to the metal. Driving nuts were specified for removing pins, but most of these had been cut so badly by the eyebars, some to a depth of ¼ in., that new pins will be required in reërecting the spans. The parts were matchmarked by the contractors and were shipped to the railroad shops at West Burlington, Iowa. There they are being worked over, parts of the floor systems which were badly rusted being replaced. The drawspan will be converted into simple spans. Removal of the substructure will be described in a separate article. The superstructure was taken down by the American Bridge Co., under the direction of G. A. Haggander, bridge engineer of the Chicago, Burlington & Quincy R.R., with H. W. Smith as resident engineer.

Highway Bridge Piles Concreted to Avoid Replacing

Work Accomplished Without Interruption of Traffic When Piles Had Been Practically Destroyed by Teredos

By F. E. Semon
City Engineer, Port Angeles, Wash.

COMPLETE reconstruction of the pile foundation of a long wooden highway trestle which had been honeycombed by teredos, and the consequent interruption of highway traffic, were avoided by casing the affected portions in concrete. The bridge was a 2000-ft. connection across the bay at Port Angeles, Wash., and, being the only route, it was necessary to keep it open for traffic. Inspection showed that the piles were nearly eaten away at the ground line, there being only about 4 in. of riddled wood at the center. Instead of trying to renew them, it was decided to place the con-

FIG. 1. FORMS BOLTED TOGETHER AROUND PILES READY FOR CONCRETNG AT LOW TIDE

crete, thus protecting them from further ravages by the borer. Untreated piles last here only about three years.

In the placing of the casings, all work was carried on from the bridge floor. Sand and gravel were obtained from the beach near by, mixed in proper proportions, loaded in dump wagons and conveniently distributed on the floor. Cement was stored in small knockdown sheds, and water was provided by a 6-in. water main resting on brackets under the bridge, the pipe being tapped at suitable intervals.

The forms, which are shown in an accompanying illustration, were designed so as to be knocked down easily, and were constructed of 1-in. boards dressed on one side and nailed to 2 x 4-in. pieces. Four ½-in. iron rods were passed through the 2 x 4-in. pieces and tightly drawn up by nuts at either end, to hold the frames together. The inside faces of the forms received a heavy coat of black oil. The forms were 2 ft. square, inside measurement, and a piece of 4 x 4-in. timber sawed diagonally was nailed in the corner. It was found that forms not more than 6 ft. in length were the most convenient; if necessary they were extended after the first length had been filled with concrete.

Placing of the forms was accomplished at low tide, and the filling was done during the 8-hour period of lowest tide. It was afterward found that suitable wood

FIG. 2. PILES WERE HONEYCOMBED BY TEREDO AND COVERED WITH BARNACLES BEFORE REPAIR

yokes made from 2 x 3-in. material and of such size that they could be wedged around the outside of the forms, thus drawing them together, were much easier to erect, adjust and knock down than bolted forms. The forms were braced to the piles to keep them from floating at high tide.

Concreting was done with a small mixer, the proportions being one part of cement to five of aggregate. Each batch was turned for about 1 min., or until a very thorough mixture was obtained, and wheeled in barrows to the chute that led into the form around the pile.

The complete force consisted of nine men, one to handle the sand and gravel, one to put in the cement and water and run the mixer, two to wheel the mixed concrete to the chute, one to tamp the concrete in the forms, one carpenter and two helpers to erect the forms, and a foreman. All work was done by city force account.

The sand and gravel cost 60c. per cubic yard, delivered. The cement cost $2.45 net per barrel, and the rental of the concrete mixer, including the operator, gasoline and oil, was $5 per day. The laborers were paid $3 per 8-hour day and the foreman was paid $4. In all, 222 piles were concreted, with an average length of 7 ft.; the cost per pile was $7. The cost of concrete in place per cubic yard, including the cost of form setting, was $10.

Every effort was used to get dense concrete, not only to support the bridge, but also to overcome further destruction by teredos. Thus far results have been very satisfactory. The base of the jackets extended to 1 ft. below the ground and the top to a point slightly above ordinary high-water mark.

Baths', Pressure and Pipes' Influence Effect of Water Meters

THREE factors which may have an important bearing on the effect of metering upon the water consumption, but which are seldom taken into account, are noted by H. P. Matte, chief sanitary engineer of the Illinois State Department of Public Health, in a recent paper presented to the Western Society of Engineers. The three factors are as follows: Pressure upon the water system; extent of house connections with sanitary sewers, especially the use of bathtubs and water closets; effective size of mains and services.

The average pressure is rarely included in comparing per capita rates of consumption, says Mr. Matte, although in cities with higher pressure the leakage rate both through fixtures and underground piping will be greater than in those which maintain a lower average pressure. In Oak Park, Ill., the per capita consumption is varied between 1 and 2 gal. for each pound of change in pressure. That is, variation of 10 lb. either way will make a difference of 10 to 20 gal. per capita daily. Thus, the Oak Park rate of 65 gal. at 45-lb. pressure can be reduced to 45 gal. at 25 lb. In Niagara Falls, N. Y., where the rate was 300 gal., exclusive of the industrial use, Mr. Matte determined this rate to be from 3 to 5 gal. per pound change in pressure, or 30 to 50 gal. per capita for each 10-lb. change.

Consumers having faucets only are seldom classified separately from those having all the sanitary conveniences. In Oak Park it was determined that where no leaks or waste existed the average consumption per capita was 20 gal. for water closets and 15 gal. for bathtubs. A person who takes a cold bath every morning is likely to consume 40 gal. per day in this item. Low pressure and consequent increase in time required to fill the tubs often reduces the consumption for baths.

Limited services and sanitary facilities in foreign cities, cutting down the number of outlets for consumption and fixture leakage, are mainly responsible for their low per capita consumption, according to Mr. Matte. Figures obtained three or four years ago indicated that some European cities of over 2,000,000 population had about as many service connections as the average city of 300,000 in this country, while the number of services in foreign cities of about 350,000 equalled that of our cities of 40,000.

Loss of pressure by friction from the reduced area of corroded lime-coated service pipes and pipes filled with algæ, crenothrix and tubercles, indicates the importance of the effect of size of service pipes and mains on leakage and waste. Water bills on metered premises in which leakage and waste exist often double in size after the renewal of service pipes, both in the ground and in the interior of the house, especially when iron pipe has been replaced.

New Methods for the Solution of Backwater Problems

Use of Diagrams With Only One Major Variable Reduces Computations and Leads To More Accurate Results

BY H. R. LEACH
Saginaw, Mich.

COMPUTING the amount and determining the profile of water backed up behind an obstruction in a stream is one of the most difficult problems with which the hydraulic engineer is confronted. The complicated conditions which arise in actual practice,

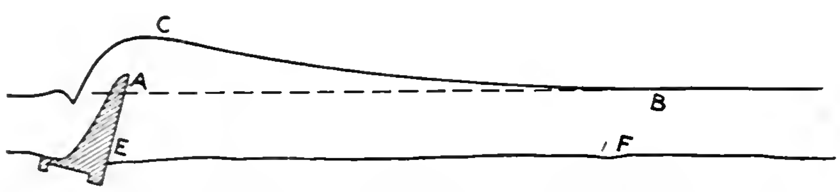


FIG. 1. OUTLINE OF A TYPICAL BACKWATER CURVE

coupled with the numerous variable factors which affect the results, often lead the engineer into a maze of calculations which render complete solution far from easy. It is the purpose of the present paper to explain some methods of treating this problem which the writer has found helpful in eliminating some of the more tedious parts of the computation, and which he believes will lead to more accurate and complete results.

A simple case of backwater is shown in Fig. 1. EF is the bed of a stream channel and AE represents a spillway or other obstruction placed across the channel at E. Under normal channel conditions, with no obstruction at E, the water-surface profile for a given discharge is shown by AB. With the obstruction in place the water-surface profile for this same discharge is shown by CB. The difference in elevation between these two profiles is the amount of backwater caused by the obstruction for the given flow. The usual method of determining the profile CB consists of dividing the channel upstream from the obstruction into reaches, computing the fall through each reach by means of slope calculations, and with this data plotting the backwater profile. The equation to be used in computing slopes through the reaches will be considered first.

The writer has adopted Manning's modification of Kutter's formula for the flow of water in an open channel, but this method is not confined to the use of this formula. Any discharge formula of the type $v = Cr^a s^b$ may be used provided C does not vary with s, so that it is adapted to either Bazin's or Manning's formula, or to some of the more recent exponential formulas. For a justification of the use of Manning's formula and a comparison with Kutter's formula, the reader is referred to the excellent discussion of this formula in King's "Handbook of Hydraulics." The coefficient of roughness in this formula is in most cases identical with that in the Kutter formula, and the engineer in adopting it can still think of channel roughness in terms of n.

By Manning's formula

$$v = \frac{1.486}{n} r^{\frac{2}{3}} s^{\frac{1}{2}}$$

in which n is identical with Kutter's n. For any short reach of a channel there is a definite relation between the depth of water in the channel, the discharge through the channel, and the slope of the water surface required to give this discharge, so that if any two of these quantities are known the third is also determined. The discharge of an open channel using Manning's formula equals

$$Q = CAr^{\frac{2}{3}}s^{\frac{1}{2}}$$

in which $C = 1.486/n$. For any given channel of uniform cross section $CAr^{\frac{2}{3}}$ is a definite quantity for a given depth, as it is dependent only on the size and shape of the cross-section of the channel, hence a curve can be drawn showing the values of this quantity corresponding to any assumed depth. This quantity $CAr^{\frac{2}{3}}$ has been called K_d to indicate a quantity varying only with the depth of water in the channel. Substituting in Manning's formula $Q = K_d s^{\frac{1}{2}}$, this equation is readily solved by a logarithmic diagram, Fig. 5, in which the Q lines are parallel, with a slope equal to $\frac{1}{2}$, and spaced on any s line in proportion to values of K_d. Only the Q lines corresponding to the discharges to be used in the problem need be drawn, though a complete diagram once drawn can be used in any problem.

The practical advantage in the use of the factor K_d is that this one quantity replaces three other variables, and thus eliminates the necessity for any further consideration of them, when it has once been computed. Besides this, it gives a direct index to the carrying capacity of the channel having the given cross-section and might well be called a "type curve" of the cross-section. Aside from the backwater problem, the writer believes that this curve may be adopted to advantage in many other fields of open-channel computation.

In solving the backwater problem, it is first necessary to divide the stream above the obstruction into reaches of suitable length. Each reach should be selected so that the channel conditions throughout its

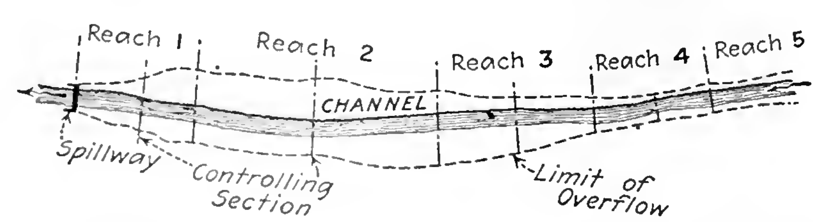


FIG. 2. METHOD OF DIVIDING A STREAM INTO REACHES

length are as uniform as possible and so that it may be fairly represented by one typical cross-section. The cross-section area of the stream determines the surface slope required for a given discharge, and hence any material change in this area, either through restriction of the channel or change in the depth of the water, will change the slope. With a slight slope, however, there may be considerable change in slope without material change in the total fall through the reach, so that in that portion of the stream near the obstruction where the slopes are comparatively flat, longer reaches may be used.

After the reaches have been chosen, the next step is the selection of a typical cross-section for each reach. For this it is desirable to use the average of several cross-sections of the stream in the reach, but where this is not possible care should be exercised to select a section representative of the entire length of reach. When the controlling sections have been selected, the K_d curve is drawn for each section, Fig. 4. This is done by determining the area and hydraulic radius for several depths covering the probable range in stage of water surface, and computing the value of K_d for each of these

depths from the equation $K_d = CAr^{\frac{2}{3}}$. Only enough values need be computed to determine the curve for each section.

In order to start the backwater calculations, the elevation of the water surface at the point of obstruction for the given or assumed discharge should be determined. If the obstruction is a weir or an overflow dam, the discharge curve for the dam is easily com-

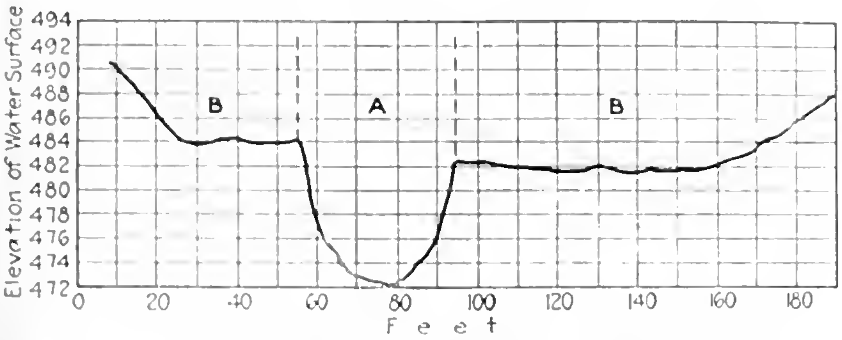


FIG. 3. TYPICAL CROSS-SECTION OF REACH (SEC. 1)

puted (see "Weir Experiments, Coefficients, and Formulas," by Robert E. Horton, Water Supply Paper No. 200, U. S. G. S. for data on discharge coefficients of weirs and dams), and this will give the elevation of the water surface above the dam for any discharge. The water-surface elevation above the dam which is found for the given discharge is the elevation of the water at the foot of the first reach. The elevation of water at the location of the controlling section of the first reach is then assumed, and the corresponding value of K_d taken from the K_d curve. With this K_d and the given discharge, s is taken directly from the logarithmic discharge diagram. Multiplying s by the distance from the foot of the reach to the controlling section gives the rise in water surface, and this added to the water-surface elevation at the foot of the reach gives the elevation at the section. If this elevation corresponds to the assumed elevation used in getting K_d, the assumption was correct, but if it does not, a second trial must be made, assuming a different elevation at the section and using the result of the first trial as a guide. When the computed elevation at the section coincides with the assumed elevation, the correct slope through the reach has been found. The fall through the reach is then computed, and this added to the elevation of water at the foot gives the elevation at the head of the reach. This is also the elevation of water surface at the foot of the reach above, and with it as a starting point the slope through Reach 2 is computed, using the same method as for Reach 1. In a similar manner, the computation is carried through the successive reaches as far as desired, or to the point where backwater becomes zero.

It may be stated in passing that the advantage of working through the slope calculations with only the

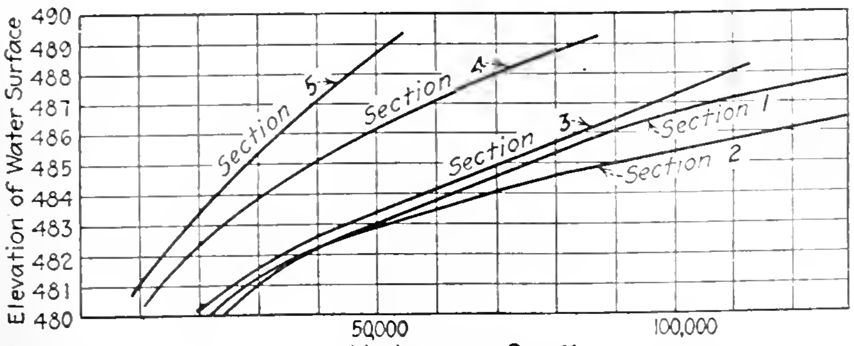


FIG. 4. CURVES SHOWING TYPICAL VALUES OF $K_d = CAr^{\frac{2}{3}}$

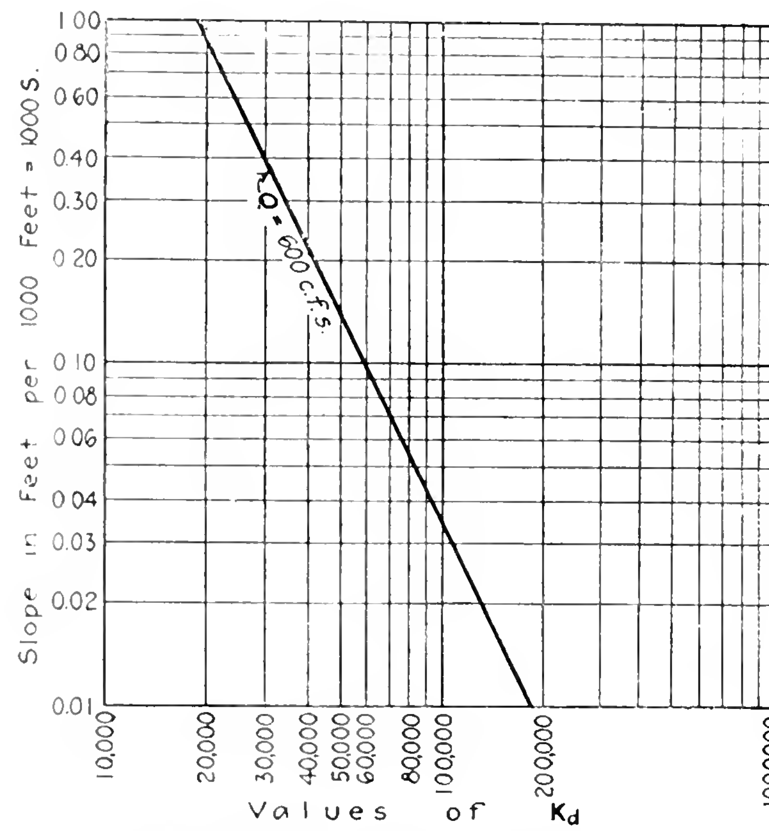


FIG. 5. DIAGRAM FOR THE SOLUTION OF $Q = K^p \sqrt{s}$

three quantities Q, K_d and s, instead of the six factors involved in the usual method, more than compensates the slight additional labor required in computing the K_d curves.

It will be noted that the coefficient of roughness has considerable effect on the results shown by the computations, and that it is therefore important that the value of this factor should be correctly determined. With a constant discharge, s will vary as n^2, and a small variation in the value of n will cause a relatively large variation in the required slope. If the slope is slight, a considerable change in its value may not produce any material change in the fall through the reach. As the slope increases, however, it becomes increasingly important that the roughness coefficient be correctly determined. Where it is possible, an actual profile of the water surface for a given discharge should be made,

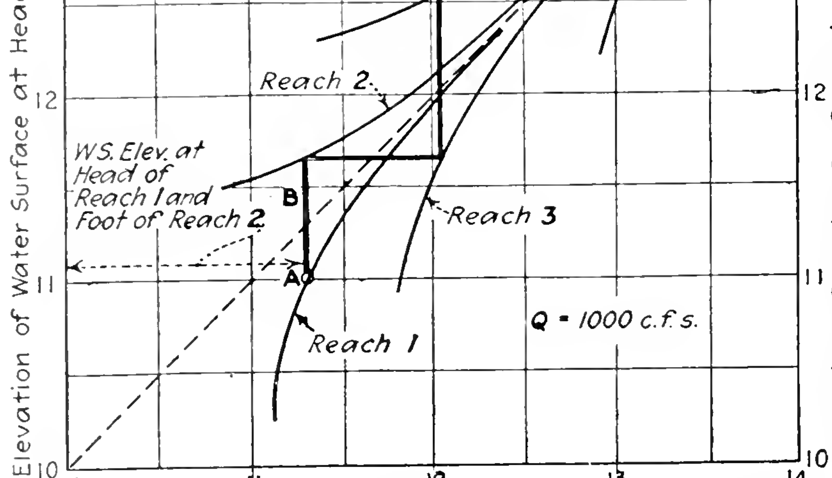


FIG. 6. CURVES FOR THE SOLUTION OF THE BACKWATER PROBLEM WHEN THE INITIAL WATER STAGE IS NOT DEFINITELY DETERMINED

TABLE I. METHOD USED IN TABULATING CROSS-SECTION DATA

Elevation of Water Surface	Channel Section: Area of Section A	Width of Water Surface w	Mean Depth d	Wetted Perimeter	Hydraulic Radius r	$r^{\frac{2}{3}}$	$K_d = \frac{1.49}{n} Ar^{\frac{2}{3}}$ $n = .030$	Overflow Section: Area of Section A	Width of Water Surface w	Hydraulic Radius r	$r^{\frac{2}{3}}$	K_d $n = .040$	Combined K_d
Section No. 1													
480	190	35	5.4	46	4.13	2.57	24,200	.	...	....	..	......	24,200
482	264	38	7.0	52	5.08	2.95	38,500	.	...	...	...	......	38,500
484	340	38	8.9	56	6.07	3.32	55,900	135	78	1.69	1.42	7,100	63,000
486	417	39	10.7	60	6.95	3.64	75,200	231	120	1.86	1.51	13,000	88,200
488	495	39	12.7	64	7.73	3.91	95,800	489	135	3.52	2.31	42,000	137,800

and this will give the data from which the roughness coefficient can be determined. Where this is not possible, it is advisable to investigate the effect of a change in the coefficient of roughness on the backwater profile. The assumption of too low a value for the roughness coefficient decreases the elevation of the water surface profile but increases the amount of back water, and vice versa. This is because the depth of water for a given discharge would be lower under normal channel conditions (no backwater) with the lower coefficient.

The case of the divided-flow problem offers the greatest opportunity for advantageous use of the K_d curve. This problem arises when the cross-section is so irregular that the flow in adjacent parts of the channel must be considered separately. This is best illustrated in the case of a channel in which the water is above the banks, so that for accuracy the flow over the adjoining overflow lands must be considered separately from that in the channel proper. The elevation of water surface throughout the reach must be the same for both the overflow land and the channel, so that, ordinarily, the given discharge must be apportioned by trial between the two until this condition is satisfied. The use of the K_d curve eliminates the necessity of proportioning by trial. The discharge capacity through the reach will depend directly on the total capacity of the two (or more) sections. Values of K_d are computed separately for the channel and for the overflow land, and these are combined to form one K_d curve for the entire cross-section which gives the total capacity of the entire cross-section at any depth. The slope calculation is then made in exactly the same manner as for a simple channel, using the K_d curve for the combined sections. A typical backwater problem is illustrated by the channel shown in Fig. 2. This shows the reaches selected and the location of the cross-section controlling each reach, which will usually be at the middle of the reach. Fig. 3 gives one of these cross-sections and shows the manner in which the flow through the section is divided in order to allow for the irregularity of the section. A is the normal stream channel and B the overflow land. Table I gives a tabulation of the data and the results used in determining K_d for this section, and Table II shows a convenient method of tabulating the slope calculations.

TABLE II. METHOD OF TABULATING BACKWATER COMPUTATIONS

Number of Reach	Length of Reach	Elevation of Water Surface at Controlling Section	K_d	S Ft. per 1000 Ft.	Fall Through Reach	Elevation of Water Surface Foot of Reach	Elevation of Water Surface Head of Reach
Discharge = 600 c.f.s.							
Elevation of water surface above spillway from discharge curve = 485.26							
1	400 ft	485.27	79,000	0.058	0.02		485.28
2	800 ft	485.30	101,000	0.036	0.03	485.28	485.31
3	500 ft.	485.32	75,000	0.064	0.03	485.31	485.34
4	400 ft	485.38	42,000	0.203	0.08	485.34	485.42
5	500 ft	485.52	31,000	0.375	0.19	485.42	485.61

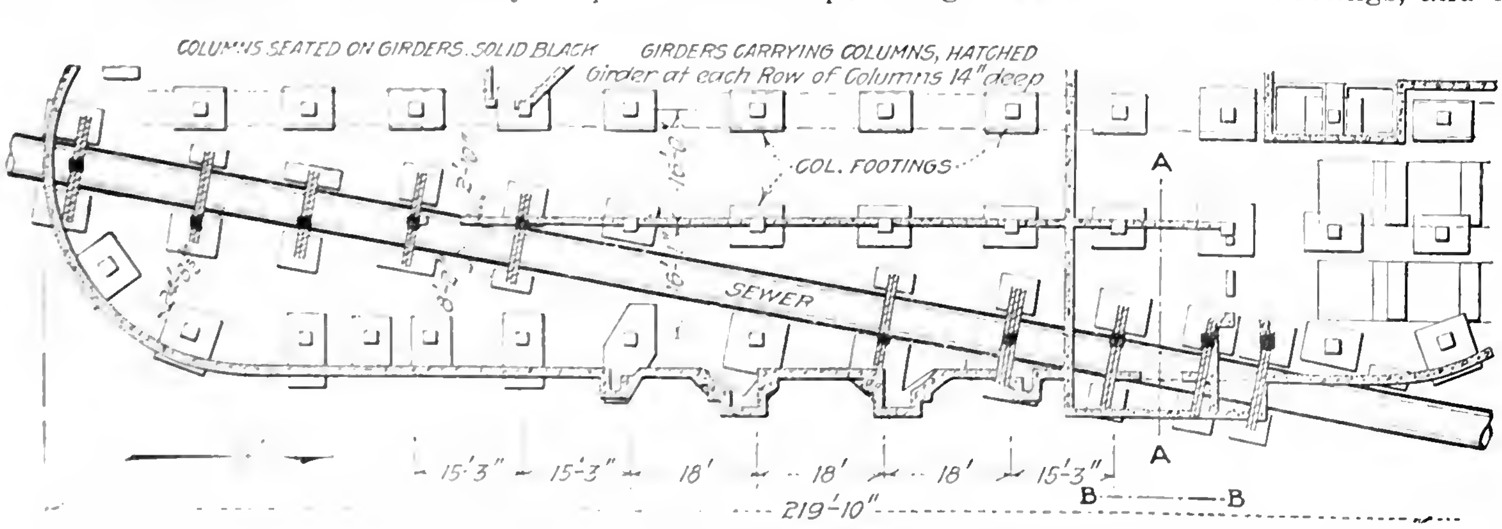
It may sometimes occur in backwater problems that the initial water-surface elevation at the lower end of the channel is unknown or not definitely established. Such a case might arise in the investigation of a proposed dam of undetermined height. It is obvious that for each assumed stage at this point, with a given discharge, there will be a different backwater profile. The writer has found the method shown in Table II very convenient in arriving at a complete solution of this problem.

Sewer Complicates Foundation Plans

Armory Building Has Concrete Columns Seated On Girders Spanning Sewer — Basement Floor Is Carried by Girders

UNSYMMETRICAL arrangement of the foundations of a Chicago armory was made necessary by the presence of a 4½-ft. brick sewer which crosses the site diagonally, as shown in the accompanying plan. The armory, built for the Second Illinois Cavalry, is a reinforced-concrete building, with pedestal footings on wood piles.

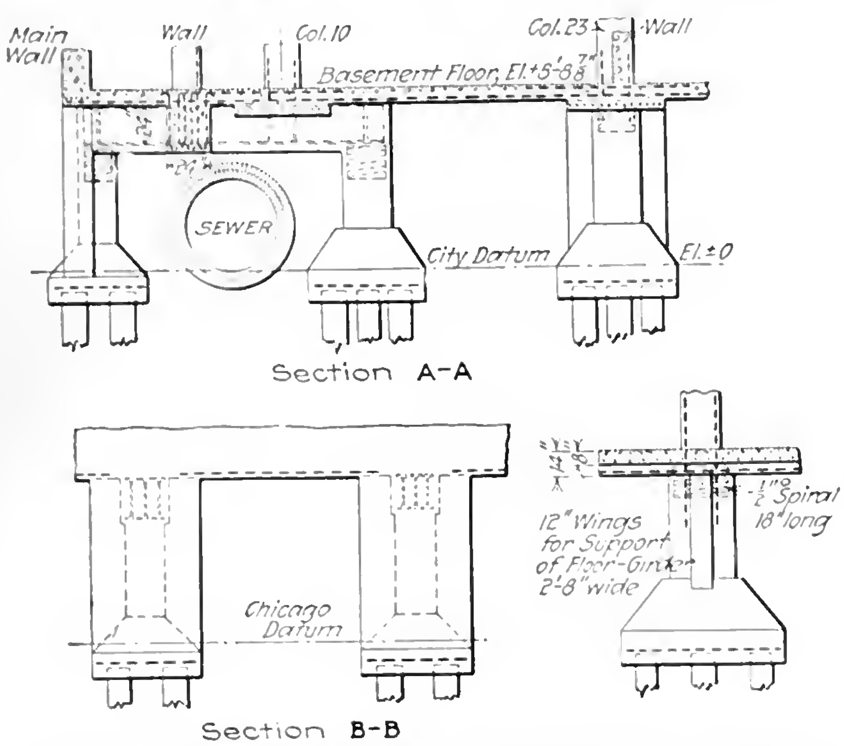
Where the sewer intersects column locations it is spanned by cross-girders which support the columns and are in turn carried by stub columns on footings on either side of the sewer. The girders are about 11 ft. long between centers of footings, and each is composed of three (in one case of four) I-beams of 18-in. to 24-in. size, the girder being cased in concrete as a protection against rust and corrosion. Where the sewer crosses the



SEWER UNDER ARMORY NECESSITATES UNSYMMETRICAL ARRANGEMENT OF FOOTINGS

line of the east side wall, this wall is carried on a continuous longitudinal girder extending between the cross-girders. The column loads on these cross-girders are from 130 to 165 tons. Typical construction is shown by the cross-sections.

Footings for the outer columns also support the 16-in. concrete wall of the basement, which is about 33 in. outside of the columns. This wall is irregular in plan, conforming to the circular or tower-shaped ends



SHORT COLUMNS CARRY CROSS-GIRDER FOR MAIN COLUMN AND LONGITUDINAL GIRDER FOR WALLS

of the building. Around the sewer and over the entire site the ground is filled to the level of the basement floor, but this fill does not carry the floor. An 8-in. slab covers the basement area, resting on the concrete footings and the cross-girders. Between the interior footings the thickness is increased to 14 in. for a width of about 4 ft., forming longitudinal girders which serve to brace the foundation and support the floor independently of the fill, as the armory is situated on ground reclaimed from the lake.

Column reinforcing consists of rods and spiral hooping, the rods being extended 4 ft. 3 in. into the footing or spliced to dowel rods 8½ ft. long, which are embedded in the footing. Spirals and dowels are omitted from the columns which rest on the I-beam girders. The floors above the basement are of slab-and-joist type, the joists being spaced 24 in. on centers and running longitudinally between the 12-in. transverse girders at the panel points. The depth of the joists is 10½ in., including the 2½-in. slab, upon which is a ¾-in. cement finish. Floor loads are 100 lb. for the basement and all floors.

This being a state building, the designs were made by J. B. Dibelka, state architect. Holabird & Roche, Chicago, as the consulting architects, prepared the plans. The general contract was let to the Hanson Brothers Co., for which C. T. McClelland was superintendent.

Electric Street-Cleaning Vans Efficient

Recent reports state that electrically propelled street-cleaning vans used in England have proved much more efficient than horse-and-cart methods for collecting street refuse. One van accomplishes the same amount of work as three carts. The operation cost per day of three carts is $19.58, while that of one van is $8.70.

Special Motor Equipment Used on Road Maintenance

North Carolina Highway Department Has Combination Truck and Tractor to Plow, Drag and Transport Materials and Men

By D. H. Winslow
State Maintenance Engineer, Raleigh, N. C.

MAINTENANCE is being succesfully handled in North Carolina by the use of specially constructed motor equipment. An interchangeable motor truck and tractor is employed and special maintenance autos are also being utilized by the district supervisor, who can thus cover a territory of from six to 14 counties. A new type of road drag is also being used.

With a view to keeping its large mileage of highways in good condition, the state has been divided into 10 districts, with a district maintenance supervisor placed in charge of each. A district consists of from six to 14 counties, and the supervisor has general supervision over all the patrolmen in his district, inspecting the roads and giving the patrolmen advice on maintenance methods. In order to cover this large territory, he is supplied with a specially constructed auto, as shown in an accompanying illustration. On account of the high prices for teams, labor and materials, the state has adopted new methods of maintenance. It was found that the patrolmen needed extra help under present conditions to cover their work, which consists of inspecting and dragging their roads after each rain, filling depressions with good material, removing débris from the right-of-way, repairing culverts, cutting weeds and brush at intersections to give a clear view, maintaining guard rails at culverts and bridges, and generally keeping the road in good condition. To give this extra help, the state has designed and had constructed special interchangeable motor trucks and tractors, which have been found of great assistance.

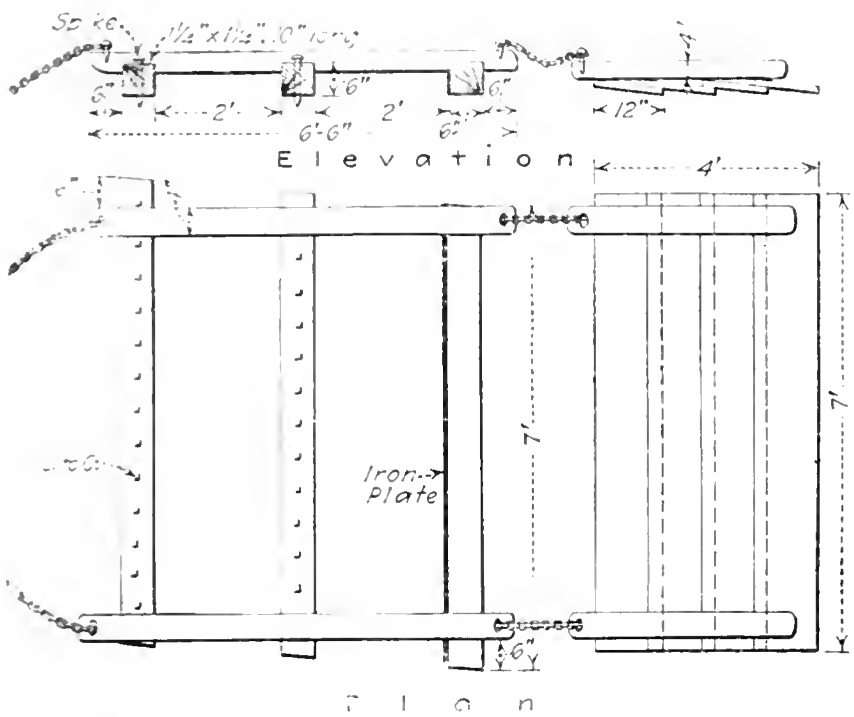
There are 100 counties in the state. Tractor trucks have been placed in 30 or more, and, on account of the satisfaction which they have given, are being placed in the others as fast as possible. A view of one of these

TRUCK WITH INTERCHANGEABLE WHEELS WORKS AS MAINTENANCE TRACTOR

trucks is shown in an illustration. Those in use at present have an ordinary small chassis with a truck body and a closed cab for the driver. The truck body is used to carry the special tractor wheels when moving from one section of road to another, and also to

carry such other equipment and men as are needed to do the work. Extra springs have been put over the rear wheels, so that a heavy load can be carried on the truck body. It is possible to change from a truck to a tractor in 15 minutes.

In some sections it had been necessary to move laborers 20 miles by mule teams, and then board the



RURAL ROAD PLANER HARROWS, DRAGS AND PACKS

men in addition to paying them. By the use of the trucks they can return home each night, which is an advantage to all concerned. As the truck is equipped with a closed cab for the operator, he is able to work in the heat of the sun and cover a greater mileage in all kinds of weather. Formerly the teams had to abandon work during very hot weather.

When the machine is used as a tractor for plowing and dragging and for hauling road machines, a special hitch is employed, so that the tractor can stay in the middle of the road while the grader operates in the ditch. It is estimated that in plowing and dragging the tractor saves the hire of from six to eight mules, and that two men can do the work previously done by four.

The highway commission is trying out a new road planer in connection with its tractor-trucks. The new planer, the details of which are shown, increases the mileage dragged in a day and does better work than the old-style drag. It is modeled somewhat after the hone and is a combination of a harrow, a drag and a packer. The forward part has case-hardened spikes and

SPECIAL INSPECTION AUTO USED BY DISTRICT MAINTENANCE SUPERVISOR

loosens the bumps on the road. The middle section cuts and spreads this loosened material. The rear portion packs the material. Unlike a road grader, it cuts the high places and spans the low sections.

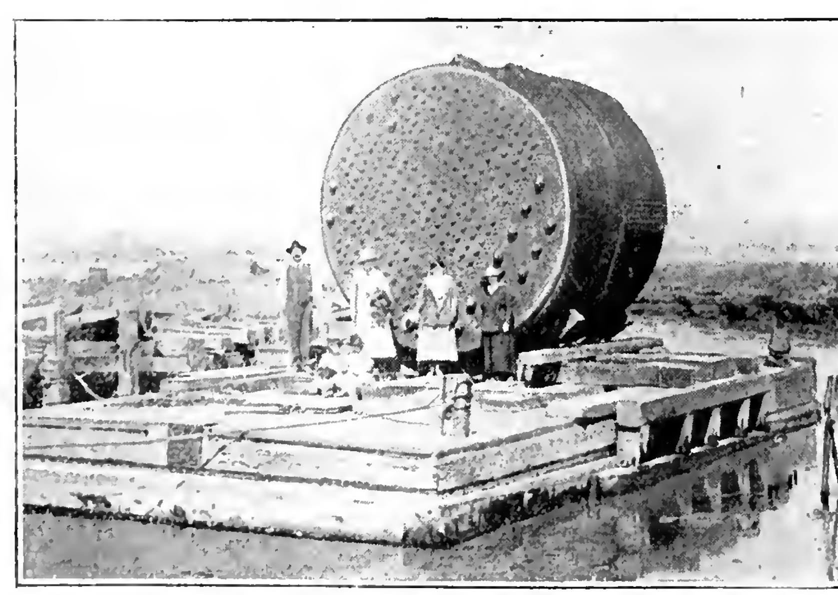
It has worked with marked success on earth, sand-clay, topsoil, gravel and on slightly worn macadam. The tractors have no difficulty in pulling it up almost any grade. By being made very light, it can be pulled with teams, but is designed for tractors or trucks.

Maintenance in North Carolina is carried on under the State Highway Commission; W. F. Fallis is state highway engineer, and the writer is in charge of the maintenance department.

How 45-Ton Boilers Were Rolled 21 Miles Along Coast

After Being Salvaged From Wreck, Donkey Engine Rolled Them, Between Tides and Storms, Along Improvised Roadway

MACHINERY and other equipment salvaged from the wrecked passenger steamer "Bear" was recently removed from the vessel as it lay stranded in the surf on the northern California coast. Salvaging the boilers presented a special problem, because of the bulk and weight of each piece. After the boilers had been taken out and landed on the beach, efforts were



LOADING BOILER ON BARGE AT MOUTH OF EEL RIVER

made at frequent intervals, extending over almost a year, to salvage them by towing them to sea. This plan was then abandoned, and a contracting firm undertook to deliver them at a wharf in Eureka, Cal., for a fixed sum. The boilers were successfully moved by rolling along 21 miles of ocean beach and rocky coast, making two river crossings, and finally loading them on a barge on Humboldt Bay for the last lap of the journey.

A donkey engine and other necessary equipment were landed on the beach near the boilers after they had been brought ashore, and a rough roadway was built on which to roll them. For the most part the roadwork consisted of breaking up large rocks with dynamite, but there were also several deep cuts which had to be made in solid rock. Part of the way work could be carried on only during calm weather and at low tide, because at high tide the surf broke against the cliffs. Progress was frequently delayed because a rough sea would wash out the roadway prepared for the moving operations.

PASSING THROUGH ROCK CUT IN BASE OF CLIFF

The boilers weighed 45 tons each and measured 12 ft. in length by 13 ft. 8 in. in diameter. They were rolled along one at a time by means of a single $\frac{3}{4}$-in. line from the engine drum. The end of the line was attached to the front of the engine frame and was laid thence along the ground, the bight being passed around the boiler and back to the engine drum. This method gave a direct pull on the boilers, and if roadway conditions had been favorable they could have been moved ahead at a rapid rate.

One of the chief problems was to keep the boilers rolling straight. With a diameter greater than the length, there was a tendency to "head off," first in one direction and then in another. This was overcome by attaching a block to a line on the ground just ahead of the boiler and pulling over the bight of the line with a team of horses. The block was attached to the line far enough ahead of the boiler so that the pull could be made and the block loosened before the boiler reached it. Thus, the tendency to roll off to one side could usually be corrected without stopping the engine. After the line had been moved sufficiently the block would be loosened and allowed to slip along the line as the team walked ahead, until it was necessary to pull to one side again.

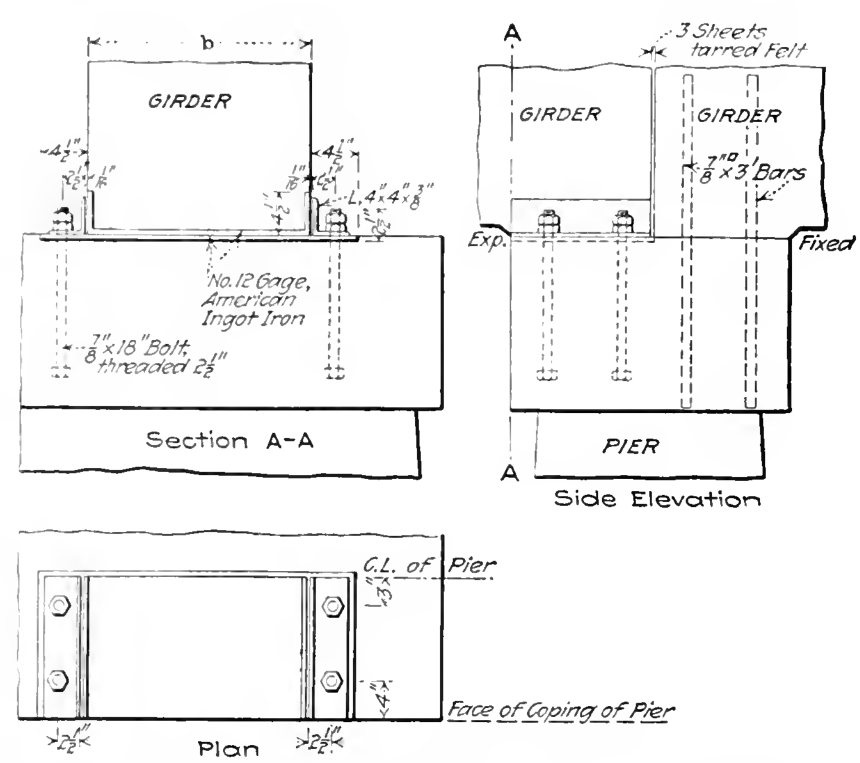
In this manner the boilers were sometimes moved an entire quarter of a mile without having to stop the engine. The donkey engine was usually set about a quarter of a mile ahead of the six boilers and they were rolled along one at a time until all had been brought up, whereupon the engine would be moved again.

In crossing the Bear River a ford was found where the boilers could be rolled across by the same method that was used along the beach. At the Eel River, however, this plan was not feasible, and there the boilers were loaded on a barge one at a time and towed for two miles to a favorable point for continuing the rolling process. On arriving at the shore of Humboldt Bay all six were loaded on a single large barge and towed to the wharf in Eureka. The contract was taken by the Mercer-Fraser Co., of Eureka, Calif., J. D. Fraser, president, and J. L. Brown, secretary.

New Type of Expansion Joint Devised for Concrete Girders

FOR a bridge just designed for the Highway Department of the State of Arizona, S. M. Cotten of the office of the state engineer has devised a new type of expansion joint, illustrated in the accompanying drawing. The joint has points of novelty and desirability for reinforced-concrete girder bridges. It consists, in effect, of a bent iron plate, in which the concrete girder is seated, which slides on a flat plate fastened to the pier, sidewise movement being avoided by guide angles also fastened to the bed plate.

The principal features of the design are ease of fabrication and low cost, according to the claims made. American Ingot Iron is specified for the plate because of the rust-resisting quality of this metal, this being a factor of most importance in the sliding expansion joint. The upper plate is not anchored to the girder in any manner. Mr. Cotten explains this feature as follows: The purpose of the expansion joint is to permit the movement of the structure with the minimum of friction. The coefficient of friction of concrete on steel



EXPANSION JOINT FOR CONCRETE GIRDER CONSISTS OF TROUGH-SHAPED STEEL PLATE SLIDING ON BEDPLATE

is much greater than that of steel on steel. Should these plates rust or for any reason develop a greater coefficient of friction between their contact surfaces then that of concrete on steel plus a certain amount of bond, the girder will move on the upper plate.

Motor Truck Used To Inspect Water-Supplies

Public water-supply field investigations made by the engineering division of the New York State Board of Health have been materially increased in number during the past season, largely by the increased facilities afforded by the use of a small motor truck. In every case they include a careful inspection of the watershed and of the conditions affecting the water-supply, and the collection of samples. The new method of transportation makes possible a much more extensive and complex sanitary control than existed heretofore.

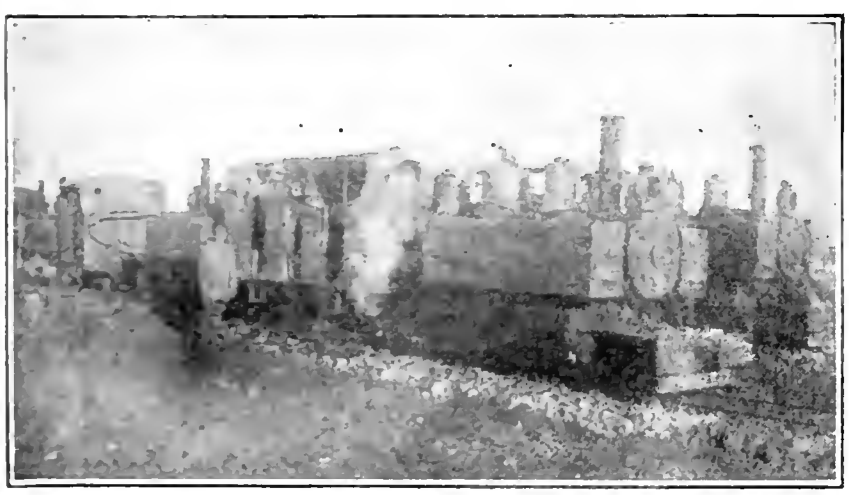
Dwarf Railways of the Front Line Trenches

The Soixante or 60-Centimeter-Gage Tracks Used For Many Purposes—Connect With Broad-Gage Railroads In Battle Areas

By James E. Sellers

Private, 23rd Engineers, American Expeditionary Forces, France

MOST effective of the "combat railways" which served the front-line trenches in the great war was the French narrow-gage *Voie de Soixante*, generally called the Soixante railway, the gage being 60 cm., or 1 ft. $11\frac{5}{8}$ in. Various types of locomotives and cars were used, and their work in the battle areas of France was of exceptional variety. The Soixante railway was used chiefly for the transportation of troops, taking the wounded from the front to hospitals in the rear, carrying to the front rations, ammunition, guns, fuel, clothing supplies, forage, water, engineering supplies, etc. The materials were received on the



AMERICAN NARROW-GAGE LOCOMOTIVE IN YARD

broad-gage track at the "railhead" and transferred to the narrow-gage cars. Some of the materials were received by canal barges.

According to the nature of the work and the proximity to the trenches, the means of transportation varied from mules and horses to the American (Baldwin) locomotives, the French double-end steam locomotives, and gas engines. It was not an uncommon sight to see three of these little "dinkies" chugging and puffing with their load of 28 cars over a grade of three per cent. The steam locomotives were used up to within 5000 yd. of the front trenches. Gas engine, horse, or man-power was used from this point to the destination, because the enemy was able to detect all movements of steam locomotives. A steam locomotive within a distance of three miles from the front, without careful camouflaging of its surroundings, would be "shot up" in 10 minutes.

Locomotives and Power

Locomotives used on the Soixante differ in size and design. The American steam locomotive, 2-6-2, is a 50-hp. engine with a wheel-drive base of 5 ft. 10 in.; total wheelbase 15 ft. 7 in.; overall length 21 ft. 7 in.; width 6 ft. 5 in.; height above the rail, 9 ft. 3 in., and weight 34,500 lb. The A. E. F. gas engine is equipped with a four-cylinder, four-cycle, 35-hp. water-cooled motor, wheelbase 3 ft.; overall length 10 ft. 9 in.; width 4 ft. $7\frac{1}{2}$ in.; height 7 ft. 11 in., and weight 8000 lb. The French double-end steam locomotive (Model 1888) has a total wheelbase of $12\frac{1}{2}$ ft.; total length about 18 ft. 9 in.; width 5 ft. 2 in.; height 9 ft. 5 in., and weight about 31,000 pounds.

Four kinds of cars were used: Box cars with a capacity of 600 cu.ft., or 22,000 lb., weighing 10,900 lb., with a length of about 24 ft., width of 6 ft. and height of 8 ft. 4 in.; gondola cars with a capacity of 210 cu.ft., or 22,000 lb., weight 9000 lb., length 24 ft., width 5 ft. 7 in., height $4\frac{1}{2}$ ft.; flat-cars with a capacity of 22,000 lb., weight 8000 lb., length 24 ft., width 5 ft. 7 in., height to the floor 2 ft. 4 in.; dump cars with a capacity of 27 cu.ft., weight 1050 lb., length 5 ft. 8 in., width 4 ft. 8 in. Tank cars, used for carrying water to the front-line trenches, were about the same design as the box car, with the exception of the tank, and weighed 12,200 lb. The French used generally a gondola car with a capacity of about 10 tons.

All buildings were made from standard designs when possible, calling for wood and corrugated-iron construction, except within the front area, where all buildings are in dugouts. It is not unusual to see a cluster of these dugouts, emerging from a cut or hillside, resembling a huge culvert, partially filled with drifting sands. From above and in front they are carefully camouflaged to resemble natural earth, and it is hard to detect them from a distance of 2000 yd., or more.

The narrow-gage railways generally run at right angles to the broad-gage line at the railhead, their main lines being connected with laterals in loop formation to form a continuous one-way road. Double tracking is only used when short hauls call for it. In this case, ample protection must be afforded to the operation of the line.

The single continuous track construction allows the handling of more traffic in a shorter time, and also tends to serve more area and allows for the diversion of traffic over any lateral when necessity demands. The average train run is about 10 miles.

Construction of the Railway

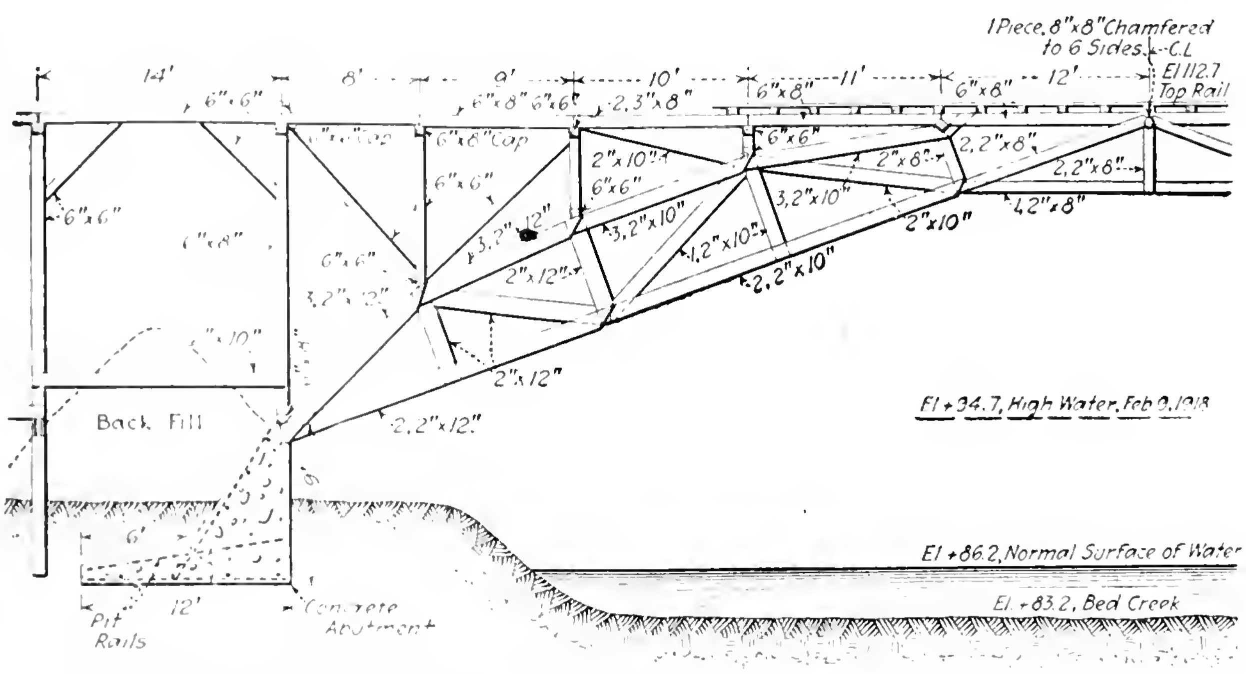
In the construction of the Soixante system it is very important that no grades should exceed three per cent., and curves should not be sharper than 50 m. (164.04 ft.) in radius. In the St. Mihiel salient the writer has traveled lines having 5% grade and 30-meter (98.42-ft.) curves, but this was unusual and would not have occurred if the topography had not made it necessary in order to traverse the territory without detection by the enemy. Compensation for curvature on grades is made at the rate of 0.02% per degree.

It is very difficult to determine accurately the cost of constructing this railway, as the data are kept by the Government. The British assume that one mile of track completely laid requires 7000 man-power hours; the French are capable of grading, tracklaying and ballasting about 0.75 m. (2.46 ft.) of roadway per man per day.

The track sections are composed of two 25-lb. rails, 5 m. (16 ft. 5 in.) in length, bolted to eight steel ties, and weighing about 25 lb. per yard. These sections are very easily handled and placed by four men. The British and French sections are similar in design, but,

instead of bolting the rail to the ties the French rivet them; the British use wooden ties in most cases in connection with steel ties, and this is also done on American lines when soft ground or muddy places are encountered. To illustrate the accomplishment of these narrow-gage railways—it is not uncommon to unload an entire trainload of supplies in 30 min. and place them in piles ready for distribution. For example, 308 tons of material have been received at 9 a.m., some five miles from the front, and in less than three hours' time placed in the hands of the cooks at the front ready to be made into "chow."

The Soixante was responsible in a great measure for the wonderful progress made by the Americans during the trying days of September, when they pushed the Huns out of the St. Mihiel sector. The many uses found for the narrow-gage railway during the past four years prove conclusively its value in military tactics.



DESIGNED IN ACCORDANCE WITH LUTEN FORMULA FOR CONCRETE ARCH

Timber Arch Bridge One Hundred Feet in Length

Forces of Fulton Coal Company Design and Build Structure—Luten Formula for a Concrete Arch Ring Used

BY D. R. WALKINSHAW
Greensburg, Penn.

A TIMBER arch span 100 ft. long was built recently over the Big Sewickley Creek at Hunker, Westmoreland County, Penn., for the purpose of getting out coal during the shortage. The bridge was designed by the writer for the Fulton Coal Co. and was erected by the forces of the company under the direction of the carpenter.

The increased demand for coal has caused the development of a large area of "Freeport" coal in the district around Hunker, which coal has hitherto been considered of little value. In a distance of five miles along the above-named creek some forty mines have been opened in the "Freeport" vein.

In order to provide the shipping facilities that were needed it has frequently been necessary to extend trestles or tipples across this creek so as to load the coal at the railroad sidings, and the accompanying sketch shows the design of one of these bridges with the various dimensions.

Big Sewickley Creek has considerable width at places, and the bridge shown was designed with a clear span of 100 ft. and a height of about 18 ft. The arched members were designed in accordance with the Luten formula for a concrete arch ring. The curve is therefore a mean between the semicircle and the ellipse. The bottom chords and trusses are merely used to stiffen the short panels. The bridge is symmetrical throughout and consists of two ribs spaced 4½ ft. c. to c. and completely X-braced. In order to prevent swaying at the center two ½-in. wire-rope guys were anchored to large trees along the bank. A photograph of the completed bridge, in which is seen the old suspension footbridge heretofore used for crossing the stream, is shown.

TIMBER ARCH CONNECTS COAL MINE WITH RAILROAD SIDING

The writer was the designing engineer and Joseph Kettering was the carpenter who had charge of the construction for the coal company.

Field Methods on Rapid Stadia Surveys at Columbus

All Lines Run by Stadia, Levels Taken With Transit—Special Rod Extension—Colored Cloths and Whistles for Signals

By H. K. Kistler

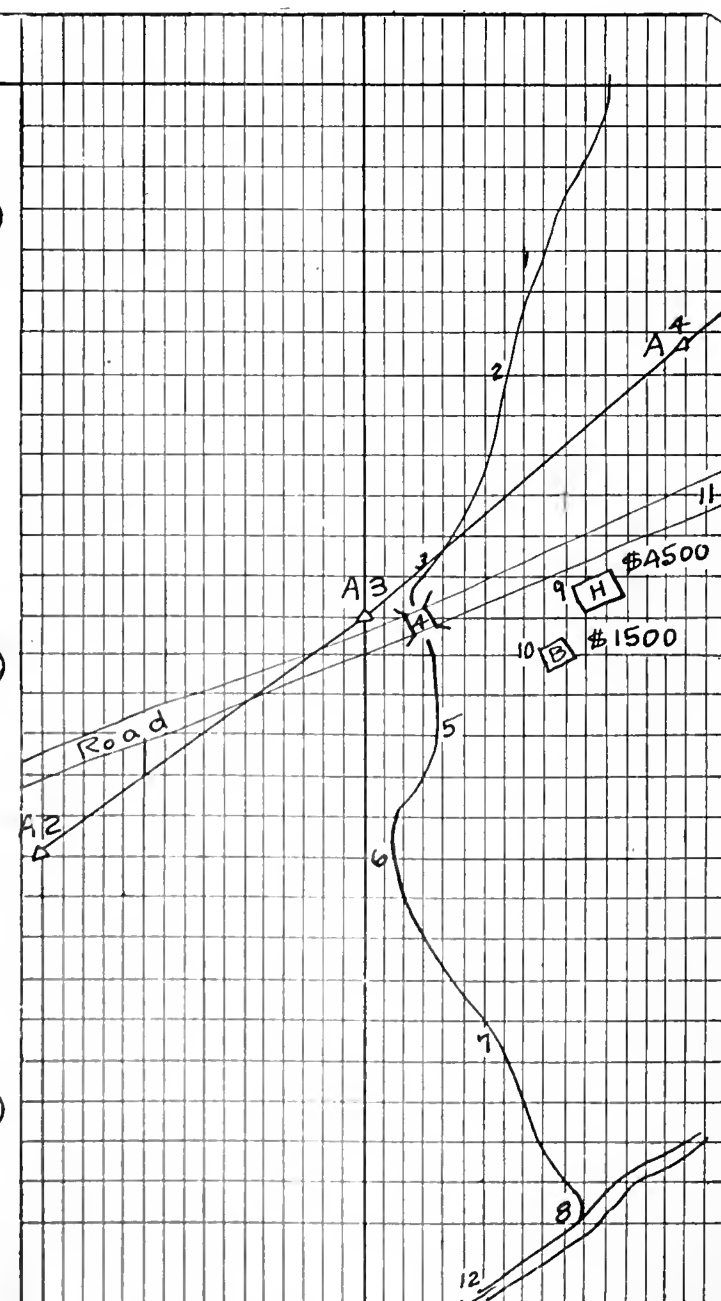
Instructor in Civil Engineering, Pennsylvania State College

COSTS and progress of the stadia surveys made for the Franklin County Conservancy District, Columbus, Ohio, were outlined by L. R. Howson in *Engineering News-Record* of Sept. 27, 1917, p. 606. A description of some of the details of the actual field work, as carried out by one of the parties, may be of interest. At the time the surveys were made the writer was assistant engineer for Alvord & Burdick and in charge of the field party making the survey of the Delaware reservoir area.

Primary transverse lines were run by stadia, the double-deflection method of measuring angles being used. Stadia distances were read in both directions on each line, the mean of the two readings being taken, or the checked-back reading in each case of apparent error in the forward reading. Levels were carried by transit. One tripod leg was graduated to indicate the height of the instrument above the hub when the point of the plumb bob was swung over to that leg. Level readings were taken in both directions on each line, and the difference of elevation was computed in both directions for each line, the mean of these differences of elevation being adopted. Where level readings could not be taken, the upper or lower cross-hair was read and the half interval applied. Vertical angles were seldom necessary on the primary line. Frequent level checks were had at United States Geological Survey bench marks. Primary traverses averaging 15 miles in length were easily kept within an error in minutes of angles of one-half the length of traverse in miles and within a linear closure of 1 in 1500, while levels always checked between Geological Survey bench marks as well as five-hundredths of the length of the levels in miles.

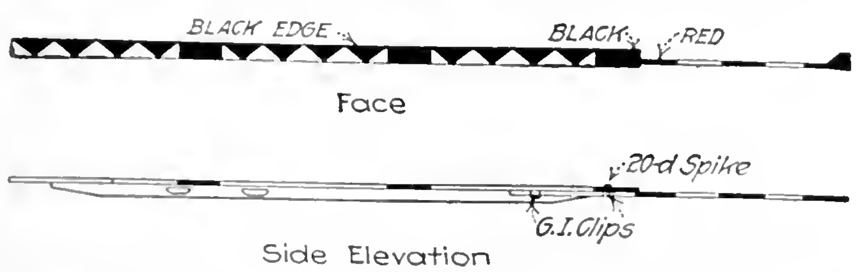
The transitman was provided with a referee's whistle, for signalling to the rodman. Each rodman carried a strip each of red, white and blue signal cloth. The red cloth tied in a single simple knot near the top of the rod indicated the bottom of a ditch, creek or ravine watercourse; the white cloth similarly placed meant a river bank or a road center line; the blue indicated a fence-line intersection; the hat held in the hand and waved or placed on top of the board meant the corner of a building. These signals were necessary, because one cannot call shots half a mile, and it is impossible to tell at that distance whether the rodman is at the corner of a building or 100 or 200 ft. nearer on line with it.

Sta.	Shot	Az.	Dist.	Rod	Chg.	Elev.
A3	HI=4.96 LHI=975.2				+3.69	970.27
	A2	44-26	520	8.62	-3.66	
	A4	225-20	462	3.27	+1.69	
	dh 1	205 —	450	4.3		970.9
		165-30	500	3.2		972.0
	dh 2	215-30	300	4.7		970.5
	dh 3	261-45	80	5.3		969.9
	br 4	330-20	108	2.7		972.5
	dh 5	337-30	215	5.9		969.3
	dh 6	1-20	305	6.6		968.6
		7-30	455	4.8		970.4
	dh 7	332 —	470	7.3		967.9
	dh 8	320-10	610	8.0		967.2
	Ho 9	300-20	210	2.8		972.4
	B 10	325-30	225	3.1		972.1
		327 —	510	4.7		970.5
	℄ Rd 11	266-20	400	3.5		971.7
		180 —	800	Th 2.5 −1.5		976.7
		176-20	1010	Th 2.3 − 2.7		977.9
		181-30	1420	Th 2.7 −4.4		979.6
	dh 12	334 —	865	10.2		965.0
		183-20	1680	+0°-21′	+10.3	980.6
A4	HI=4.[illegible] LHI=976.9				+1.67	971.94
	A3	45-20	465	6.57	-1.65	
	A5	227-19	1015	2.79	+2.13	
		180-20	800	2.3		974.6
		179 —	520	3.7		973.2
		177-30	305	4.2		972.7
		330 —	155	6.3		970.6
		271 —	210	5.1		971.8



REPRODUCTION OF FACING PAGES TAKEN FROM NOTEBOOK—LOOSE-LEAF PAGES USED

In shots taken on the rod the following order was observed: Distance and level readings were taken and *remembered;* the rodman was signalled to move to a new point (one blast on whistle for Rodman No. 1 and two blasts for Rodman No. 2); the level reading and distance recorded and the azimuth read and recorded before the instrument was disturbed. If the level reading was taken the distance had been read on a



FIFTEEN-FOOT STADIA BOARD WITH EXTENSION

shot it would be taken first on the next shot, thus saving the time necessary to reset the bubble. Three blasts on the whistle indicated that Rodman No. 1 could not be seen and four blasts that Rodman No. 2 was not visible.

Inclement weather caused practically no loss of time. Each rodman was provided with a rainproof coat. A large wagon umbrella which had been treated with a coat of boiled linseed oil was used to protect the transit and the transitman during rain or snow. The umbrella was mounted on a sharpened oak post driven into the ground near the station and was carried between stations by the rodman giving backsight.

A system of rectangular coördinates was established for the area to be surveyed, and primary traverses were computed and adjusted before the plotting of topography was started. Secondary or topography lines were computed by slide rule. Having the coördinates of the primary stations previously established greatly simplified the work of adjusting and plotting the secondary lines.

A sketch, showing the station occupied, the back station and the forward station, was required for each topography point used; the top of the page being always oriented to the north. The form of notes kept is illustrated by the accompanying facing pages reproduced from the notebook.

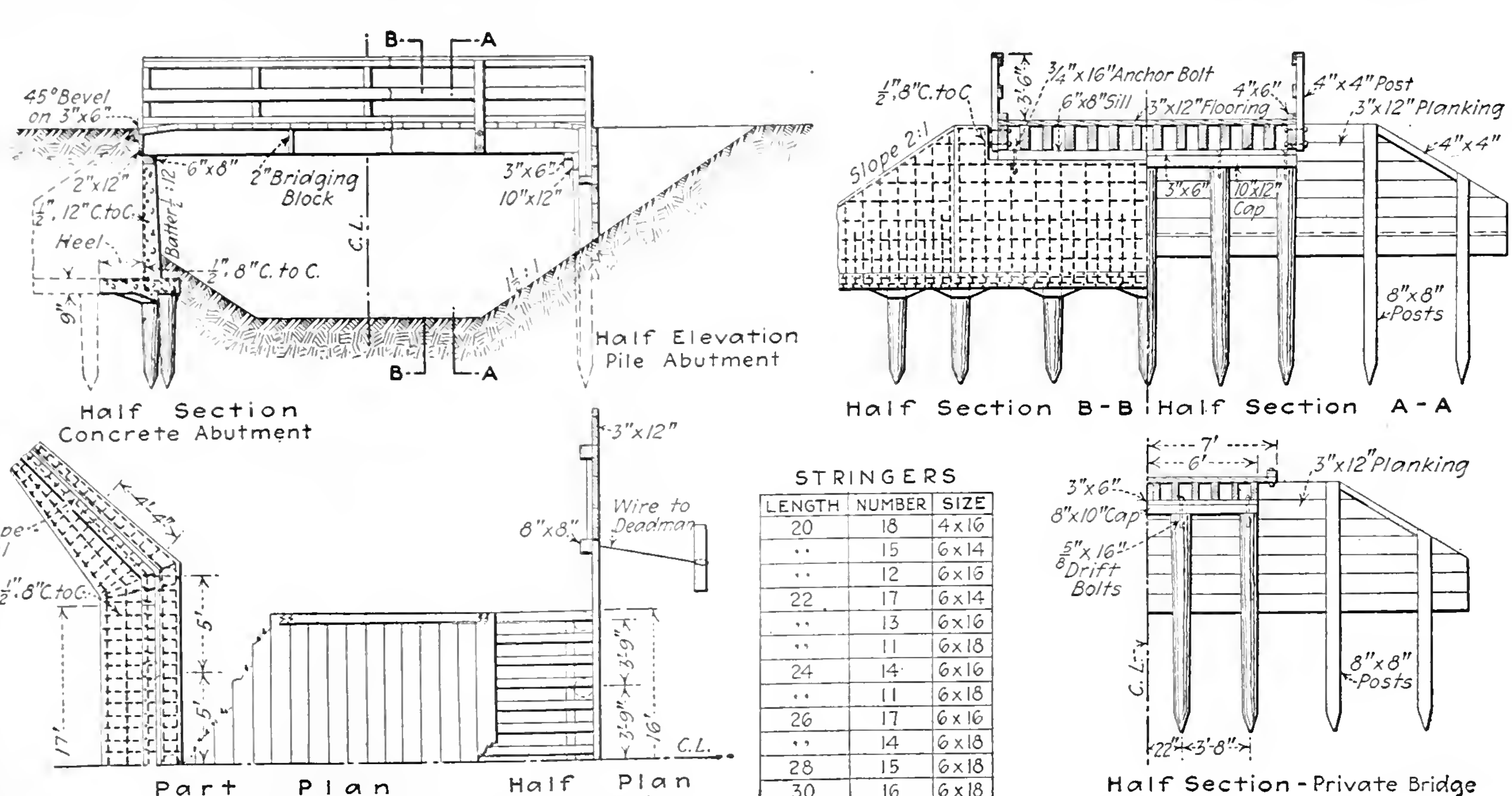
Standard Bridge Abutments on Canal Projects

Two Types of Abutments, Reinforced-Concrete and Timber Pile, Are Used on Rio Grande Irrigation Development

By D. C. Willett
El Paso, Texas

ONE of the most serious problems in the Rio Grande project in New Mexico and Texas has been the construction of satisfactory foundation in the quicksand which underlies the surface soil throughout the region. On all main highways of the Reclamation Service, substantial timber bridges are being installed, usually with reinforced-concrete abutments of the type illustrated herewith, instead of the heavier gravity type of plain concrete walls. In this soil, piling is necessary, the piles being easily jetted into place.

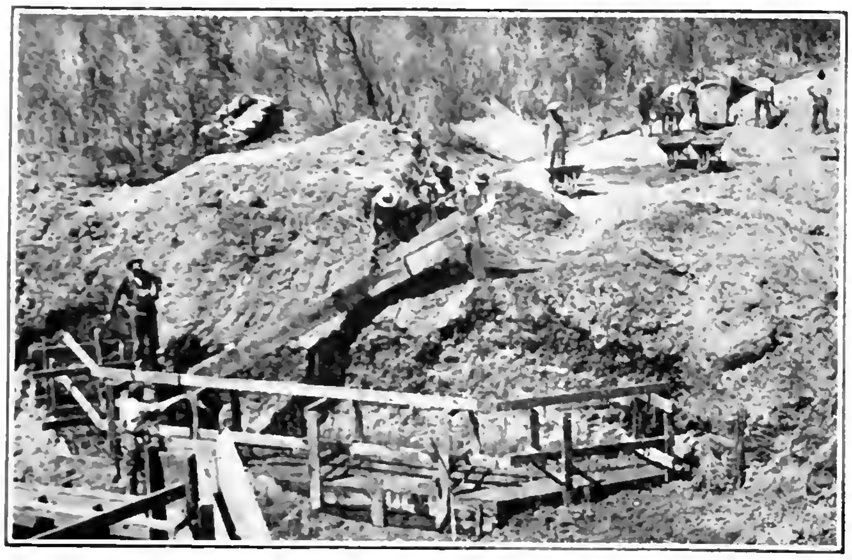
The reinforced-concrete abutments, one of which (on the Borderland Road at Nemexas drain in the Mesilla valley) is illustrated here, are designed to have a base width of 70% of the height. The heel for a 6-ft. height is 2 ft. 4 in., and for each foot of height added or subtracted 4 in. are added or subtracted for the base. The wing wall is made at an angle of 45°, the length depending upon height and local conditions, the top generally having a slope of 2:1. Reinforcement is used as noted on the drawing, but for higher and lower walls the steel is spaced according to the United States Reclamation



STRINGERS

LENGTH	NUMBER	SIZE
20	18	4 x 16
..	15	6 x 14
..	12	6 x 16
22	17	6 x 14
..	13	6 x 16
..	11	6 x 18
24	14	6 x 16
..	11	6 x 18
26	17	6 x 16
..	14	6 x 18
28	15	6 x 18
30	16	6 x 18

DETAILS OF THE TWO TYPES OF ABUTMENT USED FOR HIGHWAY BRIDGES



CONSTRUCTION OF REINFORCED-CONCRETE ABUTMENT

Service standards. The length of the pile below the concrete is varied to suit conditions, but the minimum is 5 feet.

The pile abutments are designed as shown; in the case of quicksand extra sheeting is carried down to several feet below the surface of the slope. The length of piles varies with soil conditions encountered, but the minimum is 12 feet.

The work shown in the photograph was done by the Government force, with L. R. Fiock as superintendent.

Algae Cause Taste in Fort Worth Water

By Robert H. Craig

Captain, Sanitary Corps, United States Army, Camp Sanitary Engineer, Camp Bowie, Texas

ALGÆ growths give the water-supply of Fort Worth so much vegetable taste in the summer and autumn months as to necessitate special treatment. Copper sulphate having proved to be inadequate an aëration basin is being built.

The water-supply is drawn from Lake Worth, an artificial reservoir formed by damming the west fork of the Trinity River. The lake has a capacity of 35,000,000,000 to 40,000,000,000 gal., an area of nine square miles and a drainage area of 1800 square miles.

Samples of water collected in November, from within a radius of a half mile of the water intake, showed the following microscopic organisms:

Diatomaceæ	*Navicula*
Chlorophyceæ	*Spirogyra*
	Pandorina
	Hyalotheca
	Closterium
Cyanophyceæ	*Gloeocopsa*
Protozoa	*Arcella*
	Paramaecium
Crustacea	*Diaptomus*
	Cyclops

Tumblerfuls of water collected from the top of the filters at times showed hundreds of crustacea.

The water from the lake flows six miles through a concrete pipe line six miles to the filtration plant. Iron and lime is used as a coagulent and liquid chlorine as a disinfectant.

After filtration the water often has a stronger taste than the raw water, giving rise to the belief that filtration breaks up the minute particles of the algæ and causes the vegetable oils to be diffused through the filtered water. The taste in the system is the same as the taste in the lake, showing that the application of chlorine does not make any alteration in the kind of taste.

It was the intention of the municipal authorities to clear the bed of the lake of trees and underbrush but not to strip the land, as the cost would have run into prohibitive expense. Some of the trees were removed, but difficulty was experienced with the contractors, and the lake was filled up without stripping and with little clearing.

Thousands of trees were covered with the water, and many are partly submerged and partly exposed. The theory was advanced by some that the taste was due to vegetable decay of the trees, forming such products as tannic acid, but as the taste disappears after the autumn "turnover" it would seem that the taste is entirely due to algæ. This belief is strengthened by the fact that handfuls of the algæ growths have an odor which corresponds to the taste noticeable in the water.

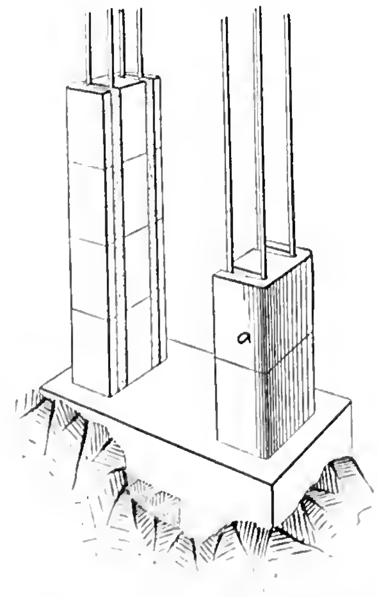
Attempts were made to rid the water of the taste by dragging bags filled with copper sulphate through the water from the rear of a motor boat, within a radius of three-quarters of a mile from the water intake. The "draw-off" level at the intake was also changed. These measures helped somewhat, but did not eliminate the taste.

An aëration basin is being constructed at the filter plant, designed by John Gregory, consulting engineer, Baltimore, Md. It is a shallow basin with 64 aëration nozzles spraying the water into it. The aëration will undoubtedly better the condition, and it is hoped will get rid of the taste entirely.

Reinforced-Concrete Columns of Precast Pieces

PRECAST concrete pieces of similar size and shape to the usual concrete block have been used in France recently to build up reinforced-concrete members, notably columns.

A typical detail of a column is illustrated herewith in the accompanying sketch. Each of the concrete pieces as shown is about 10 in. high and weighs about 20 lb., so it can be lifted into place by hand. In operation, a concrete base is poured in place and rods are left protruding from the base in such location as to form a reinforcement for the column. The E-shaped blocks with their two grooves to surround the reinforcement are then slipped into place, and the column is built up with mortar joints. After it has reached the proper height the grooves into which the rods slip are filled with poured concrete. A number of details have been devised for column connections and for various types of construction. The method is described in a recent issue of *Le Génie Civil.*



PRECAST CONCRETE COLUMNS

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

"Engineering News" Book Index Completed

INDEX TO "ENGINEERING NEWS" FOR THE YEARS 1919 TO 1917 INCLUSIVE—Compiled by Nathan C. Rockwood, Assoc. Am. Soc. C. E., Formerly Associate Editor of *Engineering News*. New York: McGraw-Hill Co. Cloth; 6 x 9 in.; pp. 469. $3 net or $6 in combination with indexes for 1890-99, 1900-04 and 1905-09.

The publication of this volume completes the series of uniform consolidated indexes to *Engineering News* from 1890 to the close of March, 1917. The four volumes in the series are as many keys or guides to the history of civil engineering and construction for the 17 years preceding our entrance into the great war. The three earlier volumes, all fortunately still in print, covered the periods 1890-99, 1900-04 and 1905-09.

In the preface to the 1905-09 index it was stated: "This book is not 'an enterprise of profit' . . . it is published solely for 'the convenience of the users of *Engineering News*.'" The same is true of the present volume. It is designed to make easily and quickly accessible the contents of thousands of pages of *Engineering* News, from 1910 to its consolidation with *Engineering Record*.

Like the earlier volumes, the fourth is a carefully classified subject index, with liberal use of cross-references. The author had the advantage of intimate knowledge of the contents of *Engineering News* during the period covered, a knowledge acquired by service both on its editorial staff and as indexer of its half-yearly volumes. The general plan of the earlier indexes, made by a trained indexer under the guidance of the editors, has been followed by Mr. Rockwood, because long use has proved its value and also to make the whole series uniform in style, so all four may be used together with ease.

An idea of the wealth of material on leading topics made more quickly available by the 1900-17 index may be given by noting that Bridges, with its subclassifications, fills 22 pages; Buildings, nine; Canals, seven; Concrete, 15; Dams, nine; Engineers, eight; Railways, 26, not counting six pages on electric railways and electrification of steam railways; Roads, 19, besides three pages on Highways; Sewage Disposal and Treatment, nine; Surveying, nine; Tunnels, six, not counting three pages on Subways; Water Purification, seven; Water-Supply and Water-Works, 12.

The wide range of topics and a further idea of the large number of references included are indicated by the fact that aside from the 12 heads already mentioned as filling six to 26 pages each there are 35 or more that fill at least two pages. These heads are: Aqueducts, Arches, Cement, City Planning, Columns, Contracting, Drawing, Engineering and closely related matters, Engineering Schools, Flood Protection and Floods, Foundations, Garbage, Irrigation, Locomotives, Motor Trucks, Municipal, Patents, Piles, Pipe, Pumps, Rails, Reservoirs, Retaining Walls, Rivers, Sewerage, Ships, Steel, Subways, Tanks and Standpipes, Typhoid, Valuations, Viaducts, Water Power, Wharves and Docks.

Thoroughness is evidenced by not only the cross-references already mentioned but also by the inclusion of news notes of permanent value. To save the reader from being mislead, the notes are designated by the letter "n." As a further guide to be found under the separate entries the approximate number of words in each article of 500 or more words in length is given. Editorial discussion and letters to the editor are designated by abbreviations in parentheses.

Before concluding, it may be noted that an index to the first 17 years of *Engineering News*, 1874-90, was published in 1891 as a thin volume of 118 pages. It has long been out of print. Moreover, having been made before the days of trained indexers, this early volume is not satisfactory. Fortunately, the later and more important part of the period is covered by the valuable "Descriptive Index of Current Engineering Literature, 1884-1891," prepared under the direction of the late Prof. J. B. Johnson for the Association of Engineering Societies, and since continued as "The Engineering Index."

Finally, it is a pleasure to announce that it is the intention of *Engineering News-Record* to publish consolidated indexes to its contents at five-year intervals, thus carrying on without a break the work of making readily available the record of engineering practice and progress pursued for so many years by *Engineering News*. This, the editors feel confident, will encourage subscribers to preserve and bind their volumes, a practice which already prevails to a large extent but might well be extended with advantage.

Asphalts Broadly Treated

REVIEWED BY A. W. DOW

Consulting Paving Engineer, New York City

ASPHALTS AND ALLIED SUBSTANCES: Their Occurrence, Modes of Production, Uses in the Arts, and Methods of Testing—By Herbert Abraham, B.S. of Chemistry, Member A.C.S., S.C.I., A.S.T.M., I.A.T.M. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 606; illustrated. $5

There is hardly a subject with which the engineering profession has to deal that is more difficult to inform oneself on than the technology of asphalts and allied materials. What little has been written on this subject is scattered through numerous magazines, proceedings of societies and Government publications, many of which are out of print or inaccessible to the large majority. Mr. Abraham has gone far to remedy this difficulty by abstracting the literature on this subject and compiling it with considerable information from well known authorities and original data of his own.

The book is divided into five parts. In the first is a short history of the early discovery and uses of bituminous materials, and the classification, terminology, chemistry and geology of bituminous substances. The terminology and classification appear to be entirely original with the author, as is usually the case in all books published on this subject. Part II deals with semi-solid and solid native bituminous materials, their occurrence and methods of refining. Under this heading are classed such materials as ozokerite and other mineral waxes, pure native asphalts and those associated

with more or less mineral matter. gilsonite, grahamite and allied materials, elaterite, wurtzilite, albertite and bituminous shales. The third part takes up tars and pitches and their production from wood, peat lignite, bituminous shale, fatty acid and bone tar. It also deals with petroleum, its refining, and products made therefrom, such as all grades of burning oil, paraffine wax, wax tailings, residual oils, asphalt both straight run and blown, and pitches formed as byproducts in the manufacture of various petroleum products. The fourth part treats manufactured products from the various pitches and bitumens, and their application and uses in the arts, such as paving, waterproofing, roofing and paints. The fifth part deals exclusively with the methods of testing bituminous materials.

The book is comprehensively written, and the subjects are succinctly described and well illustrated by photograps and diagrams. As the work covers a very large field, many of the topics are of necessity greatly condensed, but the author has given preference to those topics concerning which little has been published, such as fatty-acid pitches; bituminized roofings, floorings and other fabrics; bituminous paints, cements, varnishes and japans.

As is to be expected in a book covering so large a field, there are a number of misstatements in various sections. These, in the majority of cases, are of minor importance and do not detract from the value of the work. There are, however, a few that should be commented on, as, for instance, in speaking of the steam distallation of oils for the production of asphalt, the maximum temperatures stated as those to which the stills are heated are entirely too low. Excellent California asphalts are often made at temperatures much over 700° F. It is also the custom in the production of high-grade asphalts from Mexican petroleum by steam distillation to carry the temperature considerably over the maximum stated by the author, and it is doubtful whether a practical run could be made at so low a temperature.

The description of the different grades of California asphalt under the designations A, B, C, D and E are very misleading. In the first place, the limits of the penetration of the different grades are not those usually in use, although there is considerable variation in this respect with different manufacturers. The description of how the different grades chew is very misleading. A material of 15 penetration will not grind between the teeth but will chew hard, while a material of 50 penetration will chew quite soft, and 75 penetration is about as soft as can be chewed without sticking to the teetn.

The statement relative to sheet-asphalt paving, where the author says, "Neither the dust nor bituminous cement should be present in excess, as these tend to make the mixture too smooth to form a proper bond with the foundation," is incorrect. In the first place, the normal mixture of a sheet-asphalt pavement does not adhere to the foundation and, contrary to the statement of the author, an excess of bitumen would tend to cause the mixture to adhere. The objection to the use of too much bitumen is that is produces an unstable, soft pavement.

The average penetration of the bituminous cement for sheet-asphalt paving is given as 35 to 77° F. This is very much too low, and is only used in pavements for the very heaviest traffic. Fifty-five penetration is about the average. The limitations of penetration at 32, 77 and 115° F. of the bituminous cement for bituminous macadam are so limiting that they exclude many of the better-grade asphalts. Several other tables giving the physical characteristics of asphalt are also open to this criticism.

The method described of laying wood block in a tar cushion, if followed, would be likely to result in having the pavement slide around on the foundation. The safest way, and the one that has been adopted as standard of late, is to coat the smoothly prepared foundation with as thin a layer of coal-tar pitch as possible and lay the blocks directly on this and not on a thick pitch cushion sprinkled with sand.

The book will be found of value to all who are interested in the subjects treated. Engineers, architects and contractors can inform themselves on the technology of bituminous paving, waterproofing, roofing, paints, insulation, etc., and on the origin and processes of manufacturing the various ingredients used in these arts. The manufacturer of products in which bituminous materials are used can enlarge his knowledge on how such substances are produced and of their chemical and physical properties, which knowledge may enable him to improve his own products. The technologist will find the book of value as a ready reference for methods of analysis and for the preparation of bituminous compounds. The many references throughout the text add greatly to the value of the book, and will be found most helpful to anyone wishing to make a more thorough study of the subject. Another excellent feature is the system used throughout the book of placing a number opposite all results of tests.

Water Disinfection by Chlorination

By Frank E. Hale

Director of the Mount Prospect Laboratory, Brooklyn, N. Y.

CHLORINATION OF WATER—By Joseph Race, F.I.C., City Bacteriologist and Chemist, Ottawa; Captain Canadian Army Hydrological Corps; Member of Committee Standard Methods of Analysis, American Water-Works Association. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 158; illustrated. $1.50.

The author has filled a niche which needed filling. Though this is a small book, every phase of chlorination seems to be covered. Many interesting and useful data have been gleaned from the numerous scattered publications containing information on the subject. Much original work is also included. At the end of each chapter is a short bibliography.

It is perhaps natural that the author should give credit to England for first employing chlorine in the disinfection of water, at Lincoln, in 1904-5, although it was in America, since 1908-9, that the importance of the method was first realized and low dosage utilized, so much so that London commenced only in 1916 to chlorinate its supply and Europe, as the book states, did not realize its importance until the war necessitated such action.

In the second chapter is brought together considerable interesting evidence on the old question as to whether oxygen or chlorine is the important active element in the hypochlorites. Such evidence as is contained in Table III appears to be inconclusive, as insufficient data are included. For example, permanganate in acid solution yields five oxygen atoms, in alkaline solution only three. No mention is made of the conditions of the experiment. The table shows the effect of relative stability, or rapidity of action, of two oxidizers rather than the amount of relative work done, since after

sufficient time the results are alike for practically the same oxygen content.

The chapter on dosage throws a considerable light on the effect of organic matter, temperature, admixture, time and light. Particular attention should be paid by operators to the statement on admixture, pp. 41 and 42.

Aftergrowths receive several pages in the chapter on "Bacteria Surviving Chlorination." The absence of sanitary significance is mentioned. The chapter on "Complaints" is particularly complete, referring not only to taste and odor and means of correction, but also to the effect of chlorination on fish life, plants, animals and corrosion. The chapters on "Bleach Treatment" and "Liquid Chlorine" contain information probably more generally familiar. So up to date is the book that reference is made to the mobile motor-truck filter and sterilization units employed by the United States Army late in the war. Possibly not so familiar is the chapter covering the electrolytic processes. The Montreal plant is described, with cost data.

The chapter on "Chloramine" (which employs ammonia with bleach) contains the results of this very recent method of chlorination developed by Race. Judgment upon this method must be withheld, since the most recent tests of its efficiency tend to show very little or no greater efficiency than that obtained by other forms of chlorine. Particularly important is the question of cost as well as the handling of two solutions instead of one. Its effect on aftergrowths may be due to greater stability. Under "Results Obtained" the author lays stress on reduction in cost of filtration by the use of chlorine and consequent increase in filter capacity by increase of load. The last two pages contain a very sane statement on the limits of use of chlorination.

The author deserves praise for producing so readable a book, covering so much ground in so few pages.

The Shipbuilding Art

PRACTICAL SHIP PRODUCTION—By A. W. Carmichael, Lieutenant Commander, Construction Corps, U. S. N., Member Society of Naval Architects and Marine Engineers. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 252; illustrated. $3.

To furnish the great army of new workers in the shipyards with a sound elementary introduction to the conceptions and methods underlying the construction of modern vessels, the Emergency Fleet Corporation last year issued a little pamphlet entitled "Shipbuilding for Beginners." Precisely the same motive thought, carried out very much more fully, is embodied in the present book. It is still a Shipbuilding for beginners, but it will carry them far into the art, and is capable of developing their ideas and stimulating their thoughts in highly effective manner to the point of a live understanding of shipyard requirements.

A rough notion of what the book contains may be gleaned from the chapter headings: Requirements of Ships, General Description of Ships, Structural Members, Design, Shipyards, Preliminary Steps in Ship Construction, and The Building of Ships. The first two chapters and the one on design, except for a short section describing the materials used in ship construction, are likely to be of less immediate value to the engineer than the other five. The last named, illustrated with many sketches of structural parts, of tools, of good and defective rivets, of bending-slab operations, and other vital matters in hull construction, should prove permanently valuable in tying together the structural engineer and the shipbuilder.

Condensed Handbook of Iron and Steel

IRON AND STEEL: (A Pocket Encyclopedia) including Allied Industries and Sciences. By Hugh P. Tiemann, B.S., A.M., with an Introduction by Henry Marion Howe. Second Edition, Enlarged and Revised. New York: McGraw-Hill Book Co. Flexible Cover, Pocket Size; 5 x 7 in.; pp. 514; illustrated. $4.

Having taken a commanding position in the ironworking industries in its first edition (see *Engineering News* of Dec. 15, 1910, p. 58 of the Engineering Literature Supplement) Tiemann's glossary and manual as now revised and rewritten makes an even stronger claim to this position. The author has evidently labored with care and devotion to bring the work up to date and to give proper recognition to the increased importance of the scientific aspect of iron, as represented in metallography. Incidentally, he has amplified the contents of the book considerably, by adding mill terms used in various special branches of the art as well as by expanding the monographs on separate scientific and practical phases of the subject—as Chemistry, Rolling, Heat Treatment, Special Steels. By a short introductory outline of iron metallurgy he has, furthermore, provided a valuable means of coördination. Altogether, the result of the revision is a book that is indispensable to everyone engaged in iron metallurgy.

In its present form the book is essentially a handbook, or highly condensed treatise, with an alphabetical arrangement of sections and with a directly incorporated index. The glossary, though important, is subordinate to the special discussions of the larger individual subjects, which, though arranged in their proper alphabetical position in the glossary, form a series of chapters on the several parts of the entire subject. Of the minor items, forming in number by far the larger part but in space occupying the smaller part of the total, a great number are merely cross-index entries, which refer to the appropriate point in one of the special discussions for the definition and explanation of the term in question.

Another Novel With an Engineer as Hero

THE GREAT HUNGER—By Johan Bojer. Translated from the Norwegian by W. J. Alexander Worster and C. Archer. New York: Moffat, Yard and Co. Cloth; 5 x 8 in.; pp. 327. $1.60.

Although the hero is a great engineer, this Norwegian story keeps engineering work in the background and depicts a lifelong soul hunger which not engineering achievements, wealth, wife or children appease. The reader is told something of the technical education of the hero, and gets glimpses of his work as a builder of a dam on the Nile and later as an engineer-contractor who ruined himself financially on what was perhaps a hydro-electric plant in Norway. Finally the "great hunger" is satisfied by a simple and secret act of self-sacrifice for a man who had done a great injury to the hero. The story is simply but strongly told.

Books on Ships and World Trade

The Free Public Library of Newark, N. J., has compiled for the United States Shipping Board lists of book on (1) "Ships, Commerce and the Merchant Marine; (2) "World Trade"; (3) "Foreign Countries." Each book is briefly outlined. Prices and publishers are given. The compilations were made by Miss M. L. Prevost, under the direction of John Cotton Dana, librarian. Requests for the pamphlets should be addressed to the library.

Publications Received

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings of 28th Annual Convention, 1918—Chicago, Ill.: C. A. Lichty, Secretary. Cloth, 6 x 9 in.; pp. 196; illustrated.

THE AMERICAN YEAR-BOOK: A Record of Events and Progress for 1918—Edited by Francis G. Wickware, B.A., B.Sc. With Coöperation of a Supervisory Board Representing National Learned Societies. New York and London: D. Appleton and Co. Cloth: 5 x 8 in.; pp. 850. $3.50.

The ninth issue of this annual, like the earlier ones, has sections on engineering, Federal, state and local Government activities, public resources and public works, besides many other subjects.

BENGAL SMOKE-NUISANCES COMMISSION: Annual Report, 1917-18—Calcutta, India: The Commission. Paper; 9 x 12 in.; pp. 5. Price, 5 annas; or 6 pence.

THE COLLEGE OF ENGINEERING AND EXPERIMENT STATION, UNIVERSITY OF ILLINOIS: A Pictorial Description. Urbana, Ill.: The College. Paper; 6 x 9 in.; pp. 62; illustrated.

CONSERVATION COMMISSION, STATE OF NEW YORK: Annual Report, 1918. Albany, N. Y.: The Commission. Paper; 6 x 9 in.; pp. 205; illustrated.

DIRECTOR OF THE NATIONAL PARK SERVICE: Report to the Secretary of the Interior, June 30, 1918. Washington, D. C.: Department of the Interior. Paper; 6 x 9 in.; pp 284; illustrated.

DOMINION WATER POWER BRANCH: Annual Report, March 31, 1917. Ottawa, Canada: Department of the Interior. Paper; 7 x 10 in.; pp. 106; illustrated.

DRAINAGE IN MICHIGAN—By Dalton G. Miller and Perry T. Simons, Senior Drainage Engineers, U. S. Department of Agriculture; Prepared Under the Terms of an Agreement Between the Michigan Geological and Biological Survey, R. C. Allen, Director, and The United States Department of Agriculture, Bureau of Public Roads, [late] Logan Waller Page, Director. Prepared Under Direction of S. H. McCrory, Chief of Drainage Investigations. Lansing, Mich.: Michigan Geological and Biological Survey. Cloth; 6 x 9 in.; pp. 133; illustrated.

FIRST BIENNIAL REPORT OF THE CALIFORNIA HIGHWAY COMMISSION: A Subdivision of the Department of Engineering of the State of California; to Accompany the Sixth Biennial Report of that Department, Dec. 31, 1918. Sacramento, Calif.: The Commission. Paper; 6 x 9 in.; pp. 142; illustrated. Folding map in pocket showing state highway systems.

Reviews commission's work to date. Contains reports on the various phases of the work, tables of costs and tests of material.

GOVERNMENT OWNERSHIP OF PUBLIC UTILITIES IN THE UNITED STATES—By Leon Cammen, M. A., Associate Editor of the *Journal* of the American Society of Mechanical Engineers; Member New York Academy of Sciences, Etc. New York: McDevitt-Wilson's. Cloth; 6 x 9 in.; pp. 142. $1.50.

IRRIGATION ENGINEERING—By Arthur Powell Davis, D. Sc., M. Am. Soc. C. E.; Director and Chief Engineer U. S. Reclamation Service, Author of "Irrigation Works Constructed by the United States," etc., and Herbert M. Wilson, C.E., M. Am. Soc. C. E.; Former Chief Engineer and Irrigation Engineer, U. S. Geological Survey; Author of "Topographic Surveying," etc. Seventh Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 640; illustrated. $4.50.

LABOR LOSS: Handbook on Employment Management in the Shipyard; Dealing with Modern Methods and Practices of Employment Management. Philadelphia, Penn.: U. S. Shipping Board, Emergency Fleet Corporation. Paper; 8 x 10 in.; pp. 30; illustrated.

THE LARGER UNDEVELOPED WATER POWERS OF TENNESSEE—By J. A. Switzer, Professor of Hydraulic Engineering, University of Tennessee, and Hydraulic Engineer of the Tennessee State Geological Survey. Nashville, Tenn.: Geological Survey. Paper; 6 x 9 in.; pp. 35; illustrated.

Reprint of a paper, which was prepared for presentation at the thirty-third general meeting of the American Electrochemical Society, held at Knoxville, Tenn., Apr. 30, 1918. The expense of the field and office work was met by the Knoxville Board of Commerce.

MAN TO MAN The Story of Industrial Democracy—By John Leitch. New York: B. C. Forbes Co. Cloth; 5 x 8 in.; pp. 249. $2.

MICHIGAN STATE BOARD OF HEALTH: Forty-Sixth Annual Report of the Secretary, June 30, 1918. Lansing, Mich.: The Secretary. Cloth; 6 x 9 in.; pp. 180; illustrated.

MOTOR TRANSPORTATION FOR RURAL DISTRICTS—By J. H. Collins, Investigator in Market Surveys. Washington, D. C.: U. S. Department of Agriculture. Paper; 5 x 9 in.; pp. 32; illustrated.

On motor-express routes. Some of the topics covered are selection of the route, advance estimates of operating costs, selection of equipment, determination of rates, bills of lading, and operation methods. Interesting to both those who are now operating and those who are intending to establish truck routes.

NEW YORK STATE ENGINEER AND SURVEYOR: Supplement to the Annual Report for 1917. Albany, N. Y.: State Engineer and Surveyor. Cloth; 6 x 9 in.; pp. 470.

NOTES ON TRANSPORTATION, WITH ESPECIAL REFERENCE TO TRANSPORTATION PROBLEMS ON CANE SUGAR PLANTATIONS—By Capt. Carl B. Andrews, Engineer Corps, U. S. A. Honolulu, T. H.: Hawaiian Engineering Association. Paper; 6 x 9 in.; pp. 63; illustrated.

Water transportation in flumes and such other means of transportation as steam, electric, and funicular railways, as well as cableways, are considered. The treatment is in part descriptive and in part it gives design data. But little is given on the specific problems of moving cane, and most of that seems to be under "Flumes," where there is also considerable on flume hydraulics in general.

PRACTICAL SHIP PRODUCTION—By A. W. Carmichael, Lieutenant Commander, Construction Corps, U. S. Navy, Member Society of Naval Architects and Marine Engineers. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 252; illustrated. $3.

PRINCIPLES OF COMBUSTION IN THE STEAM BOILER FURNACE—By Arthur D. Pratt. New York: The Babcock & Wilcox Co. Cloth; 6 x 9 in.; pp. 114. Free on request.

RECLAMATION BOARD OF CALIFORNIA: Fourth Biennial Report, 1918. Sacramento, Calif.: The Board. Paper; 6 x 9 in.; pp. 53; illustrated.

Deals with progress and status of flood control in the Sacramento and San Joaquin Drainage District.

SAVING STEAM IN INDUSTRIAL HEATING SYSTEMS.—Prepared by the U. S. Fuel Administration in Collaboration with the Bureau of Mines. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 14; illustrated. 5c. from Superintendent of Documents.

SEWAGE-DISPOSAL PROBLEM OF NEW HAVEN: Report, 1918—By C.-E. A. Winslow, D.P.H., Professor of Public Health, Yale School of Medicine, and F. W. Mohlman, Ph.D., Chemist, New Haven Experiment Station. New Haven, Conn.: The Authors. Paper; 6 x 9 in.; pp. 97; illustrated.

Describes experimental sewage-treatment plant, summarizes results and gives conclusions and recommendations. In briefer form, much of the same information appeared in *Engineering News-Record*, Jan. 2, 1919, p. 32.

SMALL SAWMILLS: Their Equipment, Construction and Operation—By Daniel F. Seerey, Logging Engineer. Washington, D. C.: U. S. Department of Agriculture, Bulletin No. 718. Paper; 6 x 9 in.; pp. 68.

STATE ENGINEER OF ARIZONA: Third Biennial Report, 1916-17 and 1917-18. Phoenix, Arizona: B. M. Atwood, State Engineer. Paper; 6 x 9 in.; pp. 243; illustrated.

A cost distribution system, instructions to highway engineers and the results obtained with convict labor—which are in general satisfactory—are included with the routine reports of work done.

STATISTICAL REPORT OF LAKE COMMERCE PASSING Through Canals at Sault Ste. Marie, Michigan and Ontario, During Season of 1918; With a Supplementary Report of Commerce Passing Through the Detroit River—Prepared Under Direction of L. C. Sabin, District Engineer, U. S. Engineer Office, Sault Ste. Marie, Mich. The Engineer. Paper; 6 x 9 in.; pp. 30; illustrated.

STATISTICS OF MANUFACTURES: Report for 1917—By Charles F. Gettemy, Director of the Bureau of Statistics. Boston, Mass.: The Bureau. Paper; 6 x 9 in.; pp. 129.

TABLE OF UNIT DISPLACEMENT OF COMMODITIES—Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 67. Copies free upon request.

An alphabetical list of commercial commodities, giving the weight per cubic foot, cubic feet per long ton, cubic feet per short ton, and in many instances how the commodity is packed for shipment.

TARVIA ROAD BOOK: For Highway Engineers, Contractors and Road Builders. New York: The Barrett Co. Leather; 3 x 6 in.; pp. 70. Free upon request.

A handy pocket book primarily for the use of engineers who are applying tarvia to their roads, but containing some more general data. Among the tables are: Quantity of tarvia per mile; distance covered by various tank capacities; weight per cubic yard of various substances; spacing for covering material in half-ton piles; costs per mile at price per square yard. Also contains specifications for applying tarvia.

TESTS OF HOLLOW BUILDING TILES—By Bernard D. Hathcock, Laboratory Assistant, and Edward Skillman, Laboratory Assistant, Bureau of Standards. Paper; 7 x 10 in.; pp. 29; illustrated. Copies free upon request.

Records and discusses about 250 compression and absorption tests.

THE USE OF WOOD FOR FUEL: Compiled by the Office of Forest Investigations. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 40; illustrated. 10c. from Superintendent of Documents.

WATER STORAGE AND THE WATER CODE—By G. E. P. Smith, Irrigation Engineer. Tucson, Ariz.: University of Arizona. Paper; 6 x 9 in.; pp. 7; illustrated.

WATER SUPPLY PAPERS—Nathan C. Grover, Chief Hydraulic Engineer. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; illustrated.

No. 411: 1915. Part XI. Pacific Slope Basins in California. H. D. McGlashan and F. F. Henshaw, District Engineers. Prepared in coöperation with the State of California; pp. 345. No. 422: Ground Water in the Animas, Playas, Hachita, and San Luis Basins, New Mexico—By A. T. Schwennesen; with Analyses of Water and Soil by R. F. Hare. Prepared in coöperation with the New Mexico Agricultural Experiment Station; pp. 152. No. 427: Bibliography and Index of the Publications of the United States Geological Survey Relating to Ground Water—By Oscar E. Meinzer; pp. 169.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Send Questionnaire on Legislation

To the membership of the Montreal branch of the Engineering Institute of Canada was sent a questionnaire, in anticipation of the meeting of the committee on legislation on Apr. 5, in order to provide information for the representatives on that committee. The following questions were used:

"1. Are you in favor of a closed corporation for engineers having responsible charge of engineering works?

"2. If so, do you favor legislation embracing all engineering works, or only public works?

"3. In the event of the majority of the members of the institute residing in Quebec declaring in favor of a closed corporation, what are your opinions on the following questions: (a) Do you consider that the only method of entrance into the engineering profession should be through the engineering colleges? (b) If not, do you think that candidates who do not follow college engineering courses should be obliged to pass an examination for admission to study somewhat along the lines of the matriculation examinations required for university entrance? (c) Do you think that candidates should be required to pass an examination for admission to practice, similar to the examinations required by the bar and medical associations? (d) Should candidates be obliged to serve a period of apprenticeship or employment under an engineer before being allowed to take the final examinations for admission to practice? (The word practice is understood to mean taking responsible charge of engineering works). (e) If in favor of examination, do you consider that these should be held by the Corporation only or by a joint board of the members of the Corporation and representatives of the McGill and Laval faculties of applied science? (f) Do you consider that graduates of engineering schools should be exempted from any or all the examinations? (g) If so, from what examinations should they be exempted? (h) Do you think that graduates of engineering schools should be required to prove that they have had experience under some engineer before being admitted to take charge of engineering work?"

Western Society Studies Legislation

A "public affairs" meeting to inform the members of the Western Society of Engineers concerning bills and projects now before the Illinois legislature is the latest development in the broadening activities of the society. That it sees the need of extending the field of thought of the engineer, who has been too much centered in his technical work, and that this applies especially to the young men, was the keynote of the opening remarks by the president, A. S. Baldwin, at the recent meeting. Brief notes of several bills relating to waterways, licensing, housing and other subjects were presented by the secretary. State Senator James J. Barbour, who attacked particularly the present housing bill and some labor bills, expressed the opinion that most legislation is so bad that the community would benefit if the legislature should meet only at 10-year intervals. The housing bill was criticized in form but not in principle by H. K. Holsman, secretary of the Chicago chapter of the American Institute of Architects.

Society Backs Railway Organization Plan

A comprehensive plan for railway organization was outlined by Dean William G. Raymond at the annual meeting of the Iowa Engineering Society, and the society, believing that it contains ideas and suggestions which may be of service in the solution of the present difficult railway problem, has had the plan printed and distributed (through its publicity committee) to newspapers and periodicals. The society has also brought the plan to the attention of members of Congress, as well as of Congressional committees dealing with the subject. In general, it provides for a Federal holding company in financial control, with separate management for each property under the direction of a board on which both the stockholders and the employees are represented.

Co-operation at Pittsburgh Proposed

Engineers in Pittsburgh who are working for progress in professional organization have taken active steps toward bringing about local and state coöperation. The Pittsburgh Association of Members of the American Society of Civil Engineers delegated a committee to confer with the Engineers' Society of Western Pennsylvania with a view to associating all local technical bodies in a federation for professional service and cooperation in city and state. The latter society has the matter under advisement.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

On The Strength of Concrete in Shear

Sir—The tests on reinforced-concrete beams described in your issue of Feb. 27, 1919, p. 430, by W. A. Slater, and your editorial of the same date, would seem to warrant the use of higher units on concrete in shear than those in common use. Before adopting higher unit stresses it would be well to look into these tests and examine the results to see just what they do disclose.

On the face of it the tests seem to show that the concrete of these beams carried shears amounting to more than 2000 lb. per square inch in some cases. It must be remembered, first, that the concrete webs had failed long before this shearing value was reached, and, second, that these shearing units are a conventional thing and not the actual shear on the concrete section.

The thing that was subject to shear was a system of very closely spaced web members, unlike the stirrups in an ordinary beam both because of the close spacing and the large section. If these web members had been spaced as they usually are in reinforced-concrete beams, there would have been a chance for the beam to break between two web members, and quite a

different story might have been told of the capacity of concrete to carry shear.

The only thing of interest in tests of this sort for ship work is what the unit shear on the actual area of concrete is at the first crack, for it is the first crack of the hull of a ship that would let in the ocean. It would not matter particularly whether there was a residual strength after the first crack from shear of 10 or 20 times this real ultimate. For it is the first crack that tells what the concrete will stand, and, as Professor Talbot showed some years ago in a series of tests, stirrups do not perform any office until the concrete web has failed.

The test results show that all of the beams had cracked when the shear on the nominal resisting section was 400 lb. per square inch. How much earlier in the test this failure had occurred is not stated.

The section assumed in shear by Mr. Slater is only the web of the beam. Now, there are large heads on these beams which have an area much larger than the web. Why should a broken and utterly failed web be considered as taking so much shear per square inch when the only thing that is approximately whole is the two heads of the beams with their steel connecting web members?

If there were no concrete web whatever in these beams, they would probably take nearly the same ultimate load. This supposed shearing strength of concrete could then be increased *ad libitum* (by using a thinner web) just as some laboratory tests made some years ago attributed all of the tensile resistance in a whole reinforced-concrete beam to the reinforcing steel, and as, even at this date, the tensile resistance of flat slabs is attributed to the reinforcing steel aided by the opinions of adroit mathematicians.

Pittsburgh, Penn. EDWARD GODFREY.

[This letter was submitted to Mr. Slater, who has replied as below. Note should be made of the typographical corrections of the original article appearing in *Engineering News-Record* of Mar. 20, 1919, p. 570. —EDITOR.]

Sir—On reading Mr. Godfrey's letter, I am convinced that he failed to see the significance of the data presented in this paper, or else he ignored the data entirely. In order to bring this out, I wish to call attention to the nature of many of his statements, in approximately the order in which he makes them.

1. "The thing that was subject to shear was a system of very closely spaced web members. . . . If these web members had been spaced as they usually are in reinforced-concrete beams . . . quite a different story might have been told, etc."

The data in the paper refer to a system with closely spaced web members, and no conclusion on any other kind of system was attempted. The article in question even calls attention to the importance of extending the investigation to determine "the effect of variation of spacing of stirrups."

2. "It is the first crack of the hull of a ship that would let in the ocean." Concrete ships are not free from cracks, and yet they do not sink.

3. "Stirrups do not perform any office until the concrete web has failed."

If by "failure" he means the formation of tension cracks the statement is practically correct. But this is quibbling, for it is common knowledge that a reinforced-concrete beam has not failed when the first tension crack occurs. The test data given should remove the last doubt on this point. The first tension crack occurred at shears generally ranging from 200 to 300 lb. per square inch, while the shear at maximum load for the same beams ranged from 950 to 2400 lb. per square inch.

4. "Now, there are large heads on these beams which have an area much larger than the web. Why should a broken and utterly failed web be considered as taking so much shear per square inch when the only thing that is approximately whole is the two heads of the beam with their steel connecting web members?"

Mr. Godfrey would have found by reading the article that I recognized that the shearing stress given "must be somewhat in error, etc." The only difference of opinion is as to how large this error is. I judge that Mr. Godfrey thinks the flanges carried most of the shear. Mr. Godfrey will perhaps recall that approximately the same relation between flange area and web area exists with a steel plate-girder as with the reinforced-concrete beams under discussion; yet I doubt if he would give much shearing value to the flanges of a steel plate girder.

Mr. Godfrey assumes that the two heads were "approximately whole" when the web was "utterly failed." As a matter of fact, they were not.

5. "If there were no concrete web whatever in these beams, they would probably take nearly the same ultimate load."

Had Mr. Godfrey read the article carefully, he would have noted that beam 4AD1, which was of exactly the type to which he refers, carried 174,000 lb. less load than similar beams (4X1 and 4X2) which had concrete also in the web. That is, he would have noted that the beams with steel alone in the web carried only half as much load as one with a web having the same amount of steel and the concrete in addition.

Not only is Mr. Godfrey's statement at variance with fact, but, further, it is at variance with his own conviction as stated in the *Journal* of the American Concrete Institute for December, 1914, p. 19, where he says: "The Joint Committee report does not state whether the stress in a shear member is shear, or compression, or tension. All three are equally absurd." On this as a basis it is difficult to see why the web reinforcement in these beams carried so much load and why Mr. Godfrey now even expects it to carry so much more load than it did. Perhaps he has torsion in mind.

Philadelphia, Penn. W. A. SLATER.

Cost-Plus Contracts and Proposals

Sir—E. T. Johnson in your issue of Apr. 3, 1919, p. 683, hits the nail squarely on the head in amusing fashion. I quote his opening paragraph:

"In your issue of Mar. 6, 1919, p. 485, is a communication from J. B. Chaffey, major, Quartermaster Corps, U. S. A., Fort Sill, Oklahoma. He descants upon the beauties of cost-plus contracts. What especially interests me he does not touch upon—that is, how to get one. I am a contractor and tried hard during the war to get a cost-plus contract, not only in construction, but also in spruce production. What I received was a polite bowing out. I could not find any way at all to break in."

Here we have light, not heat. Proposals form a method of selection.

The difficulty, in my experience, is not to find one

good contractor for a project, but to select among a number of good contractors. Proposals naming price and time, from a list of selected contractors, upon properly prepared drawings and specifications by engineer or architect, are the final examination to determine the contractor best qualified, at that particular time, for the particular project.

When this method is not followed your correspondent's query, "How Were Cost-Plus Contracts Obtained?" is always pertinent.

CHARLES H. HIGGINS,
New York. M. Am. Soc. C. E.

Would Use Surrendered German Warships to Form Training Walls for Channels

Sir—The problem of what to do with the surrendered German warships seems to be causing quite a difference of opinion, and I would suggest that they might be advantageously used as jetties or training walls for the improvement of channels to obtain a greater depth of water over sandy river bars, if sunk in line on each side, taking the place of jetties constructed of logs or stone.

In this position they would serve a double purpose, not only deepening the channel for navigation, but as a monument of the great war, for all ages, and they would become a great attraction for excursionists and sightseers. The submarines and other small captured craft could well be used to fill gaps between the larger ships that might unavoidably occur in sinking them. They would all be linked together with chain cables, and the seacocks opened.

Old vessel hulks have before this time been used in this way, by engineers, on several occasions.

It seems almost a crime to sink these costly ships in the deep sea, when there are so many good uses to which they could be put and at the same time preserve them for their moral and patriotic effect on coming generations. J. FRANCIS LEBARON.

Panama City, Fla.

Draftsmen Assert Further Unfair Play on Part of Navy Department

Sir—The attention of the International Federation of Draftsmen's Unions, chartered under the American Federation of Labor, has been invited to the article in the letter columns of your issue of Mar. 27, 1919, p. 634, entitled "Navy and Fleet Corporation Unfair to Their Own Draftsmen." I am directed to request the insertion in an early issue of the following statement, in which it is desired to point out and elaborate certain points in the article referred to, and also to bring your article up to date.

The letter by William F. Fox is correct as regards the action of the Navy Department in putting into effect, for the navy yards, bureaus and other offices and stations under that department, the award for draftsmen of the Shipbuilding Labor Adjustment Board, commonly known as the Macy Board.

Furthermore, the letter of Secretary Daniels is, on its face, correct except in one particular. This particular is the last paragraph, which involves two inaccuracies. These are not placed to the discredit of Mr. Daniels, as everyone familiar with department procedure may be certain that Mr. Daniels did not write the letter himself. It is incredible that anyone familiar with the facts "believes" that the Macy Board award has been effected for Government draftsmen. The award which was effected was that of the secondary board mentioned by Mr. Daniels, the so-called Henry Board, which was based, not upon the Macy Board award, but upon the recommendations submitted by the various chiefs of bureaus, industrial managers, commandants, etc. As these recommendations were themselves a cut as compared with the Macy award, and were further cut by the Henry Board, it is easily seen that the Macy award is not in effect in Navy Department offices.

Neither letter brings out the vexatious delay resorted to by the department to avoid putting even the Henry award into effect.

The Macy award went into effect in private yards immediately upon its announcement in October and was retroactive to Oct. 1. It was not approved by the Navy Department until Nov. 12, although the original award was signed by Dr. Marshall as official representative of the Shipping Board and the Navy Department. The instructions of the department were so vague that prompt action by the various yards was impossible. Numerous letters and telegrams between the yards and the department for interpretations of innumerable points were necessary. Owing to the incompetence of the instructions, a month elapsed before any of the yards submitted its recommendations. The total delay so far was about one and one-half months.

The papers were turned over to the Henry Board late in December, but all department activity ceases during the holidays. When this board finally got to work it realized its utter inability to reclassify over a thousand men of whom it had no personal knowledge and no way of knowing the local conditions governing the recommendations for each individual. The board therefore hit upon the expedient of fixing an arbitrary average increase of $1.60 per diem, with this exception, however—yards whose recommendations showed increases averaging over $1.60 were brought down to give about that figure, but those yards whose average increase was less than $1.60 were kept where they were and not brought to this average.

The papers were returned to the department Jan. 17, and two months after the department's approval of Nov. 12. Action was then delayed until Feb. 4, owing to the personal refusal of Mr. Daniels to approve the award of his own board, his opinion being that the award was too high, although it was far below that of the Macy Board, which the Government had forced the private yards to grant some four months previously. Even then Mr. Daniels signed practically under coercion, as the temper of the men had been stretched to the breaking point, and was scheduled to break Feb. 8.

On Feb. 4, however, Mr. Daniels signed a letter putting the Henry award into effect, but as certain revisions in the recommendations were required, it was several days, and in some cases weeks, before the men received the new pay. There was no retroactive feature to compensate them for the long and needless delay.

The draftsmen did not enjoy the fruits of this award in peace for very long, however. On Mar. 13 the department issued a circular letter reducing the force 10%. This was on the eve of Mr. Daniels' departure for Europe, and the answer to all protests has been that Mr. Daniels had issued emphatic orders which could not be changed in his absence.

The reason assigned in the letter was "economy." Let us examine that reason. Draftsmen are paid from an appropriation covering several classes of employees, yet of these only the draftsmen are affected. There are about a thousand draftsmen in the Government service, and as the reduction is 10%, the saving would be the pay of about 100 men. The real reason for the reduction is found in the last part of Paragraph 1 of the letter of Mar. 13, as follows:

"If it is desired to retain the services of any draftsman with a civil-service status, selected for separation in his particular grade, in a lower grade, he may be so reduced only upon his own application or consent, but he shall be considered among the total number of draftsmen in such lower grade in figuring the percentage reduction in that grade."

This is the kernel. The object is to reduce wages and to deprive the draftsmen of the benefits awarded them by an impartial board appointed by the President of the United States. They are offered the choice of having their pay reduced or of losing their jobs in these times of unrest and at the very time when the Government is appealing to private firms to furnish jobs for the unemployed.

INTERNATIONAL FEDERATION OF DRAFTSMEN'S UNIONS,
By Anthony F. Oliver, President; A. H. Miller, Secretary.
3304 20th St., N. W., Washington, D. C.

Motor Truck Costs Much Higher Than Generally Assumed

Sir—I have read with interest the article in your issue of Feb. 27, 1919, p. 438, entitled "Motor Truck Costs Much Higher Than Generally Assumed." It calls to mind a letter by myself published in *Engineering Record* of Feb. 13, 1915, p. 211, criticising an article in that journal describing the hauling of 400 tons of stone per day with auto trucks for 8.28c. per ton-mile. There was a marked tendency at the time to underestimate greatly the cost of auto-truck haul—a tendency which today is being largely overcome.

Data collected by me on a truck operating for a general contractor from Sept. 1, 1913, to Oct. 1, 1915, harmonize quite closely with those now published by the Motor Truck Association of America in your recent article. This truck, the operation of which furnished the data collected by me, was a five-ton Locomobile truck, which was new when it went into service at the beginning of the period described. During this period, quarter-monthly reports were made by the driver; they gave all data as to loads hauled, daily expenses, mileage, ton-mileage, accounts or individuals for whom work had been performed, etc.

In order to make a comparison of cost with earnings, it was necessary to estimate and charge on this report certain regular rates per mile traveled to care for interest, insurance, depreciation and tires. The charges for the first three of these items were lumped at 10c. per mile. This figure was obtained by dividing the annual cost therefor by the estimated annual mileage. The charge of 6c. per mile for tires was obtained by dividing the cost of a full set of tires by the manufacturers' guaranteed mileage.

The charge for interest, insurance and depreciation proved too low for this particular case, because the truck was not kept steadily engaged. It traveled only 16,242 miles in the 25-month period, and thereby, at the 10c.-per-mile rate, earned only $1624.20 for interest, insurance and depreciation. The charge of 6c. per mile for tires proved higher than necessary, because it was found easy to exceed the manufacturer's guaranteed mileage on tires. Approximately 4¾c. would have been a sufficient charge to compensate for tire expense.

The truck was engaged in a miscellaneous lot of hauling, and was seldom long at any particular line of work. The roads were almost always poor and some were almost impassable. It was necessary to provide a helper for the driver during a considerable portion of the time. Gasoline was then 17c. per gallon, as compared with 21c. now, and lubricating oils and distillate, which was used to a large extent instead of gasoline, were correspondingly cheaper. The driver was paid $4 per day and his helper $2.50.

The truck was in actual operation only 450 days, during the 25-month period, and averaged approximately 36 miles per day of operation. The table herewith gives the segregated costs:

OPERATION COSTS PER MILE FOR FIVE-TON TRUCK

Driver	$0.111
Helper	.052
Gasoline, distillate and lubricants	.068
Repairs to engine and chassis	.086
Miscellaneous expenses	.013
Charges for interest, insurance and depreciation	.100
Charges for tires	.060
Total cost	$0.490

Waterford, Calif. EVERETT N. BRYAN.

Railway Bridge Impact Allowances

Sir—Referring to the editorial on p. 454 in your issue of Mar. 6, 1919, entitled "Railway Bridge Impact Allowances," I entirely agree with you concerning the fallacy of increasing materially the impact for short spans and decreasing materially that for long ones.

There seems to be a tendency these days to change bridge specifications in most illogical ways—for instance, stressing steel 20,000 lb. per square inch for tension members and less than 12,000 lb. per square inch for short compression members, without there being any legitimate foundation for such a radical modification. While I am not at all opposed to making changes in standard bridge specifications that are really improvements, I am decidedly against altering anything therein until after it has been shown that there is a valid *raison d'être* for the innovation—especially when the suggested modification militates against true economy.

Recognizing that both of the old standard impact formulas

$$I = \frac{30,000}{L + 300} \quad \text{and} \quad I = \frac{40,000}{L + 500}$$

for railway bridges with open floors give percentages of impact which are too low for very short spans and too high for long ones, according to the A. R. E. A. tests, a few years ago I established the formula

$$I = \frac{16,500}{nL + 150}$$

where n is the number of tracks and L is the span length in feet. For single-track spans of 15 ft., which is about as short as railroad spans are made, this formula gives percentages of impact equal to 100; and very few impact records have ever exceeded that amount. At the same time, for long spans the formula holds fairly well, the curve passing above all the records taken from single-track railroad bridges. By referring

to my diagram on p. 926 of your issue of Nov. 21, 1918, the correctness of these statements will be seen: and it will be there noticed that, while the proposed A. R. E. A. formula

$$I = \frac{100}{1 + \frac{L^2}{30,000}}$$

passes above practically all of the plotted points for spans of 200 ft. or less, it drops below two of them at a span length of 300 ft. In my opinion, it gives results that are too low for long-span bridges. For instance, in a 600-ft. span the percentage it provides for the truss-chords is only 7.7, while by my formula it is 22 for single-track structures and 12.2 for double-track structures.

For short spans the new A. R. E. A. formula and mine for single-track structures coincide at a length of 16 ft. and again at a length of 166 ft.; but between these two lengths my formula is as much as 11 points lower, and averages about 7½ points lower over the whole distance of 150 ft. As my curve is above almost all the plotted points, I claim that my formula is better than the proposed A. R. E. A. formula in that it tends to economy of metal.

In considering the advisability of a general adoption of the proposed A. R. E. A. impact formula with its somewhat extravagant employment of metal for short spans, it must be remembered that the day of the electrification of main-line railroads is not far distant, and that, as far as we know at present, the impact from electric locomotives is only about one-third as great as that from steam locomotives. When the time comes for operating electric trains over bridges designed for steam live loads, there will, of necessity, be a large surplus of strength in short spans and in the floor systems of all spans; consequently, it behooves us to keep down the said surplus as much as we consistently can—and we should not be doing so by adopting for impact the new A. R. E. A. formula.

J. A. L. Waddell,
Kansas City, Mo. Consulting Engineer.

Earthwork Computations Simplified

Sir—The common average-end formula for volumes for n stations used in earthwork computations may be written in three ways, as follows:

$$\frac{A_0 + A_1}{2} l_1 + \frac{A_1 + A_2}{2} l_2 + \ldots . \frac{A_{n-1} + A_n}{2} l_n \quad (1)$$

$$A_0 \frac{l_1}{2} + A_1 \frac{l_1}{2} + A_1 \frac{l_2}{2} + A_2 \frac{l_2}{2} + \ldots . A_n \frac{l_n}{2} \quad (2)$$

$$A_0 \frac{l_1}{2} + A_1 \frac{l_1 + l_2}{2} + A_2 \frac{l_2 + l_3}{2} + \ldots . A_n \frac{l_n}{2} \quad (3)$$

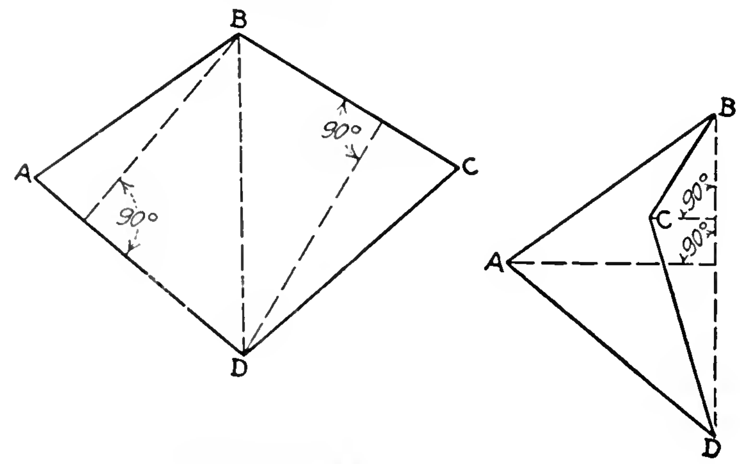
By formula 1 each section will have two areas to be added and volumes computed. By formula 2 two volumes for each station, and for substations one or two multiplications and the addition of volumes are required.

By formula 3, however, one volume is computed for each station, and never but one multiplication for a substation. The volume recorded for any station will be the section area for the station multiplied by half the distance from the previous station to the one next following. This "half distance" will of course be 100 ft. for full stations. Tables of volumes of level or three level sections 100 ft. long may be used. For calculations based on irregular areas, taken with the planimeter or otherwise, the formula is especially simple.

The writer's experience prompts the suggestion that the time saved by the use of formula 3 would justify its more extensive employment. J. H. Dorroh,
Dean, School of Engineering,
University of Mississippi.
University, Miss.

To Compute Area of Four-Sided Figure

Sir—It seems to have escaped the notice of writers of textbooks on surveying, and of computers generally, that the area of any four-sided figure may be obtained and the traverse checked in a much shorter way than by latitude and departure and the D.M.D. method. The



AREA BY SUM OF TRIANGLES

double area of any quadrilateral not containing a reëntrant angle is equal to the sine of any angle into its adjacent sides plus the sine of the opposite angle into its adjacent sides. Thus, from the diagram:

2 × Area = A D × A B sin A + C D × C B sin C

For the case of a reëntrant angle, note that in using angles A and C, the double areas of triangles A B D and C B D, respectively, are obtained. The area is then half the difference of the two products.

If now we take the other two angles of the quadrilateral, B and D, and their adjacent sides, we shall obtain the same double area, provided the traverse is correct, thus checking the first computation and the traverse at the same time.

By the D.M.D. method we should have arranged nine columns and 42 items. This method requires only about one-fourth the labor. C. K. Averill.
Bridgeport, Conn.

Quarantine Against Influenza in Alaska

Quarantine against influenza is said to have kept the disease out of Fairbanks and Nenana, Alaska. According to a statement in the *Alaska Railroad Record*, the official publication of the Alaska Engineering Commission, every person in each city had to wear on hat or coat a blue ribbon lettered "Health Department," which was purchased from the department for a fee of $1, or $2 for a duplicate in case of loss. Persons failing to obtain and wear the ribbon were subject to arrest and quarantine confinement. Civilian sentries guarded all the trails, and persons entering either city were detained five days in quarantine, being then permitted to proceed if no symptoms of the disease had developed. The fees went toward the expense of guarding the trails and quarantining travelers.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Simple Heating and Ventilating System for Contractor's Hospital

By Dr. J. M. Stadter
Wilmington, Del.

Even distribution of stove heat and uniform ventilation without drafts were secured in a knocked-together construction camp hospital by the simple arrangement of stovepipes and wind shields illustrated by the accompanying view. The hospital was a two-story timber building about 90 x 20 ft., with a ward on each floor.

Exactly similar heating and ventilating arrangements were provided for the two wards. The illustration shows the lower ward. About 65 ft. of the length of each ward was occupied by cots, the remaining 25 ft. at one end being partitioned into toilets, chart room, locker and bathroom.

Wood-burning stoves, A and B in the illustration, were set about 40 ft. apart in the 65-ft. space occupied by cots. The pipe from each stove was carried up to the ceiling at CC, and then along the ceiling about 26 ft. toward the other stove, to DD, and thence to EE, and through the walls to outside tile chimneys. With dampers set near the outside walls this arrangement gave about 40 ft. of pipe radiation from each stove, and gave a very even distribution of heat—usually difficult with stoves.

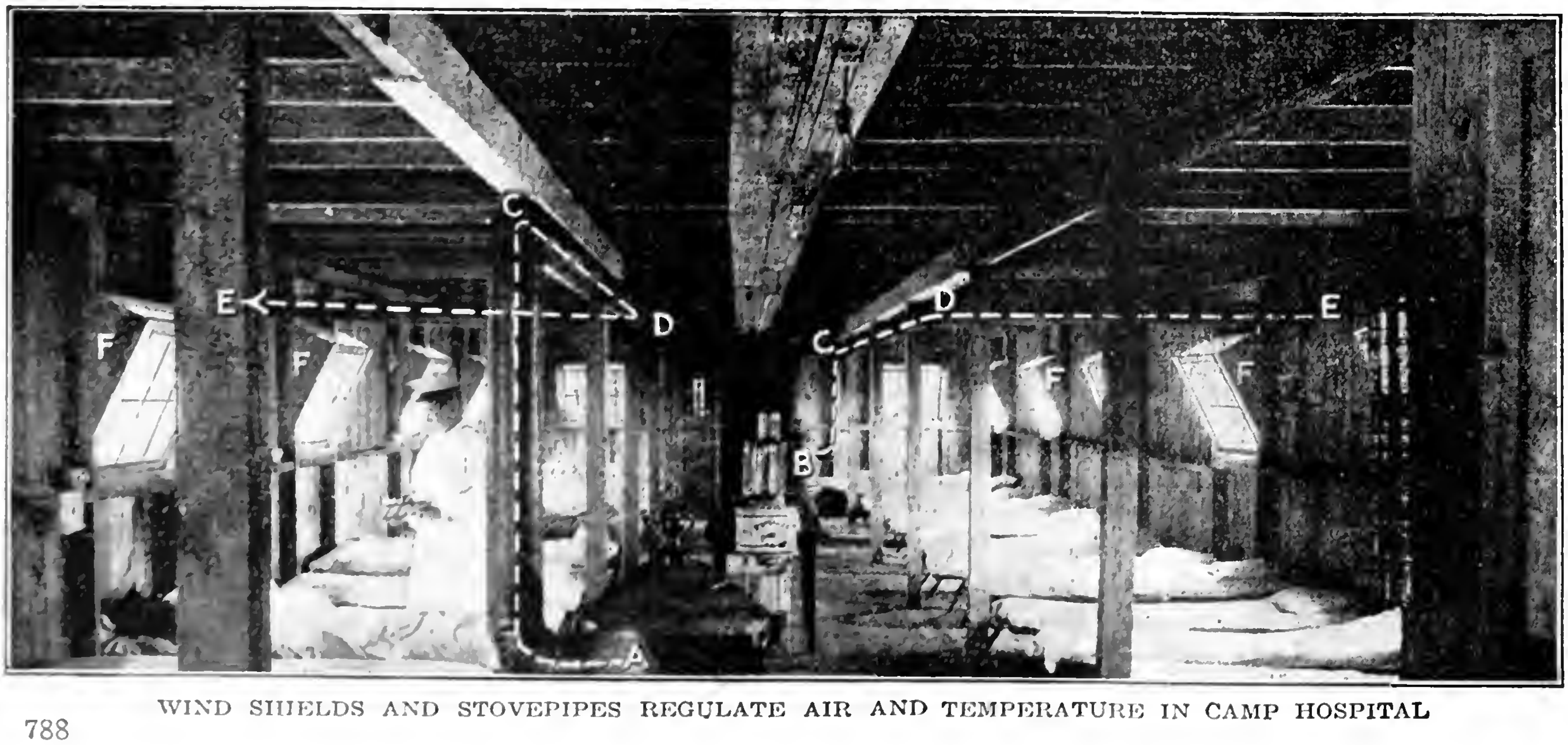
Ventilation was accomplished by equally simple means. Single sash were used for the windows and were hinged at the bottoms to swing into the room. Galvanized-iron shields were then fitted to each window as shown at FF. The air entering was deflected toward the ceiling, and a good circulation was secured without direct drafts on the cots.

This hospital has the noteworthy record, for a contractor's hospital, of having handled 285 cases of influenza, of which 124 cases were serious, with only four deaths. The hospital was constructed and equipped for operation in 48 hours. It was built at Union Park Gardens, a housing project of the Emergency Fleet Corporation located near Wilmington, Del.

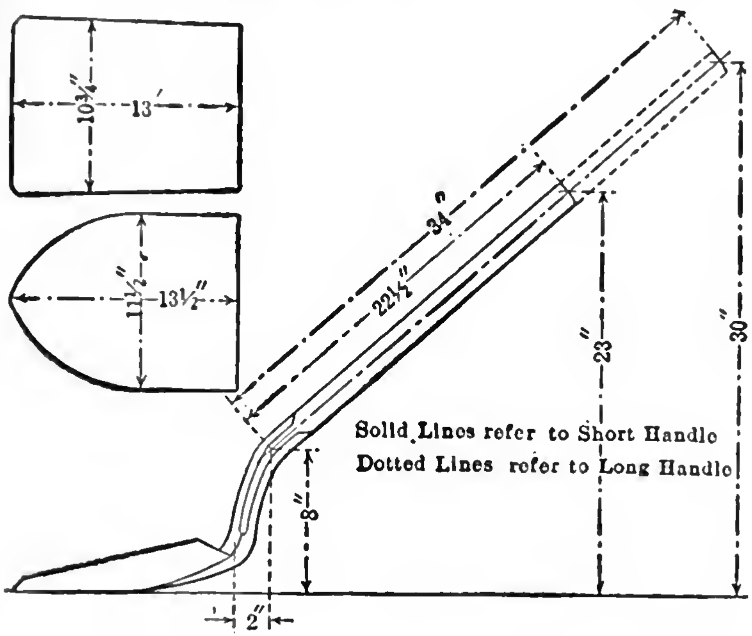
Other Articles in This Issue of Interest to Contractors:

Scoops Found Slower Than Shovels For Handling Ore

Best results applicable to construction operations such as mucking rock tunnels and loading broken stone have been determined in shoveling ore at the Tyrone, N. Y., mines of the Phelps-Dodge Corporation. Investigation was confined largely to comparison of work with No. 2 scoops and No. 4 shovels, under various conditions of loading. For jobs of less than four hours' duration a greater tonnage can be handled with a scoop, but for longer jobs the shovel is greatly superior, since, as the day progresses, the percentage of time required for resting becomes greater with the scoop than with the shovel. In general, for shovels smaller



WIND SHIELDS AND STOVEPIPES REGULATE AIR AND TEMPERATURE IN CAMP HOSPITAL



DESIGN OF SHOVEL BEST ADAPTED TO MINING WORK

than No. 4 (21-lb.) the tonnage handled per shift is, approximately, directly proportional to the shovel capacity. The design of shovel determined as best is shown by the drawing.

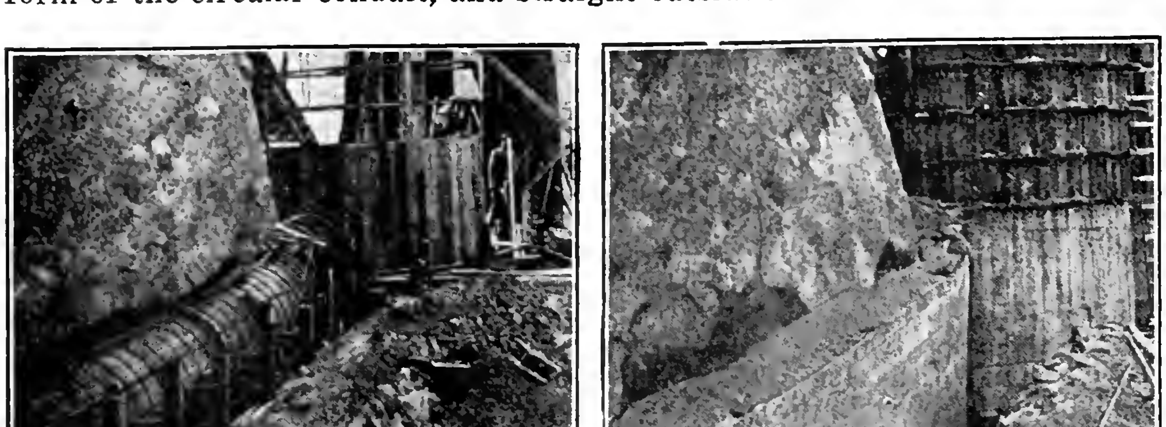
Other instructive facts brought out by the tests were: Owing to poorer light and air, greater humidity, increased temperature and other conditions prevalent underground, the tonnage handled is 20½% less than on the surface. Decrease in shoveling speed due to 1-ft. increase in distance of throw was 2½% for the scoop and 1.8% for the shovel; underground the corresponding percentages were 4.4% and 3.2%. Of a 7½-hour actual working day the men are shoveling only 82½% of the time, the remaining time being spent in nonproductive occupation. This figure is the average of several hundred man-shifts. In loading wheelbarrows a throw of 3 ft. gave the best results. In loading cars 42 in. high the best distance to maintain between car pile was four feet.

These data are from a paper by G. T. Harley, efficiency engineer, Phelps-Dodge Corporation, published in *Engineering and Mining Journal* of Mar. 15 and 23, 1919.

Wood Core Is Inside Form for Monolithic Concrete Conduit

CONDITIONS at the Gibraltar dam, near Santa Barbara, Calif., made it desirable that the concrete intake conduit should run from the intake tower upstream, beneath the shoulder of a projecting rock bluff, and through a tunnel to a point below the dam. In building the part under the overhang a bench was cut out of the rock, a wood core was placed for the inside form of the circular conduit, and straight outside forms were placed for the outside concrete wall, which was offset from the wall of the bluff.

The inside core form, of circular section resembling a wood-stave pipe, was made up of 1 x 3-in. strips nailed to circular segments and the reinforcement was attached to the core. Concrete was then poured in between the core and the outside forms. After the concrete had set the wooden core was broken up on the inside, and pieces were taken out at the intake tower end of the conduit. The contractors on the work were Bent Bros. and W. A. Kraner, the latter being in personal charge of construction.



AT LEFT, FORMS INSIDE OF CONDUIT; AT RIGHT, STRAIGHT WALL IS THE OUTSIDE OF CONDUIT

Loose Bolts for Temporary Bridge Deck

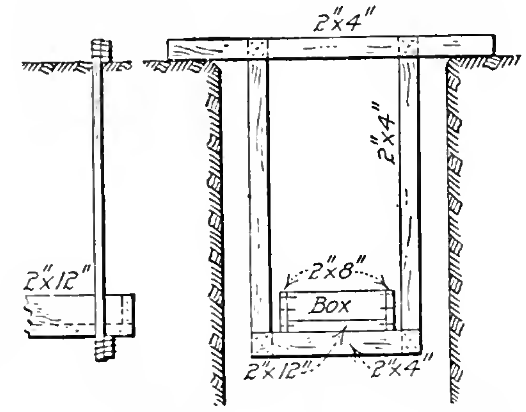
DROP bolts which resemble loose drift bolts are used in constructing temporary bridge decks on the Alaska Ry. When material for the timber trusses is not available, the deck is laid, on the falsework bents on which the permanent structure is to be erected later on, and the fastening must be such that the deck can be taken down readily and without damage to the timbers. The bolts are ½ in. and ¾ in. in diameter and 10 to 14 in. long, and the holes for them are bored to a diameter ⅛ in. larger, so that the bolts drop in easily. W. J. H. Fogelstrom is bridge engineer of the Alaskan Engineering Commission.

Portable Trench-Excavation Platform Saves Shoveling Time

By M. R. Lewis

United States Reclamation Service, Boise, Idaho

FOUR men move the shoveling platform (illustrated by the accompanying drawing) in the time it takes to walk the distance of the move, or in about one-fifth the time taken to move the ordinary trenching platform. Platforms are always necessary in making deep trenches by hand. In trenching by machine they are frequently needed for cleaning up the bottom by hand.



HANGING SHOVELING PLATFORM EASILY MOVED BY FOUR MEN

Usually, such a platform is constructed by placing a shallow box or two or three planks on the trench braces, or on wood struts wedged across the trench. To move the platform when the trench is not sheeted requires 10 to 15 min., the time needed to take down both braces and replace them a few feet farther along the trench.

The platform illustrated sets in yokes hung from the trench edges. By using the projecting ends of the top pieces of the yokes, as handles, four men lift and move the whole assemblage in one operation.

This device was used by J. A. Hoskins & Co., contractors for the Malheur Drainage District at Ontario, Ore.

NEWS OF THE WEEK

New York, April 17, 1919

Railroad Administration Plans Use of Inland Waterways

In a letter to Senator Fletcher of the United States Senate Interstate Commerce Committee, Director General of Railroads Hines has announced the policy of the Railroad Administration in the matter of inland waterways. The nub of his statement is in the following paragraph: "The attitude of the Railroad Administration with respect to the relation between water and rail competitive rates is that the rates should bear a relation to each other proportionate to the cost and desirability of the service by the respective routes and methods of transportation."

He further states that the rate structure in the United States is so complicated and of such standing that the adjustment of one portion of it inevitably affects all the others, so that there seems to be little prospect of any reduction in the rate along the waterways. What can be hoped is that there will be an easier provision for transshipment by means of through waybills and through rates. There seems to be no prospect that the Railroad Administration will do anything to foster the traffic along the New York State Barge Canal, for Director General Hines says: "The administration has agreed, if the traffic justifies it, that it will establish joint rates between responsible independent canal lines and rail carriers under Federal control by connecting points on the canal."

In answer to one of Senator Fletcher's questions Director General Hines states that in the event of the railroads returning to private ownership, in his opinion it will be desirable to continue the Federal control of the waterways under some Government agency.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

The Federal director of the United States Employment Service in New York State announces the receipt of a letter from J. P. Morgan & Co., in which $100,000 is offered for the purpose of continuing the work of the service up to July 1 of this year. The Professional and Special Section in New York will therefore be continued, but will be located at the main office, 469 Fifth Ave., New York City.

New East River Tunnel In Service

Rapid-transit operation through the new pair of tunnels under the East River at New York City, extending from Old Slip, Manhattan Borough, to Clark St., Brooklyn Borough, was inaugurated on the morning of Apr. 15. The tunnels are part of the new west side subway, formed of that portion of the old subway extending north of Forty-second St. along Broadway, and the new Seventh Ave. subway extending south from Forty-second St. through Seventh Ave., Varick St. and West Broadway to South Ferry, and branching east along Park Place, Mail St., William St. and Old Slip to the tunnels. In Brooklyn the tunnels extend to Borough Hall and connect with the old subway. At that point trains of the east side and west side subway systems meet, the former reaching Brooklyn via the original Battery tunnels, whose easterly continuation is in Joralemon St., while the west side system uses the new Clark St. route. The present extension of the west side subway across the East River thus completes the separation of the old subway into the parts south and north of Forty-second St., and the joining of these parts with the new Lexington Ave. and Seventh Ave. subways to form independent east and west side systems.

Six rapid-transit tunnels under the East River remain to be opened to traffic: Two connecting Whitehall St., Manhattan, with Montague St., Brooklyn; two connecting Fourteenth St., Manhattan, with North Seventh St., Williamsburg; and two connecting Sixtieth St. with the Queensboro Plaza.

Federal Highway Council Formed

Pursuant to the intent of resolutions passed by the Highway Industries Association, following the Highway Congress held in Chicago last December, the Federal Highway Council was organized in Chicago, Apr. 8. The work of securing the coöperation of other organizations and their representation in the movement to promote a national highway system, and to create a Federal highway commission, has been going on for months under the auspices of a joint committee, headed by the Highway Industries Association; until now some 775 civic and commercial organizations throughout the country have indorsed the plan.

The meeting in Chicago decided that the work should be placed under the direction of a board of directors and the customary officers, supported and advised by an advisory committee composed of the leaders of the principal highway organizations.

Following the discussions which determined the type of organization, the Townsend bill, introduced in the last Congress and providing for the creation of a national highway system and a Federal highway commission, was considered and indorsed in all substantial features. A number of constructive suggestions were made, such as one fathered by A. R. Hirst, state highway engineer of Wisconsin, calling upon the Federal Highway Commission to maintain the existing road surfaces on all roads designated as parts of the national highway system as soon as they are taken over. These suggestions were passed along as matters for the consideration of the committee which drafted the bill.

The officers elected are as follows: Chairman, S. M. Williams; secretary-treasurer, H. G. Shirley; vice-chairmen, Coleman duPont, David Jamieson, Charles P. Clifton, Lewis J. Hill, A. H. Blanchard and C. F. Adams.

Freight Reduced on Road Materials Consigned to Government

A reduction in freight rates on road-building material to be used on Federal, state, county, parish, township or municipal Government road work has been decided upon by Walker D. Hines, director general of railroads. This decision was reached after a consultation with the Departments of Agriculture, Commerce, and Labor. The reduction will not be allowed, however, unless the material is consigned to, and the freight thereon is paid by, the particular Government authority using

the material. The reduction will be 10c. per net ton, but a minimum charge of 40c. per net ton will be charged, except where the regular published rate is less than 40c. at the present time.

This ruling will authorize all railroads under Federal control to apply reduced rates on carload shipments of broken stone, slag, shells, chatts, cherts, sand and gravel, from May 1 to Dec. 31, 1919, where the material is to be used as outlined above. These reduced rates may be applied on shipments consigned to the Governmental unit but in care of a contractor, provided the freight is paid by the Government, and provided proper certification is made that the shipments are for the use of, and the reduction in rate will accrue to, the Government. Responsibility for administering this ruling rests with each railroad hauling such material.

Money for Hudson River Tunnel Appropriated

On Apr. 11 Governor Smith of New York signed a bill making an appropriation of $1,000,000 for beginning construction of a vehicle tunnel under the Hudson River between New York and Jersey City. A New Jersey bill authorizing the construction of the tunnel has been signed by Governor Edge. The work will be in charge of the Interstate Bridge and Tunnel Commission, 115 Broadway, New York City.

Designs Largest Concrete Arch

Minneapolis will have a concrete bridge with the longest reinforced-concrete span in the world, if the designs recently made by City Engineer F. W. Cappelen are adopted. This new bridge will be across the Mississippi River on the line of Franklin Ave., will have two end spans of 60 ft. each, two side spans of 200 ft. each, and a center span of 400 ft. The largest reinforced-concrete arch today is the Risorgimento Bridge across the Tiber at Rome, with a span of 100 m., or 328.1 ft. There was designed to cross Spuyten Duyvil in New York City some years ago a concrete arch, commonly known as the Hudson Memorial Bridge, with a clear span of 715 ft., but the project never got beyond the design stage. The Minneapolis City Council already has a fund of $50,000 from the sale of bonds for the construction of the bridge, and it is stated that work will begin as soon as possible.

Pacific Coast Ship Contracts Reinstated

Reinstatement of canceled contracts for 25 steel vessels to be built for the Emergency Fleet Corporation by the Skinner & Eddy shipyard, Seattle, Wash., is reported. It is said that the price agreed upon is less than that fixed in the original contracts.

Defense Council Reorganizes Highways Transport Committee

Reorganization of the Highways Transport Committee of the Council of National Defense is announced by Grosvenor V. Clarkson, director of the council. Direct representation for the Bureau of Public Roads and the Bureau of Markets of the Department of Agriculture, the Postoffice Department and the Department of Commerce is provided for. It is believed that closer coöperation of the departments most vitally interested in the matters of highway transportation, forming a clearing house of action for all Federal interests concerned, will thus be brought about.

Problems growing out of the entrance of the motor truck into the commercial transportation field will be one of the particular problems which the Transport Committee will take up. In carrying on this work, it will coöperate with all transportation agencies, including the United States Railroad Administration, in the study of the various problems of speedy and economical delivery of goods. Special attention will be given to the relation of the rural motor express to interurban electric lines and waterway traffic, in the interest of all elements concerned. While the regional directors of the Highway Transport Committee will still be retained, the committee itself has been reorganized, as follows:

John F. Cravens, of the Council of National Defense, chairman; James R. Blakslee, fourth assistant postmaster general; John M. Goodell, consulting engineer, Bureau of Public Roads; James H. Collins, investigator in market surveys, Bureau of Markets; R. S. MacElwee, second assistant chief of the Bureau of Foreign and Domestic Commerce; Charles W. Reid, executive secretary, and Grosvenor V. Clarkson, director of the council, member ex officio.

The committee will be assisted by the Highways Transport Committee Advisory Board, consisting of William Phelps Eno, of Washington, D. C.; A. H. Blanchard, of New York; C. A. Musselman, of Philadelphia; Raymond Beck, of Akron, Ohio, and John T. Stockton, of Chicago.

Government Bureaus Do Not Agree on Steel Prices

Reduced prices for steel and iron, proposed by the Federal Industrial Board and agreed to by the steel producers, have been unsettled by the refusal of the Railroad Administration to approve them as being reasonable prices. Director General Hines has stated that he does not consider that there was any power conferred on the Industrial Board to impose any prices upon the Railroad Administration, and that the representative of the Railroad Administration who was in attendance in the conference which fixed the prices at no time approved of the decision. On behalf of the Industrial Board, Chairman G. N. Peek in a public statement defends the price established by the board and complains that Director General Hines is unreasonable in stating that in his opinion the prices are too high. Mr. Peek says the situation has become so involved it must be settled by the President.

Conference on City Planning in Buffalo May 26-28

The eleventh annual national Conference on City Planning will be held May 26-28 at Niagara Falls and Buffalo, under the auspices of the American and Canadian cities and towns of the Niagara frontier.

The conference will meet two days at Niagara Falls and will then consider city-planning problems of growing industrial districts. There will also be discussed the problem of regional planning and the regulation of railroads as affecting civic development. On the third day of the meeting in Buffalo, residental zoning and civic centers will be discussed.

Flavel Shurtleff, 19 Congress St., Boston, is secretary of the conference.

Better Pay for Oklahoma Engineers

Authority for salaries of $4200 per year for the county engineers of Tulsa and Oklahoma Counties was one result of an endeavor of the Oklahoma Society of Engineers to persuade the legislature to increase the pay of county highway engineers in general. It was proposed to change the pay from $5 per day, which the present law grants for time allowed by the county commissioners, to a sliding scale of salaries based upon county valuation. A bill was drawn originally to apply to Tulsa County only, but it was shown that some counties, in order to keep their engineers, were paying them (for extra services) $720 per year in addition to the $5 per day allowed by law.

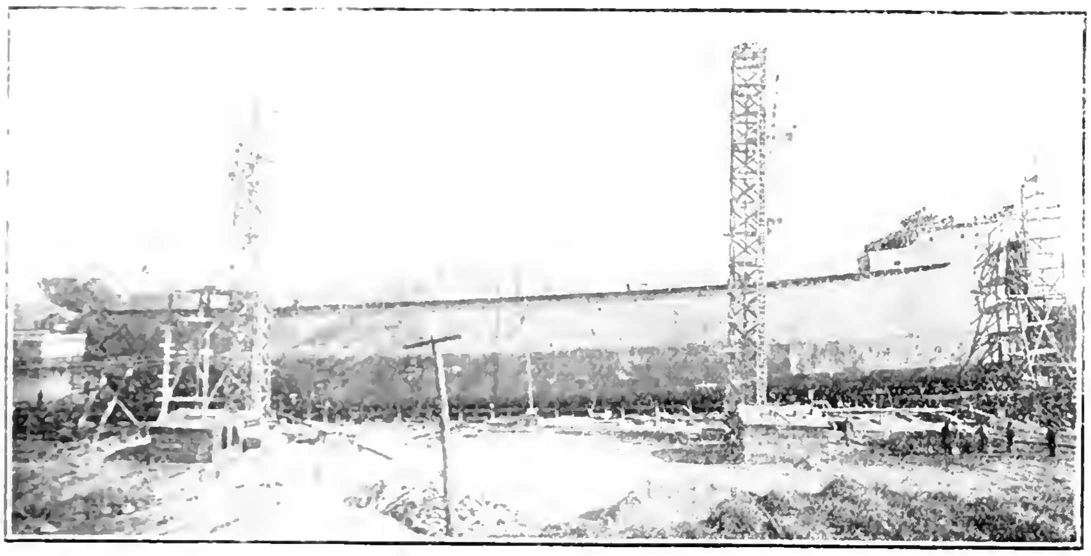
The amendment as proposed by the society was to legalize present salaries and to provide future salaries of $1800 for counties having less than $10,000,000 valuation, $2100 up to $20,000,000, $2400 up to $30,000,000, $2700 up to $40,000,000, $3000 for over $40,000,000; and not exceeding $4200 for counties having over $50,000,000 valuation. It provided also for inspectors on bridge and road work.

Ford "Eagle" Built in Ten Days

On Apr. 12 the shipbuilding plant of the Ford Motor Co., at River Rogue, near Detroit, launched its "Eagle" boat No. 59 in 10 days after the keel was laid. This represents an outdoing of the 21-day operating schedule for which the plant was designed (see *Engineering News-Record* of Oct. 17 and 31, 1918, pp. 698 and 788) as the ship-assembly shop contains 21 building stations and the program was to launch a boat a day at the period of full production. The first "Eagle" was launched in July, 1918.

Third American Concrete Ship Ready to Launch

Some time toward the end of April the United States Shipping Board concrete ship "Polias," which is shown practically completed in the accompanying view, will be launched at the yard of the Feugner Shipbuilding Co., on Long Island. This ship was described in detail in *Engineering News-Record* of Dec. 12, 1918, p. 1058. It is a 3500-ton vessel and is the third oceangoing concrete ship to be launched in this country. The "Faith," which was launched about a year ago, has successfully completed nearly 20,000 miles of ocean travel. The "Atlantus," the 3000-ton vessel which was launched at Brunswick, Ga., in December, 1918, is now being outfitted and should be ready for service in a short time. The "Polias" has been ready for launching for some time, but on account of difficulties in dredging the offshore slip, it has been held on the ways.



3500-TON CONCRETE SHIP READY TO LAUNCH AT FLUSHING, L. I.

Preliminary Report on Portland Elevator Subsidence

The committee of engineers appointed by the Portland Commission of Public Docks to report on the subsidence of the concrete municipal grain elevator being built at Portland, Ore., has presented a preliminary majority and minority report. The majority report, signed by Chairman H. C. Holmes, G. C. Mason, R. A. Cummings and G. W. Beschke, states that the storage annex should be supported by a spread foundation, and that this work can go on while the contractor is completing the structure. It is their opinion, furthermore, that the track shed can be left alone without any treatment whatsoever, the subsidence being very slight. The main report relates to the operating house, the part of the structure which has sunk the most. The report says there are two solutions which could be considered: First, to wreck the present structure and move the site of the operating house to a point south of the track shed, where it would be built upon a spread foundation; second, to complete the present operating house and to carry concrete cylinders under it to gravel.

The minority report, signed by W. R. Phillips, states that in the opinion of the signer the ground surrounding the storage annex is not sufficiently stable to carry the load of the annex upon a spread foundation. Nor does Mr. Phillips think that the proposed new site for the operating house would be stable. It is his opinion that the subsidence is still continuous. He therefore recommends that concrete cylinders be sunk to the underlying gravel under all of the buildings. This would require 63 cylinders for the storage annex alone.

No action has been announced as yet. The board of engineers is soon to present a final report.

New State Commissioner of Highways Appointed in New York

Confirmation by the New York State Senate makes effective the appointment by Governor Smith of Capt. Frederick Stuart Greene as state commissioner of highways. He succeeds Edwin Duffey, who was appointed by Governor Whitman. There has been considerable controversy as to whether Mr. Duffey's term has expired. When he was appointed originally, the term of John N. Carlisle, then commissioner, had not yet expired. The term would have expired Apr. 29, 1918.

At the expiration time Commissioner Duffey was not reappointed, but merely held over. Attorney General Newton offered the opinion that his term expired on the aforesaid date, and as there had been no new appointment the present Governor was at liberty to make one.

Captain Greene is a resident of Nassau County and has had extensive experience in engineering and general construction work. Since 1905 he has been vice-president and general manager of the Waterproofing Co. of New York.

During the war he was a captain in the 302d Engineers and served in France.

Idaho State Government Reorganized

Centralization of executive power and responsibility in the Governor of Idaho is effected by a bill which recently became a law. With the exception of the elective officials provided for by the Constitution and the officials of the Department of Education, all the various commissions, bureaus, etc., of the administrative branch of the Government of Idaho are done away with by the bill. In their place there are set up the following nine departments: Agriculture; commerce and industry; finance; immigration, labor and statistics; law enforcement; public investments; public welfare; public works; reclamation. A single commissioner will head each department. For some of the departments other officers are provided for by the statute. All of the officers named in the act are to be appointed by the Governor and may be romoved at his discretion. The salary of each commissioner will be $3600 a year. Several departments will deal with engineering matters: The department of law enforcement will register architects, surveyors and civil engineers. The department of public works will take over the work previously done by the state highway department, by the trustees of the capitol building, and by the Heyburn Park board of control. The department of reclamation will take over the duties of the State Engineer and of the state board of land commissioners, except as to the duties of the latter in holding, leasing and selling state lands. The act provides that the director of highways in the department of public works must be a civil engineer of not less than five years' experience in road building, and that the director of water resources in the department of reclamation must be a hydraulic engineer with not less than five years' experience in the practice of irrigation engineering.

Patent Office Employees Organize Society

For the purpose of advocating certain reforms in the administrative branches of the United States Patent Office, the employees have been organized under the name of the Patent Office Society which, it is claimed, will bring about a higher efficiency in the system. Committees on legislation and publicity have been appointed with a view to educating the public to the necessity for an immediate improvement of the present Patent Office system and to push Congressional enactment to broaden the scope of the office.

The plan includes the separation of the Patent Office from the Department of the Interior and provides for an executive officer who shall be an industrial and efficiency expert, the position eventually to be that of a cabinet officer when the department shall have assumed the proportions to warrant such a distinction.

The society proposes the establishment of five bureaus—namely, a bureau of information and education, a bureau of patents and publications, a bureau of utility, a bureau of validity examinations, and a bureau of priority of inventions.

The society is publishing a monthly journal in the interest of the principles being advocated in the reorganization of the Patent Office. The officers are as follows: President, M. H. Coulston; vice-president, J. H. Lightfoot; secretary, Bert Russell; treasurer, W. F. Avery.

Low Price Asked for Building Fabricated Ships

An offer to build 12,000-ton steel vessels for the price of $149 per ton deadweight capacity has been made to the Shipping Board by the Submarine Boat Corporation, Newark, N. J. These vessels would be powered for 12 knots speed, with either reciprocating engines or geared turbines. The vessels would be 473 ft. long and 62 ft. in beam, and draw 28½ ft. The Newark Bay yard is at present building 5000-ton ships for the Fleet Corporation, using bridge-shop fabrication. Enlargement of the ways would be necessary to permit building the larger ships. It is proposed to reconstruct eight ways, and the price made is contingent on the ordering of 16 vessels. According to E. N. Hurley, chairman of the Shipping Board, steel ship prices in 1916 ranged from $50 to $69, while recent prices have been $185 to $225 per dead-weight ton.

Members of National Societies Have Association in Cuba

What may prove to be a forerunner of similar association in this country is seen in the Association of Members of American National Engineering Societies in Cuba, recently organized to provide for activities "to foster the interests of the various national engineering societies represented on the island" and to promote the discussion of engineering and technical topics of local interest. Not the least attractive of the proposed activities are the dinners or smokers for the promotion of good-fellowship and for showing hospitality to members of the American societies temporarily visiting in Cuba. Luther Wagoner, president, suggests that since there is no danger of prohibition in Cuba there may be many visitors after July 1, who will be welcome.

Filters Added and Water Softening Proposed at Minneapolis

Having enlarged its mechanical filtration to 24 units, with a total capacity of 96,000,000 gal., Minneapolis is now considering plans for water softening. The plant was put in operation in 1913. A previous enlargement was completed in 1917. W. N. Jones is in charge of filter design and construction and F. W. Cappellen is city engineer.

Connecticut Electric Railways Bankrupt

Of the 828 miles of electric railways in Connecticut, 98% are either in the hands of a receiver or are insolvent, according to the report of a special commission made to the legislature Apr. 1. So bad is the situation that operations on many of these lines must be partially or completely suspended unless substantial temporary relief is afforded by the present legislature. The commission enumerates twelve causes that have contributed to create the financial difficulties. Besides the decrease in the value of the nickel railway fare and the great increase in cost of fuel, supplies and wages, the commission points out that a large part of the traffic formerly enjoyed by the electric railways is now carried by privately owned automobiles and by the unregulated jitney omnibuses. As a means of meeting this critical situation and enabling the companies to continue in operation, which is a public necessity, the commission recommends the release of the companies from the payment of state taxes and assessments for bridges and street paving. Motor omnibuses should be under state control so far as schedules, routes and rates are concerned, and should be compelled to give bonds for damages to injured persons. The electric railway companies should be permitted to abandon portions of their system which are unprofitable and to operate motor-vehicle service where desired. Bills have been drawn to carry out these recommendations and also providing for a loan of state funds, amounting to not more than $2,000,000, to electric railway companies to tide them over the present critical situation.

City To Buy Dredged Fill from Government

New land is to be made by the City of Jersey City, N. J., on the Hackensack River, from fill which is to be dredged from the river by the United States Government. The city commissioners have just passed a resolution authorizing the city to purchase from the Federal Government enough of the dredged fill to make about 50 acres of new land 5 ft. above the present river level. The agreed price is 10c. per cubic yard, and the estimate provides for the removal of about 400,000 cu.yd. of material.

New Assistant to Secretary of Interior Appointed

John W. Hallowell, member of the firm of Stone & Webster of Boston, who has been in close touch with engineering matters for the past 18 years, has been appointed the new assistant to the Secretary of the Interior, and will have under his immediate charge the Bureau of Mines, the Reclamation Service and the Alaska Ry. Mr. Hallowell has been associated with Stone & Webster for 16 years, specializing in the financial side of public utilities and other engineering projects.

Two years ago he joined the staff of the Food Administration, from which he resigned recently after his return from abroad, his last work being a survey of the industrial situation in Belgium and northern France. He succeeds H. A. Meyer, who resigned to become associated with the Prairie Oil & Gas Company.

Industrial Conference Addressed by Prominent Men

At an editorial conference held under the auspices of the New York Business Publishers' Association in New York City on Apr. 11 some of the most prominent men in the country discussed the pressing industrial problems now before the country. Dr. Charles P. Steinmetz, consulting engineer of the General Electric Co., made a keen analysis of the various proposals for industrial coöperation. Dr. Charles A. Eaton presented a forceful address on the subject of industrial democracy, and John Calder, consulting engineer, formerly general manager of the Remington Typewriter Co., treated the subject of "Recent Advances in Industrial Management."

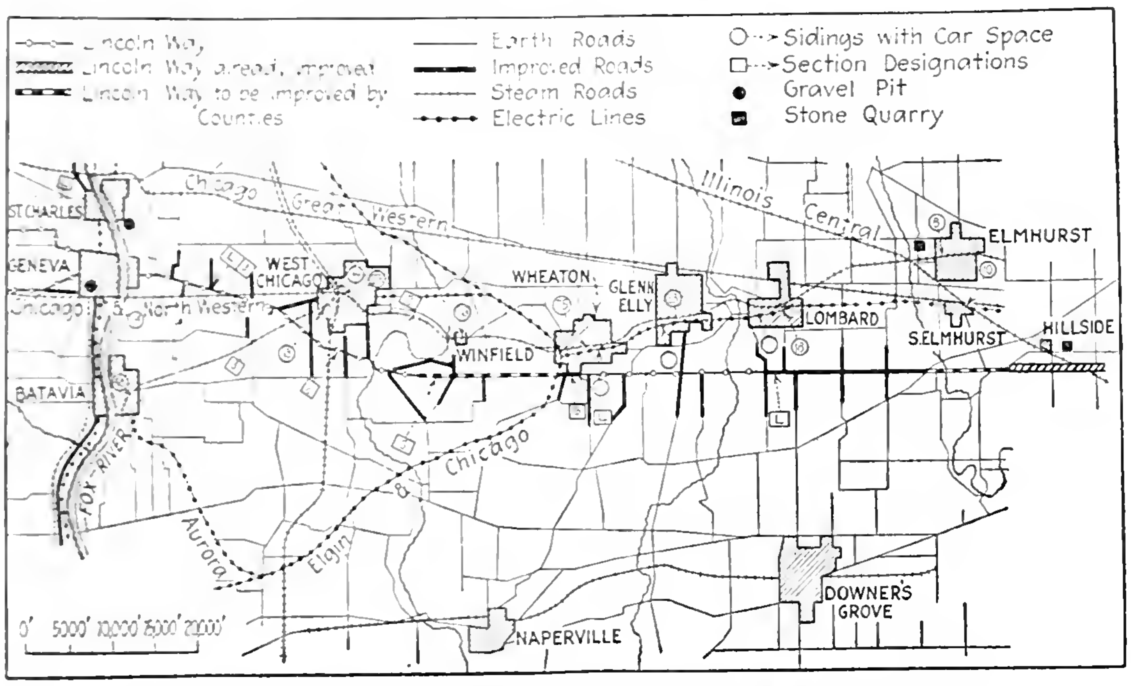
The necessity for organization in the settlement of labor disputes was the subject of an address by V. Everit Macy, chairman of a committee on adjusting wages in private shipbuilding plants during the war, and now president of the National Civic Federation. Four papers were presented on the subject of financial problems: "Post-War Financial Problems," by Francis H. Sisson, vice-president of the Guaranty Trust Co., New York; "Problems of Our Foreign Trade," by G. A. O'Reilly, foreign trade expert of the Irving National Bank, New York; "Prices Yesterday, Today and Tomorrow," by O. P. Austin, chief statistician of the National City Bank of New York, and "Stabilizing the Dollar in Purchasing Power," by Prof. Irving Fisher of Yale University.

Surveys for Large Washington Irrigation Project

An appropriation of $100,000 for surveys of the Columbia irrigation project, embracing some 2,000,000 acres to be put under water in Washington, has been made by the state legislature. Water would be taken from Pend Oreille River at Albany Falls, just over the line in Idaho. Federal coöperation through the United States Reclamation Service is hoped for. The studies are being made under the direction of the Columbia Basin Commission, the chairman of which is Marvin Chace, state hydraulic engineer. It is reported that A. J. Turner, Seattle, has been appointed chief engineer, and J. C. Ralston, Spokane, consulting engineer to the commission, and that headquarters will be in Spokane.

Pits and Quarries Mapped for Bidders on Road Work

Transportation routes and deposits of materials are mapped for the benefit of contractors who will submit bids and obtain contracts for 115 miles of the Dixie and Lincoln Highways to be built in Illinois in 1919. The fragment of the Lincoln Highway map reproduced here indicates the nature of the information depicted. Accompanying the maps are lists giving the car capacity of each railroad siding, and the character of the materials from each quarry and pit, together with the names of the operators. On the Lincoln Highway work, for example, 40 sidings are listed at 31 towns and cities, and on the Dixie Highway 31 sidings at 27 locations. For both contracts some 60 pits and quarries are listed. Clifford Older is chief state highway engineer.



MATERIAL DEPOSITS AND TRANSPORTATION FACILITIES MAPPED FOR ILLINOIS ROAD CONTRACTORS

Funds Available For Extensive Road Work in Oregon

A total of about $30,000,000 is to be available for highway construction in Oregon during the next three years. Plans have been made for beginning immediately an extensive construction program. All of the work except the forestry roads will be under the direction of the State Highway Commission. Herbert Nunn is chief engineer.

The funds included in the total figure mentioned come from several sources. Before the legislature met this year there was a total of $3,500,000 in unexpended bonds remaining from the bonds authorized in 1917, and authority was given by the legislature to sell bonds for $10,000,000 more. The ¼-mill tax is expected to net the road fund about $250,000 this year, while the tax on gasoline and distillate (1c. per gallon on the former and ½c. per gallon on the latter) will add $400,000. The net share from the auto-license department will be about $450,000 more. Federal funds for post and forestry roads to be used under the coöperative plan will also be forthcoming.

There are to be two road-bond issues on the ballot at the election in June, one for a property tax of one mill per annum for paying half the cost of local roads in those counties which will raise an equal amount, and also a measure providing for a military highway to be built along the full length of the Oregon coast, with $2,500,000 of state funds matched by an equal amount from Federal funds. The last project is the only one concerning which there is any doubt.

The plan for the expenditure of these funds calls for the completion of some 4000 miles of state highways. Of these, about 790 miles are to be hard-surfaced. On the coast roads concrete is specified wherever paving is to be done. On other parts of the system the type of road will depend on the prices bid, the alternative being bituminous pavement on macadam base. The concrete will be 6 to 7 in. thick, the 6-in. section being used in the dryer eastern part of the state, while the 7-in. depth is considered necessary west of the mountains. The pavements are to be laid 12, 16 and 18 ft. in width, depending upon the amount of travel; 80% will be 16 ft.: 15% 12 ft. and 5% 18 ft. wide., all with 2-ft. crushed-rock shoulders.

Michigan Votes for Highway Bond Issue of $50,000,000

Aproval by the voters of Michigan of a highway bond issue of $50,000,000, assures the construction of the 5000-mile system of intercounty roads described in *Engineering News-Record* of Feb. 20, 1919, p. 399. The system is planned to reach every county in the state.

While the road-bond issue voted on Apr. 7 was carried by a large majority, it is significant that the constitutional amendment which would have provided for the sale and manufacture of beer and wine was rejected. It will be remembered that the brewing interests tried to tie these two propositions together during the campaign.

Kansas Plans State-Aid for Roads

State aid for highway construction in Kansas is provided for by a constitutional amendment passed at the recent session of the state legislature, and this will be submitted to public vote at the general election in 1920. If it is carried it will permit the state to pay 25% of the cost of road construction, not to exceed $10,000 per mile and not to exceed 100 miles in any one county, except that this may be 150 miles for counties having an assessed valuation of over $100,000,000. The amendment provides also that the state may reimburse the counties which build roads after March, 1919, if the legislature so desires. It is pointed out that this constitutional amendment is more of a legislative act than a part of a constitution, but it was all that could be obtained from the recent session of the legislature.

The outlook for road work in Kansas during the coming season is said to be good. The Federal-aid funds will be taken care of with an equal amount from the counties. It is estimated that this, with a considerable amount of other work, will involve about $8,000,000 per year for the next two years. High prices are delaying progress, but with 50% aid it is hoped to get a good percentage of the work under way at an early date. Contracts have been let for five sections of road, and other contracts will soon be ready for letting. The State Highway Commission, however, has received so small an appropriation that it will have some difficulty in handling the work. M. W. Watson is acting state highway engineer.

Iowa Has Extensive Road Program

Hard surfacing of the intercounty road system, which consists of approximately 6000 miles of the most important roads in the state, during a period of 10 to 12 years, is provided for in a bill now before the Iowa legislature. Provision for bond issues in limited quantities by the counties is included, but bonding is not advocated or recommended, except in a few counties where the work should progress more rapidly. The bill covers the establishment of a primary road fund composed of the automobile fees and the Federal-aid money received each year. This fund is to pay 75 per cent. of the expense and the remainder is to be assessed against the adjacent property, for 1½ miles back on each side of the road.

Under the first Federal-aid law Iowa has 27 projects estimated to cost $105,630. These total 394 miles, principally of grading and draining. It is expected that they will be put under contract soon, and that work will be started early in the summer. Bids on two or three of these have been rejected as being too high. There are also projects aggregating $1,000,000, in progress in 13 other counties, for which contracts may be let and work started this year.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, $1200-$1440 per year, May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District, $1501 to $2100 per year. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File Application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

United States.—Expert patent investigator, $1800 to $2400 per year, and technical patent expert, $2400 to $3600 per year, May 20.

United States.—Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

United States.—Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

United States.—Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

United States.—Scientific assistant in public health work, Public Health Service, $1500-$2500 per year, June 3. Apply for form 2118, to be filed before June 3.

United States.—Senior engineer and senior architect. Interstate Commerce Commission, $1800-$2700 per year, June 10. File applications before June 10.

United States.—Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

United States.—Junior recreational engineer, Forest Service, Denver, Colo., $1800 to $2400 per year, May 6. Apply for Form 2118.

United States.—Statistician, Department of Interior, $1800 per year, May 13. Apply for Form 2118.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

The Rochester (N. Y.) Engineering Society will hold a meeting Apr. 25 in conjunction with the regular monthly meeting of the local section of the American Institute of Electrical Engineers. The speaker will be Prof. Vladimir Karapetoff, of Cornell University.

The Engineers' Club of Philadelphia will be addressed by Prof. George B. Pegram, dean of the School of Mines, Engineering and Chemistry, Columbia University, on "A Broader Type of Training for Engineers," at the weekly luncheon Apr. 22.

The Engineers' Society of Milwaukee held a joint meeting with the Milwaukee sections of the national engineering societies Apr. 16, at which George R. Lawrence, president of the Lewis-Lawrence Aëroplane Co., Chicago, presented an illustrated paper on "Flying Today and Tomorrow."

The Engineers' Club of Trenton, N. J., was addressed Apr. 10 by H. C. Eddy, senior inspector of traffic, Public Utility Commission of New Jersey, who spoke on "The Development of the Electric Railway."

The Brooklyn Engineers' Club will be addressed at the meeting Apr. 17 by Maj. W. McI. Wolfe, who will speak on "The Work of Engineer Troops in France." At the Apr. 24 meeting, to be held in the Sperry Building, Manhattan Bridge Plaza, Brooklyn, Elmer A. Sperry, of the Sperry Gyroscope Co., will speak on "The Sperry Searchlight" and will give a demonstration of the searchlight on the roof of the building, if weather permits.

The Engineers' Society of Northeastern Pennsylvania will hold its regular monthly meeting at Scranton, Apr. 17. Maj. L. S. Doten will speak on "Sewage Disposal in Army Camps."

The Engineers' Club of Cincinnati will be addressed Apr. 17, by W. W. Freeman, president of the Union Gas & Electric Co., on "Power Problems of a Modern City and Their Solution."

Personal Notes

G. A. TOMLINSON, director of inland waterways and canals, United States Railroad Administration, has resigned and will soon go to London to become resident director there of the American Shipbuilding Co., which controls a number of shipyards on the Great Lakes.

J. R. WEST, for the past three years professor of railway and structural engineering, Pei Yang University, Tientsin, China, has been appointed engineer-in-chief of the Min River Conservancy at Foochow, China, for the purpose of regulating and deepening the Min River to permit steamers engaged in coastwise trade to reach the wharves at Foochow.

LEROY D. GIFFORD, formerly construction engineer, California State Highway Commission, and recently of the 19th Regiment C. A. C., has returned to civil life and is engaged in establishing a chemical manufacturing plant at Anaheim, Calif., to specialize in citrous byproducts.

CAPT. L. R. MACKENZIE, U. S. A., recently engineer of roads on the staff of the commanding general, port of embarkation, Newport News, Va., has been appointed district engineer in charge of the new district office of the Portland Cement Association at Des Moines, Ia.

EDWIN R. WEBSTER, for several years assistant engineer on the Iowa and Dakota divisions of the Chicago, Milwaukee & St. Paul R.R., in charge of construction and maintenance work, has taken up private practice in general civil and sanitary engineering and has opened an office at 327 S. La Salle St., Chicago.

CHARLES H. HURD, consulting engineer, Indianapolis, whose resignation from the Board of Sanitary Commissioners was noted in *Engineering News-Record* of Apr. 3, 1919, p. 693, has been apponted supervising engineer of construction for the commis-

sion. He will have charge of the building of the new city sewage-disposal plant. Mr. Hurd went to Indianapolis as chief engineer of the Indianapolis Water Co., later becoming its vice-president.

CAPT. ERLE P. DUDLEY, Engineers, U. S. A., who recently returned from overseas, has received his discharge from the service and has resumed his work with the Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho.

ROBERT GARDNER, assistant superintendent of the water department, Lowell, Mass., has been appointed superintendent of the department, succeeding Robert J. Thomas, who has resigned to become New England representative of the Gamon Meter Co., Newark, N. J., as noted elsewhere.

MAJ. ROBERT A. ALLTON, Field Artillery, U. S. A., who has received his discharge from the Army, has resumed his position with Samuel A. Greeley, hydraulic and sanitary engineer, Chicago.

CHARLES B. BALL, chief sanitary inspector for the Department of Health, Chicago, has been granted leave of absence to go to France as an adviser in the work which the Y. M. C. A. is undertaking for housing and city planning in the devasted districts.

H. E. PHELPS, assistant sanitary engineer, United States Public Health Service at Petersburg, Va., has resigned to become highway engineer for Moreland and Bennett Counties, at Pine Bluff, Ark.

LIEUT. RAYMOND G. CLINITE, Corps of Engineers, U. S. A., who recently received his discharge from the service, has resumed his work as assistant topographer, United States Geological Survey.

CAPT. WILLIAM T. HUBER, Engineers, U. S. A., who was recently discharged from the service, has become field engineer for the Portland Cement Association, in charge of western New York territory.

BURT A. HEINLY, formerly associated with William Mulholland, chief engineer for the Department of Public Service, Los Angeles, has entered the employ of the California Willite Road Construction Co., Los Angeles.

CAPT. C. A. JENNINGS, Construction Division, U. S. A., has received his discharge from the service and has returned to the technical staff of the Wallace & Tiernan Co., New York City, to resume charge of the Chicago office. While in the Army his work was done in the supervision, operation and maintenance of water-purification and sewage-treatment plants in various camps.

JOHN T. GEPHART, JR., for the past three years county engineer of Fayette County, at Uniontown, Penn., has resigned to enter a state position at Harrisburg.

ENSIGN EDMUND A. PRENTIS, JR., U. S. N. R. F., has been placed on inactive duty by the Navy Department and has resumed his connection with the Underpinning & Foundation Co., New York City.

CAPT. HARRY C. KITTREDGE, Engineers, U. S. A., who recently received his discharge from the service, has been appointed superintendent of city construction, Rochester, N. Y.

D. C. FENSTERMAKER has been appointed district engingeer, Chicago, Milwaukee & St. Paul R.R., with headquarters in Chicago.

A. C. BLAIR, Lyons, Kan., has been appointed to the State Highway Commission, succeeding E. R. Moses, resigned.

E. C. MCCULLOUGH, assistant road engineer of Fayette County, Uniontown, Penn., has been appointed connty engineer, succeeding John T. Gephart, Jr., as noted above.

CAPT. JOHN A. MCLEAN has been appointed city engineer of Crookston, Minn., succeeding A. Hunt, who resigned on account of poor health.

W. S. LOZIER, chief project engineer, United States Shipping Board, Housing Department, Philadelphia, has returned to Rochester, N. Y., to resume private practice.

CAPT. CHARLES L. COULSON, 2nd Canadian Division, at present in England awaiting demobilization, has been appointed city engineer of Welland, Ont. The City Council will endeavor to obtain his release from military service as soon as possible.

ROBERT J. THOMAS, for thirty years superintendent of the waterworks department of Lowell, Mass., has been appointed New England representative of the Gamon Meter Co., Newark, N. J. He is succeeded by Robert Gardner, as noted elsewhere.

JOHN R. ALLEN, dean of the College of Engineering and Architecture, University of Minnesota, has been appointed director of a national bureau for heating and ventilation research. His work will be done in connection with the research laboratory maintained by the United States Bureau of Mines in Pittsburgh. Although the formal contract has not yet been announced, it is understood that he will select his staff, which is expected to begin work in August. Dean Allen went to the University of Minnesota from the University of Michigan in 1917.

SAMUEL A. GREELEY, hydraulic and sanitary engineer, announces that he has moved to new offices at 39 W. Adams St., Chicago.

OBITUARY

CURTIS DOUGHERTY, chief engineer, maintenance of way and structures, Southern Railway System, West, died in Cincinnati Mar. 30. He was born in 1863 and was graduated from Washington University, St. Louis, in 1886 with the degree of C. E., shortly afterward entering the chief engineer's office of the Wisconsin Central Ry. From 1888 to 1892 he was assistant engineer, Chicago & Western Indiana R.R. at Chicago, and for the following nine years was roadmaster of the Chicago division of the Illinois Central R.R. He afterward became superintendent of the Springfield division of the Illinois Central at Clinton, Ill., and in 1907 was appointed assistant chief engineer, Cincinnati, New Orleans & Texas Pacific Ry.-Alabama Great Northern R.R. From 1910 to 1917 he served as chief engineer of the two railroads. In 1917 he was appointed chief engineer, maintenance of way and structures, Southern Railway System, Lines West.

MARSHALL TEN BROECK DAVIDSON, president of the M. T. Davidson Co., pump manufacturers, died in Brooklyn, N. Y., Apr. 10. He was born in 1837 and was educated in the public schools and the Academy at Hudson, N. Y. In 1857 he entered a marine-engine machine shop in New York City and later went to sea as assistant engineer. He served as a chief engineer in Army transport service during the Civil War. After the war he engaged in business as a contracting mechanical engineer and in 1878 commenced the building of the Davidson steam pump and pumping engine. He constructed the pumping machinery for the old City of Brooklyn and the high-service pumping engine at the Prospect Park reservoir, as well as the machinery for the water-works extension at the Millburn station.

CHARLES E. WESTLAND, who became assistant to the hydraulic engineer, Turners Falls Power & Electric Co., after his release from the Reserve Officers' Artillery Training School at Fortress Monroe, died at Turners Falls Apr. 5. He was graduated recently from the Massachusetts Institute of Technology.

Special Pneumatic Device for Cutting Rivet Heads

A pneumatic rivet cutter for use on structural steel work and in repair shops is shown in the accompanying view. It consists of a long barrel with compressed air connection at one end and a chisel at the other, the stem of the chisel being held by a coiled spring which draws it back after each stroke. A plunger travels freely in the

RIVET CUTTER IN USE ON STRUCTURAL WORK

barrel or tube, and a small bypass pipe connects the ends of this tube. Two men are employed, the one at the rear operating the valve and the one at the front keeping the chisel against the rivet head.

In operation, air is admitted first through the bypass pipe to the chisel end of the tube and drives back the plunger, the shock being absorbed by a coiled spring. Air is then admitted at the other end of the tube and drives the plunger forcibly against the stem of the chisel. Another turn of the valve exhausts the air charge and admits air again through the bypass to drive back the plunger for another stroke. The force of the blow can be regulated by the valve. Air pressure of 40 to 90 lb. may be used, the higher pressures being the more effective. A punch can be inserted in place of the chisel for backing out the rivets.

In the larger size the stroke is 40 in., and the weight of the machine complete is only 65 lb. A smaller size will cut rivets up to [illegible] in. in diameter. These two sizes are known respectively as the "Red Devil" and the "Baby Devil." They are made by the Rice Manufacturing Co., Indianapolis, Ind.

Manufacturers of Electric-Furnace Products Organize

An organization to be known as the Electric Furnace Association was formed at a meeting called at Niagara Falls Mar. 21-22. Representatives of a large number of companies manufacturing electric-furnace equipment, accessories, etc., and electric-furnace products were present. The following officers were elected: President, Acheson Smith, of the Acheson Graphite Co., Niagara Falls; Secretary, C. G. Schluederberg, Westinghouse Electric Manufacturing Co., Pittsburgh.

Building Materials and Machinery For South America

According to a recent report issued by the Department of Commerce, the time is ripe for the sale of construction materials and machinery in several South American countries. This is notably the case in Chile, Peru and Ecuador. The Chilean public is generally favorably impressed with American goods and considers them more up to date than those from Europe.

Large amounts of public improvements are contemplated in these countries, which are more prosperous than before the war, and, having become more progressive, they desire all manner of sanitary fixtures, etc. A publication entitled "Construction Materials and Machinery in Chile, Peru and Ecuador," covering this subject in detail, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Business Notes

Charles F. Ames & Co., Ltd., 90 West St., New York City, announces that they have been appointed to act as the New York sales department of the Platt Iron Works of Dayton, Ohio, handling the pumping and power-plant equipment of the latter.

The Chicago Pneumatic Tool Co. has disposed of its Giant truck department and will confine its operations hereafter to its pneumatic-tool, electric-tool, air-compressor and oil-engine lines. The truck business, consisting of the Chicago Heights plant, with all stocks, inventories, agencies and branches, has been transferred, and the purchasers will continue the business, probably under the title of the Giant Truck Corporation. The tool company also announces that F. V. Sargent has been appointed district manager of sales for its Boston territory, succeeding F. S. Eggleston. The headquarters will be at 182 High St., Boston, Mass.

The Turner Construction Co. has opened an office in Philadelphia in the Presser Building, 1713 Sansom St. It will be a complete unit of the parent organization.

The Advance Machinery and Supply Co., of Denver, Colo., announces that Lieut. F. A. Koenig, recently discharged from the coast artillery service, has joined its organization as sales engineer.

The Trailer Manufacturers' Association of America, the reorganization of which was reported in *Engineering News-Record* of Mar. 6, 1919, p. 499, has announced the appointment of H. W. Perry as general manager. Mr. Perry has been associated with the National Automobile Chamber of Commerce for the past nine years, was secretary of the commercial-vehicle, good-roads, legislative, and export committees, and recently has been manager of the statistical and information department, with offices at Washington. The offices of the association will be located in New York City.

E. I. du Pont de Nemours & Co., Wilmington, Del., announce the following changes in the personnel of their organization: T. E. Doremus has been transferred to the export division of the company as general Eastern manager, with headquarters in Shanghai, China; E. R. Galvin has been appointed manager of the sporting powder division to succeed Mr. Doremus.

Trade Publications

The Central Foundry Co., 90 West St., New York City, has issued a pamphlet containing instructions for laying Universal cast-iron pipe and connecting up the joints. There are 11 pages, $2\frac{3}{4}$ x $4\frac{1}{2}$ in., with illustrations.

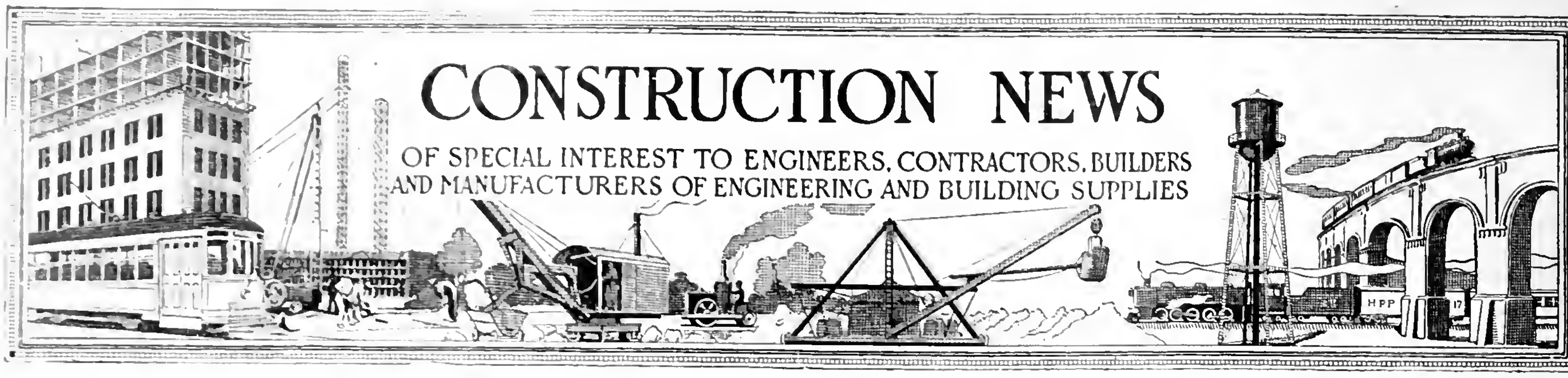
A set of five catalogs has been issued by the Chain Belt Co., of Milwaukee, Wis., covering the various sizes of Rex mixers. Of these catalog 95 is a general pamphlet covering all the sizes. Catalogs 101, 102, 103 and 104 contain descriptions with methods of using various types recommended for building and paving work. The catalogs are illustrated with line cuts and half tones and are $7\frac{1}{2}$ x 10 in. in size.

The C. H. & E. Manufacturing Co., Inc., has issued bulletins Nos. 2 and 3. No. 2 covers power pumps, while No. 3 covers hoists, elevators, mortar mixers and engines.

The Edward F. Terry Manufacturing Co., Grand Central Terminal, New York City, has issued Bulletin No. 3, devoted to cargo cranes. This bulletin contains fifteen $8\frac{1}{2}$ x 12-in. pp. and illustrations on the methods of loading ships by the use of traveling cranes.

"Concrete Chutes and Equipment" is the title of bulletin No. 200 recently issued by the Ransome Concrete Machinery Co., Dunellen, N. J. It covers a complete line of chutes and other auxiliary concreting equipment, is $8\frac{1}{2}$ x 11 in. in size, contains 51 pages and is illustrated.

"Blueprint Suggestions on Haulage, Loading Stations and Mixer Equipment for Road Work" is the title of a book recently issued by the Koehring Machine Co., Milwaukee, Wis. The pamphlet is $9\frac{3}{4}$ by $5\frac{3}{4}$ in. and consists of 10 pp. of reading matter and nine charts, showing the layout for different kinds of machinery on road operations. These charts are in blueprint form and are folded in to fit the size of the booklet



PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
Apr. 18	Bayonne, N. J. Adv. Apr. 10.	Apr. 10
Apr. 23	Kansas City, Mo. Adv. Apr. 3 and 10.	Apr. 3
Apr. 24	Benson, N. C. Adv. Apr. 3 to Apr. 17.	Apr. 10
Apr. 25	Akron, O. Adv. Apr. 3.	Apr. 3
Apr. 25	Toledo, O.	Apr. 17
May 1	Poughkeepsie, N. Y.	Apr. 17
May 5	Pottsville, Pa. Adv. Apr. 17.	Apr. 17
May 6	Ely, Minn. Adv. Apr. 17.	Apr. 17
May 13	Hollandale, Miss.	Apr. 17
May 14	Gilboa, N. Y. Adv. Apr. 10 and 17.	Apr. 17

SEWERS

Bids Close		See Eng. News-Record
Apr. 21	Highland Park, N. J. Adv. Apr. 10 and 17.	Apr. 10
Apr. 21	Akron, O.	Apr. 10
Apr. 21	Sheboygan, Wis.	Apr. 17
Apr. 22	New York, N. Y.	Apr. 17
Apr. 22	Cleveland, O.	Mar. 27
Apr. 22	Akron, O.	Apr. 10
Apr. 24	Chicago, Ill.	Apr. 10
Apr. 24	Coatesville, Pa. Adv. Apr. 3 to Apr. 17.	Apr. 10
Apr. 25	Toledo, O.	Apr. 17
Apr. 28	Flagstaff, Ariz. Adv. Apr. 10 and 17.	Apr. 10
Apr. 30	West Roxbury, Mass.	Apr. 10
Apr. 30	Detroit, Mich.	Apr. 17
May 1	Duluth, Minn.	Apr. 3
May 1	La Grange, Ga. Adv. Apr. 17.	Apr. 17
May 5	Macon, Mo. Adv. Apr. 17.	Apr. 17
May 6	Newark, N. J.	Apr. 3
May 6	Cleveland, O. Adv. Apr. 3 and 10.	Apr. 10
May 8	Platte, S. D. Adv. Apr. 17.	Apr. 17

BRIDGES

Bids Close		See Eng. News-Record
Apr. 18	St. George, S. I., N. Y.	Apr. 17
Apr. 21	Long Island City, N. Y.	Apr. 17
Apr. 21	Chicago, Ill.	Apr. 17
Apr. 21	Washington	Apr. 17
Apr. 22	Kingston, N. Y. Adv. Mar. 20.	Mar. 20
Apr. 22	Waverly, Ia.	Apr. 17
Apr. 22	Toledo, O.	Mar. 27
Apr. 22	New York, N. Y.	Apr. 17
Apr. 22	North Bergen, N. J.	Apr. 17
Apr. 22	Massachusetts	Apr. 17
Apr. 22	Waynesboro, Pa.	Apr. 17
Apr. 22	Salt Lake City, Utah	Apr. 17
Apr. 23	Brooklyn, N. Y.	Apr. 17
Apr. 24	New York, N. Y.	Apr. 17
Apr. 24	Provo, Utah	Apr. 17
Apr. 28	Idaho Falls, Idaho	Apr. 17
Apr. 28	Toledo, Wash.	Apr. 17
Apr. 29	Maryland Adv. Apr. 17.	Apr. 17
Apr. 29	Franklin, Pa. Adv. Apr. 10.	Apr. 10
Apr 29	Ottawa, Ont.	Apr. 10
Apr. 29	Ann Harbor, Mich.	Apr. 17
Apr. 30	Clarksdale, Miss.	Apr. 17
Apr. 30	Lockhart, S. C. Adv. Apr. 17.	Apr. 17
May 5	Akron, O Adv. Apr. 10 and 17	Apr. 10

STREETS AND ROADS

Bids Close		See Eng. News-Record
May 5	Eureka, Kan.	Apr. 17
May 6	Pine Grove, Pa. Adv. Apr. 17.	Apr. 17
May 7	Dillion, Mont.	Apr. 17
Apr. 20	Terra Haute, Ind.	Apr. 3
Apr. 21	Wadena, Minn.	Apr. 10
Apr. 21	Indiana	Apr. 3
Apr. 21	New Iberia, La.	Apr. 3
Apr. 21	Tulsa, Okla.	Apr. 3
Apr. 21	Kent, Wash.	Apr. 3
Apr. 21	Washington	Apr. 17
Apr. 21	Des Moines, Iowa	Apr. 17
Apr. 21	Mason City, Iowa	Apr. 17
Apr. 21	Mapleton, Ia.	Apr. 17
Apr. 22	Montreal, Que.	Apr. 17
Apr. 22	Spencer, W. Va.	Mar. 13
Apr. 22	West Orange, N. J.	Apr. 17
Apr. 22	Fairfield, Ia.	Apr. 17
Apr. 22	Toledo, O.	Apr. 10
Apr. 22	Salem, N. J. Adv. Apr. 10 and 17.	Apr. 10
Apr. 22	Hartford, Conn.	Apr. 10
Apr. 22	Maryland Adv. Apr. 10.	Apr. 10
Apr. 22	Bellville, N. J.	Apr. 10
Apr. 22	Trenton, N. J. Adv. Apr. 17.	Apr. 17
Apr. 22	Ardmore, Pa.	Apr. 17
Apr. 23	Illinois	Apr. 23
Apr. 23	Baltimore, Md.	Apr. 10
Apr. 23	Baltimore, Md.	Apr. 17
Apr. 24	Illinois Adv. Apr. 10 and 17.	Apr. 3
Apr. 24	New York, N. Y. Adv. Apr. 3.	Apr. 3
Apr. 24	New Mexico	Apr. 3
Apr. 24	Auburn, Me. Adv. Mar. 27 and Apr. 3.	Apr. 3
Apr. 24	Dormont, Pa.	Apr. 10
Apr. 24	Jackson, Mich. Adv. Apr. 17.	Apr. 17
Apr. 24	Jersey City, N. J.	Apr. 17
Apr. 24	Peckering, Ont.	Apr. 17
Apr. 24	Jacksonville, Fla.	Apr. 17
Apr. 25	Maryland Adv. Apr. 17.	Apr. 17
Apr. 25	Rutherfordton, N. C.	Apr. 10
Apr. 25	Trenton, N. J.	Apr. 17
Apr. 25	Connecticut Adv. Apr. 17.	Apr. 17
Apr. 25	Ridgefield, Conn. Adv. Apr. 17.	Apr. 17
Apr. 25	Edenburg, Pa.	Apr. 10
Apr. 25	Albion, Neb.	Apr. 17
Apr. 26	Weston, W. Va.	Apr. 17
Apr. 27	Pittsburgh, Pa.	Apr. 3
Apr. 28	Pennsboro, W. Va.	Apr. 17
Apr. 28	Elmira, N. Y. Adv. Apr. 17.	Apr. 17
Apr. 28	Washington	Apr. 17
Apr. 28	Scranton, Pa. Adv. Apr. 10 and 17.	Apr. 17
Apr. 28	St. James, Minn.	Apr. 17
Apr. 30	Akron, O. Adv. Apr. 10 and 17.	Apr. 10
Apr. 30	New York, N. Y. Adv. Apr. 10 and 17.	Apr. 10
Apr. 30	Delaware	Apr. 17
Apr. 30	St. James, Minn. Adv. Apr. 17.	Apr. 17
Apr. 30	New Jersey Adv. Apr. 17.	Apr. 17
Apr. 30	Freehold, N. J. Adv. Apr. 17.	Apr. 17
May 1	Augusta, Ga. Adv. Apr. 17.	Apr. 17
May 1	Olympia, Wash.	Apr. 17
May 1	Wisconsin	Apr. 17
May 2	Pennsylvania Adv. Apr. 10.	Apr. 10
May 5	Greenfield, Ind.	Apr. 17
May 5	North Dakota	Apr. 10
May 5	Worthington, Minn.	Apr. 10
May 5	Fayetteville, W. Va. Adv. Apr. 10 and 17.	Apr. 17
May 6	Durham, N. C. Adv. Apr. 17.	Apr. 17
May 7	Burlington, N. J	Apr. 10
May 7	Long Prairie, Minn.	Apr. 17
May 7	Faribault, Minn.	Apr. 17
May 12	Elk River, Minn.	Apr. 17
May 14	Arkansas	Apr. 17
May 15	Plymouth, Wis.	Apr. 10
May 19	Merced, Cal.	Apr. 10
May 19	Tulsa, Okla. Adv. Apr. 17.	Apr. 17
May 30	Dallas, Tex. Adv. Apr. 17.	Apr. 17
June 10	Clarksville, Pa.	Apr. 3

EXCAVATION AND DREDGING

Bids Close		See Eng. News-Record
Apr. 15	Trenton, N. J. Adv. Mar. 20 to Apr. 10.	Mar. 27
Apr. 15	Ft. Dodge, Ia.	Apr. 3
Apr. 16	Spencer, Ia.	Apr. 3
Apr. 22	Crowley, La. Adv. Mar. 27 to Apr. 10.	Apr. 3
Apr. 24	New Holland, N. C. Adv. Apr. 10 and 17.	Apr. 10
Apr. 28	Sterling, Ill. Adv. Apr. 10 and 17.	Apr. 17
Apr. 28	Benson, Minn.	Apr. 17
Apr. 29	New York, N. Y. Adv. Apr. 3.	Apr. 3
Apr. 30	Marion, Kan.	Apr. 17
May 2	Marks, Miss.	Apr. 17
May 6	Paragould, Ark.	Apr. 3
May 14	Poplar Bluff, Mo.	Apr. 3
May 15	Mobile, Ala. Adv. Apr. 10 and 17.	Apr. 10

INDUSTRIAL WORKS

Bids Close		See Eng. News-Record
Apr. 19	New York, N. Y.	Apr. 17
Apr. 21	Philadelphia, Pa.	Apr. 17
Apr. 22	Chippewa Falls, Wis.	Apr. 10
Apr. 25	Philadelphia, Pa.	Apr. 17
Apr. 26	Dayton, O.	Apr. 17
May 1	New York, N. Y.	Apr. 17
May 1	Brainerd, Minn.	Mar. 27
May 1	Joplin, Mo.	Apr. 3
May 15	Bemidji, Minn.	Apr. 17

BUILDINGS

Bids Close		See Eng. News-Record
Apr. 20	Hurley, S. D.	Apr. 10
Apr. 21	Albany, N. Y.	Mar. 27
Apr. 21	Moorhead, Minn.	Apr. 10
Apr. 21	Foxboro, Mass.	Apr. 17
Apr. 22	Bovey, Minn.	Mar. 20
Apr. 22	Brooklyn, N. Y.	Apr. 17
Apr. 22	St. Louis, Mo.	Apr. 10
Apr. 22	Quincy, Cal.	Apr. 3
Apr. 22	Lancaster, Minn.	Apr. 10
Apr. 24	Springfield, Mass.	Apr. 10
Apr. 25	Waterdown, Ont.	Apr. 3
Apr. 25	Cameron, Wis.	Apr. 10
Apr. 28	Campbell, Minn.	Apr. 17
Apr. 30	Vancouver, B. C.	Apr. 10
Apr. 30	Albany, N. Y. Adv. Apr. 17.	Apr. 17
May 1	Wakefield, Minn.	Mar. 20
May 1	Virginia, Minn.	Mar. 27
May 1	St. Louis Mo.	Apr. 3
May 3	Racine, Wis.	Apr. 17
Apr. 5	Akron, O.	Apr. 17
May 12	Flint, Mich.	Apr. 17
May 15	Verona, N. J.	Apr. 10
May 15	Kearney, Minn.	Apr. 17

FEDERAL GOVERNMENT WORK

Bids Close		See Eng. News-Record
Apr. 21	Post Office — Rhinelander, Wis.	Mar. 13
Apr. 21	Post Office and Courthouse —Erie, Pa. Adv. Mar. 27 to Apr. 17.	Apr. 3
Apr. 21	Sewage Disposal System— Washington, D. C. Adv. Apr. 13 and 17.	Apr. 3
Apr. 21	Barracks, Mess Hall and Officers Quarters — Spec. 3831—Yorktown, Va.	Apr. 10

F YE BREAK FAITH WITH THEM WHO DIE
HEY WILL NOT SLEEP,
HO POPPIES GROW IN FLANDERS FIELDS

plement to Engineering News-Record April 24, 1919

A Consolidation of Engineering News and Engineering Record   McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN *Editor*   CHARLES WHITING BAKER *Consulting Editor*

Volume 82   NEW YORK, THURSDAY, APRIL 24, 1919   Number 17

Keeping Faith With Those Who Died

THERE is a far-reaching appeal in the attractive poster which is a supplement to this issue of *Engineering News-Record*. Primarily, of course, its object is to preach the need for a full subscription to the Victory Liberty Loan, but the reader who draws only this inference gets only part of the message. Liberty is appealing to everyone, employer and employed, to keep the faith—and that appeal extends to every feature connected with or flowing out of the war. We must keep faith

By oversubscribing the Victory Loan;

By doing justice to every worker and by meeting with patience and in a spirit of compromise the troublesome industrial problems ahead;

By rendering a fair day's work for a fair day's pay;

By insisting that the way of sound progress is by evolution, not revolution;

By making, each in his particular job, whatever sacrifices are necessary to bring about that reign of justice for the attainment of which our sons and brothers suffered and laid down their lives.

Light Aggregate Promises To Compete With Stone

WHAT is virtually a new structural material is made possible by the light-weight concrete aggregate whose properties and methods of manufacture are outlined on another page. Structural concrete rarely requires the weight that generally is necessary or at least useful in mass concrete or masonry. Every pound that is gained without loss of strength is a saving multiplied many times in the reduction of other members proportioned to carry dead as well as live load. Ten months of experimenting have demonstrated that a satisfactory artificial aggregate can be made almost anywhere in this country, and that the technique of its manufacture, while not easy to be learned, can be developed in many types of kiln. The crucial element yet to be determined is its price, and a favorable reply to this question will be eagerly awaited by structural engineers. If such a material can be put down on the job at competitive figures, the stone and gravel men will soon find that their selling problem has taken on new difficulties.

Typhoid Honor Roll Continues To Lengthen

NOTHING can be more gratifying to the sanitary engineer and few things more satisfactory to public-health men generally than the continued decline of typhoid fever. No fewer than 22 cities in 1918 won a place on the provisional typhoid fever honor roll suggested for cities by *Engineering News-Record*, in the issue of Oct. 18, 1917, p. 723. The standard then set tentatively was a rate of 5 per 100,000 or less. Six more cities gained places on this roll in 1918 than in 1916. Some years ago a typhoid rate of 20 or under per 100,000 was considered creditable, and anything over that as indicating, though not proving, a polluted water-supply. In 1918 there were only five cities in the above-20 class, compared with eight in 1916. The detailed figures on pp. 812-813 deserve study, especially by engineers and health officials in cities whose rates are still high. The need for most watchful attention in 1919 will be great, in view of the possible spread of typhoid by demobilization. During the latter part of 1918 and early in 1919 typhoid in our Expeditionary Forces, although still low, increased considerably, as noted in *Engineering News-Record* of Apr. 3, 1919, p. 677. As the forces return there may be among them a sufficient number of carriers, even if not of sick or to-be-sick cases, to spread innumerable typhoid germs in this country. The wise health officer will be on the lookout, ready to act the moment there is the slightest evidence of an increase in typhoid.

The Electric Railway Versus the Motor Truck

RECENTLY the executive secretary of the Highways Transport committee, in addressing a meeting of motor-truck salesmen, pleaded earnestly for coöperation between motor-truck interests and the electric railways, pointing out that the latter were in a bad way financially and needed help in order that the investment represented might be conserved. All will agree with him that it will be a national loss if widespread financial disaster overtakes the electric railways, urban and interurban. Also, when coöperation can produce economies there should be coöperation. The burden, however, is not so much on the motor-trucking interests as on the electric railways. The latter were first in the field. They had a great opportunity to develop intercity express service, and, by and large, had not the business acumen to grasp it. Now they must not whine when a new type of carrier, with great intrinsic merits and under skillful promotion, comes in to preëmpt the field which in great part might have been theirs. Their efforts must be directed not to recommendations of coöperative discussion but to actual demonstrations of economy in freight carriage. The burden is clearly upon the electric railways, not on the operators and advocates of motor trucks. Theoretical discussions have some value as contributions to engineering knowledge, but they do not take the place of demonstrations and records of fact in the application of new methods in this workaday world.

An Influential but Unobtrusive Organization

THE publication elsewhere in this issue of the remarkable address on prices by O. P. Austin, chief statistician of the National City Bank, New York, makes opportune the mention of an organization which in an unobtrusive way is having a very definite influence on the industrial life of the nation. The organization in question is the Editorial Conference of the New York Business Publishers' Association, composed of the editors of the leading technical and trade papers published in New York City. The purpose of the conference is to consider problems that affect industry and business generally, to the end that the editors may have available the best information obtainable in formulating their policies. During the war, for example, there were two conferences at Washington, at which members of the cabinet and heads of important bureaus laid before the editors the main features of important war activities, while at the New York conference at which Mr. Austin's paper was read three big topics were set for discussion —post-war finance, industrial coöperation and foreign trade. These were discussed by the most eminent men obtainable. Besides Mr. Austin, the financial problems were covered by Francis H. Sisson, vice-president of the Guaranty Trust Co. and Prof. Irving Fisher. Dr. Charles P. Steinmetz, V. Everit Macy and Dr. Charles A. Eaton discussed industrial coöperation, while G. A. O'Reilly presented the problems of our foreign trade. While there is no thought of imposing opinions and policies on the editors, the influence of the organization is nevertheless potent, for it is an instrument by which there is constantly made available to the editors the very best thought on urgent general problems.

Cost-Plus Contracts Do Not Encourage Low Labor Output

STUDENTS of cost-plus contracting—and that means almost every engineer and contractor—will be interested in the evidence of its cost efficiency which is presented by Henry C. Turner of the Turner Construction Co., on page 815 of this issue. It is good management and not the form of contract which determines the efficiency of labor in construction; it was floating labor and shortage of trained workmen which caused the low records of labor output in war construction. Seldom has any fact in construction practice been demonstrated more convincingly than these are shown by Mr. Turner's article. For the first time cost comparison of percentage and lump-sum contract work is made.

War construction accomplished much in educating the construction industry to the possibilities of cost-plus contracting. Unfortunately, it also did much to cast suspicion on this form of contract. War construction was wastefully extravagant in the expenditure of labor. Workmen of all classes were most inefficient. Unit costs of construction ran high. These facts may not be denied. They are being charged to the cost-plus contract. If this charge is not to hold good in the opinion of the building public, the true reasons for inefficiency of labor in war construction must be demonstrated. The article here considered comes closer to furnishing the unimpeachable evidence required for complete demonstration than any utterance heretofore made.

Presentation of the precise figures of comparison is left to the article itself. Two broad conclusions stand out from the detail. One is that in a properly organized construction company there is no difference in efficiency in labor engaged in percentage work and that engaged in lump-sum work. The second and equally important conclusion is that there is no reason or justice in forming an opinion as to the advantages of percentage or lump-sum work based on war construction experience.

Wider Use of Standards Should Be Promoted

WHY is it that in some cases important standards of engineering design and practice fail to be used generally even by members of the technical associations that formulated and adopted them? We speak of those standards, such as rail sections, which acquire their greatest value only through practically universal use.

Doubtless inertia is one large factor in the case. Pride in personal designs and prejudice against the standards are others. Positive or well defined objections also play a part, of varying magnitude.

If these are the principal causes operating against the standards, certain obvious remedies are available. For inertia and prejudice the remedy lies in insistent promotion or education, not only as to individual standards, but especially as to the broad advantages of uniformity and the necessity of some amount of compromise or even sacrifice to produce these advantages. Where specific objections are urged against the standards these objections must be analyzed and the reasons for allowing them to outweigh the advantages of uniformity must be brought into the light of day. By means of such methods it is possible to make headway in extending the use of the standard, and thereby transform a potentially valuable document into a productive asset.

A moment's consideration of the special case of rail sections may be illuminating. In touching upon the subject of standardization in his presidential address to the American Railway Engineering Association, C. A. Morse referred to the unnecessary number and variety of rail sections and stated that at the present time 12 sections of 100-lb. rail are being rolled. It is beyond all probability that each one of these is superior to all the others under the conditions of the road or roads using it. On the contrary, it is safe to say that the difference between some of the sections is comparatively or absolutely insignificant, so that other sections would give equally good service. In regard to such cases, it would be pertinent to ascertain the extent to which these special sections are used, and the reasons for not substituting standard sections. Some of the reasons would doubtless appear weak in the light of expert analysis.

Special sections mean extra expense and trouble at the mills. Orders for them cannot be filled from stock, as can those for standard rails, but must wait until the mill has time to change the rolls. Such changes also involve time and money, spent to no useful purpose. In fact, if large amounts of several special sections should be ordered at the same time during a busy period they would constitute a distinct bar to rapid and economical production or output. The same remarks apply to railway splice bars and to many other manufactured parts.

Technical associations having standards should promote their use by informing consumers of their advantages and by finding and combating the objections urged against them.

Expiration of the Norcross Flat-Slab Patent

ON APRIL 29, 1919, the famous Norcross patent, U. S. No. 698,542, on reinforced-concrete flat-slab floors expires, and with it, according to the present legal status of the case, goes the right of the Flat Slab Patents Co., the present owner of the patent, to charge a royalty or to issue a license for the construction and use of a flat-slab floor. This right has been generally recognized since the 1918 decision in the Lauter Piano case, and by many admitted since the 1914 Drum vs. Turner decision. It has been so recognized, however, not because engineers believe those decisions to be just or reasonable, but because it became evident that the complicated legal patent procedure had firmly established the Norcross patent as the basic patent on flat slabs and that it would be futile to try to override the precedent of two original Circuit Court decisions, with several confirmatory later decisions.

It is not the intention of this journal now to enter into a discussion of the evidence and procedure which marked the various Turner-Norcross patent cases. The printed record of those cases occupies many volumes, and only one who was forced to do so would attempt to wade through it. Certainly, the various engineering experts on both sides, whether intentionally or not, succeeded in obscuring the real issue and in confusing the judges as to the technical questions involved. It is of interest, though, to note that the two cases are founded on diametrically opposite principles. According to the Drum-Turner decision, Norcross showed invention in his novel arrangement of steel in a flat-slab floor, although obviously flat-slab floors had been previously patented and built. The later Lauter decision held that Turner's patent infringes Norcross' because its difference in placing reinforcement does not constitute invention. In other words, the first case sets up Norcross as a basic patentee on analogous grounds to which the second case denies invention to Turner. To confuse matters, in a later decision the Drum-Turner court specifically stated that it considered the Norcross invention to lie in a floor without supporting beams, not merely in the location of the reinforcing rods.

In practically all of the other reinforced concrete patent cases there has been a growing movement toward consistent thought. Arrangement of reinforcement to meet stresses is now fairly definitely established as mere engineering design and not invention. On such a basis neither Turner nor Norcross was entitled to a patent, because both developed through ready processes of engineering thought a type of structure established by record if not by extensive practice. A flat reinforced-concrete slab, supported on four columns, antedated both patents. Whether the designers and builders of these earlier slabs understood the actions that took place in the structure or designed correctly to meet those actions, is not pertinent if there was sufficient suggestion in them to permit an engineer skilled in structural design to adapt the principle to meet acceptable theory.

The progress of the litigation and the subsequent success of the Norcross patent, with its levying a tax on hundreds of structures, was a legal victory entirely and not an engineering one. No one doubts that Turner developed a commercial flat-slab floor, though few agree with his highly optimistic views on the strength of his floors. On the other hand, the Norcross case bore every evidence of lying only in a paper patent put forward to fight Turner's claims for invention and his prospective, if not actual, demands for royalty. Neither patent, in the views of most engineers today, was anything but a step forward in design, and the enforcement of a tax to be paid to either one of the patentees on the ground that his was a broad basic patent was bound to be resented as a legal imposition, although unfortunately there was no redress when once the courts had made their decision.

The Concrete in the Teaching of Engineering

DISCUSSIONS of engineering education have been so frequent recently that one is inclined to pass them by and to await the action of the colleges before indulging in more theory. However, we believe that engineers will read with more than ordinary interest the clear, forceful presentation of the plea for the concrete teaching of engineering made by Professor Morrow on page 827 of this issue. His views on his major topic are not altogether novel, but he repeats them with a strength and conviction that throw them into higher relief than in any presentation that has come to our attention.

Briefly, he pleads that the fundamentals of engineering—physics, chemistry, mathematics, etc.—should be taught in the applied manner. He would show through the concrete how things are done, and then seek the causes. Obviously, the teaching of the fundamentals would not follow after the engineering experiments themselves, but would go hand in hand with them. The same thought dominates the coöperative system of education as developed at Cincinnati, but it is clearly apparent that the method proposed by Professor Morrow can be applied at institutions far removed from industrial centers. It is a difference in spirit rather than equipment that is determinative in his scheme.

The danger, as we see it, in the plan he proposes is that which inheres in any scheme of education which stresses practice rather than theory; namely, that the student may be inclined to apply the quantitative standard not merely to the engineering works with which he deals, but to all other factors in life. It may be answered that even the abstract teaching of science has the same tendency, but we are inclined to believe that the stressing of principles which comes in the older method of teaching has somewhat the advantage as to this feature over Professor Morrow's scheme.

In criticising Professor Morrow's proposals we are not to take his attitude on the teaching of the engineering fundamentals as the whole of his plan, for when the latter part of his paper—that referring to the humanities—is taken into consideration, the first objection to the materialistic tendency of his proposed method of teaching engineering is largely removed. The problem is one of spirit just as much as method. An engineering faculty with little sympathy with the humanities could work much mischief, in the way of turning out one-sided men, with a plan such as Professor Morrow's. On the other hand, if the leaders are cultured men with a clear vision of the type of student they wish to turn out—young men prepared to take their places not merely as engineers but as citizens—the concrete teaching of the engineering subjects would be mellowed by the correct emphasis upon ideals.

History and Properties of Light-Weight Aggregates

Burnt Clay or Shale, Producing Material Full of Nonconnecting Cells and Making Concrete of High Strength and Light Weight, Developed by Government's Concrete-Ship Engineers

LIGHT-WEIGHT aggregate made from an artificially burnt shale or clay is now being used for the concrete on all of the Government concrete ships. The concrete so made, in rich mixtures and with a fine-ground cement, weighs from 100 to 118 lb. per cubic foot, and tests in compression from 3500 to 5500 lb. per square inch at the end of 28 days. Furthermore, it is impermeable, readily workable, and, so far as has been ascertained, has no defects not common to concrete with any of the more generally used aggregates. This artificial aggregate has been developed by the concrete ship section of the United States Emergency Fleet Corporation, but until now no definite statement of its method of manufacture or of its properties has been given out. *Engineering News-Record* is permitted here to make public the present knowledge of the material.

Early in the study of the concrete ship it became evident that to compete commercially with wood and steel the concrete must be lighter than the 150 lb. per cubic foot of the structural mixture commonly used. Naturally, low-weight concrete meant a low-weight aggregate. Many investigations were made into the possibilities of slag and various light, natural aggregates, such as volcanic scoria, pumice, etc., all of which are of a vesicular nature; that is, full of small nonconnecting cells which reduce weight. In pursuance of these studies it was found that certain clays or shales could be burnt so as to produce a light-weight vesicular product similar in appearance and qualities to the volcanic basalts, but more uniform in character and therefore better fitted for aggregates.

Accordingly, experimental work was started at the Bureau of Standards in the early summer of 1918 on quantity production of this material. The first working plant was a down-draft beehive kiln near Birmingham, Ala., where enough aggregate was turned out to supply the 3000-ton "Atlantus," launched in December at Brunswick, Ga. Experiments were also carried on in a portland cement rotary kiln at Ragland, Ala., and initiated at a railroad tunnel kiln at Perth Amboy, N. J., local clays and shales being used at each, but neither progressed beyond the experimental stage. Later, however, two contracts were let for quantity production for the big concrete ships under way; one to the Atlas Portland Cement Co., which makes the aggregate in cement kilns at Hannibal, Mo., and one to the Los Angeles Pressed Brick Co., which made the aggregate in dome kilns formerly used for burning brick. Both plants are now producing aggregates, the Hannibal plant supplying the ships at Wilmington, N. C., Jacksonville, Fla., and Mobile, Ala., and the Los Angeles kilns those at San Diego and San Francisco. In all, 25,000 tons of the aggregate will be required for the present Government program.

The new light-weight aggregate, as has been stated, is an artificially burned clay or shale uniformly filled with small nonconnecting cells. Speaking nontechnically, it is a bloated brick; that is, the basic clay or shale from which it is formed, when subjected to a temperature of about 1800° to 2000° in a kiln, becomes plastic and sears over on the surface, a coating being formed there which retains the gases generated by the decomposition, under heat, of the contained compounds. This expanding gas blows the brick or the clay ball full of holes and bloats it to several times its original size.

Various clays and shales are of the proper quality and consistency for such an aggregate. The material from which the aggregate is made should be rich in compounds of metallic oxides, carbon, sulphur, sodium, potassium or other equivalent compounds, some of which, when the material is subjected to heat, will either act as a flux in reducing the more refractory compounds or will give off gas at the desired time, or both. The use of clay or shale containing a relatively high percentage of calcium carbonate or magnesium carbonate should be avoided, as such undesirable elements, after being subjected to a temperature sufficiently high to change their form, would be detrimental to the product. The ratio of the fluxing constituents to the nonfluxing constituents can vary within wide limits, but ratios indicating fusibility at comparatively low temperatures may be commercially preferable.

LIGHT-WEIGHT AGGREGATE AS IT LOOKS BEFORE IT IS REDUCED TO PROPER SIZE FOR CONCRETING

This material was made at the Los Angeles Pressed Brick Company. Lettered brick near middle of bottom of view is of standard size.

Such material is widely distributed, having been found in Alabama, New Jersey, Missouri, New York and California, and used commercially in the production of aggregates in those localities. An analysis of a typical clay or shale of which such aggregate is made is as follows:

	Per Cent.		Per Cent.
S_1O_2	60	SO_3	1
Fe_1O_3	8	CO_2	2
Al_2O_3	19	Alkalis	3
CaO	1	Water	5
M_gO	1		
		Total	100

Such composition is found both in shales and clays. Both can be used in the manufacture of the aggregate, although the process of manufacture is slightly different. Either one weighs about 100 lb. per cubic foot in its natural state.

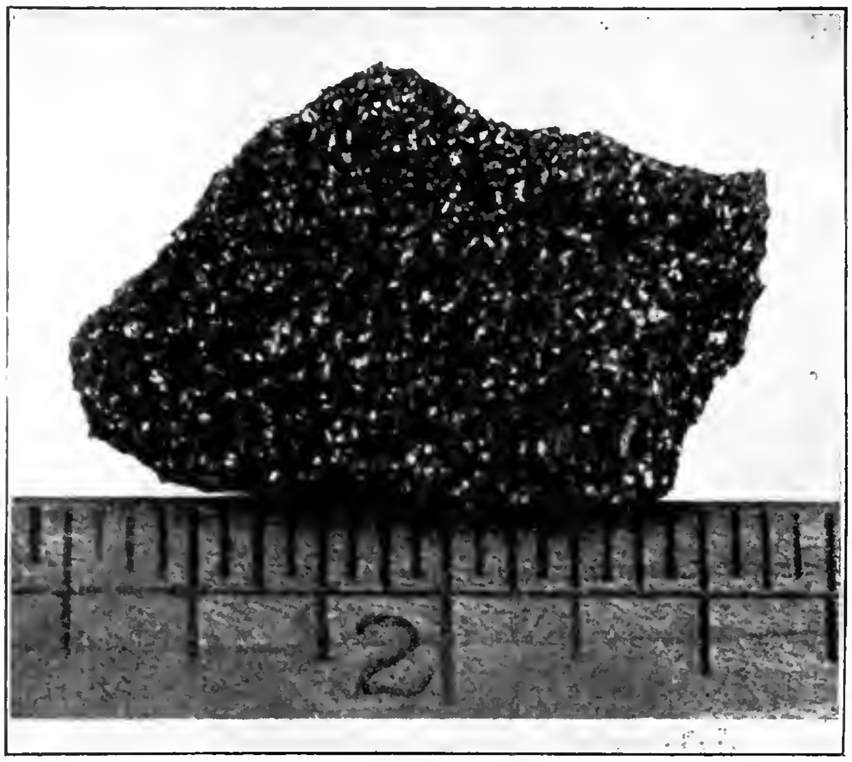
In general, in the production of the aggregate, the raw shale or clay must first be reduced by means of suitable crushers or disintegrators to a fineness so that all of it will pass through about $\frac{3}{16}$-in. openings. The purpose of this reduction is to obtain uniform texture and to prevent striations or laminations which might otherwise result in the finished material. It is then burned in a kiln, according to either the wet or dry process as noted hereinafter, is taken from the kiln either in large balls or in the bloated brick, and is then crushed to the required sizes for the aggregate which, in the concrete-ship work, is not larger than passing through a $\frac{1}{2}$-in. round opening.

The aggregate burned in the stationary brick kilns is prepared as an ordinary brick for the burning. Such a product used on the Brunswick ship was made at the brick plant of the Copeland-Ingles Shale Brick Co. at Alton, near Birmingham, Ala. This material was burned in an ordinary type of down-draft dome brick kiln. The raw material, which was a shale, was prepared as for common, stiff-mud brick, and after drying to a less degree than is the practice for the production of common brick, was placed in the kiln, set rather close in columns, leaving space for swelling, and fired rapidly. The resulting product was more or less oxidized on the surface, and lacked the uniformity possible by other methods of burning. However, most of the product was quite satisfactory. The bricks, when sufficiently cool, were taken from the kiln, crushed and screened. The coarse aggregate was that which passed the $\frac{1}{2}$-in. screen and was retained on the $\frac{3}{16}$, the fine aggregate that passing the $\frac{1}{16}$-in. screen to dust. The tests of the concrete made from this aggregate are given in Table III. Local coal was used for the fuel in the kilns.

While burning the aggregate at Alton, experiments were also made in burning the same material in a rotary kiln at the plant of the Coosa Portland Cement Co. at Ragland, Ala. In the experiments, the shale from Alton and the shale from the cement company's land were both used. There was practically no difference in the products of the two materials, neither was there much difference in the analysis of the shales. In this experiment the shale was prepared by passing it through Fuller mills and then directly to the kiln in the form of both a dry powder and a slurry. Bricks, also, were made at Alton and shipped to be burned in the rotary kiln, with quite satisfactory results. From the experiment, though it was not extensive enough to establish the fact, it would seem that somewhat better results might be expected from the use of a slurry than from the use of a dry feed. Some very excellent material was produced during this experiment, made in an ordinary cement kiln 8 ft. in diameter by 125 ft. long, using powdered coal as fuel. None of this material was used in the ships.

Further experiments were made at certain other places, both with tunnel kilns and with ordinary brick kilns, but none of the material was used in practical work.

Later a contract was entered into with the Atlas Portland Cement Co. to produce light aggregates in its plant at Hannibal, Mo., using shale found on the property. The raw material here was reduced to a fineness of approximately 100% through a 50-mesh screen, and introduced into a large cement rotary kiln in a dry state, with powdered coal as fuel. This burned ball coming through the rotary was passed directly into a crusher while hot and sorted at the distribution end of the kiln. Crushing the material while hot and malleable produced particles of a spheroid shape with few of the sharp corners which distinguish the cold-crushed material. In this product there is a rather large quantity of extra hard, burned small particles, which are screened out before the larger particles are crushed. These hard fines weigh considerably more than the more porous product, but on account of the expense of production they are being used in the ship work. As noted in the tables and descriptions further on, they tend to increase the weight of the concrete a few pounds over that of the concrete made from the brick aggregate. The product of the Hannibal mill is now being shipped to the Atlantic and Gulf yards.



PIECE OF CRUSHED LIGHT-WEIGHT AGGREGATE SHOWS FIXTURE

The scale shown in the view is to one-sixteenth of an inch

Still later an agreement was made with the Los Angeles Pressed Brick Co. to produce the aggregate in semi-muffle and down-draft kilns, using oil as fuel. In this plant the material is pugged and mixed with water and forced through brick machines and burned as ordinary brick. There is being produced here a remarkably light and satisfactorily strong material, as shown in the data in Table IV. It is being used on the San Diego and San Francisco ships.

The aggregate as used in the concrete ships is as a rule being divided into two sizes, the coarse material, that which passes through a screen having $\frac{1}{2}$-in. round openings and is retained on the screen having $\frac{3}{16}$-in. round openings, and the fine material, that which passes through a screen having $\frac{3}{16}$-in. round openings. In the ships the concrete is mixed in the proportions of one part cement, two-thirds part fine aggregate, and one and one-third parts coarse aggregate, although in some of the yards these proportions have been changed to slightly different mixtures which are noticed in the various strength tests given herewith. The early speci-

TABLE I COMPRESSION TESTS OF LIGHT-WEIGHT AGGREGATE CONCRETE MADE AT HANNIBAL, MO.

Tests made on 6x12-inch cylinders at mill. Mixture = 1 part Atlas portland cement, ⅔ part fine aggregate, 1 part coarse aggregate.

Typical sieve analysis:

Fine aggregate: Per cent. passing sieves No.

10	20	40	60	80	100
90.0	70.0	44.3	29.1	18.1	12.1

Coarse aggregate: Per cent. passing screens.

[illegible] In	[illegible] In	[illegible] In.
5.0	78.0	100.0

Fine Aggregate Wt. Lb. per Cu.Ft.	Coarse Aggregate Wt. Lb. per Cu.Ft.	Water, per Cent	Consistency Drop, Inches	Compressive Strength, in Lb. per Sq.In. One Week Age	Strength	One Month Age	Strength	Wt. of Concrete Green Lb. per Cu.Ft.
70.1	41.8	22.6	8	7	2510	28	4303	115.0
68.0	42.0	21.9	9	7	2584	28	4199	115.5
76.0	44.0	21.5	8	8	2545	28	3554	115.0
74.0	46.0	22.0	8	7	2428	28	3751	116.5
74.0	47.0	20.9	7	8	2313	28	4173	116.0
72.0	47.0	21.1	9	7	2313	28	3806	117.5
69.0	42.0	22.2	9	7	1793	28	3246	115.5
73.0	44.0	22.3	9½	10	2062	28	3290	117.7
72.0	42.0	22.0	9		1863	28	3567	116.0
72.0	43.5	21.9	9		1766	30	3703	115.0
68.0	43.0	20.6	7	11	2552	28	4718	114.0
68.6	45.0	19.3	7½		2485	28	5059	114.5
65.0	42.0	22.2	9	11	3192	30	3920	114.0
66.5	43.2	22.2	9½	9	2910	28	3852	114.0
67.0	43.0	21.2	8	10	3117	28	4495	114.5
68.0	43.0	21.5	7	7	2370	28	4252	112.6
71.0	44.0	20.7	7	7	2941	28	4664	114.0
71.0	44.0	20.5	9	7	3074	28	5128	114.5
70.0	45.0	20.4	8	7	2844	28	4982	116.0
71.0	43.5	22.0	8	7	2529	28	4055	114.0
70.0	45.0	21.2	9	9	2893	28	4333	117.0
70.0	44.0	21.4	8	7	2473	28	3735	116.0
68.0	44.0	21.0	8	7	2532	28	4732	114.0
64.0	40.0	21.0	7½	7	2678	28	4808	112.0
64.0	38.0	22.0	8½	7	2125	28	4112	112.0
68.0	41.0	22.2	8	8	2360	28	3669	114.0
68.0	45.0	22.0	8½	9	2394	28	4299	112.6
73.0	45.0	22.0	9	7	2415	28	4370	115.3
72.0	46.0	22.0	8½	7	2415	28	5397	115.8
71.0	46.0	22.0	8	7	2783	28	4703	116.5
70.0	45.0	22.0	9½	8	2959	28	5358	115.0
69.0	44.0	22.7	10	8	2761	28	5096	114.0
70.0	44.0	22.0	9	8	2694	28	4104	114.2
70.0	44.0	22.0	9	9	2970	28	4344	114.5
69.0	44.0	23.0	9	7	2431	28	4562	114.0
70.0	50.0	22.8	9	7	2491	28	4561	114.2
71.0	45.0	22.0	8½	7	2780	28	4857	116.0
71.0	44.0	22.1	9	7	2429	28	4531	114.4
68.0	43.0	22.0	9	7	2605	28	4587	114.0
70.5	46.0	22.1	9	7	2557	28	4858	114.2
69.0	43.0	22.0	8½	7	2332	28	4602	114.0
67.0	42.0	22.0	8	7	2617	28	5049	114.0
67.0	43.0	22.7	9½	7	2423	28	4742	113.5
67.0	43.0	22.4	9	8	2848	28	4194	112.7
68.7	43.5	22.0	8	8	2772	28	4528	112.6
68.0	44.0	22.2	9	7	2374	28	4972	113.1
72.0	44.0	22.0	8½	9	2454	28	3897	113.9
69.0	43.5	22.0	9	7	2439	28	4510	...
67.6	42.5	22.0	9	8	2840	28	4601	112.1
70.2	45.5	22.5	8	7	2638	28	4378	114.0
76.0	45.0	23.5	9	7	2288	28	4489	113.2
74.0	45.3	22.9	9	7	2325	28	4179	112.8
68.0	46.0	22.0	8	9	2758	28	5141	112.8
70.0	45.0	22.0	8½	7	2407	28	5061	114.0
68.0	43.0	22.9	9	7	2284	28	4596	112.5
70.0	43.0	23.0	8	7	2517	28	4233	112.7
68.0	42.0	22.5	9	7	2257	28	4729	113.0
68.0	43.0	2.6	9	8	2316	28	4964	112.8
68.0	42.0	21.8	10	7	1916	28	4048	112.6
72.0	43.0	23.0	9½	8	2186	28	4271	112.5
70.0	41.0	24.0	10	7	2173	28	4529	113.0
Average							4,417	114.2

TABLE II COMPRESSION TESTS ON LIGHT-WEIGHT AGGREGATE MADE AT HANNIBAL, MO

Tests made on 6x12-inch cylinders poured with ship at yard
Portland cement passing 90% through 200-mesh sieve.
Consistency drop averages 9 inches

Yard and Ship	Age, Days	No. of Cylinders	Mixture	Weight per Cu.Ft.	Compressive Str., Lb. per Sq.In.	Modulus of Elast.
Wilmington, 1562	28	9	1:1:1	118.5	4744	3,030,000
Wilmington, 1560	28	11	1:1:1	116.0	5169	3,105,000
Mobile, 1716	28	18	1:1:1	118.9	5591	3,306,000
Mobile, 1715	28	20	1:1:1	117.1	5157	2,997,000
Jacksonville	7	3*	1:1:1	116.0	5158	.

* Tests on cubes

fication for the concrete was that the 1: ⅔: ⁴⁄₃ mixture with sufficient water to produce a consistency drop of 9 in., according to the test noted in Mr. Davis' paper in *Engineering News-Record* of Mar. 27, 1919, p. 603, shall develop in seven days a minimum strength of 2500 lb., using standard American portland cement. In the ship the special fine-ground cement, passing 90% through the 200-mesh screen, is being used. The tests, as given in the accompanying tables, indicate that the 2500 lb. would be a safe minimum for the seven-day test, with 4000 or even 4500 lb. per square foot for the 28-day test. The early specifications for the weight of the aggregate were that the coarse material should not weigh more than 37 lb. per cubic foot. This is somewhat lighter than the average material produced.

Tests are given in the various tables herewith. Table I represents the mill test of the concrete aggregate made at Hannibal, mixed to a 1: ⅔: 1 proportion. These are compression tests on 6 x 12-in. cylinders and represent material shipped to Mobile, Jacksonville and Wilmington. The screen analysis of only one of the aggregates is given, but this is fairly representative of the group. From this it will be seen that the fine aggregate made at Hannibal averages about 67 lb. per

TABLE III. COMPRESSION TESTS ON LIGHT-WEIGHT AGGREGATE MADE AT ALTON, ALA.

Tests on 6x12-inch cylinders poured with ship at yard.
Portland cement passing 90% through 200-mesh sieve.
Consistency drop averages 8½ inches.

Mix	Age	No. of Spec.	Wgt. Lb. Cu.Ft.	Compression Lb. Sq.In.	Modulus of Elast. at 1500 Lb. Sq.In.
1:⅔:4/3	1 mo.	2	115.7	3042	2,866,000
1:⅔:4/3	1¼ mo.	14	114.2	3774	2,608,000
1:⅔:4/3	60 days	14	111.6	3836	2,398,000
1:2	1 mo.	2	128.1	4375	3,080,000
1:2	1¼ mo.	5	122.0	3740	2,608,000
1:2	60 days	15	121.0	4493	2,733,000
1:1	1 mo.	3	124.3	4055	2,720,000
1:1	60 days	2	125.2	6195	2,355,000
1:⅔:4/3	59 days	4	112.0	4425	....
1:⅔:4/3	35 days	3	124.0	4280	....

cubic foot in weight and the coarse aggregate about 43 lb. per cubic foot, that the seven-day compressive strength is about 2500 lb. per cubic foot, the 28-day compressive strength averages 4417 for 61 tests, and that the weight of the concrete for the same number of tests is 114.2 lb. per cubic foot. The low compression for 28 days is 3246 and the high 5397, with only two testing below 3500 and eight above 5000. The low weight for the wet concrete is 112 lb. and the high 117½ pounds.

Table II gives the result of cylinders taken from the actual pourings of the various Atlantic and Gulf ships of concrete made with the Hannibal aggregate. From these it will be seen that the 28-day test of a 1: 1: 1 concrete made up of the aggregates of the sizes noted before averages well above 5000 lb. per square inch, and that the weight is somewhat higher than the weight of the mill-tested concrete of the 1: ⅔: ⁴⁄₃ mixture, running around 116 lb. per cubic foot. This, however, is the weight immediately after pouring, and other tests have shown that this decreases 3 or 4 lb. in the 28-day test. Table III shows the tests of various proportions and various ages of the dome-kiln aggregate used in the "Atlantus" at Brunswick, Ga. The strengths are not quite as high as the others given, but the weights are about the same. Tables IV and V give the results of some of the tests of the Pacific Coast aggre-

TABLE IV COMPRESSION TESTS OF LIGHT-WEIGHT AGGREGATE MADE AT LOS ANGELES, CALIF.

Tests made on 6x12-inch cylinders mixed by hand for the test. Mixture 1 part portland cement ground to pass 90% through 200-mesh sieve, ⅔ part fine aggregate, 4/3 part coarse aggregate. Typical sieve analysis:

Fine aggregate. Per cent passing sieve No.

10	20	30	40	50	80	100	200
93.4	74.2	64.0	57.4	54.6	40.4	35.4	25.4

Coarse aggregate. Per cent passing sieve:

½-in.	¼-in.	1/10-in.
98.4	80.4	4.6

Fine Aggregate Wt. Lb. per Cu. Ft.	Coarse Aggregate Wt. Lb. per Cu. Ft.	Consistency Drop in Inches	Water, per Cent	Compressive Strength, Lb. per Square Inch 7 Days	Compressive Strength, Lb. per Square Inch 28 Days	Wt. per Cubic Ft. in Lb Green	Wt. per Cubic Ft. in Lb 7 Days	Wt. per Cubic Ft. in Lb 28 Days	Yield per Cent
61.5	41.5	9	20.4	2563	3676	111.0	106.5	107.5	147.0
61.0	41.0	9¼	23.8	2765	..	112.0	108.2		151.0
57.5	37.2	9¼	22.7	3035	.	113.5	108.2		143.2
61.3	37.5	9	22.4	2641	.	113.0	106.2		149.5
60.3	39.7	8⅞	21.4	2816	. .	113.0	109.5	....	145.5
58.8	38.8	9¼	22.[illegible]	2682	. .	111.5	107.3		145.5
62.8	46.0	9⅛	17.7	2390	.	109.5	108.7	. . .	150.1
57.5	42.5	9	20.9	2794	....	107.5	107.2	. .	150.5
61.3	40.0	9	23.5	2480	....	113.5	108.5	. .	147.5
60.0	42.8	9¼	21.3	2861	....	112.0	108.7	. .	145.5
62.8	45.6	9⅛	23.1	3015	....	116.0	109.0	....	154.5
69.0	44.3	9¼	22.8	2639	...	114.5	109.6	....	158.6
63.0	41.5	9	22.3	2575	....	112.0	. .	.....	145.5
61.7	38.0	9	21.1	3625	....	113.0	108.6	.....	145.5
66.6	39.0	9⅛	23.6	3216	....	113.0	109.6	....	145.5
64.0	39.5	9	23.8	3315	....	113.5	109.1	.....	145.5
55.6	38.0	9¼	23.6	....	....	111.0	.....	.....	143.3
56.8	39.0	9	21.1	....	....	111.0	.....	.....	150.6
58.4	40.3	9	23.2	....	....	110.5	.....	.....	145.1
Average.........			....	2867		112.1	108.3		

NOTES—The per cent. of water is based on the weight of dry material, including cement and aggregates.

The yield as used is the volume of concrete divided by volume of coarse aggregate.

Aggregates were wet when made into concrete.

TABLE V. COMPRESSIVE TESTS OF LIGHT-WEIGHT CONCRETE USED IN CONSTRUCTION OF HULL 1662, SAN FRANCISCO SHIPBUILDING COMPANY

MIX

1 part reground cement.
⅔ part fine aggregate (1/10 in. down).
1⅓ part coarse aggregate (½ in.—1/10 in.).

Consistency Drop, In.	Age Days	Compressive Strength Lb. per Square Inch	Weight per Cubic Foot, Lb.
8⅞	7	3040	104.2
9⅛	7	2677	107.5
9	7	2872	105.9
9⅛	7	2637	104.1
9⅜	7	2681	107.6
9¼	7	2751	109.3
9¾	7	3393	104.9
9⅜	7	3447	108.4

Last four mixes have 1 ½% diatomaceous earth by weight of cement, added to overcome the tendency of the concrete to segregate.

gates. In experimental mixtures not noted here the material dropped as low as 92 lb. per cubic foot in weight, and averaged below 100 lb. Tests on the concrete as poured in the ships show that while the weight is not quite so low it is somewhat less than with the Eastern aggregates and the strength is satisfactory.

There has not been sufficient time to make long-time tests of the light-weight concrete, but a few such tests, noted in Table VI, show values as high as 7200 lb. at 3 months, and for the standard consistency of the other tests a strength of 6483 lb. for the same period.

Some concern is occasionally expressed as to the permeability of a concrete made with this material. A number of tests have been made, and they all show that such a concrete is as low in absorption and in permeability as concrete made with an apparently more dense aggregate. The material is not porous. While full of holes, it must be remembered that they are nonconnecting holes, so that there is no reason why water should pass through such a concrete, assuming that the aggregate itself is of a dense material. Very few strength tests on the aggregate itself have been made. Recent tests at the University of Pennsylvania laboratory show that in 1-in. cubes it has an average compressive strength of about 1500 lb. per square inch, with values in test ranging from 1000 to 2500 pounds.

Commercial production of the aggregate except for the Government ships has not been started, though there are prospects that one or both of the Government contractors will continue production after the ship requirements are satisfied. There is a company in Kansas City, under the direction of Stephen J. Hayde, which is manufacturing a somewhat similar product known as Haydite. This material was used in the concrete superstructure of the freight car recently exhibited in Chicago. Haydite was developed some years ago as the

TABLE VI. THREE-MONTHS COMPRESSION TESTS OF LIGHT-WEIGHT CONCRETE

Commercial cement with a variation of workable consistencies. Mix=1:2/3:4/3

Consistency Drop, inches	Compressive Strength lb. per square inch
5½	7285
7	6560
9	6483
10½	6180

aggregate for sand-lime brick and is produced in a vertical kiln.

The technique of the manufacture of the aggregate is necessarily complicated, as the value of the resulting product depends so much on the quality and moisture content of the raw material, the nature of the preliminary treatment, the degree of heat, and many other details. There is no claim that perfection has been reached in the brief time in which experiments and quantity production have been under way, but the aggregate is uniform and satisfactory in quality and there is every hope that its commercial manufacture is possible. Costs today are not consistent, and are not therefore of much use to those contemplating the use of the aggregate for structural purposes. It seems, however, that the aggregate should be produced at the mill for $3 or $4 per cubic yard, which will weigh in the crushed state about as shown in Table I and in the ball or brick, uncrushed, about 60 lb. per cubic foot.

The studies, tests and production of this aggregate have all been carried out under the direction of Rudolph J. Wig, head of the concrete ship section of the Emergency Fleet Corporation, with C. W. Boynton and W. D. Richardson, specialists in immediate charge of the work. Credit should also be given to A. V. Bleininger, ceramic chemist of the Bureau of Standards, for laboratory burns of various clays to determine suitability for the purpose.

Will Name Bridges After War Heroes

As memorials to soldiers who lost their lives in France, the City of Hutchinson, Kan., is to name some new concrete bridges just being built after specific men. A granite cornerstone inscribed with the soldier's name, regiment, and military record will be placed at each end of the bridge. Five bridges have been so designated for the present year.

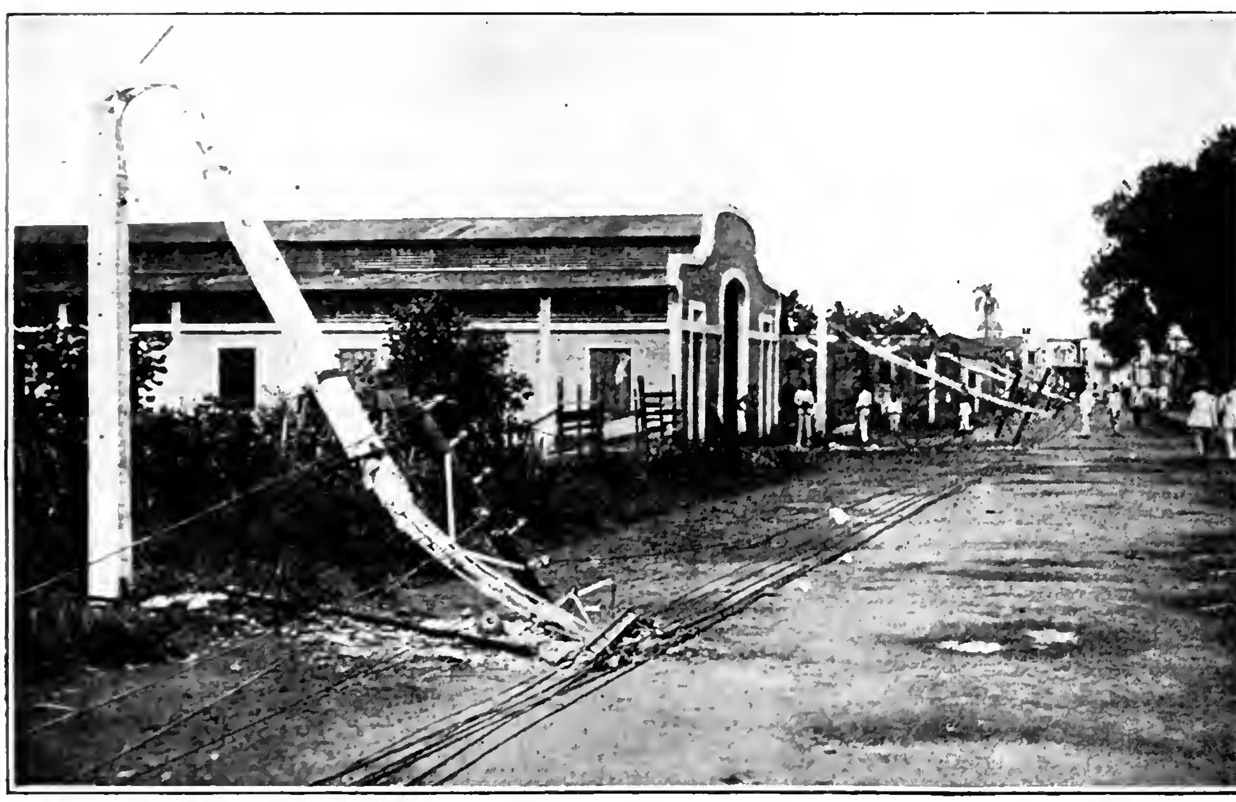
Effect On Structures of Recent Porto Rico Earthquakes

Wood Frame Proves Safest for Buildings, With Well-Built Reinforced Concrete Next, But Articulated Construction Is Poor

By M. L. Vicente and C. F. Joslin

Professor of Civil Engineering and Assistant Professor of Physics, Respectively, College of Agriculture and Mechanic Arts, Mayaguez, P. R.

Earthquake-resisting construction, which is a decided necessity in some sections of the world, can best be studied from the behavior of existing structures in a serious earthquake. Opportunity has been afforded the authors during the past six months to observe closely the effect of the successive earth shocks to which parts of Porto Rico were subjected in that period. On the calm and typically hot tropical morning of Oct. 11, 1918, there occurred in western Porto Rico a severe earthquake shock, lasting some 50 sec. and accompanied by distinct subterranean rumblings. All communication with the outside world and with the rest of the island was temporarily cut off, the property loss was about $3,000,000 throughout the island, while the loss of life was nearly fourscore. At the time of the first earthquake the writers were in their classrooms in the engineering building of the college in Mayaguez. This building, of modern reinforced-concrete construction, did not collapse, but all chemicals were thrown violently to the wooden floors, and soon the building was in flames.



LINE OF CONCRETE POLES BROKEN—ONE-STORY CONCRETE BUILDING INTACT

This first earthquake was followed shortly by a tidal wave some 15 ft. high which swept in from the sea and mainly concentrated itself at the head of the harbors of Mayaguez and Aguadilla. This wave destroyed several hundred huts along the shore, in which many of the poorer classes lived. The monetary damage was slight, but over a thousand persons were rendered homeless by the wave, which aroused so much terror among the lower classes that they started in droves for the highest nearby hills.

The first earthquake was followed by sharp quakes which occurred every few hours for a full week. It was the continual fear and uncertainty as to the outcome of these lesser quakes which kept the inhabitants in a state of terror and made it most difficult to obtain men who would help in the necessary reconstruction work. At midnight, Oct. 25, two weeks after the first earthquake, the western part of the island was visited by a second severe earthquake. There was but little property damage done by this shock, mainly because most of the damage had been done that could be done. Two and a half weeks after this second quake occurred the third severe earthquake, on the afternoon of Nov. 12. This earthquake was most discouraging; it took the heart out of many men who had considered the earthquakes as over and who had practically decided to rebuild. There have been a multitude of short, sharp tremblings ever since the first earthquake in October, decreasing in intensity, duration and frequency, but occasionally punctuated by more severe jolts of longer duration. At the present writing, Mar. 18, 1919, there have been no sharp tremblings of any kind for over 10 days.

The cause of the earthquake was left for seismologists to fathom. The most generally accepted belief is that the first earthquake was caused by the sudden falling or slippage of great masses of rock under the ocean surface in the Mona Passage, which lies between the western coast of Porto Rico and eastern Santo Domingo. Inasmuch as the cities of Mayaguez, Anasco and Aguadilla, which were most severely hit by the earthquake, are all on the western coast, and as the earthquake diminished in intensity and effect toward the eastern end of the island, this theory sounds quite plausible. The later earthquakes were apparently caused by further slippage and settlement of large rock masses in the same locality.

The writers were appointed by the assistant commissioner of the interior to act with the municipal engineer in an endeavor speedily to make the city safe for life and property. For two and one-half weeks the committee was busy in dynamiting dangerous walls and towers, erecting temporary bridges, making temporary roads and shoring up property wherever feasible. Opportunity was obtained in this work for observing certain effects of the earthquake on various structures.

The damage done in Mayaguez was pitiable, because so much of it could have been avoided. The great majority of houses, except in the heart of the city, are of simple wood construction, an absolutely safe type of structure in earthquake regions. The wooden house creaks, rocks and sways, but it does safely resist the most severe earthquakes. Shortly after the first earthquake it was very evident that no one felt secure for the night unless he slept in a tent, out of doors, or in a wooden house.

Another type of construction common here is a one-story native brick store or dwelling. We have not seen one such building which has satisfactorily withstood the earthquake. Most of them went completely to pieces. There are several reasons for the universal failure of brick structures. The bricks used here are made locally in almost prehistoric fashion. Yokes of oxen are made to work the clay with their hoofs; the bricks are handmade and burnt in crude kilns. These bricks are naturally very porous, of low compressive strength and of varying poor quality. The native brick is 1 in. thicker and 1 in. wider and longer than the typical American brick. In laying brick, joints ¾ in. thick are often found in what is considered first-class brickwork. The mortar is generally of lime and sand—rather dirty, smooth sand. Failures in brick structures were often due to lack of coherence between bricks. Very often in tearing down walls the bricks could be lifted loose by hand.

It was continually noticed that brick walls supporting roof or floor beams held up better than unloaded walls. The common type of overhanging brick cornice is an unwise design in earthquake regions. Save in rare cases, these cornices broke off and fell into the street, sometimes carrying the lower wall with them in their fall. Brick arches of all types were subject to failure. To see an intact brick arch of any type was unusual. In nearly every brick arch seen or inspected the key had either dropped several inches or had dropped out entirely. Much of this was due, of course, to the poor

TYPICAL FAILURE OF KEYS IN BRICK ARCHES.

CONCRETE WALLS OF COLLEGE BUILDING INTACT BUT CRACKED AT INTERSECTIONS—FIRE GUTTED BUILDING

quality of brick and mortar used. In general, it was evident that walls parallel to the direction of the earthquake waves, northwest to southeast, were more seriously damaged than were walls running perpendicular to the direction of these waves.

A number of buildings were made of wooden framing, filled in with brickwork. The brickwork had to be removed, but the woodwork was undamaged and was used for framework in rebuilding the house of wood. Many instances were noticed where floor and roof timbers embedded in brick walls had practically rotted away at the ends to within ½ to 1 in. of the edge of the support. In fact, this condition was so typical in the larger dwellings that the authors felt that had not the earthquake exposed these rotting timber ends, in a few years some of the floors would, under a normal load, suddenly have collapsed, with loss of life and property. No attempt had apparently been made to protect the wooden beams in any cases against the effects of the alternate wet and dry seasons.

Concrete, when properly designed and inspected, makes a dependable construction. The largest building in Mayaguez, a four-story reinforced-concrete structure belonging to the Redemptionist Fathers of the Roman Catholic Church and built by an American contractor, withstood all the earthquakes. It was used as a temporary hospital for those injured in the earthquake. It was noted in this building that the plastering on the walls was in some cases from 1½ to 2 in. thick where presumably the walls had been cast out of plumb. Wherever the plaster was over ½ in. thick it cracked loose from the concrete wall during one of the three earthquakes. This building had doors leading from the building onto the balcony from the middle of each floor. About 2 ft. above each door, and midway between the top of the door and the bottom of the door immediately above it on the floor above, were left ventilation holes in the concrete wall some 10 in. in diameter. The location of these holes was unfortunate. The concrete cracked from the top of one door to the ventilation hole, from the upper edge of the ventilation hole to the bot-

tom of the door on the next floor and thus through the door to the next ventilation hole. In other words, as these doors were all in the same vertical line from the top of the building to the bottom, and as the ventilation holes were also in the same vertical line, as a result of the earthquake cracks have connected these openings and the building has practically been divided into two parts along this center line. In general, however, this building stood the earthquake in good shape, and no material damage was done anywhere. It stands as conclusive proof that well constructed reinforced concrete can stand up in earthquake territory.

A number of buildings constructed of so-called reinforced concrete collapsed at the first severe shock. These buildings were poorly designed, were slighted on cement and carelessly erected. The most flagrant case was "La Hababera," a large two-story cigar factory. The walls were 6 in. thick and reinforced with vertical round ½-in. rods spaced about every foot. The concrete could be easily picked apart with no danger of dulling the end of the pick. The sand used was obviously too smooth and unwashed. The absence of cement was conspicuous. The collapse of this structure was a lesson to everyone who saw it, and local contractors will be more careful henceforth in choosing their aggregate. Some fifty persons were killed in this building.

The electric light wires for the city were carried on reinforced-concrete poles, some 30 ft. high and tapering from a 9 x 9-in. cross-section at the bottom to a 6 x 6-in. section at the top. A great many of these poles broke completely in two some 15 ft. from the ground. This was due in many cases to large masses of wall falling on the tense wires. It seems that the reinforcing was somewhat of a handicap, because the steel separated the inside core from the outer part of

TYPICAL FAILURE OF SECOND-STORY BRICK WALL AS A UNIT

the section of the pole. The rods were ½ in. square twisted rods, with hoops every foot vertically. As the sand was not particularly clean, the bond to the steel was poor, and the reinforcing merely served to prevent the concrete inside the steel reinforcing cage from properly bonding with the outer concrete. A hollow circular pole would have been more sturdy.

The authors are fully convinced that reinforced concrete and wood are suitable materials for construction in earthquake countries. There are no structural steel buildings in this section, and no opportunities were therefore afforded for observing the behavior of this construction. In concrete work all contractors in the western part of Porto Rico are handicapped by the

ROOF OF BRICK LAID FLAT ON 1 x 2-INCH WOOD STRIPS AND JOINTED WITH GROUND CORAL

want of sharp, clean sand. In San Juan the ocean sand is fairly reliable, but on the western coast sea sand is entirely too smooth and fine. The other alternative material is the river sand, which is rather coarse, very dirty and not very sharp. The stone is river stone and gravel, strewn with old brick bats. For these reasons the use of the smooth bar for reinforcing work is highly undesirable in this section of the island.

The greater part of the loss of property in the earthquake and practically all the loss of life could have been avoided by reliable construction so far as materials, workmanship and design are concerned. All concrete walls should be well tied by horizontal reinforcement at all corners and intersecting walls. Continuous stretches of wall of any type are unwise without tie walls or other precautions against vibration.

Calls on Water Consumers Analyzed

In one year the water department of Oak Park, Ill., made calls equivalent in number to 88.7% of the 7683 accounts it has on its books. Of the 6802 calls, 13.34% were to turn on services for new customers, 12.25% were calls on delinquents, 11.79% to shut off services and close account, 8.46% because of meters not registering, 7.2% for special reading of meters, 6.45% to shut off water-supply from vacant houses, 5.35% to investigate leaks on account of high bills, 4.98% for periodical tests, 4.68% for meter leaks, 4.45% to investigate miscellaneous complaints, 3.38% to read meter for new tenants, 2.12% to locate service boxes, 2.16% to turn off water from delinquents, 2.1% on account of frozen meters, 1.81% for repairs made by laborers, 1.54% for "no water" complaints, 1.5% to check consumption, 1.37% to re-read meters, 1.37% for service leaks, 0.87% to inspect meter boxes, 0.62% on consumers' call for test, 0.60% for special shut-off at request of consumer, 0.38% to repair fire plugs, 0.25% to inspect premises found without meter, 0.29% to repair meter dials, 0.22% to reset incorrectly installed meters, and 0.1% for repairs made by inspectors.

Prices Yesterday, Today and Tomorrow

An Analysis of the Factors—Scarcity Demand, Advance in Wages and Inflation—Responsible for the Present High Price Level

A paper by O. P. Austin, statistician of the National City Bank of New York City, read before the Editorial Conference of the New York Business Publishers' Association, Apr. 11, 1919.

THE purpose of this address, as implied by its title, "Prices Yesterday, Today and Tomorrow" is an attempt to look into the future and determine, if possible, the probability as to the course of prices. That there have been great and continuous advances during the war period we are painfully conscious, and in the five months since the cessation of hostilities we have failed to experience the reduction which some had fondly hoped would come with the close of the war. In a few instances there have been slight reductions but in others there are still advances, and the index figures on foodstuffs in New York today are actually higher than those on Nov. 5, when the whole world so joyously welcomed the apparent termination of the great conflict which had raged for fifty-one months.

To attempt to determine what is likely to happen in the future we must try to find the cause of the things which have happened in the past, and also to see whether this cause is or is not likely to continue in the near future. When prices began to advance in the opening of the war, we could readily see that the upward movement was due to the urgent demand for the food and raw material required by the enormous armies which had been put into the field, and this cause has been designated the "scarcity demand," but when we found the advance extending to many articles in which there was no scarcity and which were not used by the armies or utilized in the manufacture of their requirements, we began to realize that a part of the advance must be due to some cause other than mere war or scarcity demands.

Edgar Crammond, the distinguished British statistician and economist, in an address before the London Institute of Bankers on Mar. 26, 1919, stated that the three facts which would tend to make the fall in prices a very gradual one are: (1) the vast increase in the amount of paper money; (2) the huge increase in the amounts of public debts of the belligerents; (3) the determination of labor to maintain wages and improve the standard of living.

Price Advances World-Wide

Raw silk, for example, for which the war made no special demand and which was produced on the side of the globe opposite that in which the hostilities were occurring advanced from $3 per pound in the country of production in 1913 to $4.50 per pound in 1917, and over $6 per pound in the closing months of the war. Manila hemp, also produced on the opposite side of the globe and not a war requirement, advanced in the country of production from $180 per ton in 1915 to $437 per ton in 1918. Mechanically ground wood pulp, not a war requirement, advanced as our publishers are aware, from $14 per ton in the opening months of the war to $35 per ton in the opening months of 1916, and the grade known as "chemical bleached" advanced from $50 per ton at the beginning of the war to $160 per ton in January, 1919. Goatskins, from China, India, Mexico and South America advanced from 25 cents per pound in 1914 to over 50 cents per pound in 1918 and yet goatskins were in no sense a special requirement of the war. Pig tin, produced by Chinese labor in the Malayan Peninsula and the Dutch East Indies and not to a very great extent a war requirement sold in the country of production in 1914 at 30 cents per pound and in the same markets at 75 cents per pound in the closing weeks of the war. Sisal grass produced in Yucatan advanced from $100 per ton in 1914 at the place of production to nearly $400 per ton in 1918, and Egyptian cotton, a high-priced product and thus not used for war purposes, jumped from 14 cents per pound in Egypt in 1914 to 35 cents per pound in 1918. Even the product of the diamond mines of South Africa advanced from 60 to 100 per cent in price per carat when compared with prices existing in the opening months of the war.

The prices which I have quoted to you are in all cases those *in the markets of the country in which the articles were produced* and in most cases at points on the globe far distant from that in which the war was being waged. They are the product of countries having a plentiful supply of cheap labor and upon which there has been no demand for men for service in the war. The advance in the prices quoted is in no sense due to the high cost of ocean transportation since they are those demanded and obtained in the markets of the country of production.

Labor Doubled in Price During War

Why is it that the product of the labor of women and children who care for silk worms in China and Japan, of the Filipino laborer who produces the manila hemp, the Egyptian fellah who grows the high-grade cotton, the native workman in the diamond mines of South Africa, the Mexican peon in the sisal field of Yucatan, the Chinese coolie in the tin mines of Malaya, or the goat-herd on the plains of China, India, Mexico or South America has doubled in price during the war period? The articles enumerated were in no case for use in the war and the prices are those in the country of production and thus not due to the increase in ocean freights or dangers of over-sea transportation. The advance has been general, world-wide. In a few articles in which an over-production was occurring in which the demand fell below normal the advance was not so strongly marked but there is scarcely an article in the long list of those entering world markets in which there has not been an advance, no matter how distant its place of production from that in which the war was occurring or how little the war's demands for it or for the labor by which it was produced.

Surely there must have been some general underlying causes for this world advance, this simultaneous demand by people of all classes and in all parts of the globe for higher prices for their products irrespective of their relation to war requirements. While we may be willing to accept the immediate demands of the war as a partial explanation of the advance in the prices of foodstuffs and certain manufacturing material and manufactures we must look farther for the cause of the similar ad-

vance in articles upon which the demands of the war could have had no direct bearing. It is true that a marked advance in the price of one important class of products does cause an advance in the prices demanded for other articles which must be exchanged for those in which the advance has already occurred, but it does not seem probable that the advance due to scarcity of a comparatively few of the world products required for war could have been the chief cause of the doubling of prices in practically every article produced in every part of the world, many of which had not the most remote relation to war requirements.

Underlying Causes

Apparently the principal causes of the advance in prices during the war were, stated in their chronological order, first, "scarcity demand"; second, the advance in wages presumably due to the increased cost of living and demand for labor, and, third, the large increase in world circulating media, or to put it in a single word, "inflation." Prof. A. C. Miller, member of the Federal Reserve Board, an authority whose views are entitled to high consideration, in a recent address before the American Academy of Political and Social Science named as the two chief causes of the advance in prices, "scarcity demand" and "inflation," adding that "there is so much evidence of an artificial abundance of money in comparison with the things that are purchasable by it that the abundance of money must be credited *with at least* an equal influence in explaining the high prices which have prevailed."

What were the articles for which the war created a scarcity demand? Food, clothing, transportation facilities, and material for the battlefield. How much did it add to the world's demand for these articles? Of course, the percentage of increase in demand for strictly war materials was very large, but was there really as great an increase in demand for other materials, food, clothing, and transportation facilities as we are accustomed to imagine? Let us assume that the number of people participating in the war was forty million, which is probably more than those in the field at any one time. Do we realize how small a share those forty million were of the world's consuming population? Less than two and one-half per cent. We think of forty million as a large number of people to feed, and so it is, but it must be remembered that the number of people in the world who must be fed and clothed and supplied with transportation facilities every day of the year is 1,800,000,000 or forty-five times as many as the highest number in the military service at any time during the war. Of course the soldiers were better fed than are many of the people in certain sections of the world, but even if their per capita consumption was four times as much as the average it would still represent but a small percentage of the world's daily food consumption. And it must be further remembered that all these forty million people in the armies had been consumers of food before the beginning of the war, not to quite as great an extent perhaps as after entering the activities of the military service, but it cannot be assumed that the war added forty millions to the world's consumers of food and clothing. Nor can it be properly assumed that the withdrawal of these millions from the industries actually reduced to that extent the world's producing power, for four millions of these were already in the military service and the places of the other thirty-six million were to a considerable degree filled by others who had not been up to that time actively engaged as producers.

Much of the material used in preparing the supplies for the battlefield was "switched" from the usual lines of industry, for there was an immediate cessation of railway construction, building operation, and a thousand industries which formerly required manufacturing material and as a result of this cessation of activities the material formerly used by them became available for war purposes.

It thus appears on close analysis that the "scarcity demand" created by the war was not as great in food, clothing, or manufacturing materials as has been pictured, while the fact that fifteen millions are still under arms minimizes the reduction in military demands which had been expected.

One factor often mentioned in the attempt to determine the causes of high prices is the advance in wages of labor, but the fact that the increase in compensation of labor was in most cases given because of the fact that the cost of living had already advanced at least somewhat minimizes the relative importance of this factor in attempting to discover the real causes of the general world-wide advance in prices. And it must also be remembered that several million persons who had not been engaged in the industrial and business world came to the assistance of those engaged in these duties during the war.

Inflation

Where, then, shall we turn in the search for the principal cause of the general advance in prices of articles produced the world over and their relation to the demands of the war? What other cause can we find after giving due consideration to the scarcity demand, the destruction by war and the increased cost of labor? The most prominent among the possible or probable causes is the theory advanced or accepted by the historians, economists, statisticians and financiers of the world that inflation in currency is usually accompanied or closely followed by an advance in prices; and, as already indicated, so high an authority as a member of the present Federal Reserve Board, Prof. A. C. Miller, has recently declared that "the abundance of money must be credited with at least an equal influence in explaining the high prices which have prevailed."

I wonder if we do fully realize the quantity of paper money which the responsible governments of the world have put afloat since the beginning of the war. Thirty-six billion dollars. The paper money in existence in the fifteen principal countries of the world at the beginning of the war was less than eight billion dollars and at the end of the war was over forty-four billions, an increase of thirty-six billions in fifty-one months, and this does not include any of the eighty billion dollars' worth of paper currency issued by the Bolsheviki in the eighteen months of their control in Russia. Thirty-six billion dollars of new paper money added to the circulation of the world by fifteen responsible governments in a little over four years of time.

We had been inclined to charge up the advance in prices occurring prior to the war to the fact that eight billion dollars' worth of gold was turned out by the mines of the world in the twenty years following our famous gold and silver campaign of 1896. But here are thirty-six billion dollars' worth of paper promises

to pay turned out as legal tender money by fifteen responsible governments in a short four-year period.

Do we realize how vast a sum is this thirty-six billion dollars' worth of paper currency which has thus been put into circulation in such a brief time? It is more, *in its face value*, than all the gold and all the silver turned out by all the mines of all the world in the 427 years since the discovery of America.

True, much of this paper money is now more or less depreciated in its value as compared with gold, the world's accepted standard, but the fact that it has behind it not only a certain amount of the yellow metal but also the pledge of the governments by whose authority it was issued renders it at least an accepted medium of exchange in the countries of its origin, while the fact that nearly every neutral country of the world has meantime increased its paper currency and national indebtedness, permitting its gold to pass from circulation into the vaults of its banks as a security for the paper circulation, tends to widen the field affected by this inflated currency.

In addition to these vast sums of legal tender currency turned out by fifteen responsible governments of the world, these same governments have at the same time made an even more spectacular advance in their issue of another series of promises to pay, which while not legal tender in the ordinary sense of the term, do form a more slowly moving mass of currency. By this I mean the one hundred and eighty billion dollars' worth of bonds or other forms of national obligations issued by the governments of the world in the past four years, for national debts of the world have advanced from forty billion dollars at the beginning of the war to two hundred and twenty billions at its close. And while these bonds or other governmental promises to pay money at some future date are not legal tender currency in the ordinary sense of the term they do pass current in the financial world and prove a basis upon which money may be readily obtained by their holders, and to this extent are an addition to the world's circulating medium.

Bank Deposits Greatly Increased

Still another increase in circulating media is found in the enormous growth in bank deposits, which of itself increases circulation through the increased use of checks, especially in countries such as the United States where the check forms so large a share of the daily business transactions of the country. Bank deposits in fifteen principal countries of the world have grown from twenty-seven billion dollars in 1913 to approximately seventy-five billions at the present time, the ratio of increase being about the same as that of currency.

These increases, in circulation, indebtedness, and bank deposits, while occurring chiefly in the countries participating in the war have also extended to many other countries, especially in Europe, where the six principal neutrals have during the war period increased their national debts one billion dollars, their note circulation over a billion dollars and their bank deposits by about one billion.

Thus in a short four and one-half year period world paper money has increased thirty-six billion dollars, world evidences of national indebtedness one hundred and eighty billion dollars and world bank deposits nearly fifty billion dollars. Most of this enormous increase has occurred in "uncovered" paper. The gold mines of the world have turned out less than two billion dollars' worth of the precious metal during the war period and most of the world's gold, which formed fifty-five per cent. of world circulation at the beginning of the war, has passed into the vaults of the governments or their great banks as a basis for their paper currency, and now bears a relation of but about twenty per cent. to the flood of paper money in circulation, and this proportion of gold to paper varies widely when the respective countries are compared.

If the world's historians and financiers and economists and statisticians are right in their general belief that an advance in prices usually accompanies or closely follows inflation in currency, and especially in paper currency, can we be surprised at the world-wide advance in prices which we have witnessed during the past four years in which world currency and bank deposits trebled and national debts quintupled?

Prices of Tomorrow

We come now to the third and final question, that of prices of tomorrow. May we expect a material reduction in general prices in the near future? And in trying to determine this we must see whether the causes which brought about the advance during the war period are likely to be removed.

The chief causes of the advance seem to have been the "scarcity demand," the higher cost of labor, and the increase in circulating media.

The "scarcity demand" came on the very first day of the war, for most of the countries entering that struggle found that the demand upon them would be far in excess of their supplies either of foodstuffs or military requirements, and as the weeks and months and years progressed this fact was more strongly impressed upon them.

During the closing year of the war the ammunition factories of the various participating countries were able to meet to a great extent the requirements of their own armies but in the matter of foodstuffs the "scarcity demand" still continues with little prospect of abatement at least in the near future. The number of mouths to feed in Europe has not decreased, and that continent, which has not for many years been able to produce its own requirements of foodstuffs, now finds itself with neglected soils, a disordered population and unable to return to normal production in the immediate future. In manufacturing materials, for which Europe has also been dependent upon other parts of the world, she will require abnormally large quantities at least in proportion to her attempts to manufacture, for her stocks of this class of merchandise are absolutely exhausted. In all parts of the world which have relied upon Europe and the United States for manufactures the shelves are empty and must be filled, and most of the manufacturing sections of Europe will evidently be slow in resuming the production of manufactures for exportation, and will have limited facilities for transporting or marketing them even if produced. So it seems that, although the demand for war material has terminated, the other features of the "scarcity demand" will continue at least in a somewhat modified form in the immediate future, especially as relates to world requirements of food, manufacturing material and manufactures, while developments thus far do not point to an early reduction in labor costs.

If we are right in assuming that a considerable pro-

portion of the world advance in prices is due to the enormous increase in world currency can we expect a marked reduction in prices until the cause, "inflation," is removed? Or, to put it in another form, that part of the advance caused by inflation can only be cured by deflation, by a reduction in the enormous stocks of currency which, as I have shown you, has trebled during the war, while that other form of slowly moving currency, governmental obligations, has quintupled.

Is it probable that these two forms of currency can be or at least will be reduced in the near future? The governments of the world, which were paying less than two billion dollars a year of interest on national debts at the beginning of the war are now paying and must continue to pay a total of over ten billion dollars a year in interest, and at the same time all other expenses of governments have advanced. Official estimates of the "budgets" or expense accounts of several of the principal countries for the coming fiscal year have already been announced and indicate that their necessary expenses in the first full year of after-war peace will be about four times as great as in the year preceding the war. The British budget for the next fiscal year is estimated at about six times as much as in 1913 and those of France, United States and Canada about four times as much as before the war. Present indications are that the governments of the world will be compelled to collect in taxes from their people about fifty billion dollars a year as against about twelve and one-half billions in 1913, or say a billion dollars a week as against a billion dollars a month before the war, *and* this does not include anything for "sinking funds" or other provision for reduction of outstanding debts. If this be true is it probable that the governments in those countries which have greatly increased their circulation and must now demand such enormous increases in annual payment of taxes will find it advisable or possible to reduce materially the amounts of currency available for such payments?

If the governments which have been the chief participants in the world increase of currency should fail to reduce materially that excessive supply, and if the world's demand for food, manufacturing material and manufactures is to continue at the present rate, are we justified in expecting a general reduction in prices in the near future? The question I think answers itself. There will, of course, be instances in which there will be material reductions, but in general terms the outlook for marked or rapid decline, at least in the near future, does not seem encouraging.

Typhoid in the Large Cities of the United States in 1918

Continued Downward Trend in Majority of Cities of More Than 100,000 Population — Eight Cities Under 3 per 100,000

NOTWITHSTANDING the unfavorable conditions of the war, typhoid fever continued its downward course in 1918, according to the seventh annual survey made by the *Journal* of the American Medical Association and published in its issue of Apr. 5, 1919. In 40 of the 60 cities surveyed the rate for 1918 was lower than that for 1917, and in 20 it was higher. Three cities had a rate of less than 2 per 100,000; eight were under 3. Twenty-two were below 5 and another 22 below 10. This leaves only 16 having a rate of 10 or more.

There is a general upward trend in the rates as the population of the cities increases, but as a rule each group shows a decline in 1917 compared with 1916, and in 1918 compared with 1917. Taking the 57 cities as a whole for which complete records are available, there is a constant decline year by year from 1910 to 1918, the two extremes being 19.59 and 6.23 per 100,000. It was in 1915 that the rate for the entire group went below 10.

The two cities at each extreme in 1918 were Chicago, 1.4, and Lowell, 1.8, contrasted with San Antonio, Tex., and Richmond, Va., at 54.3 and 65.3, respectively. The *Journal* in its article asks: "Will the chamber of commerce in that town advertise the typhoid rate in Northern papers, when presenting the claims of San Antonio as a winter resort?"

The accompanying tables, taken from the *Journal* already named, give all the tabular details of the results of the survey. In its editorial comment the *Journal* says it is fair to conclude that at least in many Northern cities further typhoid reduction will have to come largely through improvement in related rural and suburban conditions.

TABLE I. TYPHOID DEATH RATES IN CITIES OF UNITED STATES

Population estimates of the United States Census have been used for this and other tables. No estimates are made by the Census for Denver, Portland, Ore., Seattle and Spokane. The estimate for Washington is made by another plan. The number of typhoid deaths is given as sent to the *Journal* of the American Medical Association by local health officers and include deaths of non-residents.

(Deaths per 100,000 population)

	1918	1917	1916	Average 1911–1915	Average 1906–1910
GROUP 1: MORE THAN 500,000 POPULATION					
Chicago	1.4	1.7	5.2	8.2	15.8
Boston	2.5	2.9	3.5	8.0	16.0
Philadelphia	3.0	6.2	7.8	11.2	41.7
New York	3.7	4.0	3.8	8.0	13.5
Cleveland	4.7	7.1	5.3	10.0	15.7
St. Louis	7.2	7.5	9.4	12.1	14.7
Pittsburgh	9.8	11.2	8.6	15.9	65.0
Detroit	10.0	17.8	15.0	18.1	21.1
Baltimore	12.2	15.5	18.0	23.7	35.1
GROUP 2: FROM 300,000 TO 500,000 POPULATION					
Seattle	2.3	5.1	3.0	5.7	25.2
Los Angeles	2.8	5.2	3.1	10.7	19.0
Newark, N. J.	3.5	3.5	5.3	6.8	14.6
Cincinnati	4.1	4.1	3.4	7.8	30.1
San Francisco	4.6	4.9	3.4	13.6	27.3
Milwaukee	6.2	5.9	14.9	13.6	27.0
Minneapolis	7.6	5.9	5.8	10.6	32.1
Buffalo	7.8	10.1	10.9	15.4	22.8
Washington	11.9	13.2	12.6	17.2	36.7
New Orleans	20.1	23.0	23.4	20.9	35.6
GROUP 3: FROM 200,000 TO 300,000 POPULATION					
Rochester, N. Y.	1.9	3.1	5.1	9.6	12.8
St. Paul	3.5	2.4	4.9	9.2	18.3
Jersey City	4.1	3.2	6.8	7.2	12.6
Providence, R. I.	4.5	5.4	5.1	10.2	14.3
Portland, Ore.	5.6	5.5	4.6	10.8	23.2
Indianapolis	6.6	10.0	26.6	20.5	30.4
Denver	8.7	5.1	7.2	12.0	37.5
Columbus, Ohio	8.9	7.6	13.4	15.8	40.0
Louisville, Ky.	12.4	12.2	9.7	19.7	52.7
Kansas City, Mo.	13.7	10.0	10.6	16.2	35.6
GROUP 4: FROM 125,000 TO 200,000 POPULATION					
Paterson, N. J.	2.1	11.3	1.4	9.1	19.3
Worcester, Mass.	4.6	4.8	3.7	5.0	11.8
Oakland, Calif.	4.7	1.9	4.0	8.7	21.5
Omaha	5.0	6.4	5.1	14.9	40.7
New Haven, Conn.	5.2	9.2	8.0	18.2	30.8
Scranton, Pa.	5.2	6.0	5.4	9.3	31.5
Fall River, Mass.	7.0	16.9	10.9	13.4	13.5
Spokane, Wash.	9.1	7.1	2.0	17.1	50.3
Syracuse, N. Y.	9.3	6.3	12.2	12.3	15.6
Toledo, Ohio	9.9	9.7	22.9	31.4	37.5
Atlanta, Ga.	14.4	16.8	17.9	31.4	58.4
Memphis, Tenn.	14.9	21.1	36.3	42.5	35.3
Birmingham, Ala.	31.9	54.1	42.6	...	...
Richmond, Va.	65.3	7.0	24.1	15.7	34.0

GROUP 5: FROM 100,000 TO 125,000 POPULATION

Lowell, Mass.	1.8	6.9	11.4	10.2	13.9
Cambridge, Mass.	2.7	4.4	0.9	4.0	9.8
Springfield, Mass.	3.6	6.4	4.7	17.6	....
Camden, N. J.	3.6	3.7	11.3	4.5	.
Bridgeport, Mass.	3.9	6.4	9.0	5.0	10.3
Tacoma, Wash.	5.7	2.5	3.5	10.4	....
Dayton, Ohio	6.9	13.7	14.7	14.8	22.5
Hartford, Conn.	7.0	13.3	6.3	15.9	19.0
Salt Lake City	7.1	18.1	10.2	13.2	.
New Bedford, Mass.	8.0	5.7	4.2	15.0	16.1
Trenton, N. J.	9.4	12.3	6.3	22.3	....
Grand Rapids, Mich.	10.3	12.2	15.6	25.5	29.7
Albany, N. Y.	10.7	10.5	7.7	18.6	17.4
Reading, Pa.	12.3	7.4	18.7	31.9	42.0
Dallas, Texas	12.6	19.4	27.5	..	
Nashville, Tenn.	32.7	18.3	27.3	40.2	61.2
San Antonio, Texas	54.3	25.7	16.9	29.5	..

TABLE II. DEATH RATES FROM TYPHOID IN 1918

First Rank (Under 5.0)

Chicago	1.4	Springfield, Mass.	3.6
Lowell, Mass.	1.8	Camden, N. J.	3.6
Rochester, N. Y.	1.9	New York	3.7
Paterson, N. J.	2.1	Bridgeport, Conn.	3.9
Seattle	2.3	Cincinnati	4.1
Boston	2.5	Jersey City	4.1
Cambridge, Mass.	2.7	Providence, R. I.	4.5
Los Angeles	2.8	San Francisco	4.6
Philadelphia	3.0	Worcester, Mass.	4.6
Newark, N. J.	3.5	Oakland, Calif.	4.7
St. Paul	3.5	Cleveland	4.7

Second Rank (from 5.0 to 10.0)

Omaha	5.0	St. Louis	7.2
New Haven, Conn.	5.2	Minneapolis	7.5
Scranton, Pa.	5.2	Buffalo	7.8
Portland, Ore.	5.6	New Bedford, Mass.	8.0
Tacoma, Wash.	5.7	Denver	8.7
Milwaukee	6.2	Columbus, Ohio	8.9
Indianapolis	6.6	Spokane, Wash.	9.1
Dayton, Ohio	6.9	Syracuse, N. Y.	9.3
Hartford, Conn.	7.0	Trenton, N. J.	9.4
Fall River, Mass.	7.0	Pittsburgh	9.8
Salt Lake City	7.1	Toledo, Ohio	9.9

Third Rank (from 10.0 to 20.0)

Detroit	10.0	Louisville, Ky.	12.4
Grand Rapids, Mich.	10.3	Dallas, Texas	12.6
Albany, N. Y.	10.7	Kansas City, Mo.	13.7
Washington, D. C.	11.9	Atlanta, Ga.	14.4
Baltimore	12.2	Memphis, Tenn.	14.9
Reading, Pa.	12.3		

Fourth Rank (Over 20.0)

New Orleans	20.1	San Antonio, Texas	54.3
Birmingham, Ala.	31.9	Richmond, Va.	65.3
Nashville, Tenn.	32.7		

TABLE III. AVERAGE DEATHS FROM TYPHOID PER HUNDRED THOUSAND IN EACH GROUP, 1916, 1917 AND 1918

Group	Year	No. of Cities	Total Population	No. of Deaths	Av. Deaths per 100,000
1	1916	9	13,743,746	854	6.2
1	1917	9	14,027,263	774	5.5
1	1918	9	13,809,901	598	4.3
2	1916	10	4,053,281	344	8.5
2	1917	10	4,150,099	329	7.9
2	1918	10	4,372,088	298	6.8
3	1916	10	2,635,983	248	9.4
3	1917	10	2,701,029	173	6.4
3	1918	10	2,773,716	193	6.9
4	1916	14	2,250,991	330	14.7
4	1917	14	2,310,372	307	13.3
4	1918	14	2,449,736	331	13.5
5	1916	17	1,983,918	235	11.8
5	1917	17	2,031,313	229	11.3
5	1918	17	2,053,215	240	11.7
Total	1916	60	24,667,919	2,011	8.1
Total	1917	60	25,220,076	1,812	7.2
Total	1918	60	25,458,656	1,660	6.5

TABLE IV. TOTAL AVERAGE TYPHOID DEATH RATE (1910 1918)

	Total Population (57 Cities*)	Typhoid Deaths	Typhoid Death Rate per 100,000
1910	20,996,035	4,114	19.59
1911	21,545,014	3,391	15.74
1912	22,093,993	2,775	12.56
1913	22,642,972	2,892	12.77
1914	23,191,951	2,408	10.38
1915	23,740,930	2,068	8.71
1916	24,205,359	1,842	7.61
1917	24,740,068	1,647	6.65
1918	24,971,278	1,557	6.32

* Three cities are omitted from this summary because data for the full period are not available.

Concrete Floor Stands Big Overload Without Collapse

Sheet Tin Piles Give Maximum Loading Six Times Design Load, and Though Beam-and-Girder Floor Cracks and Deflects It Does Not Fail

LOADS from four to six times those for which the floor was designed have just been put on a reinforced-concrete building in Long Island City, N. Y., through the almost criminal negligence of a warehouseing superintendent. The floor has cracked badly—so badly that the Superintendent of Buildings of Queens Borough has ordered the load mostly removed and the floors shored up, and has required that they be repaired. There was no definite collapse, however, nor is there any evidence of any adverse effect on the rest of the building, a remarkable testimonial to the effectiveness of this type of construction.

The building in question is known as the Kindel Bed Co. building. It is located in Long Island City in one of the boroughs of New York City. It is a four-story structure, and the section in question is 80 ft. wide and 218 ft. long. Transversely it is divided into three bays, the outer bays being 26 ft. 4 in. in span and the middle bay 27 ft. 4 in. In the other direction, columns are spaced 18 ft. c. to c. The floor is a girder, beam-and-slab type, 14 x 26-in. girders running lengthwise of the building and 8 x 22-in. beams being spaced 6 ft. c. to c. and spanning between the columns or the girders. The building was erected in 1916 and was designed for manufacturing purposes to have a load on this floor of 200 lb. per square foot.

CONCRETE FLOOR LOADED WITH BOXES OF SHEET TIN EACH WEIGHING 122 POUNDS

The original owners of the building had vacated it, and the second floor, through a series of leases, came into the control of a warehouseman in New York City. Some time early this year he began storing, on the floor, boxes of sheet tin being held for the Standard Oil Co. preliminary to shipment to the Far East. These boxes are of various sizes, but the main ones are 14 x $8\frac{3}{4}$ in. in plan and about 4 in. deep, and carry sheet tin

to such an amount that the gross load of the tin plus the box is 122 lb. This gives a loading of about 68 lb. per square foot. Apparently the entire floor, except a 4-ft. aisle down the inside of the column rows, was loaded with these boxes, some of which were piled as high as 20 deep. It is the opinion of observers that in some places the loads reached 1300 lb. per square foot and that the uniform load must have been equivalent to a load of 900 lb. per square foot over the entire floor, about 4½ times the design load.

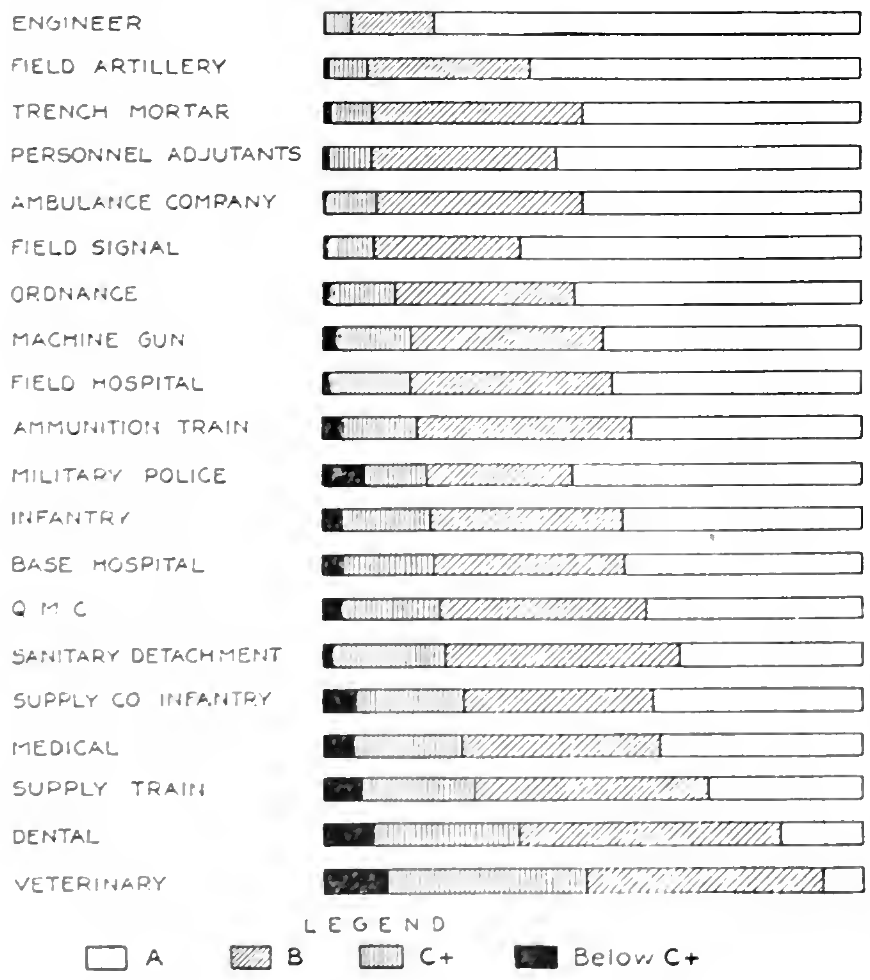
The first warning of trouble is reported to have been given by the night watchman, who heard ominous rumblings and crunchings which so disturbed him as to make him get outside of the building and stay out all night. The next day he reported the trouble, and it was found that many cracks were appearing in the floors. There was also a certain deflection, although this was not very considerable nor has it been measured. At any rate, Superintendent of Buildings Moore, immediately upon being informed of the trouble, put an "unsafe" order on the building and had a court require the survey demanded by New York law for such contingencies. Under the authority of this court order he removed enough of the load so that at present the floor is carrying somewhat over its designed amount. At the same time he strutted up those sections of the floor where the cracking appeared to be most dangerous. At present it is the intention to repair the floor or to replace it, although the exact method to be carried out has not been determined.

The cracks in the floor seem to indicate that a continuous beam action was carried clear across the three panels of the 80-ft. width. Cracks appear in the floor-slab of the interior panel about the point of inflection, and in some places are carried down a short distance into transverse beams.

Similar cracks around some of the columns appear in the longitudinal stringers, and in all cases the cracking seems to have been roughly circular around the heads of the columns.

Engineer Officers Rank First in Army Mental Tests

TYPICAL of the results obtained under the direction of the Division of Psychology, Medical Department of the United States War Department, is the chart reproduced herewith, which indicates that of all the classes of officers examined the engineer officers show the highest grade. The tests upon which the officers' ratings depend were prepared by a committee of the American Psychological Association and of the National Research Council, for the purpose of determining relative intelligence. While admitting that a man's value to the service should not be judged by his intelligence alone, it has nevertheless been thoroughly demonstrated that the intelligence ratings are useful in indicating a man's probable value to the Army service.



RELATIVE GRADES OF OFFICERS—ENGINEERS RANK FIRST

Letter ratings have been used as follows: A, very superior intelligence—this grade is ordinarily earned by only 4 or 5% of a draft quota, and is composed of men of marked intellectuality; B, superior intelligence—this class includes less exceptional intelligence than that in class A, and is obtained by 8 to 10 soldiers out of 100; C +, high average intelligence—this group includes 15 to 18 per cent. of all soldiers and contains a large amount of noncommissioned-officer material; C, average intelligence—includes about 25% of all soldiers; C —, low average intelligence—includes about 20 per cent. who, though below the average in intelligence, are usually good privates and satisfactory in work of routine nature; D, inferior intelligence—includes about 15%; and D — and E, very inferior intelligence. The comparison in the diagram is for officers only.

Engineers in United States Public Health Reserve

By recent Congressional legislation providing for a United States Public Health Reserve, provision is made for commissioning a corps of sanitary engineers, epidemiologists, chemists and other nonmedical men for a period of five years, with pay and allowances equal to those in the present regularly commissioned medical corps. Those wishing to be enrolled must be qualified citizens of the United States and must apply to the Surgeon General, United States Public Health Service, for permission to appear for examination. The grades and corresponding pay and allowances at Washington for sanitary engineers, under the legislation named, will be as follows: Assistant sanitary engineer, $2623 a year; associate sanitary engineer, $3200; sanitary engineer, $3976; senior sanitary engineer, $4651; directing sanitary engineer, $6325. Commissioned reserve officers will normally be on inactive duty without pay. They may be called to active duty for a period not exceeding one month annually for special training, and they will be subject to call in any public-health emergency. Under the new legislation men in the nonmedical branches of public-health will receive equal recognition with men in the medical branches of the service.

Labor Efficiency Good on Percentage Contracts

Carefully Kept Figures on Peace-Time Construction Contradict Common Charge Against This Form of Contract—Inefficient Laborers Rather Than Type of Contract Cause of Trouble on War Construction

BY HENRY C. TURNER
President, Turner Construction Company, New York

The editor asked the Turner Construction Co. the following questions:

1. Is it your experience that labor is less efficient in cost-plus construction?

2. If less efficient, is the fact due to the form of contract, or to some other cause?

Mr. Turner's illuminating reply is based on careful unit-cost records in all the contracts of the company during peace operations just prior to the war, and on a large amount of war-time construction. Not only does the company see no labor inefficiency in the cost-plus system but, as stated in detail, it thinks that this form of contract has many advantages.

DURING the year 1918 we were engaged almost entirely in Government work, carried on under the standard percentage with a limiting fee form of contract. To obtain a comparison between our experience with percentage and lump-sum work, it is, therefore, necessary to go back to the year 1917. In that year we find that we built 22 factories and warehouses of reinforced concrete, on which our contract exceeded $100,000 each, averaging $413,000 each. Of these 22 buildings 13 averaging $470,000 each in cost were built under a percentage form of contract and nine averaging $329,000 each in cost were built under a lump-sum form of contract.

While some of these buildings were more elaborate than others, they were all of the factory and warehouse type and enough alike to make an average comparison of units between the percentage group and the lump-sum group possible. Some of the buildings considered were flat-slab and others beam-and-girder, and later in this analysis will be noted the influence of this fact on the units obtained. Attention will also be drawn to the effect which the height of a building has on the unit cost of floor forms, etc.

For purposes of comparison of cost, three labor units have been selected covering the three principal divisions of the work included in such construction.

Item 3-F. Cost of carpenter and labor work per square foot of floor required for placing and removing floor forms, including all hoisting and miscellaneous work in connection therewith. This item does not include the cost of making the forms before they are used for the first time and, therefore, a comparison is possible as between buildings having a different number of stories.

Item 22. Cost of labor per cubic yard for all labor in connection with the mixing and placing of concrete. An average of this unit will give a very fair comparison.

Item 30. Cost of all labor per ton for receiving, handling, bending and placing steel reinforcement. As the labor conditions under which this work is done are different in the metropolitan districts from the conditions existing outside of these districts, one comparison is made between jobs located in the metropolitan districts and another comparison is made between the jobs outside of such districts.

There is also included in the table the amount of money spent for all labor disbursed under Item 19, "General Expense," expressed as a percentage of the total payroll for the job. This is done to show that the units obtained on the 3-F, 22 and 30 Items were not influenced by incorrect charging of labor to General Item 19, thereby reducing the amounts properly chargeable to the cost of forms and placing concrete and steel.

The results of the comparison are given in the accompanying tabulation:

COMPARISON BASED ON A STUDY OF COST UNITS ON ALL FACTORIES AND WAREHOUSES COSTING OVER $100,000 BUILT BY TURNER CONSTRUCTION CO. IN 1917

TOTAL NUMBER, 22

	Average unit on 13 percentage jobs	Average unit on 9 lump sum jobs	Percentage jobs were cheaper by	Lump sum jobs were cheaper by
Item 3-F. Cost per square foot of placing and removing floor forms	5.75c.	6.25c.	8%	
Item 22. Cost per cubic yard of mixing and placing concrete	$1.02	$1.04	2%	
Item 30. Cost per ton of receiving, bending, fabricating and placing steel reinforcement on jobs in the metropolitan districts	(10 jobs) $15.71	(4 jobs) $14.89		5%
Item 30. Cost per ton of receiving, bending, fabricating and placing steel reinforcement on jobs outside of the metropolitan districts	(3 jobs) $9.01	(5 jobs) $8.87		2%
Item 19. General expense. The amount charged to this miscellaneous item is expressed as a percentage of the total payroll	1.8%	2.3%		

EFFECT OF VARIOUS ITEMS

The items will be taken up separately; comparisons are made under Item 30 for jobs located within the metropolitan districts and for jobs located outside of such districts.

Placing and Removing Floor Forms—There is some difference in the cost per square foot for the 3-F item as between flat-slab and beam-and-girder construction. By a coincidence it happens that 14% of the floor area in the percentage jobs was beam-and-girder and 86% was flat-slab, while in the lump-sum jobs 13% was beam-and-girder and 87% was flat-slab. Because of this similarity the comparison made between the average units on the percentage work and on the lump-sum work is not influenced by any difference due to the slightly greater cost of beam-and-girder forms over flat-slab forms. The column spacing was near enough the same in all of the buildings, so that any difference due to this element may be disregarded. The 3-F item has a tendency to be lower in buildings having a greater number of stories, because the 3-F unit for the first floor is nearly always higher than the 3-F unit for floors above the first. As all of the buildings studied are five stories, or over, in height, with the exception of two, which are four stories, the influence of the element of height is very slight. It is to be noted that the next to the lowest 3-F unit obtained on any of the 22 buildings was at the Beckers Aniline & Chemical Building,

which is only five stories high, and the units made on the two four-story jobs are each below the average. It is believed that a comparison of the 3-F unit as between the percentage group of jobs and the lump-sum group is a fair comparison and means that if anything our organizations on the percentage had the jump on the lump-sum job organizations for this item.

Mixing and Placing Concrete—With equal efficiency on the two classes of construction the averages of Item 22 should run very close together, and such is the case, the difference being only 2% in favor of the percentage organizations.

Receiving, Bending, Fabricating and Placing Steel Reinforcement in Metropolitan Districts—The lump-sum jobs beat the percentage jobs by 5%, and this difference is probably justified by the more difficult conditions affecting this Item 30 that existed on the percentage group of buildings.

Receiving, Bending, Fabricating and Placing Steel Reinforcement on Jobs Outside of Metropolitan Districts—The lump-sum jobs beat the percentage jobs by 2%. The comparison is a fair one and should be a true indication of efficiency.

General Expense—The amount of money covered by the classification in Item 19 is very small compared with the other items used in the table. The only reason for tabulating the item was to show by its smallness that improper charges had not been made to this general item, thereby reducing the charges of payroll made to Items 3-F, 22 and 30.

Low Costs Not Confined to One Type

If lowest units made on these 22 jobs are sought it is found that the lowest unit in placing and removing floor forms was made on the Belleville job, a percentage contract, and that the next lowest unit was made on the Beckers Aniline & Chemical Co. job, also a percentage contract. The lowest unit made in placing concrete was on the Bush Service Building, a percentage contract, and the next lowest was at the United Cigar Stores Building, which was also a percentage contract for the Bush company. The third lowest was at the Belleville job, which was a percentage contract, and the next was at the Winchester Woolen Mills, a lump-sum contract. The lowest unit on placing steel reinforcement, outside of the metropolitan districts, was on Endicott-Johnson, a lump-sum job, and the next lowest was for Belleville, a percentage job. In the metropolitan districts the lowest unit for placing steel reinforcement was at the Beckers Aniline & Chemical Co. percentage job, the next best was the Bush Service Building, also a percentage job.

It is believed that the figures justify the statement in reply to the first question that in a properly organized construction company there is no difference in efficiency in labor engaged on percentage work as compared with lump-sum work. So far as this company has ever been able to see, a good superintendent, or a good foreman, shows the same interest in his job whether it is on percentage or lump sum. This will always be the case if he works for a company which rewards him just as quickly for good work on a percentage job as for good work on a lump-sum job and penalizes him just as severely on one class of work as on the other.

Answering the second question—there seems to be no valid reason why labor should be less efficient on the percentage job than on the lump-sum job. A workingman is naturally primarily interested in his own welfare, and hence in the keeping of his job. If negligence and a lack of interest in his work lead to his discharge on the percentage job just as quickly as on the lump-sum work, while he finds that diligence on the percentage job is rewarded by advancement and continuous employment by the contractor, he will work just as hard on one form of contract as on the other.

There have been published recently a number of articles in which the position was maintained that percentage work has ruined the moral character of the American contractor and the American workingman. This company believes the opinions expressed in these articles are based either upon some unfortunate personal experience with the percentage form of contract, or are founded on observation made on the general run of percentage work during the war.

Many owners have had trouble over percentage contracts, just as many owners have had trouble over lump-sum contracts, but in nine cases out of ten the fault has been with the owner in not making sufficient investigation before he awarded his contract. There are plenty of good contractors to handle percentage work if the owner will only take the trouble to find them. Any owner intending to buy a piece of property will have a very careful search made of the title, and will have someone spend much time in investigation and study before he decides to purchase. Too often the owner will select a contractor because the contractor's selling agent sometimes knowingly, but much more often through lack of knowledge of construction work, will promise anything the owner wishes in the way of speed or price. Surely, the selection of a building contractor for the confidential position he occupies on percentage work is worthy of some study, but it is not infrequent for an owner to award a large percentage contract with less study and investigation than he would give to the purchase of a motor car.

Owner Should Study Both Systems

It is not difficult for the owner to get reasonable assurance that he is picking the right man for the job. In the first place, no contractor should be selected for percentage work unless he is very well known to the owner or has a very considerable record on such work. Let the owner ask the contractor for a list of all jobs he has built. Very likely several of these jobs were for persons known to the owner, in which case the investigation will be easy. If the entire list was for strangers, then let the owner pick about a dozen jobs similar to the project he has in mind and thoroughly investigate the contractor's record on all of the jobs so selected, having his representative make personal calls, where possible, to obtain the information. The price to any owner for satisfactory work on a percentage basis is the comparatively slight trouble of thorough investigation before the contract is let.

It is a fact that a considerable prejudice against the percentage or fixed-fee form of contract has arisen because of observations made on such work during the war. Conditions in the building industry were in many cases deplorable during the war, but these conditions would have existed in most of these cases had the work been on a lump-sum basis. The majority of the large Government operations were built far away from any labor market, which made it necessary to hire men in

the large cities and send them to these out-of-the-way places where they were housed in wooden barracks. In most cases the rates of wages established by the Government, and made obligatory on percentage contracts in such out-of-the-way places, were lower than the wages paid in the large labor markets in which men were recruited. As more work was always available in the large cities than the supply of competent mechanics and good laborers living in such cities could handle, there was no incentive for a good man to leave his home. The result was that these out-of-the-way jobs had to be built with so-called floating labor; there was no other way to get the jobs done. This labor in many cases was not physically fit to do a day's work and, in order to get the work done at all, it was necessary for the superintendents and foremen to exercise the greatest of forbearance.

War-Cost Additions Due to Inexperience of Workmen

The experience of this company during the 1918 war period illustrates the condition that existed. It was then building for the Government, at the same time, the Naval base in Brooklyn, the Army base in Brooklyn and the Navy and War office buildings in Washington. During the war, on account of the shortage of labor, the Government ordered a 10-hour day for laborers mixing and placing concrete, paying time and one-half for overtime. The labor rate in Brooklyn was $3.25 to $3.60 for eight hours, while in Washington it was $3.20 for eight hours. The cost of mixing and placing concrete per cubic yard on the naval base was $1.25, including a large amount of miscellaneous work, $1.19 per cubic yard on the Army base and $1.98 per cubic yard at the Navy and War buildings in Washington. The rate of wages per hour was lower in Washington than in Brooklyn, and the overtime affected jobs in both cities to an equal extent. The more difficult nature of the work in Washington would justify a difference of only about 20c. per cubic yard had the wage rates in the two cities been equal, hence an inspection of the unit costs on the three jobs shows the inefficiency of the workmen on the job in Washington as compared with the workmen in Brooklyn.

In Washington there was no home labor market and no quarters for housing men except temporary wood barracks. As a result, in order to keep the job supplied with the 1,400 laborers required, it was necessary to ship into Washington 4,000 of such men as could be gotten from New York, and in addition considerable numbers were obtained in other cities as far west as Chicago. It is to be remembered that it was very much easier to persuade fair workmen to go to Washington than to get such men to go to the small out-of-the-way places in which most of the Government plants were located. Inefficiency and resulting high units were, therefore, to be expected in such places, and they would have existed on the work of any honest contractor in the same degree had his work been done on a lump-sum basis.

Comparing the results obtained on the naval base and on the Army base in Brooklyn with the results the company was able to get in 1917, it is found that the cost of labor per hour of actual time worked was 18% higher in Brooklyn in 1918 than in 1917, due to an increase in the average rate from $3.12 per eight hours in 1917 to $3.35 per eight hours in 1918, and the effect of paying time and one-half for the two hours of overtime each day in 1918. Hence the units of $1.25 per cubic yard made on the naval base in 1918 and $1.19 made on the Army base in the same year are equivalent to units of $1.06 and of $1.01, respectively, if made on the same jobs in 1917. This comparison shows that there was no serious loss of efficiency during the war in the labor of placing concrete in the Brooklyn district, due to the fact that Brooklyn is a good labor market, and, therefore, the gangs were composed largely of experienced concrete laborers, many of whom had worked for the company for years.

To state the effect of the war condition on construction work in another way—the experienced workman in most lines of the construction industry continued to give good service during the war when working for his old employer, but there were not nearly enough of these experienced workmen to carry on the Government building program and it therefore became necessary to employ large numbers of men new to the industry. These men were frequently found inefficient. The effect of this dilution was felt to some extent in the large labor markets and to a considerable extent in places like Washington, but affected work in out-of-the-way places very seriously, because, the established Government rates of wages on percentage jobs being lower there than in the large labor centers, it was almost impossible to get good men to leave their homes to go to such places.

There is no reason or justice in forming an opinion as to the relative advantages of percentage or lump-sum work based on war-time experience. Where such a comparison is made, the person making it is generally comparing in his mind the efficiency of the percentage job he saw during the war with the efficiency of lump-sum jobs he may have seen carried on before the war, or if he does have in his mind one of the comparatively few lump-sum jobs built during the war, he forgets that the contractor on such a job was not subject to the Government wage scale and, therefore, by paying wages above that scale could get the pick of the men.

Two Types About Same During War

Comparing again the costs obtained on percentage and on lump-sum work, it is interesting to note that the average unit of $1.47 for labor per cubic yard of concrete on the naval base, Army base and Navy and War office buildings was only 1c. higher per cubic yard than the $1.46 unit made on the only large lump-sum job we built during 1918. On the three Government jobs, the average cost of Item 3-F was 8.03c. as compared with 9.19c. on the lump-sum job. The cost of placing steel reinforcement on the Government jobs in Brooklyn in 1918 averaged $21.32 per ton, which is a considerable increase over the 1917 average for percentage and lump-sum jobs of $15.26 obtained from the table. Approximately $3.97 of this difference is due to a 26% increase in the average hourly rate of wages paid, caused by a 9% increase in the rate per eight hours and the effect of overtime. The balance of the difference between the 1917 and the 1918 unit, amounting to $2.09 per ton, must be charged in part to the fact that on the Government work economy had to be sacrificed to speed to a certain extent, and in part to a falling off in the efficiency of the workmen.

The cost of placing steel reinforcement on the job in Washington during the war was $16.22 per ton. This is

an abnormally high figure for such work outside of the metropolitan districts and was due to the inefficient men obtained in Washington. Almost the entire experienced steel gang left and went to work for another contractor who had a lump-sum contract, because he paid wages above the scale fixed as a maximum by the Government for percentage work in Washington. This statement is not to be taken as a criticism of the other contractor. He had taken his contract before the full effect of war conditions was realized and had to get fairly efficient men or suffer a very severe loss.

The percentage and cost-plus-a-fixed-fee form of contract is of great advantage to the responsible contractor in helping him to secure work on an equitable basis, and is of equally great advantage in many cases to the owner, enabling him to get work started on important projects months before detailed complete plans and specifications could be prepared for lump-sum bidding.

It is felt that the importance of the subject has justified a frank statement of the facts as this company has found them, because in our opinion any general condemnation of the percentage contract is warranted.

Panels of Movable Weir Collapse Automatically

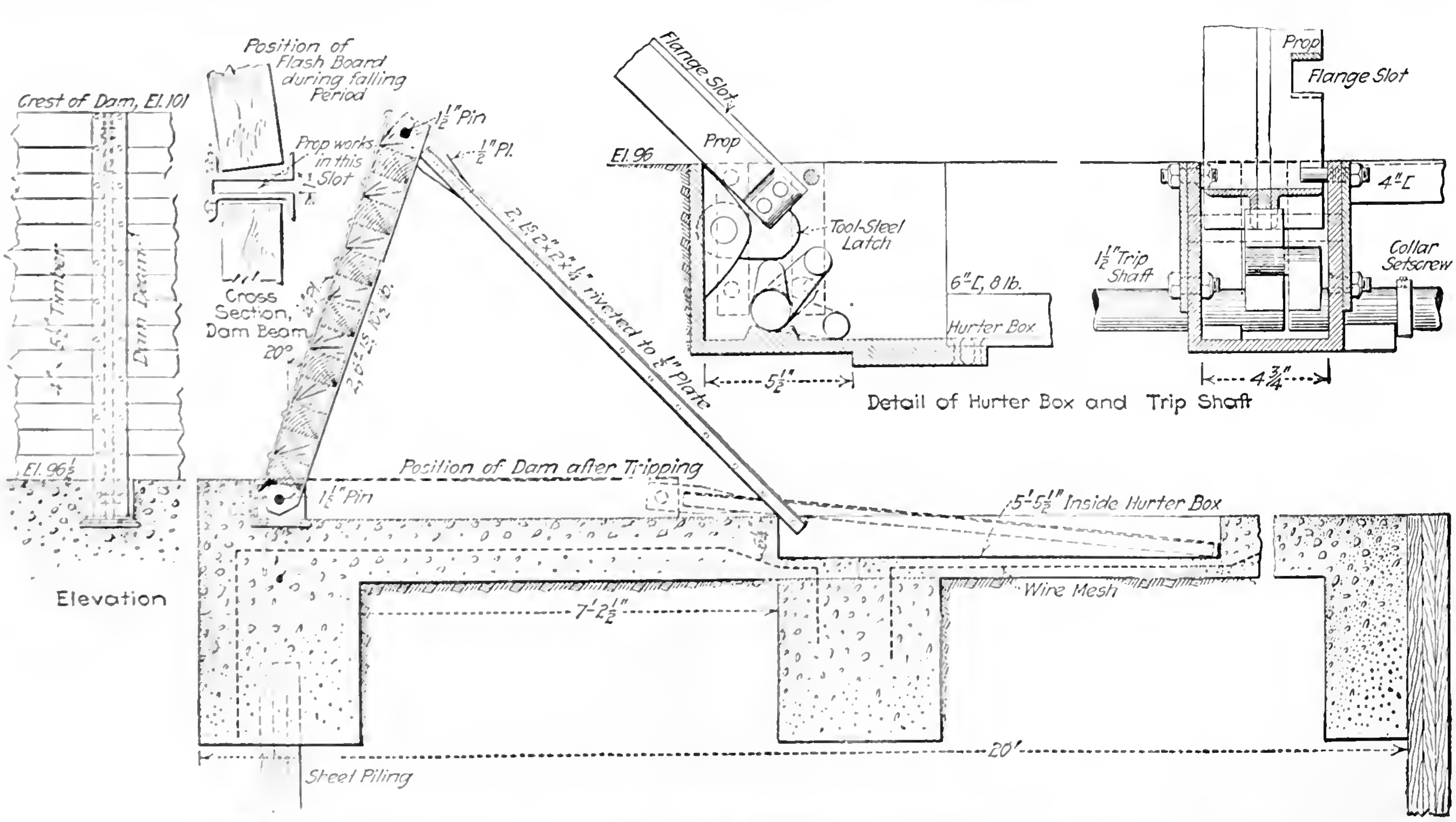
Tripping Started by Float in Chamber Filled as Flood Rises — Double Skimming Eliminates Sediment from Canals

FALLING flashboards trip those adjacent in succession in a collapsible dam built across the Huerfano River, Colorado, to divert water for irrigating 2500 acres of land belonging to the Butte-Mesa Reservoir Land Co. The tripping mechanism operates automatically should a great flood from a cloud burst unexpectedly raise the water 4½ ft. above the top of the panels. This probably will occur not oftener than once in ten years, when no attendant would be on hand to do the tripping.

The Huerfano River rises in the Sangre de Cristo Mountains, the crest elevations of which are 9000 to 14,000 ft. above sea level. The drainage area is 620 square miles, of which 170 square miles are above the 9000-ft. contour. The fall of the river is 50 ft. per mile at the dam site, increasing until 150 ft. per mile is reached at the foothills. Along the river the irrigation ditches usually have brush and stone diversion weirs. These storms occur mostly during the growing season, causing loss of crops, for reconstruction cannot be done until the low-water period.

The necessity for the adoption of a movable structure, as against a fixed weir, arose from the fact that the river is subject to sudden floods by cloud-bursts, which often convert it into a raging torrent. This condition calls for a structure that would allow the water to rise above the top, having no obstruction over the weir crest, and which may be immediately released automatically or by employees, so that the structure would fall to a horizontal (recumbent) position on the floor. This would leave no obstruction to the freedom of discharge of water, logs and débris swept down from above, and would free the entire cross-section area of the channel. It would also avoid the flooding of adjoining farm lands so far as protection may be given by the increased waterway through the weir.

With its steep slope and the flashy nature of the violent floods the river has great erosive and transporting power. Large quantities of débris are carried along the bed and in suspension. A fixed weir across such a stream would have given ground for claims for overflow damages, on the ground that the regimen of the stream had been entirely changed and that the running water would establish another channel condition. Finally, shoaling would extend upstream some distance from a beginning depth equal to the height of the weir to a point where the first grade is broken.

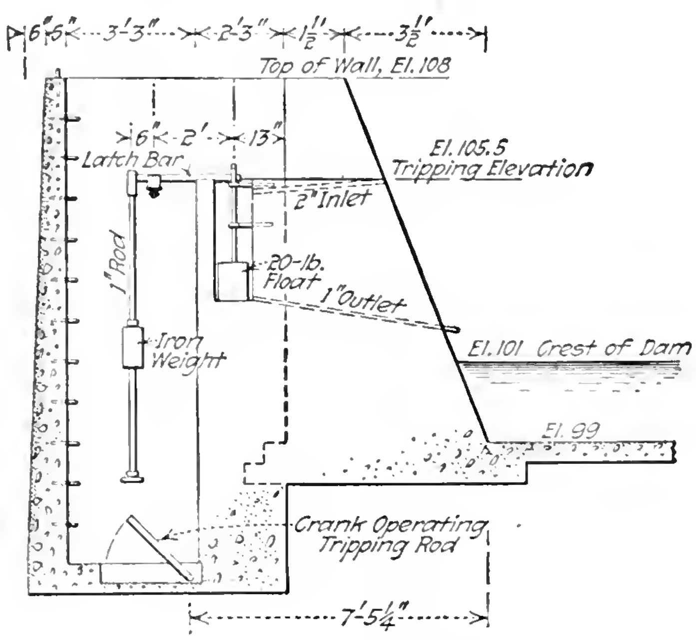


AUTOMATIC FLASHBOARDS DROP WHEN WATER IS 4½ FEET ABOVE CREST OF DAM

PANELS LIE PRONE BEFORE STATIC HEAD IN POOL CAN CHANGE TO VELOCITY HEAD—FIFTH PANEL PROPPED UP INTENTIONALLY

This contention might be hard to disprove before a local jury. With a movable weir, all danger from deposits of sand is removed, as they can be washed down the river when such result is required.

Location of the headworks was maintained at the site of the old diversion weir, and the elevations were



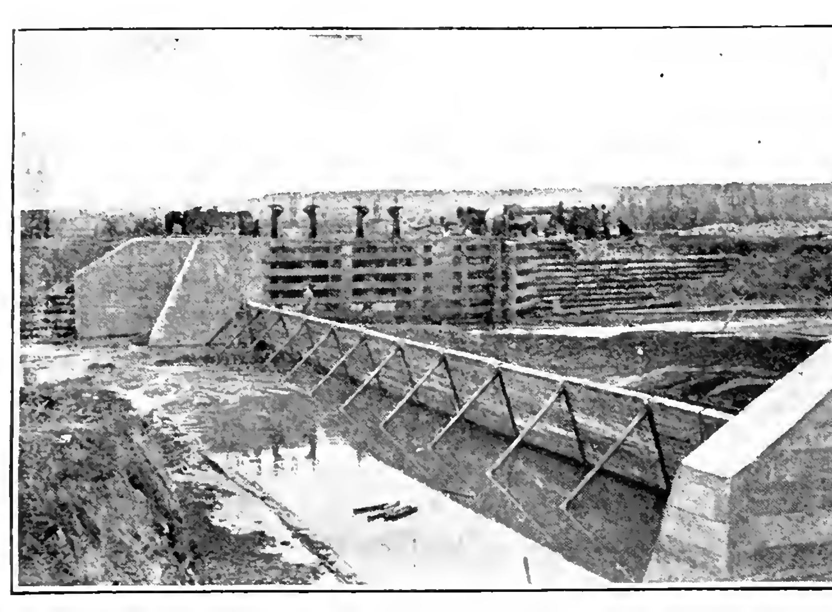
DETAIL OF AUTOMATIC TRIPPING CONTROL

controlled by the grade of the 2½-mile inlet canal, of 100-sec.ft. capacity, to the existing Homestead reservoir.

The diversion works consist of a reinforced-concrete apron, with steel frames for a movable weir, and having the headgates at right angles to the weir. The latter is 104 ft. long, divided into 13 panels, 8 ft. long and 5 ft. high, placed at an angle of 20 deg. from the vertical. The bed of the stream is composed of sand and gravel from 10 to 15 ft. thick, overlying a bed of hardpan. A row triple-lap sheet piling was driven in a trench excavated through the sand and one foot into the hardpan, extending entirely around the apron and abutments. The apron, 20 ft. wide, was placed flush with the river bottom. At the upper edge is a sill 6 in. high, behind which the bottom end of the frames forming the collapsible portion of the weir is hinged. The sill also protects the flashboards from injury when in the prone position. The posts are two channels, into which the horizontal flashboards are placed. These are supported by a hinged prop of angle irons, the foot resting upon a latch, which in turn is retained in place by a cam on the end of a tripping rod.

When the water rises 4½ ft. above the top of the weir an automatic mechanism will be put in operation by the admission of water to a float-well in the weir abutment. Raising the float releases a system of levers and allows a heavy weight to drop upon an extended arm of the first tripping bar. This turns the cam from under the latch of the prop, when the pressure of the water and the silt forces the panel to fall. In moving 1½ in. this panel strikes a crank on the next tripping bar. This action continues rapidly until all the panels are thrown down in succession.

Tripping may be done by an employee at any time, even under a small flow of water. Raising or replacing the panels forming the weir is not required until the stream has fallen to a normal stage, but it can be done in 1 to 1½ ft. of water if necessary. The steel frames are set up, then the boards are placed between them all the way across the stream at the same height above the apron before the head has much increased, and



TRASH RACK GRILLAGE BARS ENTRANCE TO HEADGATES

are pressed so closely together that but little leakage will take place between them. The fall of the weir is so rapid that the flashboards remain in place in the frames. The picture on p. 819 was taken of the operation for the first time of four of the gates, the fifth gate being braced up to save the trouble of resetting all the gates. The engineer snapped the shutter of his camera at the instant he saw the first gate begin to move, but the time lost in getting the actual exposure, $^1/_{100}$ sec., gave time for the first gate to go all the way down while the fourth gate had just started the warping motion taken by the flashboards. The water had not yet followed the gates.

A scouring sluice, at the end of the weir, with the floor at the same level as the apron, is fitted with a steel radial gate, 6 ft. wide and 5 ft. high. The purpose is to scour out any silt that may be deposited in the forebay between the headgates and the trash rack, and to regulate the water level as required.

Headgates to the canal are placed in a concrete wall at the end of the weir. They are of the overflow or skimming type, 9 ft. long and 6 ft. high, and are formed

LONG, NARROW SETTLING BASIN EASILY WASHED CLEAN —SANDY SLOPES SILTED SHOW BLACK

of three leaves each 2 ft. high, so arranged that one, two or three of the horizontal leaves may be raised, depending on the river stage. The leaves are of structural steel shapes and plates, operated by bevel-gear lifting devices, having two rising stem gate stands, connected to a common shaft on top. The top leaf is fastened directly to the rising screws by a 3-in pipe. A 2½-in. pipe inside of the first one is secured to the top of the middle leaf and ends just below the solid screw stem. Working inside of this latter pipe is a 2¼-in. cold-rolled steel rod fastened to the lowest leaf and extending just below the top of the middle pipe. By inserting wedges through the two outer pipes and the rod, all the leaves can be raised simultaneously to take water when the river is at its lowest stages. When it is raised so that the level is, say, 2 ft. higher, the gate is lowered to the floor and the wedge transferred to a slot passing through the two pipes, but just above the top of the solid rod. The bottom leaf then will not be raised when the gate is operated. Should the river rise another 2 ft. the gate is again lowered and the wedge removed, when the upper gate only may be lifted.

The sill of the gates is 3 ft. above the weir apron and 2 ft. below the top of the weir, which gives a sluiceway depth of 3 ft. in front of the gates, and a depth of water of 2 ft. through the gates before there is a flow over the weir. By this arrangement only surface water is taken from the river, and silt is prevented from entering the canal. The full supply can be obtained with only 2 ft. depth passing through the gates.

During low water, when the entire stream flow is diverted for the priority of an old ditch right, all the moving sand and silt go into the settling basin. Also, when the stream is in flood and turbid and turbulent a certain amount of silt unavoidably goes into the settling basin, where, meeting practically still water, the sediment is mostly deposited. The settling basin has a capacity of 55,000 cu.ft. and is that portion of the canal between the headgates and a steel radial sand or sluicing gate. It is 660 ft. long, and has a concrete bottom 6 ft. wide, with 1½ ft. vertical height, excavated slopes 1 on 1 and a grade of 1⅓ per cent.

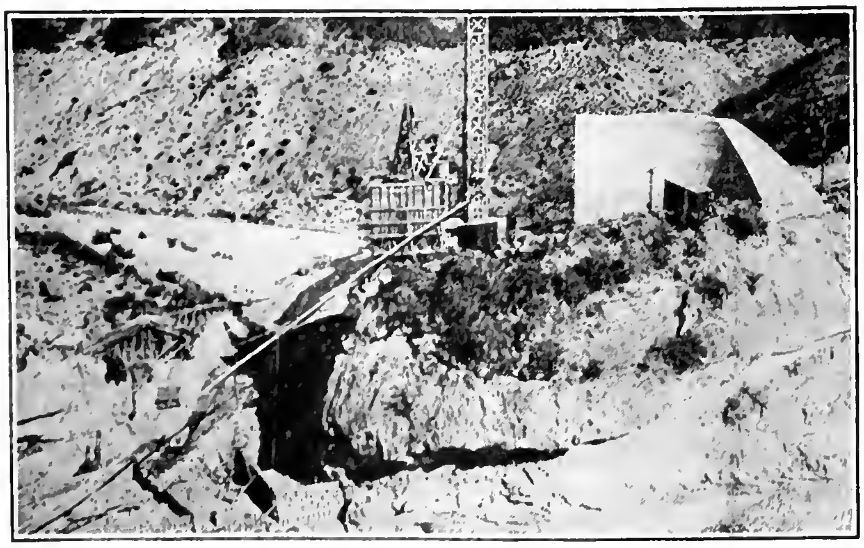
A 12-ft. weir to the inlet canal at the sand gate structure again skims the water from the top. There has been no deposit of river silt in the canal, which has a grade of 0.7 ft. per 1000 ft., since it was put in operation.

T. W. Jaycox, consulting engineer on the design and construction of these works, states that they have been in operation two years and have satisfactorily met the requirements.

Arch Dam Abutment Built Before Rest of Dam

BECAUSE one side of the cañon did not rise high enough to take the full height of the Gibraltar arch dam now being built for the City of Santa Barbara, Calif., an "artificial abutment" of concrete was placed one full year before the actual dam work was started, so that it would have a full set when the pressure began to act. As shown in the view, the abutment is a continuation of the arch curve of the dam and forms the inside face of the spillway just beyond.

Quinton, Code & Hill were consulting engineers on the work. The contractors are Bent Bros. and W. A. Kraner, the latter being in personal charge of construction.



"ARTIFICIAL ABUTMENT" TO ARCH DAM ALSO SERVES AS BUTTRESS BETWEEN MAIN DAM AND SPILLWAY

23rd Engineers Being Held to Repair French Roads

General Pershing Carrying Out Policy Insisted on by French Government—General Black Urges Patriotic Acceptance of Situation

By Wingrove Bathon
Washington Representative of "Engineering News-Record"

An investigation in Washington of the reasons why the 23rd Engineers are still being held in France, notwithstanding the fact that the armistice was signed more than five months ago and that these engineers are needed in the United States now for the building of roads at home, discloses the official information that the French Government has represented to Washington that the damaged highways in France in the sectors used by American troops should be rebuilt and repaired by the American engineers before they go home; that the United States Government has accepted that point of view; and that General Pershing is now carrying out that policy.

Coincidentally, however, Washington is expecting to hear soon by cable from Secretary of War Baker, now in France, as to what the 23rd may expect, following the passage of a resolution by the American Road Builders' Association creating a committee which took up the matter of the possible return of the 23rd with the Secretary of War through the Bureau of Public Roads and the Secretary of Agriculture, the Secretary of War having promised that he would personally present to General Pershing the matter of the return of the engineering regiments.

Basis of Men's Dissatisfaction

At the same time, the investigation above referred to brings forth the official request from Major General Black, chief of engineers of the Army, in Washington, that there shall be a cessation of complaint on the part of the men in the 23rd, who, he points out, "signed up for the war," bearing in mind, he says, that the President has not yet proclaimed peace, and that therefore the war has not yet actually ended. The complaints of the men, it may be here stated, are based principally upon the fact that they are doing pick-and-shovel work in many cases, when they were promised that they would not be obliged to do so, and that there would be labor battalions to do such work; also, that if they are not returned to the United States now, to go back into their old positions while the road-building season is on in the United States, they might just as well be kept in France until next winter.

The request for a patriotic acceptance of the situation mentioned in the preceding paragraph is made by General Black not only of the men in the 23rd, but it is made of the employers, and would-be employers, of the men in the regiment, many of whom have been urging the return of the regiment. The request is also made by General Black of the committee, referred to above, appointed by the American Road Builders' Association.

Finally, the request for a patriotic suspension of judgment and activity concerning the 23rd is made by General Black of *Engineering News-Record*, which was instrumental in recruiting the 23rd Engineers, and which, since the armistice was signed, has advocated the return of the 23rd.

The investigation at Washington to which reference has been made was undertaken as the result of many activities throughout the United States which have to do with the desire to get the highway builders and other engineering regiments home from France. These activities are growing, and others are on the point of springing up all over the country. They will undoubtedly find expression and championship on the floor of the Senate and the floor of the House of Representatives as soon as the expected extra session of Congress assembles. But the investigation was undertaken more especially because of the great number of letters received by *Engineering News-Record* direct from men of the 23rd in France, complaining of their condition, and asking the assistance of this journal in bringing them home, in the same sort of manner that the men of the 23rd accepted advice from *Engineering News-Record* in getting into the 23rd, and going to France to serve their country. These letters were offered to General Black, minus their signatures, so that there would be no question of the War Department being obliged to take official cognizance of unofficial complaints, although General Black pointed out that it was not necessary for him to see them, as the War Department has received many other letters on the same subject. At the same time, the following statement was made to General Black, in writing, over the signature of the editor of *Engineering News-Record*:

In the fall of 1917, under request from the officers detailed to raise a regiment of highway engineers, *Engineering News-Record* did its utmost through advertising to bring into the 23rd Engineers men of exceptional talent and ability as road builders.

This regiment is still abroad, and for the following reasons we beg leave to urge upon the War Department the advisability, in the interests of road building in this country, of the early return of these men:

1. As is commonly known, we are embarking on a highway-building program of exceptional magnitude, due to an endeavor not merely to catch up with work delayed by the war, but also to provide employment for returned soldiers. Highway building is an art that is learned only by long experience, and the roads to be built under this enlarged program will measure up to the needs and justify the expenditures only if there is available an adequate supply of engineers, contractors, superintendents and foremen. Engineering and contracting organizations with which we have been in touch in many parts of the country are urgently in need of the assistance of the specialists who left these organizations in order to join the 23rd Engineers. They were the men responsible for getting results in planning and in the field, and highway work is going to suffer severely if they are not here during the coming construction season to take charge of the new work.

2. In our publicity efforts to recruit the regiment we specifically stated, under direction of the recruiting officers, that only those men were wanted who were qualified to take charge of and to direct work, it being the expectation that prisoners and work regiments would be assigned to work under the men recruited in the 23rd.

3. While many of these men will find positions in highway work should they return after the construction season is well under way, naturally highway departments and contractors will try to complete their organizations at the

very opening of the construction season. In justice to these men, therefore, who showed their loyalty to their country by volunteering for service in the 23rd, we believe that they should be assigned for immediate return.

General Black's answer to the above has already been outlined in the opening paragraphs of this article. It may be stated, however, that he added that there is no likelihood, in his opinion, based on his information from General Langfitt, General Pershing's Chief Engineer in France, of the early return to the United States of the 23rd, or of any of the other regiments containing road builders. General Black is having very great difficulty in getting back from France his own staff engineer officers whom he needs here badly. In many cases he is unsuccessful, the answer to his inquiries and to the inquiries of General March, the chief of staff, from France, being that the officers wanted are "needed in France." With the policy which creates this need, of course not General Black, General March, General Pershing or any other Army officer is concerned; that is solely within the jurisdiction of the administration.

Typical Letters

It may be useful to quote one or two typical letters concerning the 23rd, on which this investigation was based. The following, from one of the men in France, is quoted in part:

Many thousand men, 85% of whom are experienced engineers, artisans, etc., in various occupations connected with the construction business, enlisted voluntarily in the 23rd Engineers for immediate service in France, with the understanding that men skilled in their particular business were urgently needed at the front. Your advertising stated particularly that only experienced men were wanted, and not pick-and-shovel men.

After spending five months in the United States this regiment was sent to France where, with the exception of the truck companies which are a part of the organization, fully 85% of these men have been since engaged constantly in nothing but pick-and-shovel work. These men are still doing pick-and-shovel work and only in rare instances has a man been assigned to the work for which he enlisted.

It seems to me that a grave injustice has been done, not only to these men who voluntarily gave up positions of trust and confidence and made many sacrifices for the great cause, but to the country at large, and more particularly to the conduct of the war, by taking these men from occupations requiring skill and experience and placing them at common labor.

A still more grave injustice will be done to those men if they are not returned to the United States by Apr. 15 or May 1 in time to take part in the season's activities in the world of practical construction.

These men are nearly all experienced, practical engineers and skilled workmen. They are still doing pick-and-shovel work in France. They gave their services voluntarily.

Do you not think that something should be done about it?

The following is from an employer in this country, interested in the return of the road builders, quoted in part:

I am sending you an extract from a letter received from a civil engineer in the 23rd Engineers, U. S. A., which speaks for itself. It looks as if it were up to you to urge the War Department to consider their early return. The extract is as follows:

"We sure are in a nice position here in France. We are in the intermediate section between the Army of Occupation and the S. O. S. Nobody knows where we are and I guess nobody at home is bothering Army officials as to when the 23rd Engineers is going to be shipped home, as we don't come from any one locality as a regular division does. I guess General Pershing thinks we have gone home. Just a brief word as to the gigantic undertakings we are undertaking. Yesterday I saw a $250 a month man peeling spuds. Today he was sawing wood to cook the spuds, and tomorrow I suppose he will be helping to dump the peelings on the garbage pile. That's what about 150 of us are doing. The rest are chasing niggers and hunting cooties and rabbits in their spare moments.

"The point is, in this regiment there are some 3500 good skilled men in various branches just stagnating over here. We, of all people, are not needed here at all. We were a technical, I was going to say *regiment*, but I supply the proper word, *mistake*, and not only that, we have been here and on the front for 12 long months, yet regiments and divisions over here, some only six months, are being sent home to gather together the shattered ends of their careers. I ask you, and through you those who may interest themselves in our return, aren't we entitled to a little consideration in the matter of an early return? I'm convinced that nothing can be done except from the home end.

"The *Engineering News-Record* threw tons of ink and paper around getting us into this and praising this regiment to the skies as being composed of such highly paid engineers, yet never a peep out of them today about getting these highly trained volunteer engineers home. Of course we did not come over here for the *Engineering News-Record* but it was through their call we responded, and now that it is over I think it is up to them to demand our early return. The only time we have ever begun to use the talent in this company is here, and that in making ourselves comfortable."

It appears to me as if there ought to be some agitation to get these boys home without delay. They were sent right out to the front a couple of weeks after they landed in France and worked on the roads under shell-fire until the armistice was signed. A lot of them are men who left good positions here and worked with pick and shovel through the campaign. They did not mind that while the war was on, but now they rightly think they ought to be released.

This is a plain statement of what is being said and done in various quarters as to the 23rd Engineers, except that it is necessary to add that no explanation is obtainable in Washington as to why the men were promised by Army officers that they would not be obliged to do pick-and-shovel work and that they are, and it ought to be said that the statement would not be a well-rounded whole if it did not contain the following explanation. It is a fact that the War Department in Washington does not specify the units which are to come home or the order in which they are to come, and that the first information the War Department has concerning which units are to come home and the order of their coming is received by cable from General Pershing. The policy on which that is based is due to the fact that upon the signing of the armistice the War Department was besieged by politicians in the United States demanding the early return of their own home contingents. To get out of that political tangle the whole matter of the order in which units should come home was left to General Pershing, who, in turn, adopted the policy that the units which could be spared first should come home in the order in which they went abroad. In other words, those who went overseas first should come home first, bearing in mind the need for their respective services in France, based on the policy of the administration. Inquiry in Washington does not seem to develop any prospect that there will be undue delay in sending home engineers recruited from many states simply because they have no one single spokesman, and the case of the Rainbow Division, recruited from many states, and now on the way home, is cited as proof that there is no such likelihood.

New Orleans Army Base Improves Facilities of the Port

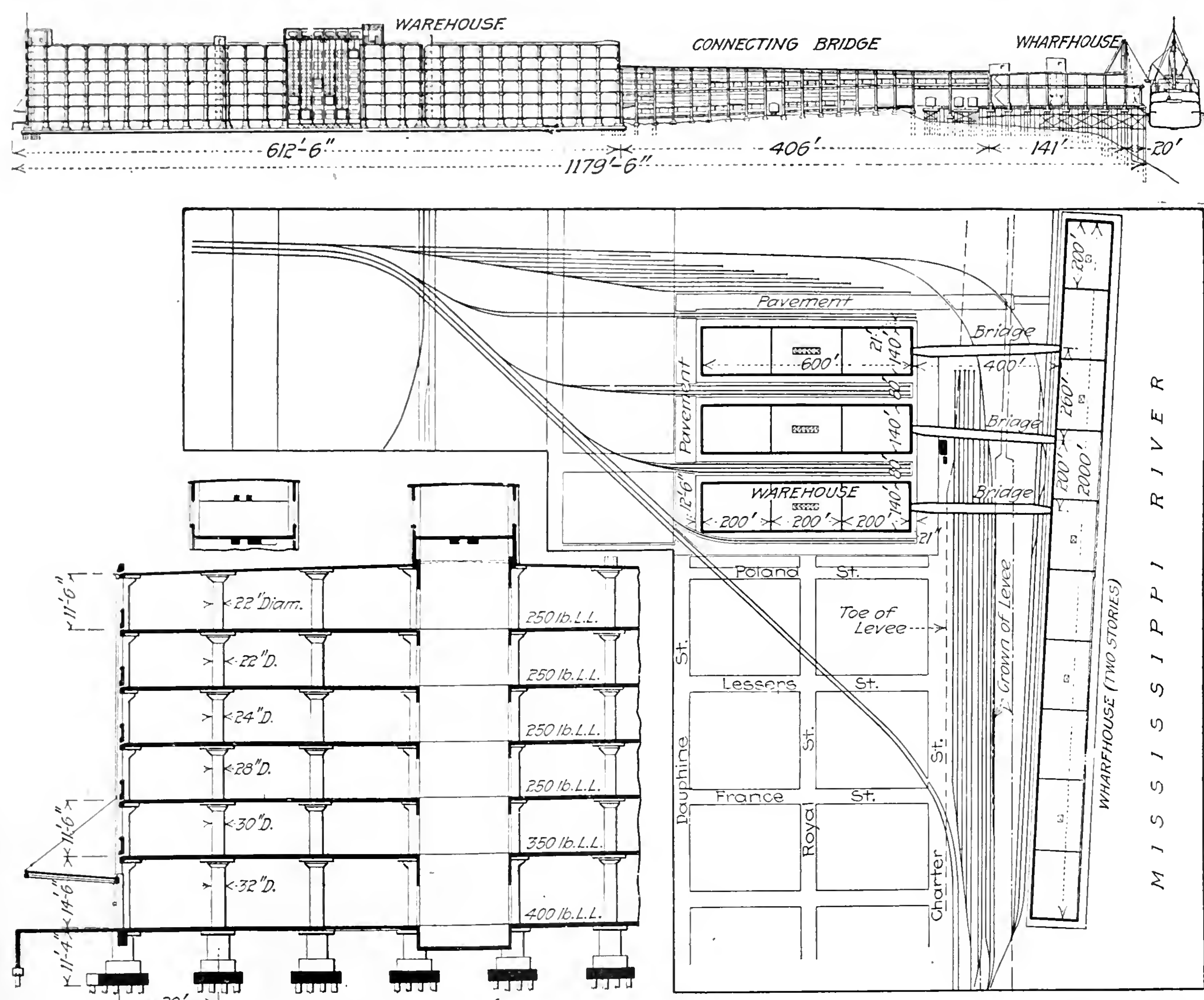
Three Concrete Warehouses Tied to 2000-Foot Wharfhouse on River by Bridges Permitting Access to All Floors — Rail and Water Connections and Storage Facilities Make Peace-Time Use Important

By George H. Davis
Ford, Bacon & Davis, Supervising Engineers

ARMY supply bases for the storage and transshipment of overseas freight to the Expeditionary Forces were located, rather late in the war, at Boston, Brooklyn, Norfolk, Philadelphia, Charleston and New Orleans. Of these the projects at Boston, Brooklyn and New Orleans are for permanent structures designed primarily for the war use but so located and arranged as to make them valuable additions to the peace-time operations of the port. The Boston and Brooklyn bases have already been described in *Engineering News-Record*. The New Orleans base, still under construction, is the subject of this article.

As shown on the accompanying plans, the plant covers an area of more than 48 acres, including various structures and yards, and is composed of three reinforced-concrete warehouse units of the same design, each 600 ft. long, 140 ft. wide and six stories in height, with two-story steel and pile wharf and wharfhouse 2000 ft. long and 140 ft. wide with connecting bridges joining the wharfhouse with the warehouse units. The connecting bridges are of structural steel of the inclosed multiple-deck type, spanning Chartres St. and the intervening railroad yards. There are approximately nine miles of single-track railroad serving the plant. The yards accommodate 520 cars, the warehouse units 135 cars and the wharf 88 cars, a total of 743. The total floor space of the three warehouse units is 35 acres, and of the two-story wharfhouse 13 acres, a total storage area of 48 acres. It will be noted that the floor area is the same as the ground area of the site. If all of the floor area of the structures were loaded to capacity the plant would contain more than 178,500 tons of freight for shipping, equivalent to more than 10 days' average movement over all the wharves, private and state, in the port of New Orleans.

The wharf is of sufficient length to accommodate at



Part Cross-Section through One Warehouse

PLAN AND ELEVATIONS OF THE ARMY SUPPLY BASE ON THE MISSISSIPPI AT NEW ORLEANS

first-off anchorage five to eight oceangoing ships simultaneously, and similarly the trackage immediately adjacent to the warehouse platforms, as previously stated, will conveniently accommodate more than 135 standard box cars.

Comparative Cost—The plant, including the yards, warehouse units, wharf and wharfhouse with complete equipment, will cost approximately $15,000,000. This is 1.2 times the cost of all the state and municipal port improvements on the river front made to recent dates, including the grain elevator plant and wharf, the cotton warehouses and wharf, the Public Belt R.R. and yards, and all the miscellaneous state-owned wharves.

The advantages to the City of New Orleans of this great expenditure by the Federal Government are self-evident. It goes further than any previous expenditure toward the fixing at this port of the center of gravity of concentration, storage and distribution of commodities for Western nations, especially South America.

The plant includes such features of design as are in use in the world's greatest ports, namely:

(a) Extensive storage capacity at ship side;

(b) Maximum loading and unloading capacity in a ship's length due to:

1. Double-deck wharfhouse;
2. Multiple-story warehouse units, and
3. Multiple-deck connecting bridges between wharfhouse and warehouses.

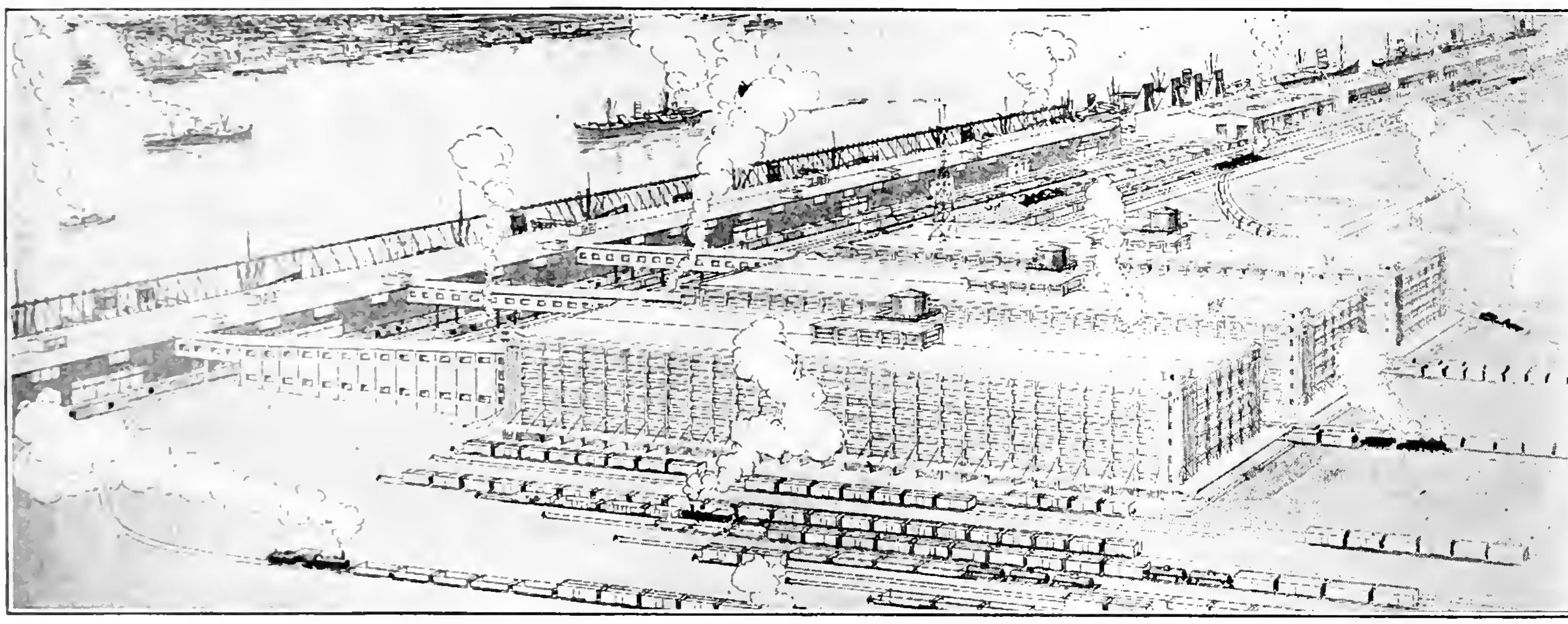
(c) Loading, unloading and transportation appliances as described.

Commercial Advantages—These are:

1. Increased speed in freight movement, thus reducing the ship's time in port by approximately 40% over the time required at the ordinary single-story unequipped wharfhouse;
2. Reduced handling cost per ton of freight;
3. Reduced storage cost per unit of capacity;
4. Reduced insurance costs on account of compartment design and fireproof construction;
5. A probable further classification of harbor facilities placing commodities such as steel and iron products, petroleum, coal, coffee, tobacco, sisal, grain, sugar and cotton at definite locations.

This warehousing, handling and shipping plant is of standard design and completely adapted to (a) the storage, transfer and loading of miscellaneous and standard package commodities; (b) both import and export transfer and storage, and (c) use as manufacturing lofts and factory machinery housing. The warehouses and wharfhouse have a column spacing of 20-ft. centers and an external glass area of 33% and 11%, respectively, being completely lighted for all the purposes noted before.

As stated, the warehouses are built for war or peace requirements of the Army as well as both public and private warehousing. Coffee merchants of Kansas City, Chicago or Denver can have their consigned coffee transferred from ships to these warehouses and from the warehouses to their customers in Memphis, Birmingham or Dallas, without handling the coffee beyond the port-of-entry storage. This is equally true of virtually all commodities. Tobacco can be shipped from Kentucky and held in storage for curing at the warehouses at New Orleans while sales are being made in Europe or elsewhere.



ARCHITECT'S PERSPECTIVE SHOWS NEW ORLEANS ARMY BASE AS IT WILL LOOK WHEN COMPLETED

The use of the warehouses can be extended so as to supplement the private storage capacity of all wholesale businesses.

The capacity of the plant is 178,500 tons, as stated, and in standard packages of principal imports and exports its capacity is:

	Warehouses	Wharfhouse	Total
Coffee (bags)	2,400,000	1,000,000	3,400,000
Sisal (bales)	350,000	150,000	500,000
Cotton (bales)	400,000	200,000	600,000
Tobacco (hogsheads)	100,000	50,000	150,000

Features of Design—As will be noted from the attached drawings, the design of the plant and its individual units is such as best to adapt it to use in a river harbor necessitating longitudinal wharf frontage.

The buildings are relatively narrow, the width being approximately one-quarter of the length. This feature allows a maximum length of railroad platforms and an arrangement of yard and loading trackage perpendicular to the wharf. The clear-story height of all the warehouse units is 10 ft. 8 in., except the first story in each building, which is 13 ft. 7 in. The minimum clear-story height in the wharfhouse is 17 ft. 6 in. for the first deck and 11 ft. for the second deck. The multiple-deck

structural steel bridges correspond in clear-story height with the joined buildings. The loading capacity on the various floors of the warehouse units is:

First	floor	400 lb. per square foot
Second	floor	350 lb. per square foot
Third	floor	250 lb. per square foot
Fourth	floor	250 lb. per square foot
Fifth	floor	250 lb. per square foot
Sixth	floor	250 lb. per square foot
Roof		25 lb. per square foot

The pile foundations of units No. 1 and No. 3 are designed for the total dead load and 85% of the live load, using a dead load of 12 tons per pile.

Under unit No. 2, to avoid the great difficulties and consequent delays of excavation, the standard piles in units No. 1 and No. 3 were replaced by composite piles, the lower section, approximately 48 ft., being of untreated timber, the upper section, approximately 8 ft., being of concrete installed in accordance with the design and under the supervision of the Raymond Concrete Pile Co. These piles are designed to sustain 16 tons.

The columns are designed for full dead loads and the following percentages of live loads:

Roof	100%
Sixth floor	85%
Fifth floor	80%
Fourth floor	75%
Third floor	70%
Second floor	65%
First floor	60%

The warehouse units are of reinforced concrete throughout. The structural design of the buildings is in accordance with the Chicago Building Ordinance, with exceptions as follows:

A. Flat-Slab Design:
1. The positive moments in bands perpendicular to the wall in the wall panels are 20% greater than for interior panels.
2. The negative reinforcement perpendicular to the walls and wall panels for the bands at columns is the same in amount as the negative reinforcement over the interior columns.
3. All negative reinforcing steel perpendicular to the walls is hooked 6 inches.

B. Beams:
1. Continuous beams are designed for the clear span.
2. The spandrel walls are self-supporting.
3. Lintels supporting the flat-slab floors are designed to carry the full dead and live load of one-fifth of the panel width tributary to same, considered as a uniform load.
4. Negative reinforcing bars in end spans are hooked 6 inches.

C. Spiral Columns:
1. The Considère formula is used in computing spiral columns.
2. The average core stress does not exceed 1200 lb. per square inch.
3. The concrete stress is 700 lb. per square inch for 1:2:4 concrete.
4. The amount of spiral reinforcement is not less than ½% of the core area nor greater than 1½ per cent.
5. The amount of vertical reinforcement is not less than 1% of the core area and not more than 4 per cent.

D. Laced Columns:
1. The concrete stress is 500 lb. per square inch for 1:2:4 concrete.
2. Lacings are not less than ¼ in. in diameter and they are spaced not more than 12-in. centers.
3. The amount of vertical reinforcement is not less than 1% of the effective area of the column nor greater than 4 per cent.

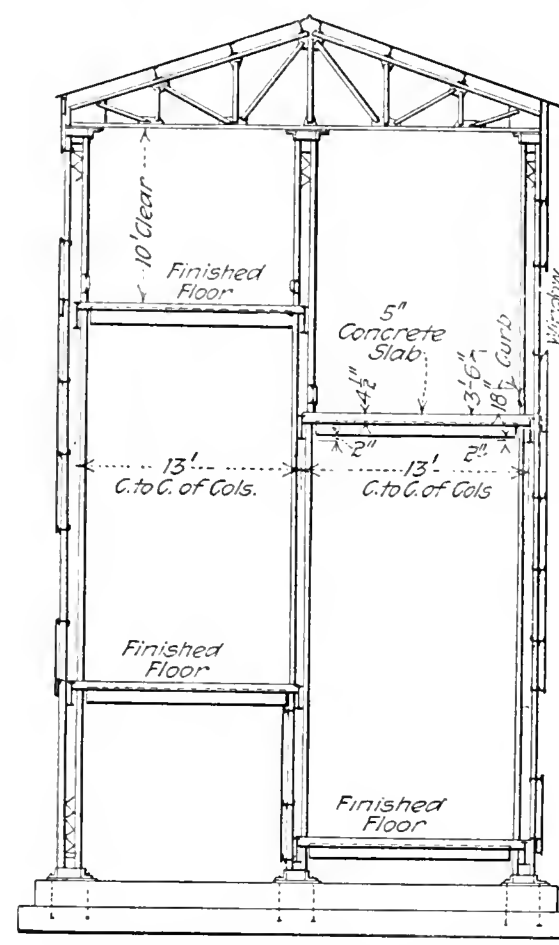
E. Concrete Stresses:
1. The extreme fiber stress for concrete in slabs and beams is not greater than 700 lb. per square inch for 1:2:4 concrete.

F. Steel Stresses:
1. Steel stress for tensile reinforcement for beams and slabs does not exceed 16,000 lb. per square inch.
2. Steel stress for tension in beam stirrups does not exceed 12,000 lb. per square inch.

G. Temperature Reinforcement:
The amount of temperature reinforcement is not less than ¼ per cent.

All other features of construction are in general accordance with standard specifications.

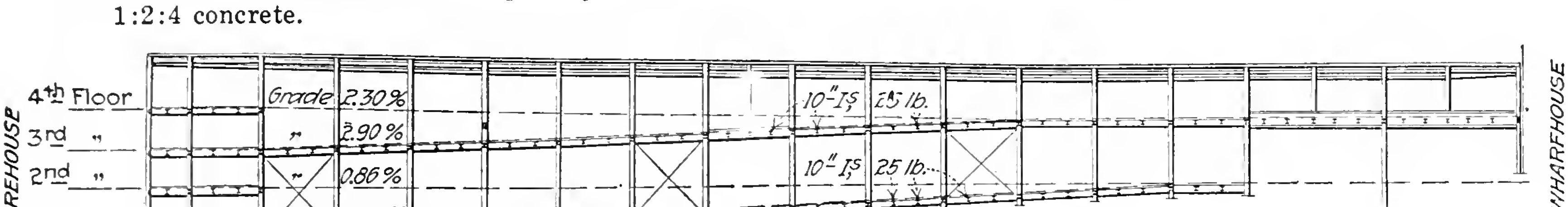
Piling is of round yellow pine and of various lengths for various parts of the plant. Under the warehouse units the points of the piles rest in a sand stratum at approximately —28 (Cairo Datum) giving a total penetration of approximately 51 ft. The piles are driven for the entire length through Mississippi River alluvial deposit until they bring up at the sand stratum before mentioned. Under the wharfhouse all piles and all exposed timbers are treated with 16 lb. of creosote oil per cubic foot. These piles range in length from 50 to 120 ft. In general, piles longer than 100 ft. are spliced, the lower portion being of plain timber and the upper of treated timber.



CROSS-SECTION THROUGH ONE OF THE CONNECTING BRIDGES

The cement is of standard brands of American portland cement. The fine aggregate is obtained locally and is limited in size to ¼ in. in diameter. The coarse aggregate consists of river gravel obtained from various sources, of sizes between ¼ and 1½ in. Concrete mix, except in special locations, is of 1:2:4 proportions.

The wharf is of treated and untreated timber, upon which is superimposed the wharfhouse of structural steel, inclosed by corrugated steel and rolling doors.



BRIDGE BETWEEN WAREHOUSE AND WHARFHOUSE HAS RAMPS TYING TOGETHER ALL FLOORS IN EACH

The plant is completely equipped for fire protection with sprinkler system and auxiliary appliances. It is lighted by electricity and heated by steam. The sewerage and drainage systems are in accordance with standard ordinances of the municipality.

As shown in the perspective a multiple-story bridge connects warehouse No. 1 with the wharfhouse. This structure has four ramps—that is, the first and second floors of the warehouse are connected to the first floor of the wharfhouse, and the third and fourth floors of the warehouse are connected to the second floor of the wharfhouse. The bridges connecting warehouses No. 2 and No. 3 each with the wharfhouse will be of two levels, extending from the third and fourth floors only of each warehouse to the second floor of the wharfhouse. Small bascule bridges close the railroad track openings in connecting bridge No. 1. Each consists of two leaves hinged at the outer end and electrically operated by a cable attached to a drum driven by a 10-hp. motor. Signals and brakes insure safe operation.

Handling Apparatus—Elevators for freight and passenger service are as follows:

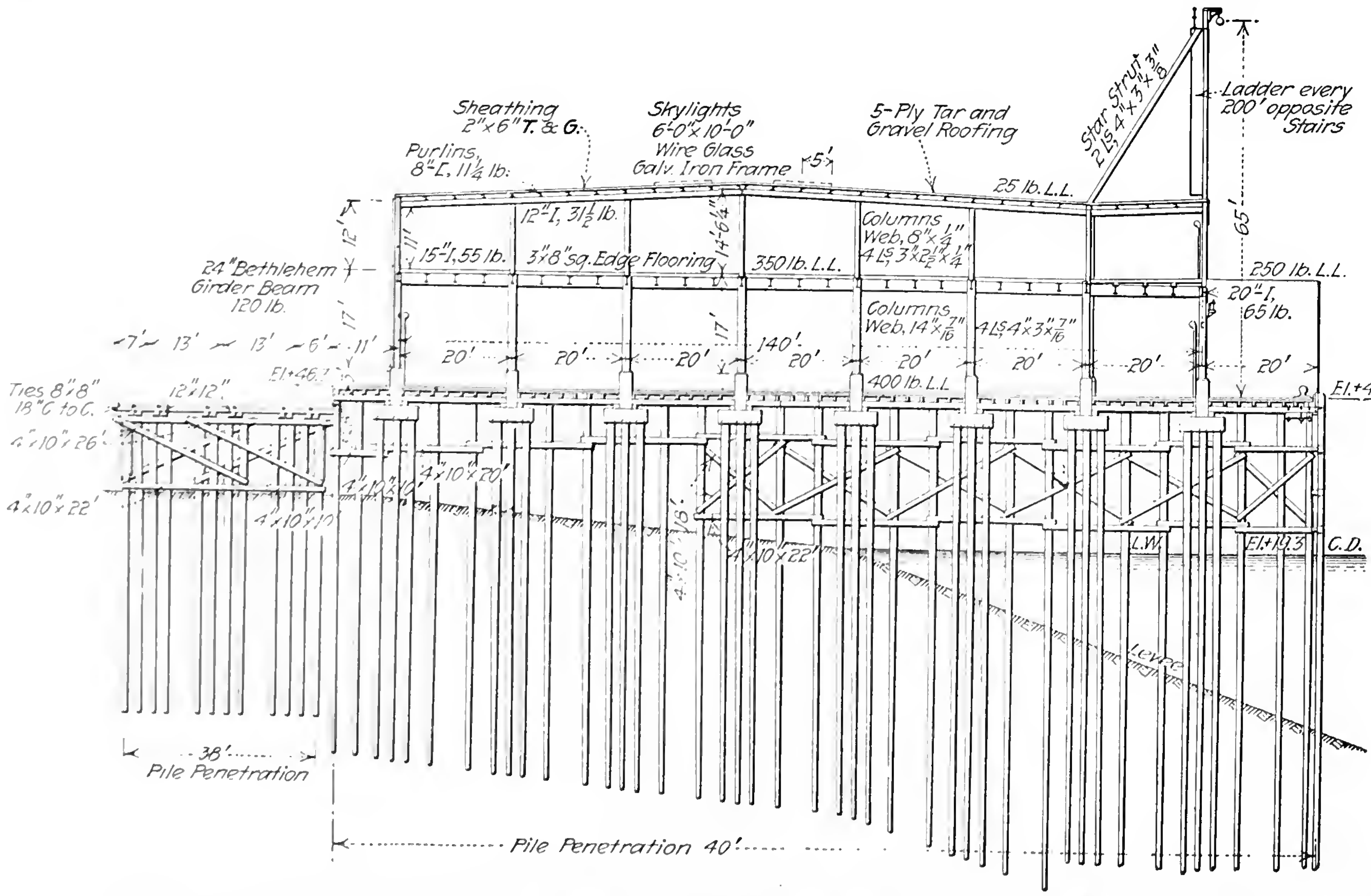
	Wharfhouse	Warehouses
Number	5 freight	15 freight 3 passenger
Location	1 every 400 ft.	5 freight 1 passenger in center of each building
Capacity	10,000 lb.	10,000 lb.
Speed	100 ft. per minute (freight)	150 ft. per minute (freight) 250 ft. per minute (passenger)
Floor area	785 sq.ft.	2295 sq.ft. (freight) 126 sq.ft. (passenger)

Space has been arranged for one additional freight and one passenger elevator in each warehouse. Provision has been made for spiral chutes for the discharge of commodities. The transfer of freight longitudinally is by means of electric tractors and trailers and the use of hand trucks. Bridges are so designed that a minimum use of the elevator system will be required, on account of the three bridges connecting the wharfhouse and the warehouses.

Quantities of some of the more important items required for this plant are as follows:

Warehouses	
Number of piles	31,700
Cu.yd. of sand,	48,000
Cu.yd. of gravel,	93,000
Bbl. of cement,	162,000
Cu.yd. of concrete	108,000
Tons of reinforcing steel	7,500
Ft.b.m. form lumber	9,000,000
Sq.ft. steel sash	113,000
Sq.ft. of roofing	252,000
Wharf and Wharfhouse	
Number of creosoted piles	21,000
Feet, b. m., creosoted timber	5,000,000
Feet, b. m., untreated timber	2,000,000
Lb. structural steel	9,000,000
Sq.ft. corrugated steel siding	96,000
Sq.yd. creosoted wood-block flooring	37,000
Sq.ft. roofing	280,000
Sq.ft. steel sash	16,000

The construction of the New Orleans Army supply base is under the general supervision of Brig. Gen. R. C. Marshall, Jr., U. S. A., chief of the Construction Division of the Army, and in direct charge of Maj. A. Pearson Hoover, constructing quartermaster, who went direct from the Boston Army supply base. Ford, Bacon & Davis are supervising engineers of the base. This firm is represented by George H. Davis, member of the firm; Charles J. Hardy, New Orleans resident engineer, and Frank J. Trelease, engineer-in-charge. The George A. Fuller Co. is general contractor for the entire work and is represented by Walter T. Smith, vice-president of the company. The wharf and wharfhouse construction was sublet by the general contractor to Holbrook, Cabot and Rollins, of Boston.



DETAILS OF WHARFHOUSE BUILT ON MISSISSIPPI AT THE NEW ORLEANS ARMY BASE TERMINAL

How Educational Reconstruction Should Develop

Modern American Engineering Education Must Become More Effectively Concrete in Application of Theory to Practice

By L. W. W. Morrow

Assistant Professor of Electrical Engineering, Sheffield Scientific School, Yale University, New Haven, Conn.

RECONSTRUCTION problems are the most important subjects now being considered by the thinkers and workers of America. One of the greatest of these is the problem of educational reconstruction. The educational system of this country has been subjected to war conditions, and has experienced an almost revolutionary experiment. Educators are considering the past with the view of building for the future, hence a proposal for revolutionary changes in methods of engineering education is timely.

Modern American education was largely based on German educational systems and ideals. German schools and German educational methods were the patterns for the American system. Germany was the Mecca for graduate students. The past four years have shown a fruition of German educational ideals. The war has proved them utterly false and materialistic, however efficient. The German goal was materialism, and the foundations of the national idea, "Might makes right," were embedded in the educational system.

Not only has the war exploded the German educational bomb, but also it has subjected the educators of this country to an experience that rocked them on their foundations of academic seclusion and caused them to study critically pre-war educational methods.

The war first depleted the schools of students through the voluntary enlistment and then, before many schools were in financial straits, refilled the schools with soldiers to be trained for Army needs. The material for vocational training was largely obtained by selection from drafted men. The vocational and special training division of the Army existed sufficiently long to demonstrate its success. It accomplished its purpose and produced startling results in training men for Army needs under war conditions.

Problem Confronting Educators

The problem now confronting the schools may be divided as follows:

1. How to apply to civilian training the good elements of military training and the educational methods learned through war training.

2. How to remove German educational ideas and ideals from our schools and yet retain true educational efficiency.

3. How to educate future generations so as to maintain the present awakened civic conscience; to secure the spiritual element necessary for true culture and ideal civilization, and at the same time secure and maintain industrial and material preëminence.

4. How to coördinate and revise educational methods to secure a product better suited to the changed world conditions, and how to coördinate the educational system with civic and industrial life, in order that both may be vitalized.

What features of war training can be profitably incorporated in civilian training? Was the vocational training a success because of its methods, or because of the sense of duty and patriotism inculcated by the war spirit?

Concrete Application of Theory in Vocational Training

Vocational training has a definite goal. Every endeavor is to reach the goal in the shortest time. No time is given to extraneous subjects. Concentration and discipline are the keynotes of the work. The cornerstone of the educational method is the physical and concrete application of theory at the time when theory is studied. The student is taught to use his hands and his brain at the same time.

Green men carefully selected, fairly matured, capable, physically fit and mentally alert, with only high-school preparation, in 13 weeks have become well versed in radio-telegraphy from the theoretical and practical standpoint. This necessitated teaching them electricity and magnetism, direct currents, alternating currents, trigonometry and radio principles. After one month's work these men passed technical examinations equivalent to those given electrical engineering students at the end of their junior year. They obtained their knowledge through concentrated study and experimentation, under rigid military discipline.

Army training teaches that selection of material, discipline, concentration and the concrete are efficient aids to education.

The discipline is not that due to a uniform or to the manual of arms, but is the discipline that means self-control, promptness, thoroughness, self-reliance and a sense of responsibility and accountability.

Concentration means the intensive study of one thing at a time and mastering it before another subject is introduced. It means having a definite goal and bending every effort to reach that goal in the quickest time.

The concrete means studying a subject from the physical and applied standpoint. It means that theory follows experimentation, and that only that theory is used which has utilitarian applications. It means using experimentation and physical presentations to obtain knowledge.

How can we obtain true discipline in civilian training? Shall we introduce military training, and trust that discipline will result? Past experience has taught that a few hours' drill each week in no sense of the word inculcates true discipline. A more vital application must be made. There is a question whether military training is essential to proper discipline. Discipline can as readily be obtained through a tightening of our educational requirements. There was too much leniency and laxness in our pre-war educational system. For the proper development of the students, too much freedom from control is as bad as too rigid repression.

Educators can require promptness in students; they can hold students more rigidly to requirements; they can instill a nobler and broader idea of education in their students, and can by word and example exemplify and introduce true discipline.

The great difference between civilian training and Army training lies in the fact that the former has no

concrete goal, no fixed target at which to aim, as contrasted with the latter.

The object of an engineering school is to develop a product that will benefit society materially and socially, the material benefit being gained through the incorporation into industrial pursuits of workers well grounded in the natural sciences and capable of increasing their industrial applications, the social benefit being gained through the addition of men to the world's citizenship who are culturally developed and equipped with perspective, vision, and civic ideals such that a better civilization and citizenship will result.

In order to produce such a product the engineering school must afford the following facilities: (1) Instruction in the fundamental sciences underlying industrial applications; (2) an atmosphere and environment conducive to social idealism, cultural, and general development and true ideas of service and worth.

The student enters an engineering school with a development of codified knowledge and personality that is very meager. It is the function of the school to develop the personality of the student to its full extent through proper environment and educational supervision; to develop the codified knowledge of the student in every direction not only as regards engineering knowledge, but as regards the humanities, and in addition to accentuate his codified knowledge of engineering and of the special branch he elects.

The larger schools of this country have developed artificial divisions called departments. These divisions, too frequently, are independent entities and give their courses without any reference to the other departments also concerned with the education of the student. The mathematics, physics and chemistry departments have their own ideas as to the proper method of presenting their subjects, and the student is taught each subject as though it stood alone and were not coördinated with the other fundamental sciences. Too often each department tries to develop a specialist in the one science rather than to coördinate all the sciences in the mind of the student.

Such conditions make for inefficiency. The departments must be coördinated and must be subordinated to the fundamental idea of turning out a product with a sound and correlated knowledge of the fundamentals of engineering.

Eliminate Abstract Teaching

The concrete method of presentation is difficult to adopt in our educational systems. Tradition and precedent are overwhelmingly in favor of teaching fundamental science as an abstract rather than a concrete thing. Theory comes before practice. This is entirely artificial, and is due to taking the easiest way.

Engineering fundamentals should be taught in the applied manner, which involves the utter elimination of the abstract subjects called physics, chemistry, mathematics, etc., as such; the entire elimination of the abstract and the general in favor of the concrete and the applied; the introduction of experimentation as the direct road to knowledge; the giving of practice before theory rather than the converse; and the use of logic, psychology, and common sense in teaching.

All science is experimental and can best be taught from the experimental standpoint. The keynote of the applied method of teaching is to use the concrete to find out the *how* of things and follow with the *why* of things and thus conform to nature's educational method —first *see* what happens and then determine *why* it happens and *how much* it happens. This means that the abstract subjects, physics, mathematics, chemistry, etc., would be applied to a given experiment or piece of apparatus sufficiently to explain *why* and *how much* it happens and would coincidently bring into the instruction English and economics as applied to expressing and appraising the experiment and its results.

This necessitates a careful planning of experiments such that in an engineering course the student will have to apply all the abstract fundamentals of physics, chemistry, mathematics, mechanics, etc., before he has finished the experimental work of the four years. This involves a revolutionary change in educational methods and in the qualifications of engineering educators, for the experiments must not only bring out the fundamentals but must be interesting, practical and of an engineering nature.

In addition, this method implies a selection of the students for the engineering schools and the classification of these students into divisions of similar mental and engineering qualifications. A few simple psychological tests are more valuable for determining whether the prospective student is of engineering caliber than any stereotyped entrance examination—the latter requires only memorization, the former requires thinking and an attitude of mind essential to engineering success.

Administrative Remodeling Required

An education scheme of this nature would use all the equipment and teachers now available in our engineering schools, but would require an administrative remodeling of departments and a coördinated type of education rather difficult to administer.

The first requirement is a carefully planned series of experiments on concrete subjects in conformity with the subdivided engineering student classifications to insure an appropriate fundamental content. The second step would be the allotment of selected instructors to handle the classes in accordance with the engineering and personality classifications of the students. The third step would be the allotment of the classes to the different engineering and scientific laboratories.

The mathematics, economics, physics and mechanics departments would cease to exist as such and the chemistry department would be changed to chemical engineering, but the instructors, laboratories and equipment of these former departments would be utilized where needed for experimental or instructional purposes. *Abstract courses would be entirely eliminated, the student would take only one course classified by the engineering department elected, and his time would be allotted by coördinated faculty agreement.*

Every experience of life and industry teaches that real knowledge is best gained by using the hands and the brain at the same time. Any efficiency engineer handling labor will bear out the foregoing statement. Mathematics, physics, chemistry and mechanics must be taught as experimental, concrete and applied subjects, if real educational efficiency is to be attained.

Probably the greatest task in educational reconstruction is to maintain the present spiritual and idealistic attitude in the nation. The war has proved that efficiency solely in materialism means destruction. Ger-

many concentrated on the materialistic; industrial supremacy, martial supremacy and financial supremacy were her civic ideals, with no leavening of truth and idealism. The world needs no greater example of the falsity of such ideals. No civilization can exist that has not humanistic ideals as well as materialistic. The war has taught that future education can only be successful if it inculcates in the students a realizing sense of the importance of idealism and true culture, as well as giving them sound training for preëminence in material pursuits. The humanities are as essential as the sciences in any true educational system.

The word "humanities," as generally accepted, means history, literature, art, etc. It is not necessary to teach Greek, Latin, art or literature to instill the true humanitarian spirit in students. As has recently been stated, "Greece was the only uneducated nation; yet every other nation has been educated by Greece"—meaning that Greece had no traditional history, literature or art to study, but developed her own culture. Greece cultivated her own humanities and culture, and they have been accepted by later nations as standards for emulation. Our humanities need not be those of Greece. Our education should develop the humanitarian spirit through developing in the nation conditions such as existed in Greece whereby spontaneous cultural development will occur.

Coöperation Needed

The day of the academic attitude in education has passed. Education must be reconstructed on the basis of the utmost coöperation between the schools and industry. The product of the schools supplies the demands of industry. Educators are needed in industry, not only on material grounds, but also because inherently they are the leaders in idealistic thought. Industrial men are needed in the schools, on the other hand, to train students properly and efficiently for industrial work.

Both the educators and the industrial men gained breadth and vision through their war experiences. The views and needs of industry became widely disseminated among educators, and, on the other hand, industrial men gained a truer knowledge of American educators and educational methods. Industry had need of pure scientific knowledge and gained it from the educators. Much of the pre-war antagonism and narrowness of view has disappeared. Every indication points to a more intense educational and industrial coöperation. Industry will establish research scholarships; will use educators as consultants on labor and other industrial problems; will furnish competent men to help educate students for the needs of the industrial era—if properly encouraged to do so by American educators.

In addition to school-room work, the educational institution must furnish the facilities and environment for intellectual and moral growth. The teachers should be men who are respected and emulated by the students, they must be approachable and must be interested in the students. They must coöperate in student activities to the utmost and encourage all social and other nonscholastic activities that make for proper student development. Teaching should be a profession and not a side issue with research or commercial engineering the main issue. Teachers should be selected for their teaching ability rather than for their research and mathematical ability.

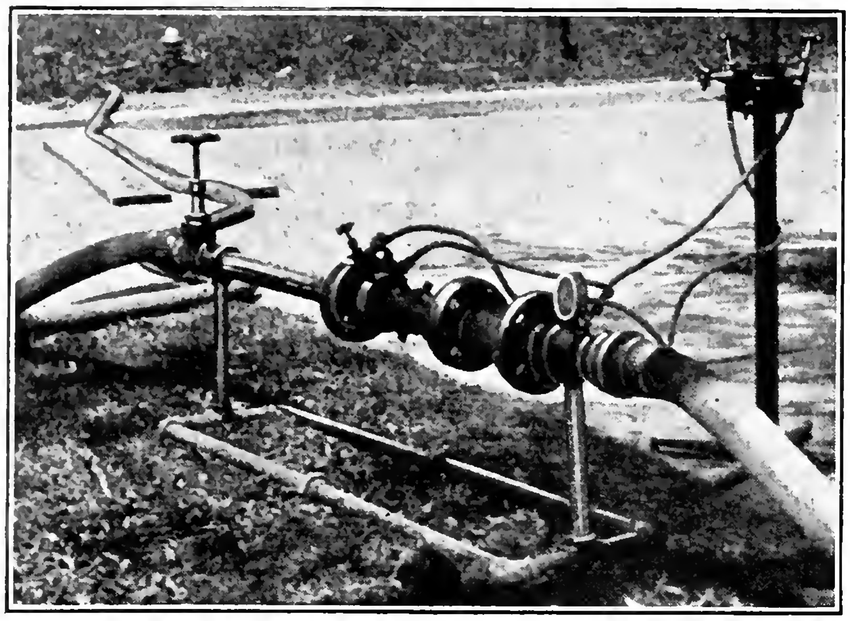
A proper application of the foregoing principles will increase the efficiency and value of engineering education, but no compromise plan will attain the results desired. The plan is difficult to carry out, but far from impossible. The war has revolutionized industry—reconstruction is the key-word of today. Nothing needs reconstruction more than engineering education.

Devices for Water-Waste Surveys at Oak Park, Illinois

Portable Venturi Meter to Test Pipe Districts—Pitometer Inserted in House Service Makes Leakage Charts

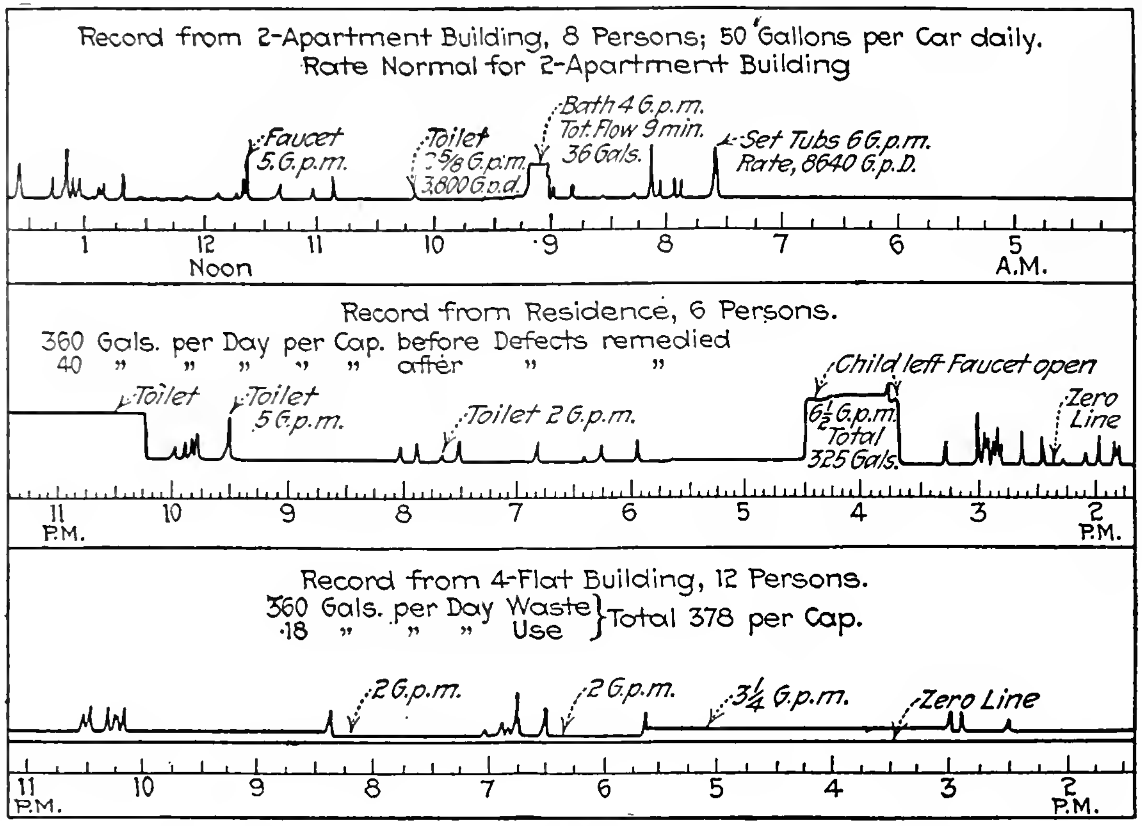
PRELIMINARY to a water-waste survey, it is advisable to make a rough pitometer test of the entire city, according to a paper read before the Western Society of Engineers by Herbert P. Matte, chief sanitary engineer of the Illinois State Department of Public Health. This is done by isolating certain districts by closing gate valves and then measuring the supply through one main left open. On small systems it is possible to make this test by shutting down those districts entirely for a few minutes, especially in the residential sections, and noting the drop in the rate of consumption as indicated by the recording chart at the master meter, providing it is on the distributing system.

In districts which are completely metered the velocity of the smallest feed main may be so low that it is impossible to obtain an accurate record of the consumption if there are no large leaks. It is then necessary to bypass the flow through a small pipe (2-in. or less) in order to increase the velocity. The most practical way of doing this is to feed from a fire hydrant outside the district through a fire hose to a hydrant within the district. A regular displacement meter may be used and the rate obtained by noting its readings at regular intervals, but this method is not very useful owing to the fact that several drafts may occur during the test. Two methods used at Oak Park, Ill., are described by Mr. Matte. One consists of a 2-in. venturi meter with a ⅝-in. throat which can accurately record rates from 3 to 50 gal. a minute. This is shown in the accompanying



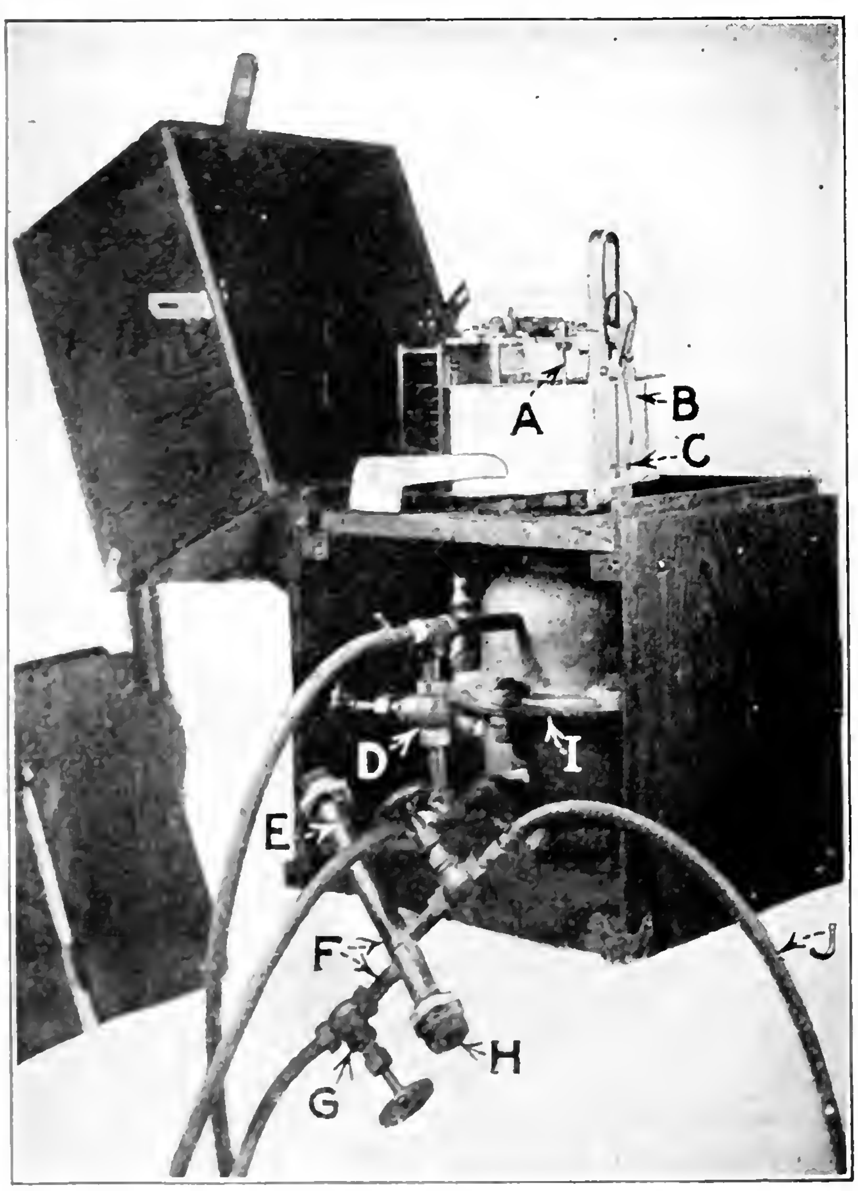
PORTABLE VENTURI METER WITH BAROMETRIC MERCURY MANOMETER FOR WATER-WASTE TESTS

view. The other is by using pitometers inserted into short pieces of pipe, 2-in. or smaller. This permits the measurement of as low as $\frac{1}{4}$ gal. per minute. Contrary to the usual method, all the Oak Park tests were made during the day, after determining the hours in which the flow was somewhat steady. The districts varied between one-quarter of a mile and two miles in length. As the rate of consumption could be watched, it was rarely found necessary to be on the job for more than half an hour at a time in order to determine the minimum rate of consumption. The population of the district was obtained from the school census, and the average daily consumption through the domestic meters was obtained from the water accounts. Thus, an estimate of the legitimate rate exclusive of the underground leakage was determined. Where there was not much leakage the normal pressure was maintained through 600 ft. of fire hose. Where the flow was abnormal, the valve on the meter was throttled, in order to bring the reading within the limits of the manometer.



SAMPLE OF CHARTS FROM WATER-WASTE DETECTOR

A rate of 60,000 gal. per day at 10-lb. pressure in a pipe only half a mile long was observed in one case, the normal pressure in the mains being 45 lb. Tests by the aquaphone disclosed six service leaks which wasted 200,000 gal. a day. This meant a leakage rate of 305 gal. per capita per day, while the service meters indicated only a total per capita consumption of 45 gal. After repairs were made the leakage rate dropped to 10 gal. a day.



DETECTOR FOR DOMESTIC WATER WASTE

A, rod to diaphragm; B, paper $2\frac{1}{2}$ in. wide; C, pen; D, bypass; E, $\frac{5}{8}$-inch brass meter nipple; F, pitot tubes; G, $\frac{1}{4}$-inch needle valves; H, threads for $\frac{5}{8}$-inch meter couplings; I, diaphragm; J, pressure tube

To determine the cause of high water bills where there was no leakage and the consumer was sure he was not wasting water, the water department at Oak Park designed a recording detector or pitometer, which, when substituted for the meter, gives a graphic record of the consumption for 24 hours or a week. This device consists of a piece of $\frac{1}{2}$- or $\frac{3}{4}$-in. brass pipe 7 in. long, into which are inserted two $\frac{1}{16}$-in. brass pitot tubes, one pointed upstream and the other perpendicular to the axis of the pipe. For convenience, these tubes are soldered into $\frac{1}{8}$-in. brass nipples. Two needle valves and strong rubber tubing complete the detector, which is inserted into the house service either in place of or tandem with the meter.

A special type of recorder with a rapidly revolving chart, so that drafts lasting only $\frac{1}{2}$ min. could be detected, indicated at what time and how long faucets were left open for baths, for washing dishes or clothes, or for lawn sprinkling; how often toilets were flushed, etc., together with a record of all leakage of $1\frac{1}{2}$ gal. a minute or more. Part of a sample chart is shown in one of the illustrations.

In the first experiments the pitot tubes were connected to a mercury U-tube, by means of which rates ranging from less than $\frac{1}{2}$ gal. per minute to 30 gal. per minute were measured by using the $\frac{1}{2}$-in. and $\frac{3}{4}$-in. nipples. A camera provided with a 3-in. revolving sheet of bromide paper was adjusted so that the lens magnified the deflections through a slot about 0.008 in. wide. A pocket flashlight supplied the illumination, through a condenser, and the power was furnished by a single cell storage battery constructed for the purpose. The only drawback was that the high deflections were beyond the range of the slot, although small leakage was detected which the disk meter failed to record.

After fruitless attempts to alter the quantitative measuring device of the displacement meter so that

it would register in gallons per minute, the next step was to design a recorder which could take care of all flows. This new recorder, shown in one of the illustrations, will detect rates as low as 1½ gal. per minute, and there is no limit to the maximum recording capacity if larger meter tubes with lower center velocities are used. The diaphragm is constructed of ⅛-in. mechanical rubber, and Mr. Matte states that it was surprising to note the power transmitted through the stuffing box. The recovery after a short draft is rapid, even at maximum velocities, as indicated by the accompanying drawing of actual records. The recorder is not extremely accurate, but frequent rating by means of the regular meter-testing outfit indicates that it is amply dependable. It has been used successfully, in connection with a 2-in. venturi meter, in making waste surveys by means of the hydrant and hose method described above, and gives much assistance in determining the varying consumption in the district tested so that the leakage can be ascertained.

Comparison of Long and Short Highway Contracts

Opportunity for Both—Outgrown Methods Should Be Discarded—Long Contracts Cheaper and Desirable to Attract Large Construction Organizations

By H. Eltinge Breed
First Deputy Commissioner of Highways, New York State

Evidences indicate that highway work offers the biggest immediate opportunity to all kinds of contractors, both large and small. For the present needs there is a scarcity of experienced highway builders, and the attraction of large construction organizations experienced in other fields will depend largely on the sizes of the contracts available. Comparison of the relative cost of letting a long stretch of road by one contract, or by several contracts, shows a large saving for the former procedure, if proper precautions are taken in organization and in the selection of the plant. More economical distribution of materials and plant, without disturbing the work of other contractors on an adjoining site, is also to be expected. While many lines of private enterprise still falter in uncertainty, there is urgent need for highway work and the means to satisfy this need are at hand. So great is the opportunity that there is danger lest is be wasted by trying to hold the future to the routine of the past. Now is the time to shape larger means to greater ends, and to advance fearlessly beyond outgrown practice.

Large amounts of money are available for highway work, and public opinion is favorable to such expenditures. Two hundred millions—and more to follow—have been appropriated by the Federal Government; $50,000,000 and $60,000,000 bond issues have been passed in Pennsylvania and Illinois, respectively, and large appropriations have been made by many other states. Public sentiment, roused by the transportation experiences of the past two years, is solidly behind road construction, and is being intensified through nationwide propaganda conducted by good roads and automobile organizations, chambers of commerce, and material and motor-car interests, while labor of all kinds demands productive employment that will hasten the readjustment of conditions.

Future Progress Threatened

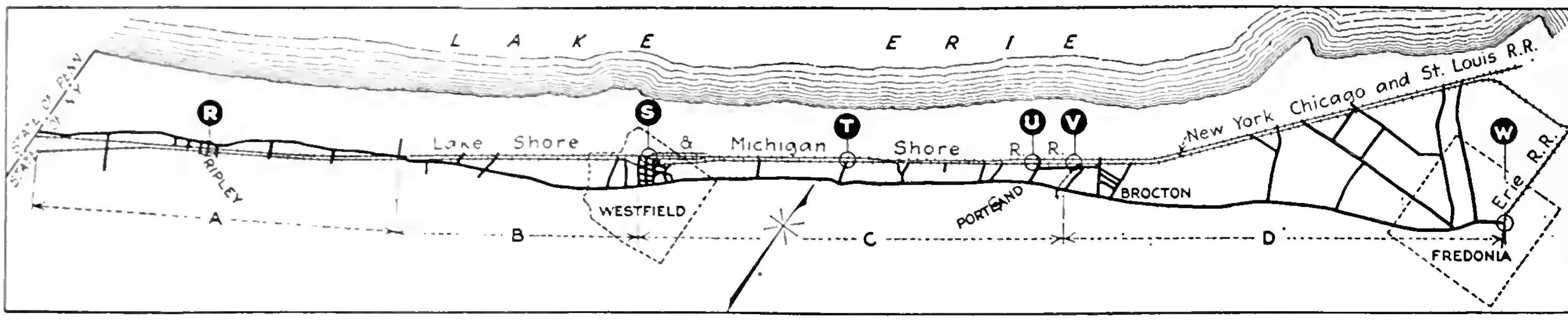
Nothing threatens our progress in the future more gravely than the practice of letting all contracts in lengths averaging one to five miles. This has encouraged the man with small capital and a one- or two-unit plant to enter the field, and to his initiative and courage our roads today owe much. But it has practically excluded large organizations which, figuring other contracts in terms of millions, could not afford a shift to such small game as the highways have offered. The reasons for the short contract are obvious: Tradition, from the days when highway contract work was trifling and uncertain; red tape, which has tied up with legal restrictions getting work done; fear felt by the small man lest he be crowded out by a more powerful competitor; and the reluctance hitherto of large concerns to enter highway work because they were not sure that it offered sufficient opportunity for a large capital investment in plant.

Scarcity of Contractors

As the matter now stands there are not enough contractors available for work advertised on the short-contract basis. In New York State there are 600 miles of abandoned and new contracts ready for letting, which require, for plant and backing, a contracting capital of about $2,000,000. Of the 554 formerly listed, there are now only about 100 going contractors in the state equipped for highway work, with an estimated total capital of $1,000,000. Not even all of these are available for new work, as some already have all they can handle. And this in the state where the extension of highway work has attracted most men into the business. We must have more men for the actual construction work. The length of our contracts will determine to a large extent whether these men shall all be comparatively small beginners in contracting or whether large and experienced organizations shall be included.

One thing is certain—long stretches of work will be let at one time. We now see our highways in terms of national systems instead of as convenient spurs to the barns of local politicians. We plan highways that shall traverse the country, north and south, east and west. A route shall cross one state and connect with the corresponding route in an adjacent state. A very few of these routes are already completed, of others only short gaps are to be built, but the majority, in stretches from 20 to 80 miles, still exist only in blueprint plans. Shall such stretches be broken up into sections or advertised for one bid?

Let us consider an actual, concrete case. Route No. 18 of the New York State highway system, shown in the accompanying sketch, runs from the Pennsylvania State line northeasterly along the New York Central & Hudson River R.R. to Fredonia. The distance is 25.76



HAULING DIAGRAM FOR ROUTE NO. 18 FROM THE PENNSYLVANIA STATE LINE TO FREDONIA, N. Y.
R, S, T, U, V and W show railroad sidings

miles. The engineer's estimate for a concrete pavement 16 ft. wide and an average depth of 6 in., at present prices, would be $800,000.

Consider this divided, according to the old practice into four contracts as follows:

State line to Forsythe	6.74 miles,	Contract A
Forsythe to Westfield	4.02 miles,	Contract B
Westfield to Brockton West Corporation line	7.65 miles,	Contract C
Brockton West Corporation line to Fredonia	7.35 miles,	Contract D

Then consider the whole distance from the state line to Fredonia in one contract lettered A-D.

For close comparison let us plant the one large contract and the four short ones with the same kind of equipment. Plant has been figured on the basis of completing the road in one season.

The total cost of a plant, new, for Contract A-D is $139,100, with $6300 additional for supplementary plant.

Contract A requires $44,600 worth of new plant with $3300 for supplementary plant; Contract B requires $35,100 worth of new plant; Contract C requires $41,100 worth of new plant and $6300 for supplementary plant; Contract D requires $53,600 worth of new plant and $6300 for supplementary plant. Total cost of new plant for the four contracts, $174,400; total cost of supplementary plant $15,900—an increase in cost over plant for a single contract of $44,900. The season's additional cost of plant for the four contracts over the one contract is $13,414 plus $2112 for the supplementary plant. These totals were arrived at by figuring the interest charge at 6% on the basis of actual cost, plus 12% for repairs on regular plant and 6% for repairs on the supplementary plant, allowing 20% for depreciation on new plant, with an allowance of only 10% for depreciation on supplementary plant because it is used less.

We must also figure the approximate freight on this plant and the on-and-off charge of loading and unloading, as well as the moving charge for the four contracts, which amounts roughly to about $2000 more than that for the single contract. Thus, on the one item of plant alone we have saved through the one long contract $17,526.

Supplementary plant is necessary to insure the completion of the longer sections in the one working season. It would, of course, have been possible to have figured other kinds of plant, but the character of the plant used—concrete mixers, unloaders, rollers and motor trucks—is such as would show smallest depreciation and greatest salvage value.

The necessary motor equipment was figured on the basis of the actual quantities involved for the exact average haul. The planting of the job and the work was figured on the basis of three organizations for the large contract, with a possible supplementary organization to piece out any section running behind, while the small work was figured on the basis of four organizations, with the possible use of two supplementary organizations.

Without doubt, the organization and overhead charges for doing the work would be less in the long contract than in the four units that comprise it. Obviously, we cannot estimate here in exact figures, because these costs always depend upon the individual contractor and the individual organization. There are, however, certain advantages and disadvantages that would apply generally.

Interference of Short Contracts with Each Other

Suppose the long stretch of road cannot be as advantageously broken up as the one shown in our map. In order that his supplies may come freely to each contractor, a cross-road must traverse his contract, either near the middle or else at both ends. Should this be lacking he must either build one himself at consuming expense, or he must petition the adjacent contractor for permission to haul over his part of the road. This may or may not be granted for all or part of the time, and John Jones may get on his job some morning to find that the crushed stone for which all his force waits is held up for a week because his neighbor has just put in green concrete.

Three efficient contractors finish their jobs on schedule time; one weak brother gets his all torn up and has to leave it impassable till the next season. The one undone makes useless the three done. The public is incensed. Having learned the value of coördination, it begins to question the wisdom of four different concerns all doing the same job, of paying four overhead costs where one might suffice, of holding four persons instead of one responsible for completion and success.

The demand thus arises that long stretches of road, from 15 to 30 miles, be let in one contract, except in unusual cases where specialized construction work is involved. Suppose this is done with Route No. 18 to Fredonia. The contract is advertised and awarded to the Mammoth Construction Co. The bids have indicated one gain over the old plan; the work can be done at less cost to the public and probably with more profit to the contractor. Here are some other items of saving besides what we have already detailed in respect to plant:

1. The contract is limited to one season, as it could scarcely be with the four concerns. The public thus has the route completed in one year. The cash saving is from $500 to $1000 a mile—the extra charge which every good contractor adds to work carried over the winter season. Engineering charges also are always lessened, according to the rapidity with which work is completed.

2. The overhead cost of a large organization doing

a big piece of work decreases in proportion to the amount of work done. Men of higher grade can be employed to conduct the work. The broader scope will attract them, as well as the larger salaries justified by their increased responsibilities. Plant can be more economically employed. The large organization carries enough plant, so it is less likely that it will have to buy special equipment for any one job. This lowers its bid. All the plant is kept more continuously busy, so that a smaller amount need be charged off against that depreciating in idleness. There is less shifting of plant from place to place, because the same units will be kept on the long job throughout the season.

3. The greater power of a large organization makes for efficiency and economy. Materials bought in quantities cost less, and better service is obtained in their delivery. Labor is often more available for large organizations, because of their wider prestige. Financial strength means the ability to tackle the hard and often less remunerative part of the work at the beginning, without playing out of time for the "velvet."

4. Equipment for efficiency is justified in the large undertaking, even at great expense. It pays to build railroad sidings and spurs for freight haulage to a 25-mile contract, whereas for a short contract the hauling and unloading would have to be done by more costly methods.

Requirements of Large Contractors on Highway Work

If the large companies entering highway work already possess ordinary equipment, such as hand tools, plows, scrapers, wagons, drills, boilers and engines, pipe line and small pump, etc., they will have to buy such new machinery as the particular job requires. For water-bound imported-stone roads, this machinery will consist of an unloader, a roller, wagons or trucks, and a road machine; where local stone is used, a crusher and bin also, but not the unloader; for roads of bituminous macadam, penetration method, imported stone, the pipe line and small pump may be omitted and a bituminous-material distributor provided; for concrete roads, a concrete mixer, and, in addition, the same plant as for water-bound macadam. Additional wheelbarrows, finishing tools, forms, etc., are required also. Brick pavements require in addition a small roller and grout machine. For bituminous macadam mixed method, a hot mixer and an asphalt roller, and if on concrete foundation, the same equipment as for concrete pavement is required. It must always be remembered that the unloading and hauling equipment will depend upon the quantities involved and the length of the haul.

There are several dangers peculiar to the large organization. If it has had experience in railroad work, it is well prepared to run its organization extensively as well as intensively, but if its operations have been confined to limited areas such as are involved in structural buildings, dams, foundations, etc., it will have to learn that a road unrolls its length like a ribbon, and that the man at one end of it can see the other end only through the eye of his mind. This quality of imagination that visualizes the unseen is prerequisite in every highway engineer and contractor, and in every assistant in charge of work. Placed himself in one spot, he must be able to tell at any given moment exactly what is happening at every other spot in his domain. He must be able so to plan that every bit of work beyond his ken as well as within it dovetails neatly into the whole, without waste of energy or loss of time. Such organizing ability is essential to the success of any highway contract. Furthermore, because it is always moving on, road work requires a flexible organization and men with power of quick adaptation. The routine foreman who has succeeded in house building would probably be out of his element in highway work.

Experienced men well trained in highway work are scarce; they should and can command good salaries. Construction companies entering the field must scan their payrolls to see that the importance of a man's particular work is commensurate with the skill and the salary of the man who is doing it. Otherwise, they cheat themselves and also some other contractor who probably needs the man's services.

At every turn is the temptation to overplant the large contract simply because it is large, on the assumption that more work will be done. It won't. Instead, machine power will lie dormant and the human power involved will be wasted. On average highway work of excavating, grading, filling, subsurfacing and surfacing, there is needed one full unit of plant for about every five miles. More than that clutters.

Any successful construction company knows the necessity of keeping down the overhead expense. Nowhere does this show more tendency to soar than in highway work, just because of that extensiveness of which we have already spoken. The large companies will find it helpful to gather exact engineering cost data and to figure in advance all the details of every phase of their work. They will then be able to correlate expenses so as to keep within bounds.

One Argument Against Long Contracts

There is one argument against the letting of long contracts—that it will exclude the smaller men from competition. This objection may be met in several ways. We have seen that there is at present more highway work to be done than there are contractors to do it, and that it will be public gain and economy to attract large construction organizations to highway work by letting contracts for long distances. As the editorial in *Engineering News-Record* of Mar. 13, 1919, p. 503, on this subject suggested, there will be enough short stretches of road, one to ten miles long, to engage all reliable contractors with small units—connecting links, short spurs to newly developing centers of traffic, resurfacing for maintenance, etc. To secure the widest competition, however, contracts could be advertised for alternate bids. The Fredonia road, for example, could be advertised in one contract for large concerns, and it could be broken up and advertised in four contracts for the smaller competitors. If the total of their low bids for the work were lower than the lowest single bid for the whole piece, then the work would be let in four contracts. I think that would be improbable, if the big concerns were making reasonable bids.

Where it would be very probable is in spurs to be built radiating like spokes from any large center as a hub. Suppose Fredonia to be such a center, with roads of permanent type leading from it five to ten miles in ten different directions. All of these could be included in one contract, and also each one could be advertised in a separate contract. It would be an interesting experiment in organization for the big con-

cern to try such a contract, with one central force in the city directing all its activities along the ten spurs. I believe it would be tremendously successful. But the smaller contractors would stand a good chance of winning their separate contracts and proceeding just as they do today. Another element would thus be added to the contracting game, played by men who are born lovers of hazard—or they wouldn't be contractors.

The alternative brings with it an opportunity for the smaller men. Their logical progression now is from one to two to three and four or more contracts. These may be scattered all over the state, so that the contractor loses all sense of coherence and spends much valuable time going from one job to another. His success will bring greater rewards, when, instead of bringing more jobs, it will add simply more miles to the one job, and leave him still with a definite center of gravity. He too will bless the long contract.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Philadelphia Club Maintains Membership by Broad Policies

The Philadelphia Engineers' Club some years ago, through a vigorous campaign, built up a large membership. Despite the war, that membership has been well maintained and the club has continued to prosper, both financially and as a social and intellectual center for the engineers of Philadelphia. Much of the success is due to the very broad policies adopted with reference to affiliated members and to the vigor and resourcefulness of the house and entertainment committees.

At present there are 1800 active members and 600 juniors and associates, giving a total membership of 2400. In addition, there are about 1000 affiliates. These affiliates are members of local sections of national engineering societies which have the privilege of holding their meetings at the clubhouse. For these privileges the sections pay to the club $1.50 a year for each of their members, and those not holding club membership are thereby constituted affiliates and get the club's monthly journal, a vigorous, well printed, well conducted organ. It costs more than $1.50 a year to send the journal to the affiliates, but the club regards its loss in this direction as the cost of advertising, as it conveys monthly to these affiliates the news as to the activities of the club, and thus serves to bring the desirable men into active membership.

As an indication of the vigor of the entertainment committee may be cited the means employed for obtaining a large daily use of the luncheon facilities of the club. An average of 65 engineers is found there every noon-time. When it was discovered that Tuesday was a small day, the entertainment committee made arrangements for Tuesday luncheon talks. Thursday, for some reason, was found to be a low day also, and therefore a special menu is always arranged for Thursday, while music is provided on Saturdays. There is a ladies' dining-room, for the wives, sisters and daughters of the members, and this dining-room is used to full capacity every noon.

Every second week there is a smoker with a paper or a "movie" on some more or less popular topic. The technical activities are provided by the local sections of national engineering societies, and there are so many of these that there are technical meetings every week. Saturday afternoon trips are arranged, during good weather, at least every other Saturday and sometimes every week.

The club supports a very well arranged clubhouse with an ample meeting room and library. The dues of active members are $25 a year, while the initiation fee also is $25.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Professional Engineers and Union Labor

Sir—It is evident that the secretary of the American Association of Engineers has handled without gloves the subject of trade unions in his letter in your issue of Feb. 20, 1919, p. 394. And the public often chastises labor organizations when they hesitate to submit disagreements to arbitration! If his statement that "the outstanding characteristic of union labor is selfishness" can be taken as any criterion of the opinion of the engineers of this country, the solution of the misunderstandings and antagonism between capital and labor is further away more years than I care to count.

Altruism can hardly be said to be the attribute of any particular class, educated or otherwise. Is it fair to put the unqualified brand of "selfish" on union labor? The setting up of class distinction is a step backward. We have just fought a war against political autocracy in order to establish democracy, and the world must progress in this direction. When labor is thus chastised unjustly a tendency to lessen the production costs or increase the output is hardly to be expected. In this connection the words of Shylock come to mind:

> "Fair sir, you spit on me on Wednesday last.
> You spurned me such a day; another time
> You called me dog; and for these courtesies
> I'll lend you thus much moneys."

Ah, no—you can demand a day's work from men, but without justice you better have the paymaster get some cash to pay off the men who want their time. With such an attitude on the part of the engineer there is not likely to be any very close bond of fellowship or mutual understanding between labor and the professional engineer. The attitude of the engineering profession toward labor has been that of aggressive haughtiness and superiority. Labor has had to buck capital for increased wages. In the process the engineer has seen fit to act as go-between. For the most part the engineer has considered capital his client and has tended to show a preference for the point of view of capital in contradistinction to the contentions of labor where disagreements arose concerning working conditions. In the shuffle the remuneration of the engineer has not improved perceptibly.

The first task of the engineering profession is to define what is meant by the term "engineer." Until

such time as this is clearly understood, all argument is futile and it is impossible to arrive at what is a fair wage. You have men calling themselves engineers who can run a level or a transit, but they have no technical education. It is true that a high-school boy can go into an engineering office and in a short time handle a level or transit; a little geometry, trigonometry and logarithms added to his outside work gives him the basic knowledge to handle a considerable variety of work. As a matter of fact, I know any number of bricklayers and carpenters who can handle either a level or a transit and they also have some knowledge of mathematics. The draftsman is closely allied with engineering, but is in the same category as the others mentioned above. Are they engineers? Tell me now, are men of this type qualified to receive as much or more than mechanics? What do you mean when you say "engineer"?

Aside from the technique of the profession, the engineer of the future, to be broadly successful, must be a master of what is called human engineering; he must have a knowledge of men and an appreciation of these conditions, sociological and economic, that have a bearing on the increased production and output of labor. It goes without saying that the cirricula of the colleges must be regulated accordingly.

Springfield, Mass. THOMAS P. MORRISSEY.

Draftsman's and Shoemaker's Salaries

Sir—As another instance of the comparative value of the highly trained technical man and uneducated skilled labor, I quote below advertisements from the official bulletin of examinations published by the State Civil Service Commission of Ohio, for examinations to be held Apr. 9, 1919:

"Architectural Draftsman—the Ohio Board of Administration; Professional and Scientific Service. Architectural group; Grade III. Salary $1500 per annum (fee $1).

"Duties—Incumbent of this position, the duties of which require the exercise of independent judgment, designs items of secondary importance under supervision of architect, develops the more important designs from rough sketches made by the architect, and exercises partial supervision over the work of a tracing clerk.

"Qualifications—(1) Such training as is evidenced by a degree of bachelor of architecture from a technical school of recognized standing, and (2) at least two years of practical experience in architectural work; or (3) at least three years of practical experience in architectural work of similar character will be accepted in lieu of a course in a technical school."

The second advertisement is as follows:

"Shoemaker—Ohio State Reformatory, the Ohio Board of Administration: Skilled Labor Service, Shoemaker Group; Grade I. Salary $1200-$1400 per annum (fee $1).

"Duties—The incumbent of this position, under supervision of the superintendent of shoe shop, assists in supervising inmates employed in the shoe factory; makes patterns for new styles, instructs inmates in the use of various machines, and keeps machines in repair.

"Qualifications—Not less than three years of practical experience in employment affording opportunity to become thoroughly familiar with modern methods and machinery used in manufacture of shoes."

C. H. MCGARRY,
Senior Civil Engineer, Bureau of Valuation, Interstate Commerce Commission.
Chattanooga, Tenn.

Why Not Higher Wages For Other Navy Engineers?

Sir—I have read with interest the letter of William F. Fox, the editor's comment, and the reply of the Secretary of the Navy in regard to readjustment of pay for Navy Department employees, in your issue of Mar. 27, p. 634. The scale of pay for draftsmen may be adjusted to their satisfaction, but for technical employees, who in my opinion are just as valuable as these draftsmen—and more valuable, in some cases—nothing has been done so far as these employees know.

Early in February, or perhaps in January, the Navy Department convened boards at all navy yards to revise the scale for technical employees, and the recommendations of these boards have been in the Secretary's office for weeks, while these employees are struggling along at rates of pay in many cases far below that paid to second-rate mechanics. The former receive the same scales that existed before the war.

The inspectors, to which class the writer belongs, are required to perform difficult and exacting survey work, often in marsh and water, engineering work that pertains to dredging, sea-wall and dock construction, besides supervising millions of dollars' worth of construction, making estimates and valuation, in most instances performing their own clerical work.

Is it fair that this class of trained men, many of whom have spent the best part of their lives in the service of the Government, should be treated this way?

J. M. LUSHBAUGH,
Paris Island, S. C. Inspector, United States Navy.

What Is Correct Interpretation of Overhaul Specification?

Sir—The following overhaul specification has been the subject of considerable contention between the engineer and contractor on a large highway project:

"The free haul on all materials incorporated into the work as a permanent part thereof shall be one mile from the points or locations designated by the engineer, from which such material may be obtained by the contractor for delivery and use upon the work. For each mile or fraction thereof in excess of the said one-mile free haul that the contractor shall be compelled to haul materials to the site at which they are to be used in the work, he shall be paid at the rate per ton-mile bid by him for such overhaul (the short ton of 2000 lb. shall be used). Payment for overhaul as above defined shall be the product of the actual number of tons of material incorporated in the completed structure by its distance in miles and fractions thereof less one mile, of its center of mass from the points of locations, designated by the engineer, as above defined."

Applying this to road-surfacing material, the contractor bids 25c. per ton-mile, and claims payment at that rate for each ton of material incorporated in every mile of work beyond the free haul. The engineer takes

the position that the above clause is merely a technical way of expressing "average haul," and that the contractor is not entitled to 25c. per ton-mile until the material has been actually hauled one mile.

Thus, in the first overhaul mile, for instance, assuming that 100 tons of material are incorporated therein, the contractor asserts there is due him, at the bid price mentioned, the sum of $25, while the engineer asserts that all the material has actually been hauled one-half mile, and the contractor is entitled to payment in the sum of $12.50.

Can readers of *Engineering News-Record* give us a frank interpretation of the above specification?

Forrest City, Ark. R. G. WILLIAMS.

Consistency Test for Concrete Used in Laboratory Practice

Sir—The article by H. A. Davis of the Emergency Fleet Corporation in your issue of Mar. 27, 1919, p. 603, calls attention to a distinct advance in field practice with reference to the control of the consistency of concrete. It may be of interest to note that this method has been in use for several years by a number of testing laboratories. The following quotation is from a set of recommendations prepared under date of November, 1914, by Subcommittee II of Committee C 9 on Concrete of the American Society for Testing Materials, of which the writer is chairman:

> There is no well-recognized standard for the consistency of concrete for use in test specimens. The following method for determining the proper consistency of concrete for laboratory tests will be found to give fairly reliable results: Mix a small batch of concrete sufficient to fill a 6 x 12-in. or 8 x 16-in. cylindrical form. Place in the form in the manner described below. As soon as the specimen is completed, remove the form entirely from the fresh concrete by a steady upward pull. Use care not to disturb the fresh concrete. The correct amount of water has been used when the specimen of fresh concrete shortens about ¼ in. for the 6 x 12-in., and ½ in. for the 8 x 16-in. cylinder upon removing the form.

This set of recommendations was drawn up in conference with Prof. M. O. Withey of the University of Wisconsin for the guidance of testing laboratories which were then coöperating with the committee in carrying out investigations of concrete. Certain revisions were subsequently made in these recommendations by the committee without making any essential change in the method for determining "normal" consistency of concrete.

It is the writer's belief that this method of consistency control was suggested as early as 1912, by Sanford E. Thompson, chairman of Committee C 9.

This "slump" test was described by the writer in the course of a discussion at the Conference on Concrete Road Building held in Chicago, February, 1916. (See *Proceedings*, p. 145.)

In our research work at Lewis Institute we now consider a "slump" of ½ to 1 in. in a 6 x 12-in. cylinder as normal consistency. This gives a more workable concrete than the smaller slump originally recommended, and is more representative of consistencies which can be used in placing concrete. It is found convenient to express other consistencies as percentages of the normal determined by the slump test.

The "slump" test can be made with entire satisfaction by placing a pair of handles or a bail on the metal cylinder form and lifting the form by a steady upward pull with the hands. This is the method contemplated in the original recommendations of Committee C 9.

This test is being incorporated in the revised specification for concrete-road construction by several of the midwestern state highway departments. The requirement is that the concrete shall show a slump of not more than, say, 2 in. for machine-tamped and finished roads, and not more than, say, 5 in. for hand-finished work.

In view of the predominant influence of the quantity of water on the strength and other properties of concrete, the control of the consistency of the mix becomes of prime importance in all work. It is a controlling factor which is generally neglected in tests of concrete carried out in the laboratory with a view to studying the relative merits of different materials, or varying the proportions or methods of concrete making.

D. A. ABRAMS,

Professor in Charge, Structural Materials Research Laboratory, Lewis Institute.

Chicago, Ill.

International Language for Modern Engineers

Sir—I, too, have read with interest the discussion upon "International Language for Modern Engineers," in your issues of Feb. 27, 1919, p. 442 and Mar. 27, 1919, p. 635. Why not adopt English as the international language? It is as expressive as any other and is used by more people than either Esperanto or French.

While French was the diplomatic language of the world, I understand that English has recently supplanted it in a large measure. H. S. MCKIBBEN.

Warren, Ohio.

Peculiar Railroad Section Identified

Sir—The rail section shown on p. 684 of your issue of Apr. 3, 1919, is a relic of about 1860, and is one of the never ending and never successful endeavors to eliminate the low joint and the consequent discomfort to the riders, and the high cost of rolling-stock maintenance.

A considerable amount of this rail was laid by the New York Central R.R. in the neighborhood of Rochester, N. Y., and possibly in other localities. It was not bolted together but riveted, the joint of one side being midway of the length of the other side. The interior ribs were to prevent the webs being drawn in by the riveting. It was smooth-riding, but its life was short.

Haddonfield, N. J. ALONZO G. COLLINS.

High Liability Insurance Rates

Based on total payroll, liability insurance rates in Wisconsin range from 3.9% to 8.95%, depending upon the character of the operation. On bridge construction of no unusual hazard as high as 10% has been charged. The losses in highway construction are very small. It is stated, for example, that on state road work from 1915 to 1917 aggregating several million dollars in cost, the total losses by accident were slightly over $5000. An excessive burden of cost for accident protection, it is considered, is thus being placed upon road construction, and the Wisconsin Highway Commission is to seek relief through legislation, to reduce the cost of liability insurance and surety bonds.

Hints for the Contractor

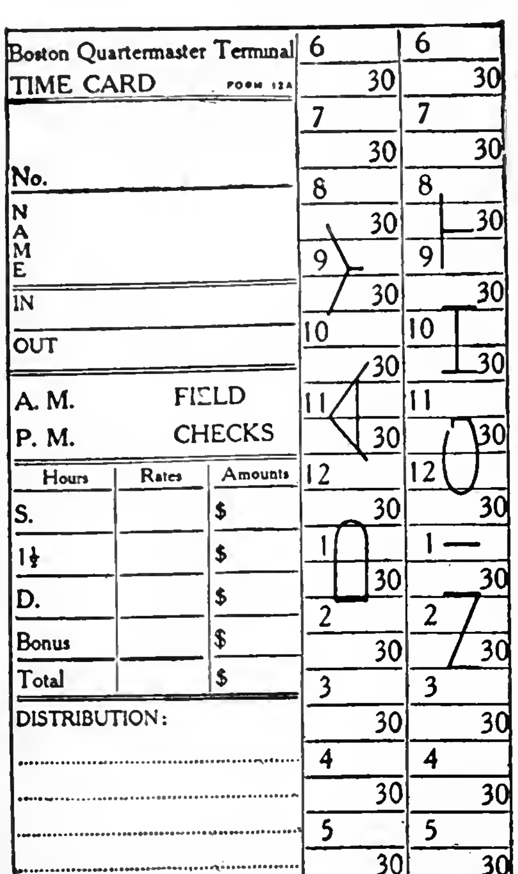
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Time Card As Complete Check On Workmen

COMPLETE daily records of the hundreds of workmen engaged in constructing the $28,000,000 Army supply base at Boston, Mass. (see *Engineering News-Record* of Sept. 19, 1918, p. 522), were kept by time cards. Each card when turned in at night carried records of time when received, time when work started, forenoon at-work check, afternoon at-work check, time when work stopped, and time when returned. By the number of the punch mark it was shown for which foremen the card holder worked and, therefore, the kind of work performed. Cards of six colors were employed, a different color for each working day of the week. The illustration represents the face of one of the cards; on the back are printed in English and Italian brief instructions to the workman.

Other Articles in This Issue of Interest to Contractors:

An exact routine was followed in recording time. After being hired the man was conducted to the Government button booth, where a serial number was assigned to him and a badge was given him. He was then conducted by a messenger to the time booth, where he received a time card and also a brass check bearing the same number as his badge. This brass check was used for getting tools. He was then conducted by the messenger to the foreman to whom he had been assigned.



TIME CARD CHECK FOR LOCATION OF WORKMAN SEVERAL TIMES DAILY

(Original size 3 x 5 in.)

Each morning the workman went to the time booth and received a time card, which was stamped by an electric time stamp, connected with the master clock. After receiving the card he went to the foreman to whom he had been assigned, and the foreman punched the time card at the time of starting work. Each foreman had a numbered punch, and should a man go to another foreman than the one to whom he had been assigned, the error was detected at once. The foreman kept the card until the man stopped work for the day, when he punched the time of stopping work. Should men be shifted to a new foreman or to a different section of the work, the time cards went with them to the new foreman. Each foreman punched the cards when the men left and when getting new men.

A time checker was assigned to a certain number of foremen and was responsible for all field work in connection with the time of these men. Once in the forenoon and once in the afternoon he located each workman by his badge and checked him on a time checker's report. He then went to the foreman and punched the card of each workman he had located. Each time checker had a different lettered punch. Should the foreman have cards of men whom the checker could not find the foreman was required to tell where they were working, and if the time checker found them he returned to the foreman and punched the cards. If he could not, the men received no time. On the afternoon check the timechecker inspected the foreman's reports, saw that every man carried by that foreman appeared on the foreman's report with the proper rate, hours and labor distribution, and, if necessary, he made the report out for the foreman.

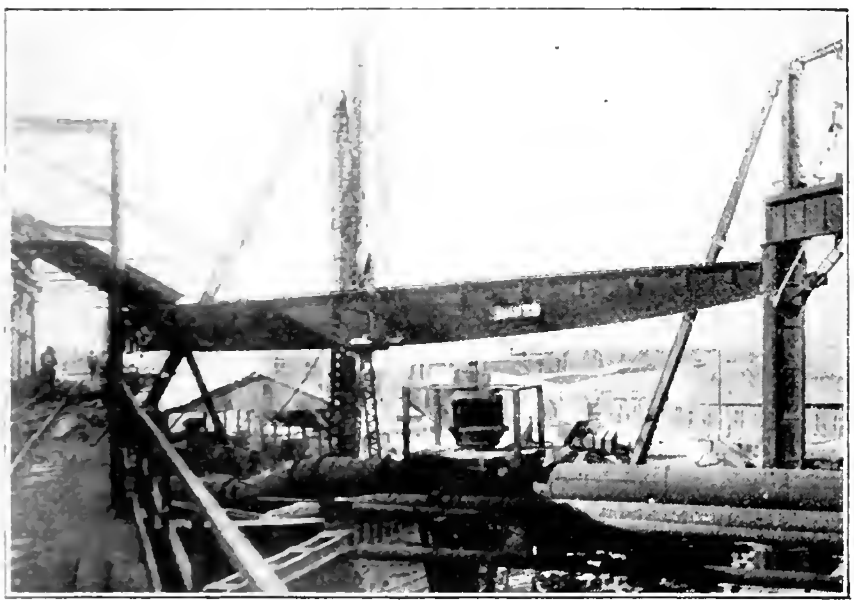
When finished working for the day, after the foreman had punched his card, the workman took his time card to the same booth from which he received it in the morning. The card was then put through the time stamp. Time was then computed, and the rate checked against the time checker's report and the foreman's daily report, and if all agreed the time was entered on the time checker's summary sheet. The cards were then turned over to the payroll department and entered on the roll. This timekeeping system was worked out by Maj. Charles R. Gow, constructing quartermaster. The W. F. Kearns Co., Boston, Mass., was the general contractor.

Derricks Tilt and Swing Long Girders Between Obstructions

FOUR 94-ft. girders were successfully passed over occupied tracks and threaded through intervening obstacles to a position 53 ft. above the ground in a converter building, by means of a crane and a derrick which repeatedly swung and tilted their load to find a clear way for hoisting. The girders weighed 37 tons each and were for bridge cranes. They had to be hoisted and set with their ends on the crane runways

of the building, which was erected over several tracks on which traffic must continue and over portions of a building which the new building was to replace. A straight hoist was nowhere possible, clearances were small, and sulphur from converters bothered the workmen. The procedure was as follows:

Each girder was received mounted in the usual manner on three flat-cars. When the time arrived for the erection of the girder it was blocked up and balanced on the middle car, and the end cars were switched aside. The girder was then run in through the first bay of the building as far as possible, while the operating tracks were still kept clear. Then a 25-ton locomotive crane, whose boom had been lengthened to 69 ft. by a 20-ft. extension, was headed up to the broadside of the



LOCOMOTIVE CRANE AND DERRICK PLACE BRIDGE CRANE GIRDERS

girder and a hitch taken so as to "telegraph" or swing the girder forward endwise until within reach of a derrick set inside the building. The derrick took a hitch well along the girder, as shown by the view, so as to support about two-thirds of its weight. The crane was then shifted to inside the building and hitched to the extreme end of the girder. Hoisting was then begun. The girder was raised horizontally by the derrick and crane until projecting parts of the old building were encountered, when it was necessary to boom right and left three times to clear the obstacles. Finally, to pass the 94-ft. girder between the runways, which were only 90 ft. apart, the derrick-supported end had to be tilted sharply upward. Good speed was made. In eight hours two girders were placed and a third girder was made ready for moving into the building.

The work was done for the Consolidated Kansas City Smelting and Refining Co. by the El Paso Bridge and Iron Co., El Paso, Tex., Henry E. Robertson, engineer of construction, acting as superintendent.

Blasting Mats Under Building Foundations

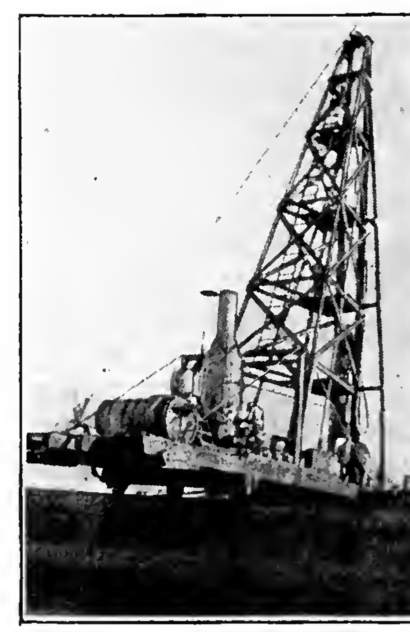
IN BUILDING the section of the Broad St. subway under the Philadelphia City Hall, one step in the work requires the use of temporary concrete mats which serve as mud sills for one end of needle beams. When the underpinning is completed, so that the needling may be removed, the first step after removal of the earth is to take out these mats. For a time they were removed with cold chisels and air hammers, but progress was so slow that the practice was adopted of putting in a half stick of dynamite and blowing them down. It is found that the effect of the charge extends a good deal beyond its immediate location, serving to loosen the mat over a large area, so that with slight hammering it can then be brought down with ease.

Part of the equipment for breaking up the mat after the charge has been fired is an air-driven cutting hammer, the barrel of which is so long that it can reach deep into confined spaces. It is a single-stroke machine, made by the Rivet Cutting Gun Co., of Cinncinati, Ohio.

The work at the Philadelphia City Hall is being done by the Keystone State Construction Co., with which is associated the Underpinning and Foundation Co., of New York City.

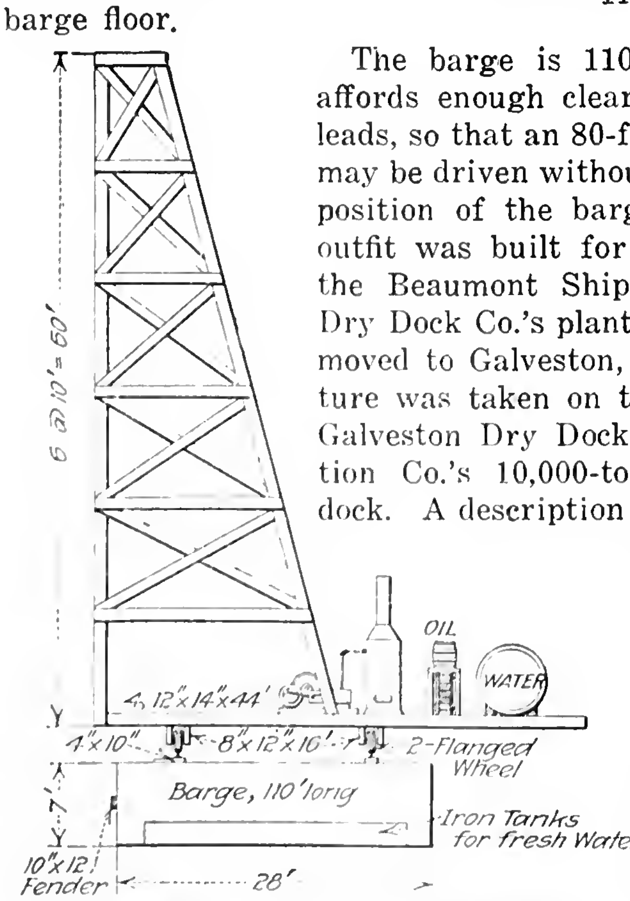
Wheels on Driver Save Many Moves of the Driver Barge

MAXIMUM speed in moving from pile to pile is gained in Capt. John Jacobson's driver-barge outfit by mounting the leads on a truck and placing the truck on a track which runs the length of the barge. A 9 x 10-in. two-drum double engine mounted on the truck is used as piledriver engine, as well as for the movement of the leads and of the barge. The boiler is also mounted on the truck. It burns fuel oil. According to Captain Jacobson, ample steam is produced with a single burner. A barrel behind the boiler and a tank at one end of the barge hold the fuel-oil supply. Steel tanks for a 10-day supply of fresh water for steam production are placed below the barge floor.



LEADS, ENGINE AND BOILER MOUNTED ON MOVEABLE TRUCK

The barge is 110 ft. long, and affords enough clear track for the leads, so that an 80-ft. row of piling may be driven without changing the position of the barge itself. The outfit was built for rush work on the Beaumont Ship Building and Dry Dock Co.'s plant, and was later moved to Galveston, where the picture was taken on the slip for the Galveston Dry Dock and Construction Co.'s 10,000-ton floating dry dock. A description of the building of this dry dock was published in *Engineering News-Record* of Mar. 20, 1919, p. 552, where many other details were described.



PILEDRIVER MOVES ON WHEELS

NEWS OF THE WEEK

New York, April 24, 1919

Predicts European Demand for Young Engineers

According to a letter recently received by A. D. Creer, consulting engineer of Vancouver, B. C., from a young engineer who had consulted the secretary of the Institution of Civil Engineers, Dr. J. H. T. Tudsbery, the latter is advising young men that within a year there will be a greater demand in Europe for engineers than ever before. This advice is considered significant, in view of Dr. Tudsbery's reputation for conservative statement.

No Labor Union for Roadmasters

The Roadmasters' and Maintenance of Way Association of America has issued a notice to railway maintenance engineers, roadmasters and supervisors of track, denying certain rumors that the association had affiliated with a labor union. The statement quotes a resolution adopted by the executive committee last November to the effect that the association cannot be identified with any labor organization without departing from the purposes for which it has stood for 36 years, and which are set forth in the charter of the association as follows: To meet and discuss matters pertaining to track and to raise the standard of work committed to the charge of its members.

Reconstruction Information Available

The United States Council of National Defense has announced that it has a great quantity of material on hand relating to the various problems which come under the general head of reconstruction, and that it will be glad to coöperate with business men who have problems along this line to solve. The reconstruction and research division of the council, 18th and D Sts., Washington, D. C., should be addressed for information.

Self-Propelled Steel Canal Barges To Be Built

The Division of Inland Waterways, United States Railroad Administration, has just let contracts for the construction of 20 self-propelled steel cargo barges for the New York State Barge Canal. Twelve of these barges are to be built by Terry & Tench, of New York City, at a price of $87,000 each. Four barges will be built by the Dravo Contracting Co., of Pittsburgh, at $87,000 each, and four by Starr & Bennett, of Newbern, N. C., at $83,500 each. The barges will carry 450 tons of cargo and will be capable of towing three 600-ton barges besides.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

The Federal director of the United States Employment Service in New York State announces the receipt of a letter from J. P. Morgan & Co., in which $100,000 is offered for the purpose of continuing the work of the service up to July 1 of this year. The Professional and Special Section in New York will therefore be continued, but will be located at the main office, 469 Fifth Ave., New York City.

Bids in for Cantonments

Bids submitted by various firms for the 13 Army cantonments offered for sale, as mentioned in *Engineering News-Record* of Mar. 27, 1919, p. 639, have been received by the War Department. The bids, in tabulated form, are given on p. 235 of the Construction News section of this issue.

W. B. Parsons Returning With Engineer Unit

Cable advices have been received from Col. William Barclay Parsons, Engineers, U. S. A., that Companies B and C, seven officers and 266 men, including Lieutenant Colonel Hudson, sailed for this country on the "Santa Theresa," and that the remaining companies, 49 officers and 696 men (including Colonel Parsons) sailed Apr. 15 on the transport "Chicago."

Iowa Water-Works Men Hold Spring Meeting

Depleted Well Supplies, Pollution of Them, Iron Removal, Hardness Limits, Uppermost Topics

Postponed from 1918 on account of the war, the annual meeting of the Iowa Section of the American Water-Works Association was held Apr. 16-17 in Iowa City. So interested in the state problems were the thirty participants that they intend to meet again in October. Serious shortages and growing pollution of the well supply, forcing cities to surface sources, problems arising from extreme hardness and iron, treatment, distribution, costs and the financial outlook, all taken up from the local standpoint, gave ample evidence of the value of the formation of the section.

As heavier drafts have been made on many well supplies of the cities of the state the ground water has receded to an alarming extent. This is particularly true in the southwestern section. Lafayette Higgins' paper on "Future Public Supplies" gave valuable information on this point, on the excessive cost of deep-well pumping and treatment—that is, if treatment can be effected at all. Many supplies have a mineral content, near or about 1100 ppm., which he considered the upper limit beyond which it is unfit for use even after treatment. He divided the state into three general areas. In the inland portion, drill or tubular wells are the only possible future source. Cities located on the streams must eventually use them, for few of the valleys contain gravel beds sufficiently free from silt to collect the water by wells or galleries. Impounded water will be the only logical course for many cities, and luckily they are located in that area of the state having the greatest rainfall and at least a 50% run-off.

Discussing pollution, Miss Zelma Zentmire, water analyst for the State Board of Health, indicated that for the 18-month period beginning July, 1917, more than 50% of the public shallow wells examined are unsafe and that only 75% of deep wells are acceptable. Of the private wells 75% of the shallow wells examined are bad, as are 33% of the deep wells. On the other hand 95% of the treated supplies examined are good.

An iron-removal plant at the Iowa State College consisting of a dripping aërator, sedimentation and rapid filter reduces the iron content from shallow wells in a creek bed from 8 to 0.07

(*Concluded on page 842*)

Greater Winnipeg Water-Supply in Service

Concrete Aqueduct 96.3 Miles Long Will Carry Soft Water to District of 92 Square Miles Area

Despite the war, the new gravity water-supply for the Winnipeg Water District, work on which was begun in 1913, became available between Mar. 28 and Apr. 5. It was doubly welcome, writes W. G. Chace, chief engineer of the district, because the previous artesian supply, obtained by pumping, had a hardness of nearly 500 ppm., compared with about 40 for the new supply. The source is Indian Bay, on Shoal Lake, an arm of the Lake of the Woods. Except for a few Indians, the drainage area is uninhabited.

The aqueduct is 96.3 miles long and has a total fall of 294 ft. For the easterly or upper 84.62 miles it has a daily capacity of 120,000,000 U. S. gal. At this point there will ultimately be built a reservoir with a capacity of 300,000,000 U. S. gal. From here 11.7 miles of pressure conduit, with a daily capacity of 75,000,000 U. S. gal., have been built and will be duplicated in the future.

Of the entire length of aqueduct, 77.5 miles are of open-flow section and 18.8 miles are of reinforced-concrete under pressure, with heads up to 90 ft. Beneath the Red River there is a tunnel 1800 ft. long, lined with 60-in. cast-iron pipe.

The Greater Winnipeg Water District includes the Cities of Winnipeg and St. Boniface, the town of Transcona and parts of St. Vital, Fort Garry, Assiniboia, East and West Kildonan, and has an area of about 92 square miles. The water debt is a lien on the works and the lands in the district. The capital charges are paid by taxes on the lands alone. Operating and maintenance charges are to be met by the municipalities supplied.

The water-supply project was based on a report made by Rudolph Hering, Frederic P. Stearns and James H. Fuertes. The latter has been consulting engineer for the district throughout. W. G. Chace is chief engineer. M. V. Sauer was originally chief of design. He was succeeded by James Hyslop.

Most of the work was done by local contractors. The largest contract, for the easterly 47.4 miles, was held by the Winnipeg Aqueduct Co., composed of Messrs. Carter, Halls and Aldinger, and the Northern Construction Co., and having William Smail as superintendent. This contractor, jointly with the Canada Lock Joint Co., also built 9.3 miles of 5½-ft. reinforced-concrete pipe. J. C. Mitchell was superintendent of the pipe company.

For a British Ministry of Health

Provision is made for a British Ministry of Health in a bill now before Parliament. It would include the present Local Government Board, with a new name and additional powers. Later some of the powers of the ministry would be transferred, including such matters as public libraries, the regulation of whistles, heavy locomotives and motor cars on highways, old-age pensions, and local elections.

Americanization Conference Program

The program for the conference of Americanization specialists and workers to be held in Washington, May 12-15, inclusive, under the auspices of the Interior Department, has been divided into four sections, each day having a special topic, as announced by the Americanization division of the Bureau of Education. Monday will be educational day, Tuesday will be given over to a consideration of Americanization in the industries, Wednesday to addresses on racial relationships and Thursday to the social aspects of the Americanization movement. Franklin K. Lane, secretary of the interior, will speak at a banquet to be held Wednesday evening.

War Material Is Available for Highway Work

The Bureau of Public Roads of the Department of Agriculture has received from the War Department an inventory of available tractors and a tentative inventory of trucks, as the first step in carrying out the law, enacted at the last session of Congress, authorizing the Secretary of War "to transfer to the Secretary of Agriculture all available war material, equipment and supplies not needed for the purposes of the War Department, but suitable for use in the improvement of highways." There is every indication that the War Department will coöperate with the Department of Agriculture in the disposal of surplus stocks, and it is expected that inventories of all materials will be completed within the next two weeks and submitted to the Secretary of Agriculture, so that he may decide what use to make of them in the construction of highways.

Some of the materials and equipment which could be used to advantage in road building has been enumerated as follows:

Machine Tools, Engineering and Construction Equipment—All metal and wood-working tools; steam shovels; hand tools; forging equipment; iron and structural workers' power tools and machinery; contractors' equipment, such as dredges, ditchers, concrete mixers; industrial railways, etc.

Trucks and Motor Equipment—Trucks; trailers; animal- and hand-drawn vehicles; passenger automobiles.

General Supplies—Tentage, paulins, harness, saddlery, saddlers' supplies; shelf and heavy hardware; tools, handles, tool chests, containers; mess, camp and kitchen equipment; hemp and jute products; brooms and brushes.

Remount—Horses and mules.

Raw and Scrap Materials—Explosives.

Ordnance and Ordnance Stores—Tractors and trailers, caterpillars.

New York State Highway Department Is Reorganized

Under the new highway commissioner, Frederick Stuart Greene, whose appointment was noted in *Engineering News-Record* of Apr. 17, 1919, p. 792, the main office force of the New York State Highway Department has been reorganized. The following changes have been made in personnel:

As first deputy commissioner, Paul Schultze, of Albany, succeeds H. Eltinge Breed, resigned; as second deputy commissioner, Irving V. A. Huie, of New York City, succeeds F. W. Sarr, resigned; as third deputy commissioner, Charles Van Amburgh, of Broome County, succeeds Benjamin Rice, resigned, and as secretary of the commission, Royal K. Fuller succeeds Irving J. Morris, resigned.

Mr. Schultze, the new first deputy, has had extensive experience in highway construction. He was second deputy commissioner from 1913 to 1915. Upon graduation from the Rensselaer Polytechnic Institute in 1891, he entered the New York State Engineer's department as assistant engineer in charge of bridges and roads, remaining until 1900. From 1900 to 1908 he was city engineer and superintendent of public works in the City of Utica, N. Y.; from 1908 to 1912, county superintendent of highways of Oneida County; from 1912 to 1913, city engineer of Troy, N. Y. Since 1915 he has been a consulting highway engineer and contractor in Albany, N. Y., and during the war was superintendent of roads at the Jacksonville Powder Works in Tennessee, and built the roads at the du Pont Powder Works at Carney's Point and Deepwater, N. J. As first deputy he will have charge of all new highway construction work of the department.

Mr. Huie, who will be second deputy in charge of maintenance, is a graduate in civil engineering at New York University, 1911. Upon graduation he entered the office of F. A. Molitor, consulting engineer, New York City, where he remained until 1916, becoming principal assistant engineer to Mr. Molitor on railway location and valuation work, both in this country and Brazil. Early in the war he was commissioned first lieutenant in Company B of the 1st Regiment of Engineers, and during the war he was advanced to the rank of major of engineers.

Mr. Van Amburgh, the third deputy, who will have supervision of all work on town highways, has been county engineer of Broome County. The new secretary, Mr. Fuller, has served several terms as secretary.

Ontario Highways Act Passed

The Ontario legislature has passed the highways act introduced by the Government, appropriating $5,000,000 for highway construction and maintenance. The Hon. F. G. MacDiarmid, minister of public works, stated that the Government highway program includes the building of a provincial highway

from Toronto to Windsor, of which probably 200 miles will be of concrete, 175 miles of macadam, and the remainder of gravel. The work will take several years. In addition, the appropriation includes about $1,800,000, to be paid to the counties for the improvement of county road systems. There are 37 counties under this scheme, the average expenditure of each being $100,000 annually. The province will provide 40% of this outlay.

Recommend Large Pier at Portland, Me.

In the report of the State Harbor Commission of the State of Maine for the calendar year 1918, there is a report prepared by the firm of Fay, Spofford & Thorndike, of Boston, on the advisability of building a public pier at Portland, Me. As a result of the investigation the commission recommends to the legislature that the state construct a pier in tidewater at Portland at the site selected and recommended by the engineers, the pier, freight sheds and railroad connections to be built, controlled and operated by a harbor board, which should be appointed by the Governor and council.

Furthermore, it recommends that the state legislature authorize the issue of $1,150,000 bonds to take care of the improvements. The engineers' report points out the strategical position of Portland as a port and the present lack of modern pier facilities there. The engineers do not specify the pier design in detail, but indicate enough of its general construction to show what the layout will be. It is expected that the legislature will provide for the structure.

Dwelling-House Plans of Housing Corporation Available

Plans for dwellings, prepared by the United States Housing Corporation for building homes in congested industrial centers during the war, are to be made available for general public use. The Department of Labor announced that types of homes would be given to "own-your-own-home" committees, promoting building activities in cities.

In the department's effort to expand the home-ownership campaign, letters were sent to municipal officials, labor leaders and club organizations in many cities, urging local campaigns.

Working Conditions Service

To assist industrial establishments in securing and maintaining the health, safety and good government of their workers, the United States Department of Labor has formed a Working Conditions Service, in three divisions: (1) Industrial hygiene and medicine, with personnel detailed from the United States Public Health Service; (2) labor administration; (3) safety engineering. Details are given in a pamphlet obtainable from Grant Hamilton, director general of the United States Department of Labor, Working Conditions Service, Washington, D. C.

British Government Plans Department of Transportation

The British Government has for some time been planning to establish a separate Government department to deal with all matters of transportation, and a bill for that purpose is now pending in Parliament. The new department is to be called the Ministry of Ways and Communications and is to take over the powers of supervision over railways and other transportation utilities, which have long been exercised by the Board of Trade. So long as the railways continue under direct Government management, as has been the case since Great Britain entered the war, this authority also is vested in the Minister of Ways and Communications. Besides the railways, the minister receives authority over the street railways, canals and other inland waterways, docks, piers, roads, bridges, ferries and the supply of electricity. The bill empowers the minister to fix all rates and charges and the wages of labor on all utilities under his charge. While there has been no official decision as to whether the Government will take over permanently the railway lines of the country, the bill in Parliament gives the minister authority to purchase any utility under his charge outright at a price fixed by agreement or by condemnation proceedings.

Great economies have been effected in the operation of British railways since the establishment of Government control, through the consolidation of facilities and the cutting down of train service. Notwithstanding these economies, the increases in wages to railway employees have so increased the operating expenses that the estimates submitted to Parliament indicate a probable deficit of some $300,000,000 on this year's operations.

It is said that the first head of the new Government department will be Sir Eric Geddes. Sir Eric spent his early business life in the United States, where he was engaged in the lumber business in the South. Later he was connected with the Baltimore & Ohio R.R. and then became manager of the Northeastern Ry. of England, and in 1916-17 was director general of military railways and inspector general of transportation.

Iowa Engineers Must Register

Engineers and land surveyors in Iowa must be examined and registered by a State Board of Engineering Examiners, according to a bill which has passed both houses of the General Assembly. The bill provides for the appointment by the Governor of an examining board of five members, who will conduct examinations and issue certificates to persons qualified to practice professional engineering or land surveying. The expenses of this board are to be paid from the examination and registration fees. Severe penalties are provided for illegal practice, and the board has authority to revoke a certificate for fraud or incompetency. All plans, specifications and reports must be stamped with the official seal of a registered engineer

Engineers and surveyors who have practiced for two years or more in Iowa may be registered without examination at any time within six months after the act takes effect. The act does not apply to full-time employees of a corporation doing work solely for that corporation; or to existing contracts; or to United States Government employees; or to assistants to registered engineers and surveyors; or to the operation of mechanical plants; or to the construction of works of a strictly private nature, such as farm drainage; or to the subdivision of land where no controversy is involved.

Pearl Harbor Dry Dock Finally Completed

The United States naval dry dock at Pearl Harbor, near Honolulu, was unwatered for the first time Apr. 11, and found free from leaks. It is expected that the dock will be ready for service by July 1. It is designed for the largest vessels, being 1040 ft. long by 148 ft. wide.

The first attempt to build this dry dock failed and the plans were abandoned, as a result of foundation failure that occurred as the site was being unwatered for the first time. Under the revised plans, according to which the dock has been built, the concrete structure was cast in 16 sections, which were floated to place, as described in *Engineering News-Record* of July 25, 1918, p. 173.

Weights and Measures Convention

A conference of weights and measures officials is to be held at the Bureau of Standards, Washington, May 21-24. The last such conference occurred in 1916, and many questions are pending which the coming conference is to consider. In the 14 years since the movement was initiated, much progress has been made in bringing about uniformity in state legislation concerning weights and measures, and in improving the methods of inspection. S. W. Stratton, director of the Bureau of Standards, is president of the annual conference, and L. A. Fischer of the bureau is secretary.

Plan Reunion of "Eighty-Niners"

Plans have been made for a reunion dinner to be held in New York City about May 27, at which it is hoped that all the survivors of a party of American engineers, belonging to the four national engineering societies, who sailed for Europe 30 years ago to visit England and the Paris Exposition of 1889, may be present, with members of their families.

It is requested that anyone who was of that party communicate with the secretary of the committee, Jesse M. Smith, Engineers' Club, 32 W. 40th St., New York City.

Iowa Water-Works Association Holds Spring Meeting

(*Concluded from page 839*)

ppm. C. S. Nichols described the installation and operating experiences, indicating that no difficulties with crenothrix had arisen and that the operating cost was $6.10 per million gallons.

The latest improvements to the Des Moines galleries in the way of an irrigation and ponding system were described by A. T. Luce, the newly appointed chief engineer of the Des Moines Water Company.

An example of the high cost of deep-well pumping was given in detail for Grinnell by Dean W. G. Raymond, a member of the State Board of Conciliation, to which the Iowa Light, Heat and Power Co. has appealed for adjudication of the water-pumping costs to which the city objected as being too high. The charge was 22c. per 1000 gal. and 15.2c. was found, on expert examination, to be the actual total cost with all interest and depreciation percentages added. Settlement was made on this basis.

Waterloo Kept Water-Main Construction Costs Low

Water-main construction costs in Waterloo for the past four years were given by W. A. Judd, the 1918 pipe-laying figure being kept consistently low by retaining the former dependable emergency gang.

C. R. Henderson, manager of the Davenport Water Co., is opposed to laying mains in alleys. His paper on the subject was in effect an argument by which he converted the city officials to his viewpoint. No room, impaired service due to alleys not being continuous, and none at all in one direction, were his chief points.

Thomas Healey, also of the Davenport Water Co., described experiences, all favorable, with metalium as a substitute for lead as a pipe-jointing material. Other uses, such as packing behind bands on cracked pipe and as a substitute for grouting under engine foundations, were noted by H. V. Knouse, of the Metropolitan Water District, Omaha.

He also described the monolithic reinforced-concrete lining of several reservoirs in Omaha since 1914. The fact that every operation in the construction was carried on with labor under direct control of the designer seemed to be a large factor in the success with which the work was prosecuted. The service has been entirely up to the expectations of the designers.

Advocates Formula for Loss of Head in Clean Pipes

S. L. Etnyre, superintendent of the Council Bluffs water-works, is of the opinion that the parent association should adopt a single basic formula for the less of head in clean pipes. In his paper were noted experiments on long stretches of new pipe 6, 8, 10 and 16 in. in diameter. Only one of the 10 formulas generally available checked with his results.

The officers elected for 1919 are as follows: Chairman, W. A. Judd; vice-chairman, G. E. Shoemaker; directors, H. V. Knouse and W. A. Hostetler. J. H. Dunlap is the acting secretary during the absence of Lieut. J. J. Hinman in France.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, $1200-$1440 per year, May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District, $1501 to $2100 per year. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

Philippines.—Wireless engineer, Bureau of Posts, Philippine Government, $3000 per year, June 10. Apply for form B. I. A. 2, to be filed before June 10, filled in by medical officer in the service of the United States.

Tennessee.—Assistant highway engineer, $1800 to $2100 per year, May 7, at Nashville. File applications as soon as possible.

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States.—Expert patent investigator, $1800 to $2400 per year, and technical patent expert, $2400 to $3600 per year, May 20.

United States.—Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

United States.—Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

United States.—Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

United States.—Scientific assistant in public health work, Public Health Service, $1500-$2500 per year, June 3. Apply for form 2118, to be filed before June 3.

United States.—Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File applications before June 10.

United States.—Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

United States.—Junior recreational engineer, Forest Service, Denver, Colo., $1800 to $2400 per year, May 6. Apply for Form 2118.

United States.—Statistician, Department of Interior, $1800 per year, May 13. Apply for Form 2118.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

The Engineering Society of Western Massachusetts was formed at a meeting held in Springfield Apr. 16. The meeting was addressed by William Spencer Murray, consulting engineer, New York City, Dr. George Otis Smith, director of the United States Geological Survey, and Prof. L. P. Brackenridge, of Yale University.

The Cincinnati Chapter of the American Association of Engineers recently elected the following officers: President, E. K. Ruth; vice-president, G. E. Halstead; secretary, L. P. Kimball; treasurer, Charles S. Carroll. The matter of proposed license laws for engineers was discussed, and a committee was appointed to make a report at the next meeting, to be held Apr. 30. The chapter will be formally installed May. 24.

The Southern California Association of Members of the American Society of Civil Engineers was addressed by Robert A. Cummings, consulting engineer of Pittsburgh, and member of the Committee on Development, at a meeting held Apr. 9. Frederick C. Noble, consulting engineer, New York City, also a member of the Committee on Devel-

opment, spoke on the work of the committee. The meeting was also addressed by Dr. Ford A. Carpenter, United States meteorologist, who spoke on "Precipitation in Southern California," and by F. C. Ebert, hydrographer, United States Geological Survey, on "Flood Run-Off." The committee on reconstruction and development presented its report to the meeting.

The Portland (Ore.) Chapter of the American Association of Engineers, in process of formation, has elected the following officers: W. H. Marsh, president; R. W. Barnes, principal assistant engineer, Southern Pacific Co., secretary-treasurer.

The Engineers' and Architects' Club of Louisville, Ky., held a meeting Apr. 15, which was addressed by Alfred Pirtle, who spoke on "Railroad Reminiscences," including a review of the history of local railroads, beginning in 1843. Several reels of motion pictures, furnished to the club by the War Department, illustrating engineering work in the Army, were shown.

The Scranton (Penn.) Engineers' Club held a meeting Apr. 17, at which Maj. L. S. Doten, U. S. A., spoke on sewage-disposal plants in the United States Army cantonments.

The Topeka (Kans.) Engineers' Club made a trip of inspection to the city water-works, Apr. 5, as the guests of Wilbur Stanfield, newly elected water commissioner, and Jesse Shaw, superintendent of the plant.

The Albany Society of Civil Engineers was addressed Apr. 22 by J. Loewenstein, assistant engineer, American Bridge Co., who read a paper, illustrated with motion pictures and lantern slides, on "The Hell Gate Bridge."

The Louisiana Engineering Society was addressed Apr. 14 by Maj. W. B. Gregory, U. S. A., on "Pumping Machinery Used by the American Army in France."

Personal Notes

MAJ. MAX C. TYLER, Corps of Engineers, U. S. A., has been assigned to duty in charge of the District of Columbia water-supply system, the reclamation of the Anacostia River and the improvement of the Potomac River, succeeding Col. W. L. Fisk, U. S. A., retired. Major Tyler had been in command of the 212th Engineers, which was reorganized at Camp Devens, Massachusetts, with the rank of colonel for the period of the war.

LIEUT. THORNDIKE SAVILLE, U. S. A., who was stationed at Langley Field, Hampton, Va., in charge of the installation of the water-works and sewage-disposal plants, has received his discharge from the service and has become associate professor of sanitary engineering, University of North Carolina.

LIEUT. PATRICK J. SLATTERY, Air Service, American Expeditionary Forces, has just received his discharge from the service and has become associated with RAYMOND J. VAN WAGNER and ANTHONY J. DAINO, both formerly assistant engineers on subway construction, New York City, under the firm name of the Slattery Engineering & Construction Co., Inc., engineers and contractors E. 42nd St., New York City.

H. A. DIXON, division engineer, Canadian Northern Railway System, Vancouver, B. C., has been appointed chief engineer, Canadian National Railway System, Western Lines, succeeding Allen T. Fraser, whose death was noted in *Engineering News-Record* of Apr. 10, 1919, p. 747.

LOUIS JALOVEC, electrical engineer and designer of X-ray apparatus, Chicago, has been appointed assistant to the United States Foreign Trade Commissioner to Czechoslovakia. He will be stationed in Prague, Bohemia, and will furnish particularly information in regard to markets, although inquiries for data of any kind about the country will receive attention.

CAPT. ROLAND TONER, Construction Division, U. S. A., who recently received his discharge from the service, has been placed in charge of the construction of buildings in Eastern Canada for the Allen Theatre Enterprises of Toronto, Ont.

ROSS J. BUCK, contracting engineer, has been appointed assistant engineer for the Board of Sanitary Commissioners, Indianapolis Sanitary District. From 1907 to 1914 Mr. Buck served in Government engineering work in the Philippines, and after his return to this country entered the general contracting business.

WILLIAM E. PETTY, who was chief draftsman for Division No. 3, New York State Highway Department, until he entered the Federal Government service several months ago to build the roads in Camp Eustis, Virginia, has been appointed confidential agent for the highway department, with office at Albany, N. Y.

CAPT. E. J. BURKE, Engineers, U. S. A., and, after his discharge examiner for the United States Employment Service, has been selected as manager of the Chicago Chapter of the American Association of Engineers. After leaving the University of Illinois in 1913 he was assistant engineer on track-elevation work for the Chicago, Rock Island & Pacific Ry., and later was employed on drainage work in Tennessee.

CAPT. B. C. BRENNAN, U. S. A., who recently received his discharge from the service, has resumed his position as city engineer of Kenosha, Wis., succeeding P. J. HURTGEN, who acted as city engineer in his absence, and who now becomes commissioner of public works.

SIDNEY B. BOWNE has received his discharge as assistant sanitary engineer, United States Public Health Service, and has resumed his position as secretary-treasurer of the W. E. Sexton Co., Inc., engineering contractors, Mineola, N. Y. He has been appointed village engineer of Mineola for the coming year.

LEWIS R. ASH, whose resignation as city manager of Wichita, Kans., was noted in *Engineering News-Record* of Apr. 3, 1919, p. 693, has again been retained as city manager of Wichita. He is a member of the firm of Harrington, Howard & Ash, consulting engineers, Kansas City. For several years he was city engineer of Kansas City.

CAPT. FRANK L. BOLTON, Engineers, U. S. A., has received his discharge from the service and has returned to the firm of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn., as resident engineer in charge of the Mill Creek flood-control project, as well as the work of the firm in western New York, western Pennsylvania and Ohio.

P. F. STARY, highway engineer, Pine County, Minnesota, has resigned to become county highway engineer at Fargo, N. D., succeeding Eric Martinson, who resigned to engage in highway contracting.

MAJ. WALTER B. ELCOCK, U. S. A., has received his discharge from the service and has returned to his former work as district engineer in charge of the Atlanta, Ga., office of the Portland Cement Association.

JOHN A. WALLACE, who has been associated with the New York State Highway Department since 1907, and was recently stationed at Jamestown, has been appointed highway engineer for the Federal Bureau of Public Roads, with headquarters at Montgomery, Ala.

CAPT. HOWARD H. GEORGE, Engineers, American Expeditionary Forces, who recently returned from France and received his discharge from the service, has resumed his former work as assistant engineer, Public Service Railway Co., Newark, N. J. Captain George served as engineer-officer

in charge of building construction of the storage depot at Montierchaume and was afterward transferred for duty with the base section engineer at Havre.

CAPT. T. E. SEELYE, of the firm of Gannett, Seelye & Fleming, who has been overseas with the 105th Engineers, has been assigned for special duty in France as instructor in advanced hydraulics at the American University, France.

CAPT. W. WATTERS PAGON, Construction Division, U. S. A., who recently received his discharge from the service, has opened offices as a consulting engineer in the Lexington Building, Baltimore.

LOUIS J. SNYDER and J. L. LANGTHORN have become associated under the firm name of the Langthorn Co., Inc., to conduct a general engineering and contracting business, with offices at 2 W. 45th St., New York City.

S. H. LEA, who formerly was engaged in construction work for the Government at the Langley Aviation Field, has been appointed road engineer for Mineral County, West Virginia, with headquarters at Keyser.

ALLEN H. STUBBS, formerly of the civil engineering department of the University of Nebraska, has been appointed manager of the Kansas City office of Hedrick & Hedrick, bridge engineers.

J. C. ALLISON and PAUL M. ENTENMANN have become associated under the firm name of Allison & Entenmann, consulting engineers, with offices in Los Angeles and Calexico, Calif.

ROY THOMAS, previously engineer of Gila County, Arizona, has been appointed city engineer of Miami, Ariz., and will have special charge of flood-control work which has just been undertaken.

W. HOWARD CORDDRY, who recently returned from overseas, has received his discharge from the service and has returned to his work with the firm of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn.

VIRGIL P. KNOTT, associate professor of civil engineering, Arkansas State University, has been elected state highway engineer, succeeding Hugh Carter, resigned.

CAPT D. A. TOMLINSON, instructor in the Coast Artillery at Fort Monroe before his discharge from the Army, has been made assistant secretary of the American Association of Engineers. He has charge of the railroad work, and will aid in the service clearing house department. He was until recently manager of the central zone of the United States Employment Service. Captain Tomlinson saw service on the Mexican border in 1916, previous to that having been valuation engineer on the Chicago & Western Indiana Railroad.

ALAN CORSON has been appointed superintendent of Fairmount Park, Philadelphia, succeeding Jesse T. Vogdes, whose death was noted in *Engineering News-Record* of Mar. 27, 1919, p. 644.

ROGER W. HARMAN, 204th Engineers, U. S. A., who recently received his discharge from the service, has returned to his former position with Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Penn.

HALE D. JUDSON has resigned as city engineer of St. Joseph, Mo., to enter the State Highway Engineering Department.

H. MARCUS, who served with the Bureau of Yards and Docks during the war, has returned to his duties with the Marcus Contracting Co., New York City.

R. W. WATERMAN, hydraulic and irrigation engineer of Los Angeles and Blythe, Calif., has removed to Fresno.

F. A. TROSKEL has been appointed city engineer of Marquette, Mich.

OBITUARY

JOHN T. DICKERSON, general manager of the Strauss Bascule Bridge Co., Chicago, died in that city Apr. 14. He was born in 1878 and was a graduate in civil engineering of Rose Polytechnic Institute in the class of 1902. For the past seven years he was identified with the Strauss Bascule Bridge Co. Prior to that time he was assistant engineer and general sales engineer with the Scherzer Rolling Lift Bridge Co., of Chicago, and before that he was in the bridge departments of the Chicago, Burlington & Quincy and the Chicago, Rock Island & Pacific R.R. companies and the American Bridge Company.

CHARLES BRINKERHOFF RICHARDS, scientist and inventor of the Richards steam engine indicator, and for 25 years Higgins professor of mechanical engineering at Yale, died in New Haven, Apr. 20, in his 86th year. During the Civil War he was consulting engineer and assistant superintendent at the Colt's Arms factory at Hartford. Later he served as superintendent of the Southward Foundry & Machine Co., of Philadelphia, before he was called to the Sheffield Scientific School. In recognition of his invention of the steam engine indicator, he was decorated with the Legion of Honor of France. He was consulting engineer for the state capitol at Hartford and other large buildings.

GEORGE FERDINAND BECKER, geologist and mining engineer, who had been connected with the United States Geological Survey since 1879, died in Washington, D. C., Apr. 20, at the age of 72. He was a graduate of Harvard University, received the degree of doctor of philosophy from Heidelberg University, and in 1871 was graduated from the Royal School of Mines in Berlin. For four years he served as instructor in mining and metallurgy in the University of California, from which he went to the United States Geological Survey. At the time of the Spanish-American War Dr. Becker was detailed to serve as geologist on the staff of General Bell with the Army in the Philippines.

CHARLES E. CHENEY, former county surveyor of Marion County, Indiana, died in Indianapolis Apr. 14. He was 45 years old. He was a graduate of Purdue University in the class of 1897, and soon after his graduation was appointed city engineer of Frankfort, Ind.

J. A. STAMPS, chief engineer of the Atlanta water-works, died in that city Apr. 5. He had been connected with the water-works department for 36 years.

JOSEPH E. JOHNSON, JR., consulting engineer, New York City, whose death on Apr. 4, 1919, was noted in *Engineering News-Record* of Apr. 10, 1919, p. 747, was born in 1870 and was graduated from Haverford College in 1888, receiving the degree of mechanical engineer in 1891. He entered engineering work as a draftsman in the Baldwin locomotive works, Philadelphia, and was afterwards engaged with the Straight Line Engine Co. and the Cranberry Iron & Steel Co. He later entered the service of the Carnegie Steel Co., in the blast-furnace department, and afterward became general manager of the Princess Furnace Co. In 1909 and 1910 he was general superintendent for the Republic Iron & Steel Co., operating three blast furnaces and 900 coke ovens. From 1901 to 1913 he was manager of the Ashland plant of the Lake Superior Iron & Chemical Co., Ashland, Wis. In 1913 he opened an office as a consulting engineer in New York City to engage in private practice. Besides being a generous contributor to the technical press, he was the author of treatises on "Blast-Furnace Construction in America," followed by "The Principles, Operation and Products of the Blast Furnace." Outstanding features of his work were his theory of the constitution of cast iron and his theory of the critical temperature of the blast furnace.

Portable Pumping Plant for General Municipal Use

A portable pumping plant and catch-basin cleaner that can be used for a great variety of municipal uses has been put on the market by the Springfield Engineering Co., of Springfield, Ohio. It consists in the main of a pumping outfit and a 6-cu.yd. tank, the whole mounted on a standard Kelly-Springfield five-ton chassis. It may be used for cleaning out catch-basins, spraying trees and shrubbery, spraying paint, and for garbage removal.

The pumping unit consists of a centrifugal pump running at 1900 revolutions per minute, driven by a silent chain direct from the drive shaft of the truck. Catch-basin cleaning is accomplished through the injector principle; that is, the material removed from the catch-basin does not pass through the pump, but the necessary lift is created by means of an injector. The vacuum thus produced is about 26 in. When the apparatus is used in this way, the procedure is to fill the tank half full of clear water, the pump then using the tank as a suction well. The tank itself is fitted with a ¼-in. screen behind which the water carrying the solids is deposited. The screen is cleaned by a jet under pressure, through a bypass from the pump. So successfully have the cleaning device and the general arrangement of the discharge pipe in the tank worked that it is possible to get from 4 to 4½ cu.yd. of solids in the tank on the completion of the operation. The lid of the tank can be screwed down tight, so there is no slopping of liquid into the street. When the tank is filled the truck can run to the dumping ground, and the body is then tilted by means of a hydraulic hoist, the tail of the tank being hinged so that no shoveling is necessary. The tail end is fitted with a gasket so that there is no leakage during pumping operations.

For spraying purposes the spray material or paint is put in the tank, and passes directly through the pump,

PORTABLLE PUMPING PLANT CLEANING CATCH-BASINS

the pressure at the jets under these conditions being from 100 to 105 lb. per square inch.

By removing the screen in the tank the body can be used for garbage or ash removal.

The machine described above is listed as the G-1. The G-2 machine is the same, except that there is in addition a pressure tank on top of the pump, and the truck is fitted with four flushing and two sprinkler heads, so that the machine can be used for street flushing and sprinkling.

Federal Trade Commission Loses Its Chief Counsel

Announcement is made by the Federal Trade Commission that its chief counsel, John Walsh of Wisconsin, has resigned to resume the private practice of law in Washington. His resignation was accepted, to take effect Apr. 15.

Business News

The Chicago Pneumatic Tool Co. has moved its Milwaukee office from room 1315 to 1418 Majestic building, to obtain larger quarters.

J. E. Mason, Western advertising representative of *Engineering News-Record*, has resigned to enter the sales department of the Blaw-Knox Co., at Pittsburgh. Mr. Mason is succeeded by Fred G. Hudson, formerly Western manager of *Chemical & Metallurgical Engineering*, McGraw-Hill Co., Incorporated.

The Neptune Meter Co., of New York City, has acquired a building from the Russell Motor Car Co. of Toronto, Canada, for the manufacture of Trident water meters for Canadian trade, under the name of Neptune Meter Co., Ltd. The manager-director for the Canadian branch is William H. Randall, formerly superintendent of the maintenance and distribution department of the Toronto Water Works.

The appointment of E. E. Maher, formerly Western manager of the Lea-Courtenay Co., and more recently district manager for the Terry Steam Turbine Co., is announced by the Dayton-Dawd Co., Quincy, Ill., manufacturer of centrifugal and underwriters' fire pumps. He will be manager of the Chicago branch, with offices at 30 North Michigan Boulevard.

The American Steam Conveyor Corporation, of Chicago, announces the appointment of Charles H. Florandin, formerly of the National Electric and Welding Co., of New York, as general manager of Eastern territory.

The A. P. Green Fire Brick Co. of Mexico, Mo., has opened an Eastern district sales office at 30 Church St., New York City. Howard C. Thayer, formerly field mechanical engineer for the J. G. White Engineering Corporation at the United States Nitrate Plant No. 2, is in charge.

Trade Publications

A new booklet on path-digging, self-feeding, self-propelling wagon loaders has just been issued by the George Haiss Mfg. Co., Inc., 142nd St. and Rider Ave., New York City.

"Tile Drainage" is the subject of a new book written by James A. King, of the King Farms Co., Otranto Station, Iowa. The publishers and owners of the copyright are the Mason City Brick & Tile Co., of Mason City, Iowa. The booklet deals with various phases of farm drainage.

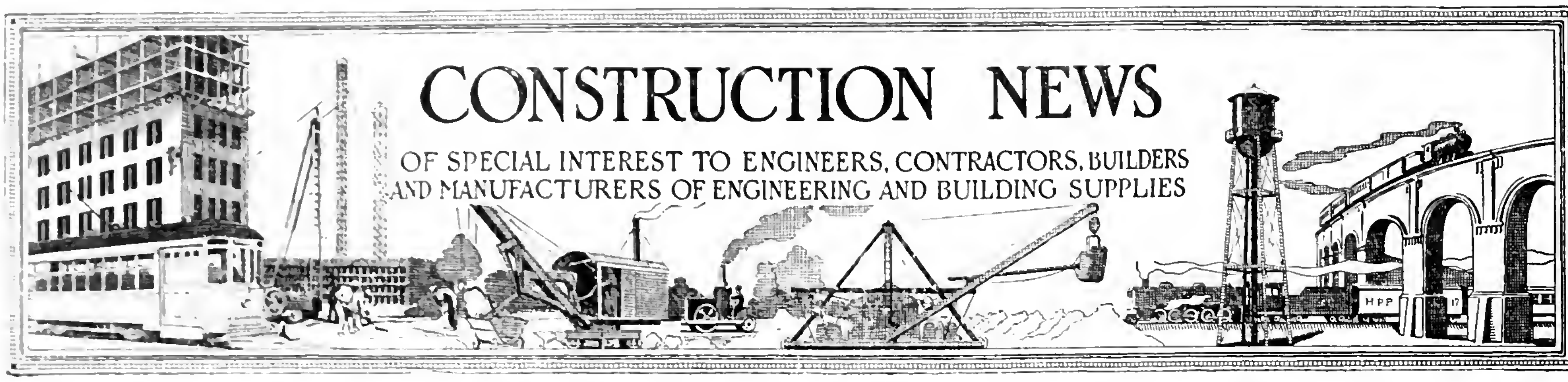
The Western Wheeled Scraper Co., of Aurora, Ill., has just issued an 8-p., 9 x 11-in. pamphlet showing a number of new machines and devices for handling road work on large contracts.

The Guarantee Trust Co. of New York has just issued an illustrated booklet, entitled "Shipping's Share in Foreign Trade—Fundamentals of Ocean Transportation." The book is one of a series dealing with export trade, and is written to meet the needs of beginners in the field, and to be a handy reference for the experienced trader. It contains information for fixing rates, computing the capacity of vessels, the customary commercial terms used in quoting prices to foreign buyers, etc.

"Pile Hammers" is the title of bulletin No. 25, issued by the McKiernan-Terry Drill Co., Park Row Building, New York City. The pamphlet is 6 x 9 in. and has 43 pages. It describes the method of using the various sizes of double-acting steam hammers in the driving of both heavy and light sections of wood and steel sheeting and concrete piles.

The Austin Manufacturing Co., of Chicago, has just issued a 9 x 12-in. pamphlet of 4 pp., dealing with road rollers of both the steam and gasoline-driven type.

"Lidgerwood Coal-Handling Cableways" is the title of bulletin No. 34 issued by the Lidgerwood Manufacturing Co., 96 Liberty St., New York City. The possibilities of cableways for storing coal are set forth, and diagrams of the various layouts for utilizing them are outlined.



PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
Apr. 28	New Ulm, Minn.	Apr. 24
May 1	Poughkeepsie, N. Y.	Apr. 17
May 5	Pottsville, Pa.	Apr. 17
	Adv. Apr. 17 and 24.	
May 5	Salt Lake City, Utah	Apr. 24
May 6	Ely, Minn.	Apr. 17
	Adv. Apr. 17 and 24.	
May 8	Brainerd, Minn.	Apr. 24
May 13	Hollandale, Miss.	Apr. 17
May 14	Gilboa, N. Y.	Apr. 17
	Adv. Apr. 10 to 24.	
May 29	Tamaqua, Pa.	Apr. 24
	Adv. Apr. 24.	

SEWERS

Apr. 28	Flagstaff, Ariz.	Apr. 10
	Adv. Apr. 10 and 17.	
Apr. 28	Elkhart Lake, Wis.	Apr. 24
Apr. 29	New Haven, Conn.	Apr. 24
Apr. 30	West Roxbury, Mass.	Apr. 10
Apr. 30	Detroit, Mich.	Apr. 24
Apr. 30	Detroit, Mich.	Apr. 17
May 1	Duluth, Minn.	Apr. 3
May 1	La Grange, Ga.	Apr. 17
	Adv. Apr. 17 and 24.	
May 5	Macon, Mo.	Apr. 17
	Adv. Apr. 17 and 24.	
May 6	Newark, N. J.	Apr. 3
May 6	Cleveland, O.	Apr. 10
	Adv. Apr. 3 and 10.	
May 8	Platte, S. D.	Apr. 17
	Adv. Apr. 17 and 24.	
May 12	Pontiac, Mich.	Apr. 24
	Adv. Apr. 24.	
May 13	Newark, N. J.	Apr. 24
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 20	Erie, Pa.	Apr. 24
	Adv. Apr. 24.	
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	

BRIDGES

Apr. 21	Provo, Utah	Apr. 17
Apr. 28	Idaho Falls, Idaho	Apr. 17
Apr. 28	Toledo, Wash.	Apr. 17
Apr. 28	Owen Sound, Ont.	Apr. 24
Apr. 29	Franklin, Pa.	Apr. 10
	Adv. Apr. 10	
Apr. 29	Ottawa, Ont	Apr. 10
Apr. 29	Ann Harbor, Mich	Apr. 17
Apr. 30	Clarksdale, Miss.	Apr. 17
Apr. 30	Lockhart, S. C.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 30	Dennison, Ia	Apr. 24
May 3	North Adams, Mass.	Apr. 24
	Adv. Apr. 17 and 24	
May 3	St. Louis, Mo	Apr. 24
May 5	Akron, O.	Apr. 10
	Adv. Apr. 10 and 17	
May 15	Valdosta, Ga	Apr. 24
May 16	Thomasville, Ga.	Apr. 24
May 19	Cottonwood, Ariz.	Apr. 24

STREETS AND ROADS

Bids Close		See Eng. News-Record
Apr. 25	Trenton, N. J.	Apr. 17
Apr. 25	Connecticut	Apr. 17
	Adv. Apr. 17.	
Apr. 25	Ridgefield, Conn.	Apr. 17
	Adv. Apr. 17	
Apr. 25	Edenburg, Pa.	Apr. 10
Apr. 26	Weston, W. Va.	Apr. 17
Apr. 27	Pittsburgh, Pa.	Apr. 3
Apr. 27	Elmira Heights, N. Y.	Apr. 24
	Adv. Apr. 17 and 24.	
Apr. 28	Pennsboro, W. Va.	Apr. 17
Apr. 28	Elmira, N. Y.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 28	St. George, S. I., N. Y.	Apr. 24
Apr. 28	Washington	Apr. 17
Apr. 28	Scranton, Pa.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 28	St. James, Minn.	Apr. 17
	Adv. Apr. 17.	
Apr. 28	Manitowac, Wis.	Apr. 24
Apr. 29	Maryland	Apr. 17
Apr. 29	St. George, S. I., N. Y.	Apr. 24
Apr. 29	Toledo, O.	Apr. 24
Apr. 30	Illinois	Apr. 24
Apr. 30	New Hampshire	Apr. 24
Apr. 30	Akron, O.	Apr. 10
Apr. 30	New York, N. Y.	Apr. 10
	Adv. Apr. 10 to 24.	
Apr. 30	Delaware	Apr. 17
Apr. 30	St. James, Minn.	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 30	New Jersey	Apr. 17
	Adv. Apr. 17 and 24.	
Apr. 30	Freehold, N. J.	Apr. 17
	Adv. Apr. 17 and 24.	
May 1	Sheboygan, Wis.	Apr. 24
May 1	Augusta, Ga.	Apr. 17
	Adv. Apr. 17 and 24.	
May 1	Olympia, Wash.	Apr. 17
May 1	Wisconsin	Apr. 17
May 1	Illinois	Apr. 24
May 1	Longueuil, Que.	Apr. 24
May 1	Santa Barbara, Cal.	Apr. 24
May 2	St. George, S. I., N. Y.	Apr. 24
May 2	Pennsylvania	Apr. 10
	Adv. Apr. 10 to 24.	
May 3	Terra Haute, Ind.	Apr. 24
May 5	Greenfield, Ind.	Apr. 17
May 5	North Dakota	Apr. 10
May 5	Worthington, Minn.	Apr. 10
May 5	Fayetteville, W. Va.	Apr. 17
	Adv. Apr. 10 to 24.	
May 5	Colfax, Wash.	Apr. 24
May 5	Dallas, Tex.	Apr. 17
	Adv. Apr. 17 and 24.	
May 6	Detroit, Minn.	Apr. 24
May 6	Durham, N. C.	Apr. 17
	Adv. Apr. 17.	
May 6	Upper Marlboro, Md.	Apr. 24
May 6	Edgerton, O.	Apr. 24
May 7	Burlington, N. J.	Apr. 10
May 7	Long Prairie, Minn.	Apr. 17
May 7	Faribault, Minn.	Apr. 17
May 7	Manhattan Beach, Cal.	Apr. 24
May 7	Guelph, Ont.	Apr. 24
May 7	New Jersey	Apr. 24
May 7	Burlington, N. J.	Apr. 24
	Adv. Apr. 24.	
May 7	Arkansas	Apr. 24
	Adv. Apr. 24.	
May 9	Norfolk, Va.	Apr. 24
	Adv. Apr. 24.	
May 9	Patchogue, N. Y.	Apr. 24
	Adv. Apr. 24.	
May 12	Elk River, Minn.	Apr. 17
May 12	David City, Neb.	Apr. 24
May 12	Wahoo, Neb.	Apr. 24
May 12	St. Paul, Neb.	Apr. 24
May 12	New Jersey	Apr. 24
May 12	Salem, N. J.	Apr. 24
May 13	Beatrice, Neb.	Apr. 24
May 14	Arkansas	Apr. 17
	Adv. Apr. 17 and 24.	
May 14	Austin, Minn.	Apr. 24
May 14	Nebraska City, Neb.	Apr. 24
May 14	Humphrey, Neb.	Apr. 24
May 15	Rushville, Neb.	Apr. 24
May 15	Hastings, Minn.	Apr. 24
May 15	Terra Haute, Ind.	Apr. 24
May 15	Plymouth, Wis.	Apr. 10
May 15	Bridgeville, Pa.	Apr. 24
May 16	Toronto, Ont.	Apr. 24
May 19	Merced, Cal.	Apr. 10
May 19	Tulsa, Okla.	Apr. 17
	Adv. Apr. 17 and 24.	
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 20	Windom, Minn.	Apr. 24
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 30	Dallas, Tex.	Apr. 17
	Adv. Apr. 17 and 24.	
June 2	St. Severe, Que.	Apr. 24
June 10	Clarksville, Pa.	Apr. 3

EXCAVATION AND DREDGING

Apr. 28	Sterling, Ill.	Apr. 17
	Adv. Apr. 10 to 24.	
Apr. 28	New York, N. Y.	Apr. 24
Apr. 28	Benson, Minn.	Apr. 17
Apr. 29	New York, N. Y.	Apr. 3
	Adv. Apr. 3 to 24.	
Apr. 29	Jonesboro, Ark.	Apr. 24
Apr. 30	Marion, Kan.	Apr. 17
	Adv. Apr. 17 and 24.	
May 2	Marks, Miss.	Apr. 17
May 6	Paragould, Ark.	Apr. 3
May 14	Poplar Bluff, Mo.	Apr. 3
May 15	Mobile, Ala.	Apr. 10
	Adv. Apr. 10 to 24.	
June 2	Beaufort, N. C.	Apr. 24
	Adv. Apr. 24.	

INDUSTRIAL WORKS

Apr. 26	Altoona, Pa.	Apr. 24
Apr. 28	Providence, R. I.	Apr. 24
Apr. 30	Brooklyn, N. Y.	Apr. 24
Apr. 30	Newark, N. J.	Apr. 24
May 1	New York, N. Y.	Apr. 17
May 1	Brainerd, Minn.	Mar. 27
May 1	Joplin, Mo.	Apr. 3
May 10	Sheboygan, Wis.	Apr. 24
May 15	Toronto, Ont.	Apr. 24
May 15	Bemidji, Minn.	Apr. 17

BUILDINGS

Apr. 25	Green River, Wyo.	Apr. 24
Apr. 26	Lackawana, N. Y.	Apr. 24
Apr. 28	Campbell, Minn.	Apr. 17
Apr. 29	Leon, Ia.	Apr. 24
Apr. 29	Hiawatha, Utah	Apr. 24
Apr. 29	Philadelphia, Pa.	Apr. 24
Apr. 30	London, Ont.	Apr. 24
Apr. 30	Vancouver, B. C.	Apr. 10
Apr. 30	Albany, N. Y.	Apr. 17
	Adv. Apr. 17.	
Apr. 30	Brooklyn, N. Y.	Apr. 24
Apr. 30	Lakewood, N. J.	Apr. 24
May 1	Wakefield, Minn.	Mar. 20
May 1	Virginia, Minn.	Mar. 27
May 1	St. Louis, Mo.	Apr. 3
May 3	Chicoutimi, Que.	Apr. 24
May 3	Racine, Wis.	Apr. 17
Apr. 5	Akron, O.	Apr. 17
May 5	Bridgeport, Conn.	Apr. 24
May 6	Bayonne, N. J.	Apr. 24
May 7	Fort William, Ont.	Apr. 24
May 8	Newark, N. J.	Apr. 17
	Adv. Apr. 17 and 24.	
May 8	Salisbury Center, N. Y.	Apr. 24
May 8	Victoria, Minn.	Apr. 24
May 12	Flint, Mich.	Apr. 17
May 12	Hawley, Minn.	Apr. 24
May 15	Port Washington, Wis.	Apr. 24
May 15	Verona, N. J.	Apr. 10
May 15	Kearney, Minn.	Apr. 17
May 15	Winnibago, Minn.	Apr. 24

FEDERAL GOVERNMENT WORK

Apr. 26	Dredging—Norfolk, Va.	Apr. 10
	Adv. Apr. 10.	
Apr. 28	Hangars — Spec. 3792 — Brunswick, Ga.	Apr. 17
Apr. 28	Storehouse — Spec. 3861 — Hampton Roads, Va.	Apr. 24
Apr. 28	Storehouse — Spec. 3860 — Hampton Roads, Va.	Apr. 24
Apr. 28	Storehouse — Spec. 3859 — Hampton Roads, Va.	Apr. 24

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc. JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 NEW YORK, THURSDAY, MAY 1, 1919 *Number* 18

Foresight as a Dividend-Paying Asset

AN investment of a hundred million in ships before the war, said Homer L. Ferguson before the Foreign Trade convention in Chicago last week, would have saved a billion dollars during the war. In other words, a stitch in time would have saved nine, a fact which the nation until recently declined to recognize in the matter of merchant marine and naval auxiliaries. Mr. Ferguson's remark goes beyond ships, however. Foresight is needed in all activities, and nowhere more than in technical industry. During the past two years those producers who had improved their plant and equipment for high efficiency and were ready for the highest demands as to capacity and speed of production formed the backbone of the home army, and incidentally earned the dividends of success. Similarly, the men who today are preparing for the future will constitute our industrial strength in the new era.

Opposing Reports on New York Garbage Disposal

THE muddled garbage-disposal situation in New York City would not be cleared a bit if equal value were to be given to the directly opposing recommendations of the Merchants' Association, which advises incineration, and the Brooklyn Chamber of Commerce, which pronounces for reduction. But the two reports are not of equal value. The Merchants' Association report reads as if written before the war, in accordance with preconceived notions that "cremation" is the only sanitary means of garbage disposal. Cost data are purposely avoided. The Chamber of Commerce report takes into account the importance of waste conservation by grease and fertilizer recovery, and presents cost estimates for both systems of disposal. Both reports—but very differently—show the need for a thoroughgoing engineering study of the whole problem of garbage collection and disposal for the five boroughs of New York City. As we have previously urged, here is work for the engineering societies. They may not be called upon to make the needed studies, but they should never rest until they have used every reasonable effort to see that the studies are made.

What Is a Building Material?

STATISTICS are dangerous things. Once they are established their source is forgotten, and the user may do with them what he wills. Offhand, it looks as though some such end may come to the figures on building-material prices collected by the United States Department of Labor and published in the pamphlet entitled "A Comparison of Prices During the Civil War and Present War." Every day quotations from this investigation bob up in unexpected places, proving many and various things. Whether the theories so expounded are valid or not, those who study them should know that the "building materials" on which this exhaustive study were based are eighteen, and their names are alphabetically arranged: Brick, cement, chestnut lumber, flaxseed, furniture, hemlock, lime, linseed oil, oxide of zinc, pine boards, pine in log, putty, spruce, tar, turpentine, tubs, window glass, wooden pails. The necessity for finding materials with available prices during two widely separated wars may have restricted the investigators, but why masquerade such a collection under the heading "Building Materials"?

An Achievement in Bridge Raising

AN achievement which probably represents the solution of a greater number of field problems than ever before confronted an erection engineer is the raising of the Pennsylvania R.R. bridge over the Allegheny River a maximum distance of 13 ft., described on another page of this issue. This operation involved the jacking up of the double-deck main spans, designed for six railroad tracks, the heaviest for their length in the country, without interference with the dense traffic in and out of the Pennsylvania station, and was carried out under a strict time limit in less than five months for the actual raising of the main spans. The great number and special arrangement of jacks necessary—the four lines of trusses were raised on the intermediate piers without shifting the jacks—and the difficulties in obtaining a sufficient number of adequate capacity; the necessity for working on these intermediate piers in restricted space limits, requiring the design of jacking girders to support the ends of two trusses in each line without encroaching on train-clearance lines, the design of grillage units which could be easily handled and installed from the hanging platforms below the main trusses; the application of a well-known hydraulic principle in a simple device for indicating the relative level of the ends of the trusses being raised on a given intermediate pier, kept at the same level to prevent twisting of portal bracing and end floor-beam connections; the design of spliced extensions for the columns in the approach viaduct, and the scheme for placing precast concrete blocks in building up the piers of these approaches—all introduced complications and difficulties which required unusual ingenuity in their solution. That the whole series of operations should have been carried out so successfully within the one-year time limit allowed by the Government is a real tribute to the engineers in charge.

Training Operators of Construction Machinery

HOW to obtain competent operators of construction machinery will be a burning question when the prospective construction program is started, for the supply of such men is always limited. It is not uncommon for a contractor to find himself faced with a shutdown because he lacks a man able to handle a road roller, concrete mixer, trenching machine or piledriver. His only recourse is to select some promising man from among the laborers and assign him to the task, with the foreman to give him such instruction as opportunity permits. This means likelihood of delaying or even spoiling a part of the work and of causing excessive maintenance and repair expense on the machinery while the man is acquiring proficiency. How can this condition be remedied and the supply of machine operators increased? The short courses in highway construction held by many Western state universities, during the winter, appear to offer a logical means for training such men. It is generally easy to get a few competent operators as instructors at that time, before the construction season opens. A method which has been tried at the Nebraska State University, in view of the shortage of men to operate construction machinery on road work, consisted in organizing a special short course very similar to that already established for the instruction of tractor operators for agricultural machinery. A three-week course of lectures and demonstrations should suffice to turn out men able to handle machinery efficiently and economically. Men thus trained are not to be classed as common laborers, and probably many of them would develop into foremen or superintendents.

Full Facts on the Engineering Standards Movement

OPEN discussion of plans and purposes is a first essential in a matter that concerns future engineering and industrial development so intimately as the Engineering Standards movement. The thought of every engineer on the subject is needed. But hitherto there has been no possibility of such thought and discussion, because those in charge of the planning failed to take the engineering public into their confidence. Dr. E. B. Rosa's elaborate statement of the case in this issue supplies a substratum of fact on which the reader may build his thought. Obviously, discussion must be based on information concerning such matters as form of organization, intersociety relations, field to be occupied, control and financing.

Relying on broad support for its ultimate success, the Engineering Standards movement is in its very nature one that peculiarly demands widest publicity; even more so at the present point of proposed reorganization on surprisingly broad lines. The statement which we publish is founded on this very thought, that the soundest results will follow if all engineers will consider the subject with close attention, on the basis of the facts.

Were any proof needed of the desirability of an open statement of the situation, it might be found in the fact that some of the men most closely concerned with the movement, men responsible for the direction of large societies in connection with it, are misinformed as to essential phases of the committee activities. Without breach of confidence it may be said that comments on the editorial discussions of the standards movement printed in these columns Apr. 10 and 17 have made this quite evident. Therefore, if misconception prevails in circles that should be fully informed, it is idle to expect that engineers the country over can form useful opinions concerning the movement.

We bespeak for Dr. Rosa's statement close and interested study. It describes the plan which is now before the directing boards of the societies—though the divisional feature of the organization is for the present only Dr. Rosa's personal idea of what should develop. The Engineering Standards movement concerns all engineers and all who are engaged in industrial technology. Few developments of such broad importance have come before the profession in years.

The central feature of the reorganization soon to be decided upon is the inclusion of safety-code work with work on standards of shape and quality of materials. But accompanying this very important change is that of improvement in organization. The aim now is to make the Engineering Standards Committee a broadly representative institution, which in its present make-up it is not and could not be. If the movement as a whole is to be constituted by the free and enthusiastic coöperation of numerous societies, only a broadly democratic constitution can bring success.

There are many phases of the remarkable organization and system set forth that invite comment; and there is not a little that might be questioned or traversed. The data of the psychological problem with which the noted physicist deals in this instance seem to call for scrutiny. Perhaps the method of deduction also may be worth examination. But it is precisely these elements of the statement that must be considered in full by the court of engineering opinion. In harmony with Dr. Rosa's clearly expressed thought, the widest range of study and reflection upon the subject will best promote the right outcome.

With respect to one point, however, the author's statement needs to be put in clearer light at once, for the point is fundamental to many considerations of the subject. Dr. Rosa disclaims all technical action or judgment on the part of the Engineering Standards Committee. He says that the committee "will approve a standard . . . not because the committee has itself examined it and passed an independent judgment upon it, which that committee will not attempt to do." This goes to the heart of the question of how conflicting interests in the formulation of a standard are to be harmonized. What will develop in those cases where duplication, or conflict of authority, or unharmonized difference of technical opinion, occurs? It is held by many advocates of the standards organization that duplication and conflict now occur to a harmful degree, and that they would be eliminated by the proposed system. And these same men, like Dr. Rosa, hold that the committee will accomplish this object without entering into technical questions.

Such views need to be tested by the proof of actual fact. They should be applied, for example, to the question of possible protests against the A. S. M. E. boiler-code work, to the controversy over motor-car axles, to the conflict in the field of specifications for cast-iron water pipe, to the situation in which steel-rail specifications are involved, and to the difficulties of some years ago in the matter of the cement specifications. In

such cases as these—as also in others that may readily arise; for example, if a standardization of I-beam sections should be undertaken—there are unavoidable technical differences which no mere overhead pacificatory direction could level. They include differences between societies, differences between producer and user, and differences between producers, or between users, but technical differences in all cases. Only technical methods can successfully settle such differences, and for this reason reassuring advance disclaimer of all technical action by the Standards Committee is likely to be belied by subsequent developments.

A Clarion Call to the Profession

LAST week's meeting in Chicago, at which delegates from 74 societies gathered to consider the advisability of pushing the formation of a Federal Department of Public Works, marked a distinct step forward in engineering-society activity in this country. What is more, it sounded a clarion call to the profession: Can engineers, architects, chemists and their co-workers in construction activities get together with an effectiveness equal to the task of carrying through a great national project?

If the spirit of last week's conference is consulted, the answer is clearly and emphatically, Yes. Could there be a more competent body to give that answer? Here were representatives of every type of society, the great nationals, the locals from coast to coast, and architects', chemists' and contractors' organizations. There was such unanimity, such confidence, that repeatedly Philip N. Moore, sitting as chairman at the really pivotal session, pleaded that if anyone saw insuperable obstacles to the movement or lacked faith in it that he come forward and express himself. But there were no objectors.

That the task is not an easy one was fully realized. The delegates went home fully appreciative of that to which the conference had set its hand, but confident not merely that the result would be accomplished but that through the doing of the task the profession would be bound together as never before. The inevitableness of that secondary result is obvious. An effective organization alone can win in this project—and that organization can be made permanent, the agency for doing thereafter the many things that have long awaited the hand of a national organization of engineers.

Fortunately, the project is one on which it is easy to unite. No selfish, no local, no partisan interest is served. The public good alone is the issue—and it recommends itself no less to other patriotic citizens than to engineers, architects, chemists and their allied workers. Therein, in fact, lies the solid reason for its success—that the public at large can be won to its support.

The project is now in hand. There is no turning back. Success alone can be the end of the endeavor.

Mr. Channing, chairman of Engineering Council, said at the dinner that nothing had given him such hope for ultimate professional unity as the proceedings of the conference. In so saying he echoed, we are sure, the views of everyone present. We take it that Mr. Channing's hopes were founded chiefly on the unanimous opinion regarding the need for a centralizing agency and on the very evident spirit of give and take that prevailed. But there were other hopeful indications—a grasp of political problems (which surely will stimulate united action), an understanding of methods of promotion and organization, and a determination that engineers shall no longer be hesitant in promoting their group interests. The agitation of the five years just passed is bringing results. Crystallization is apparent. The day of professional unity is not far off.

What form the organization that will unite the profession eventually will take cannot now be foretold. Certain it is that the first step will be federation. Repeatedly, plans have been proposed for a single engineering society, all-embracing, extending its scope to civic activities as well as to technical and scientific development. Those proposals have had but small response. Eventually we may find the mechanism for such a development, but the time is not now. At the conference the sentiment plainly was in favor of federation—and federation under Engineering Council.

As to Engineering Council, its opportunity to become the medium of unifying the profession has been immensely advanced through this conference. In fact, if we read the sentiment aright, it was that the council was the logical agent of unity. The attitude of its members was so broadminded, their appreciation of the problems of all classes of engineers so evident, that the council won friends for itself even among those most critical of it in the past and most doubtful of its ability, because of its genesis and constitution, to represent the profession broadly. The last objection seemed to be removed when Mr. Channing told of the pending amendment to the rules which would permit the admission of local societies.

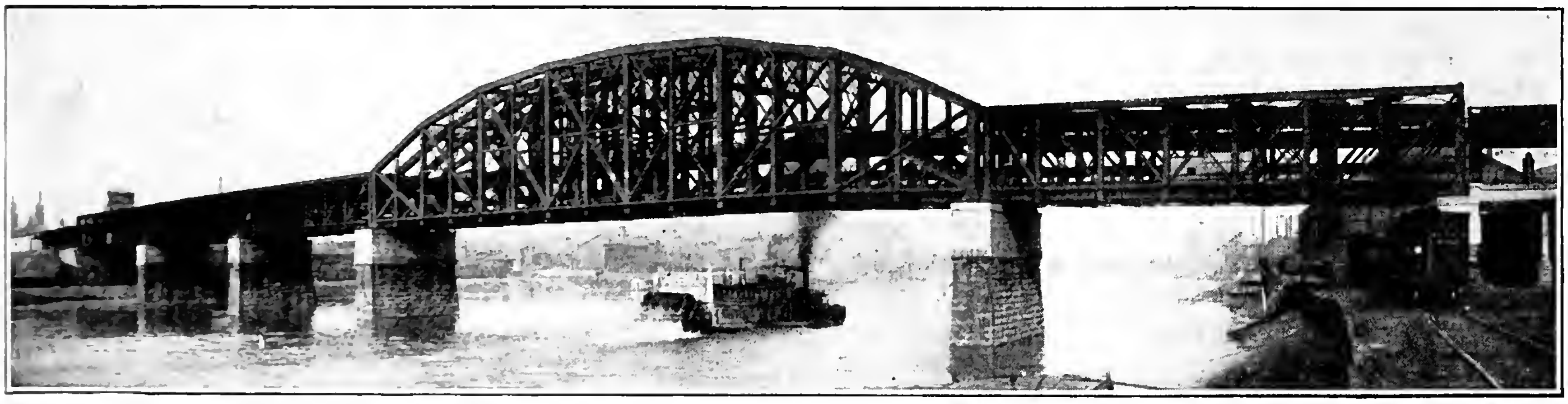
Not a little of the favorable impression made by the council was due to its broadminded handling of the conference. It called the conference, made it possible, but of its own volition elected to have no part therein. In other words, where it might easily have dominated, it freely stepped aside, declaring its object to be merely that of affording a forum where the societies could reach their own decisions. Upon the announcement by Mr. Channing that council members as such would have no voice in the proceedings, the conference at once accorded to them and to the members of the National Service Committee the privilege of the floor.

Finally, a word should be said as to the effectiveness of the arrangements for and the machinery of the conference. They were a tribute to the organizing ability of those in charge. The tentative program, adopted quickly by the conference, showed full appreciation of the probably necessary steps of the procedure, but was unhesitatingly changed in detail to suit the needs as the conference developed. The conduct of the chair was effective and tended to expedition. The Western Society of Engineers supplied not only the meeting place but plentiful stenographic and clerical assistance. The technical societies of Chicago, through their General Committee, took care of the housing of the delegates and gave a dinner to the entire conference.

It was a big piece of work effectively handled. It will linger long in the pleasant recollections of those who attended, and will go down in the annals of the profession as one of its most important meetings.

Raising Allegheny River Bridge 13 Feet By Jacking

Without Interruption of Traffic Underclearance of Four-Track Two-Level Steel Structure at Pittsburgh Is Increased 12.6 Feet



DOUBLE-DECK STEEL SPANS LIFTED BODILY TO INCREASE CLEARANCE BY 12.6 FEET—PROGRESS PHOTOGRAPH AND FINAL APPEARANCE

ONE of the most original engineering accomplishments ever carried to successful completion is the lifting of about 7800 tons of steel bridge truss spans and 7150 tons of approach viaducts a maximum distance of 13½ ft. with absolutely no interruption of the heaviest railroad traffic. On Mar. 23, 1917, the War Department ordered that the Pittsburgh, Fort Wayne & Chicago Railroad bridge over the Allegheny River at Pittsburgh, Penn., consisting of five main river spans of four-truss, double-deck type and their approaches, be raised from a clearance line at El. 738 to a revised line at El. 750.6, and fixed the time limit for completion at one year from date. It was required that the lifting operation should be carried out between trains and proceed consecutively from pier to pier to prevent excessive grades. All the truss spans on any one pier were raised simultaneously by the use of hydraulic jacks of 100-, 200- or 500-ton capacity. The actual operations of lifting these spans, which were designed for six tracks and are the heaviest for their length in the country, were carried out in less than five months.

Restricted space and side-clearance limitations complicated the problem of placing new steel grillages on the main piers and providing support for the jacking girders. Furthermore, the approach girder spans and steel bents also had to be raised and the piers supporting these bents rebuilt by the addition of precast concrete blocks. In the Pittsburgh approach where the side clearances were limited, spliced column extensions were added to the base of the steel column to give the necessary height. A simple device was installed to indicate whether the various spans at one pier were being kept at the same level during the raising operation.

After the completion of the raising, Mar. 15, 1918, much other work had to be done on the bridge, such as the replacing of corroded angles in the upper level struts of the bracing and the placing of cast-iron protection plates above the lower-level tracks, and the introduction of diagonal longitudinal bracing in the approach viaducts on both ends of the bridge.

This bridge was erected in 1902, and a general description of the structure will be found in *Engineering News* of Nov. 20, 1902, p. 417.

General Requirements—The Government order required a clear height 12.6 ft. greater than that furnished by the original structure. This involved the raising of the grade of the lower-level tracks at the ends of the longest span a distance of 12.47 ft. and 13.44 ft., respectively, the latter being the maximum lift required in the structure. The various lifts at the end and intermediate piers are given in the accompanying table, which also indicates the jacking loads at the piers, the length of spans and the dead weight of the spans.

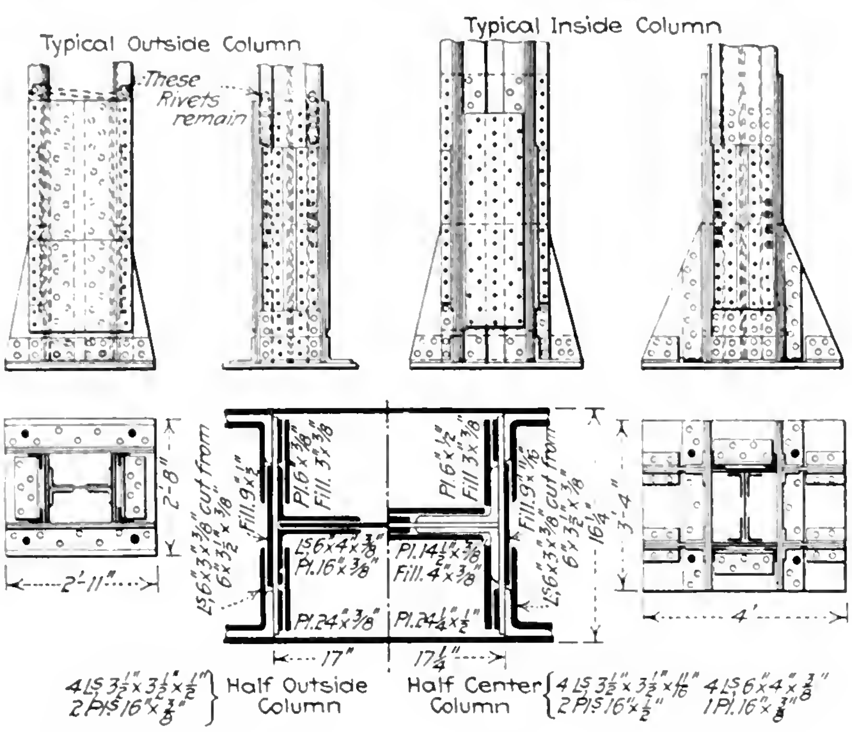
The total length raised was 3283 ft., which was divided into five operations, as follows: (1) Five main river spans supported by six piers, total length 987 ft.; each span is composed of four trusses of double-deck of pin-connected type on a skew, designed for three tracks

MAIN TRUSS SPANS AND WEIGHTS—DISTANCES RAISED

Pier or Span No.	Span Center to Center of Piers, Feet	Dead Weight of Span, Tons	Total Jacking Load at Pier, Tons	Distance Raised, Feet
1	165.5	1199	602	10.47
2	337.5	3459	2331	12.47
3	160.9	1057	2258	13.44
4	160.9	1048	1048	13.19
5	160.5	1052	1048	12.53
6	.....	....	528	11.26
Total		7815	7815	

on each deck, although only two tracks on each deck have been placed; (2) Pittsburgh approach viaduct of 25 half-through plate-girder spans supported on steel column bents, the total length being 823 ft., weight 4000 tons; (3) The Duquesne Way viaduct, 24 spans of which were raised, covering a total length of 1230 ft., weight 2350 tons. This is a double-track-deck plate-girder viaduct supported on steel columns; (4) Allegheny approach viaduct, composed of five half-through plate-girder spans, double track, on steel columns, length 177 ft., weight 800 tons; and (5) Penn Avenue bridge, which is a three-span half-through plate-girder bridge 60 ft. long, with steel columns at intermediate points.

In planning the operation noninterference with traffic was the most important point to be considered, so that all lifting equipment had to be designed to insure the most rapid lifting operations possible. No attempt was made to lift any part of the superstructure under live load. All of the superstructure resting upon any given pier had to be lifted at the same time and kept level during the operation, the distance lifted being limited by the

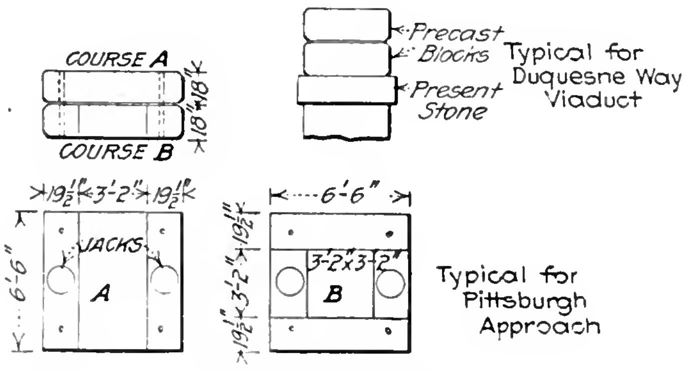


TWO TYPES OF DETAILS OF TYPICAL SPLICES FOR COLUMN EXTENSIONS

fact that no grade exceeding 1% was to be permitted during the progress of the work. In order to prevent undue strain of the riveted connections in the viaduct approaches, it was planned to raise the girders in consecutive sections of three spans, each lift to be limited to two or three inches.

As the interval between trains was seldom more than 15 min., a complete telephone system connecting the train dispatcher's office with those points in the field where the work was being carried on was installed. An elaborate chart was prepared to show when the track was required, how long, and when it would be released. During the work it was found necessary to allow 1.5% grade at various stages, and the final maximum grade is 1.28% on the Pittsburgh approach. The grade of the upper-level tracks was modified so that they were not lifted the same amount as the lower-level tracks, the difference being made up in depth of ties, some ties as deep as 20 in. being required.

History of the Operations—The work was let on a percentage basis, and as many new requirements were discovered the added work extended the time of the final completion of the contract nearly one year longer than that required to raise the bridge to its new level. Preliminary work on the approaches was started June 7, 1917, and all extra work on the main spans and approaches was completed Mar. 15, 1919. The lifting of the main spans and the Allegheny approaches began



PRECAST BLOCKS IN APPROACH PIERS

Oct. 30, 1917, and the last lift was completed Mar. 15, 1918, the contract date limit being Mar. 23. The average lift on the main piers was 3 in. at first, increasing to about 6 in. per day, the maximum, accomplished Feb. 25, 1919, being one foot three inches.

Work on the Pittsburgh approach began Aug. 11, 1917, and was finished Mar. 11, 1918, the work being carried on simultaneously throughout the structure with a force that averaged about 75 men. The addition of splice material and reinforcement for corroded struts and floor-beams, the installation of new longitudinal bracing, and other additional work, kept the contractor on the work for another year.

Approach Columns Raised—The first work was the enlargement of the concrete piers supporting the columns of the approach bents to give sufficient width to support the jacks. As seen in one of the photographs, built-up steel brackets were bolted on two sides of the columns to support the dead weight. Beneath these the jacks were placed, the capacity of these jacks varying from 40 to 80 tons. For the heavier brackets eight 1¼-in. bolts were used at the lower end to take the tension, and wood blocks were inserted between the column angles at the top to take the compression.

The first operation was the placing of wood blocks for supporting the jacks, or, in case the precast blocks were finished, outside units were used under the jacks, as indicated by one of the drawings. The jacking up proceeded in 2-in. increments, using timber blocking under the column bases until the structure had been raised about 2 ft., when the center precast block under the column base was inserted. The second tier of these blocks consisted of five units, as indicated on the drawing, the outside oblong blocks running in the opposite direction to those of the first tier. In placing this second tier, the first units placed were those under the jacks, the latter then being used to raise the column by means of brackets in 3-in. lifts, using timber blocking until the column was high enough for the insertion of the center section under the column base. The outside sections could then be placed and the work proceed in similar order tier by tier.

On account of insufficient lateral clearance for trains on the track under the viaduct, the concrete blocks on the Pittsburgh approach were brought up only to the level of the new ground line. The additional height necessary was provided by steel column extensions spliced to the old columns, as indicated on one of the drawings herewith showing the two general types—the inside column with central diaphragm, and an outside column of four angles and two web plates only,

using new center diaphragms at the splices. In placing the new column extension, the dead and the live loads were supported by timber struts from the ground to the girders, one on each side of the column, each composed of three 12 x 12-in. timbers resting on timber cribbing drift-bolted to fit. After thus supporting the superstructure, the old column bases were removed by

PRECAST CONCRETE BLOCKS FOR PIERS AND ABUTMENTS AT PENN AVENUE

cutting out the rivets, new holes were drilled, the column extensions were inserted, and the splice material was added.

As the original structure was constructed with a level grade, the introduction of the grades on the approaches made it necessary to add new longitudinal bracing between columns in certain bays. On the Pittsburgh approach this bracing was introduced in five bays at various parts of the structure, always being placed in a fixed span. Double diagonals were used in all cases except in the end bay, where a special detail was necessary to connect to the abutment because of the presence of an electric-wire conduit running along the abutment. Details of this concrete-covered steel-beam construction to span the conduit and connect to the abutment are indicated in one of the accompanying drawings. In the other approaches, single diagonals with a subdiagonal and vertical at the center to shorten the unsupported length of the strut were used, thus decreasing the number of points of connection between the new diagonals and the columns.

Jacking Up Main Trusses—The eight truss bearings at each intermediate pier were lifted at the same time, keeping all trusses at the same elevation in order to prevent undue strain on the rigidly connected floor-beams and portal bracing. The scheme finally adopted to allow rapid and continuous jacking operations is indicated by the diagram herewith. The problem was to design the jacking girders and steel grillage units to avoid interference and to keep outside of the train-clearance line. New steel brackets were bolted to the vertical end posts of the main trusses, below which the 500-ton hydraulic jacks could be placed upon jacking girders. These girders were carried by jacking columns built up of I-beams and placed in openings left in the grillage units.

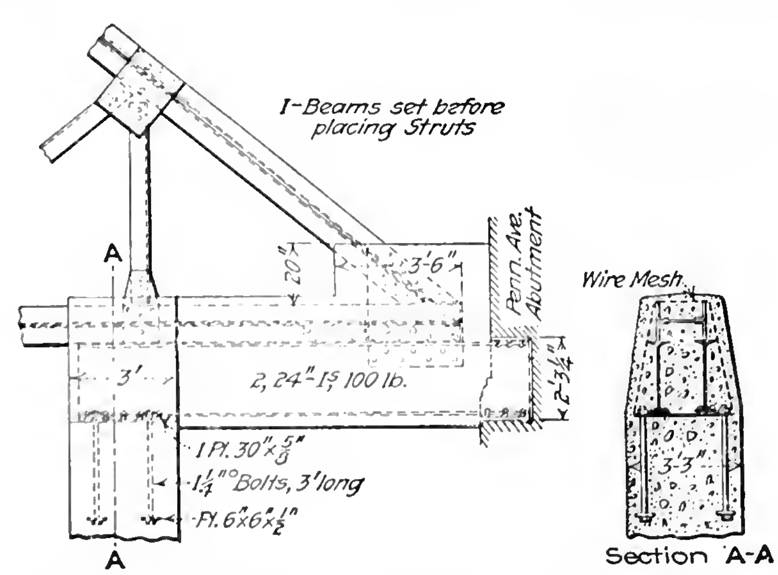
It was first necessary to raise the railroad track 8 in. to increase the clearance. The ends of the old I-beam grillages were burned off in order to allow the outside units of I-beams filled with concrete to be placed. These outside units, which had to carry the complete dead load on the jacks, were built up of I-beams bolted together before the concrete filling was placed.

The posts and jacking girders were then erected and the old truss grillages were bolted to the shoes, and jacking proceeded, using 3-in. timber blocking under the old grillages until the trusses were high enough for the insertion of the central unit of the first tier of new grillage. As the 500-ton jacks only had an 8-in. stroke, the clearance between the jacking girders and the truss shoes only permitted an 8-in. raise, and it was necessary to raise these jacking girders every time the bridge was raised 8 in. The dead load of the jacks, jacking girders and supports was about six tons, hence a set of auxiliary jacks was installed to raise the jacking girders by brackets, as indicated on the sketch, to allow rail grillages to be slipped under the jacking columns. These rail grillages were later replaced by I-beam stools. All of these operations, of course, had to be carried on simultaneously at each of the four truss points on a given pier. After the operations had become familiar, it was possible to carry through one complete cycle for a 4-in. raise and place the 3-in. plank in four minutes.

Special Device Insured the Constant Level—A simple hydraulic device was designed, on the principle of water seeking its own level, to indicate when the truss bearings were not at the same relative elevation during the operation of lifting. A ¾-in. pipe was placed below the floor of the span, and risers with glass indicator tubes were placed at each truss. Water with coloring matter was inserted, and the level indicated by placing a rubber band around the glass tube at the beginning of the lift.

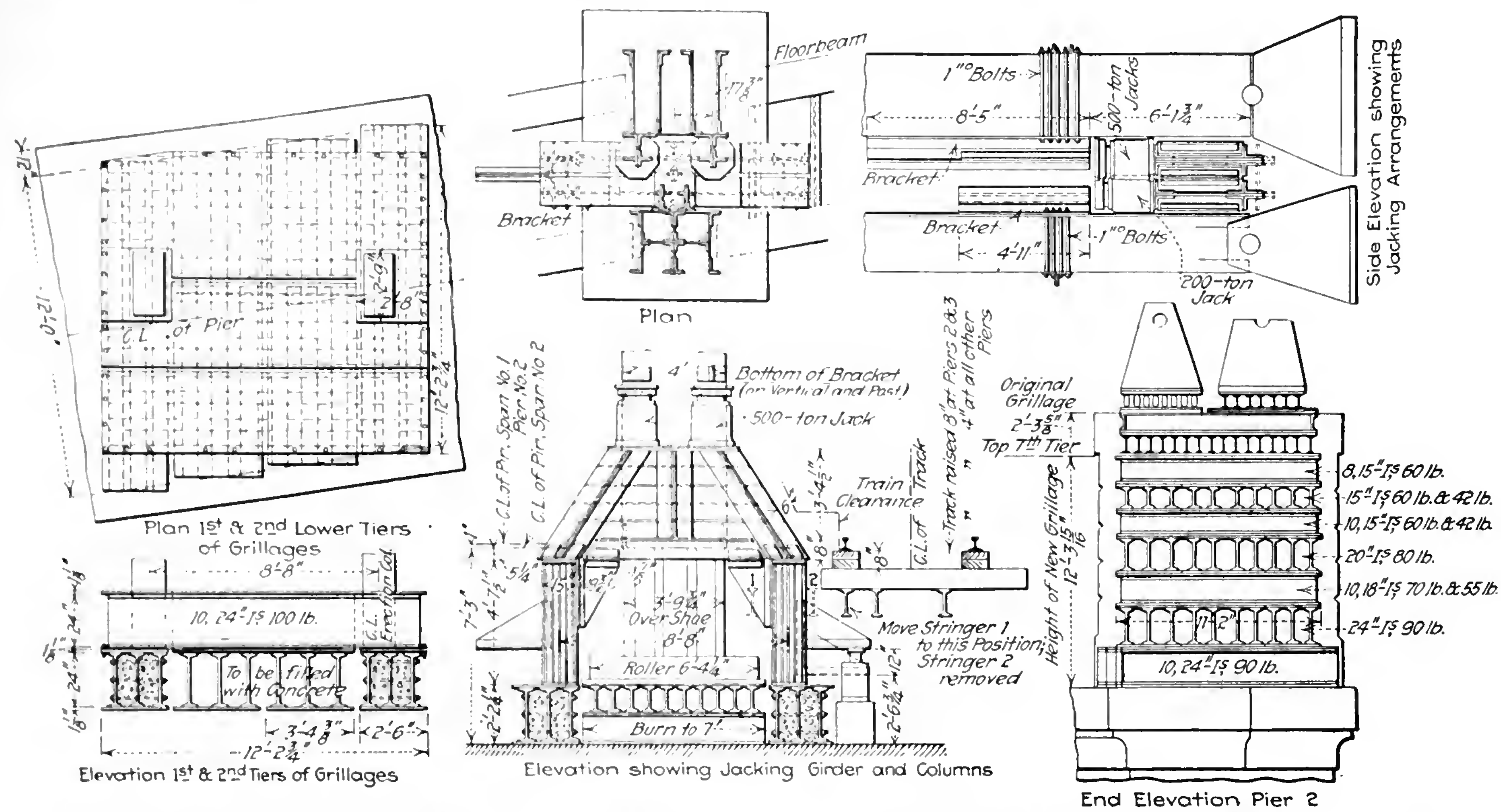
All that the men who were operating the inlet valves of the hydraulic jacks had to do was to watch carefully to see that the water in the glass tube was kept constantly at the level shown by the rubber-band indicator. After some practice this could be successfully accomplished with less than ⅛-in. variation.

The hydraulic jacks were operated from a single steam pump placed on a platform carried by cantilever supports on the north side of span No. 2. The main line



SPECIAL LONGITUDINAL BRACING ANCHORAGE AT ABUTMENT

of 1½-in. pipe extended the full length of the five bridge spans and connected to 1-in. pipes running parallel to each pier, to which copper pipe was attached and connected through the supply valve with each jack on the various piers. These valves were operated by capstans above the floor of the bridge, as indicated in one of the photographs. Stop valves were placed on each side



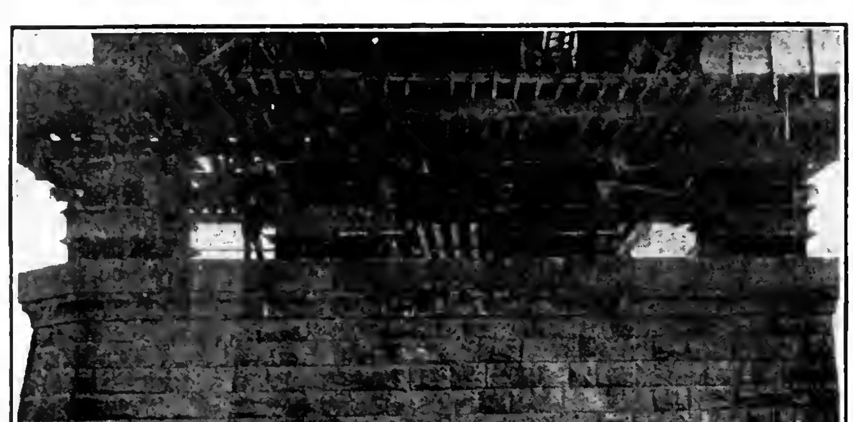
JACKING GIRDERS AND COLUMNS WITH I-BEAM GRILLAGES SATISFY CLEARANCE REQUIREMENTS—PIER NO. 2

of the connection between the pump and the longitudinal 1½-in. pipe, also just beyond each pier, in order to govern the flow of the water to any set of jacks on any pier desired. A discharge valve was also placed at the connection for the copper supply pipe for each set of jacks, allowing the mixture of water and 50% alcohol used in the winter to be saved by catching it in buckets and returning to the pump.

Placing Steel Grillages—Timber platforms were hung from the trusses on each side of the main piers at a level just high enough to allow the steel grillages to be rolled into place on pipe rollers. Platforms on both sides of the pier were required because grillage units of alternate tiers had to be made double, each half being placed from opposite sides of the pier to allow space for the jacking columns. In order to avoid delay in obtaining material it was found necessary to use I-beams for these grillages from whatever source was available. For example, 15-in. I-beams from the old Louisville bridge were obtained and many other beams were furnished by the railroad. The height of the last tier was fixed by the required total lift at the given pier. These grillage units were fabricated at the site, using as cover plates the old Quebec bridge hangers which had been utilized in lifting the suspended span. These were 1¼ in. thick for those from the old span which was lost in the river, and 1½ in. thick for the hangers last used.

The mortar beds between the grillage tiers made up about 4½ in. of the varying difference between the net height of the steel and the height of the concrete encasement forming new caps for the piers. The concrete encasement was carried up to the top of the seventh tier; the concrete was placed by first filling the I-beam grillages with 1 : 3 : 6 gravel concrete, then placing the heart, 10½ ft. wide between the grillages, of the same mix. The outside width of 13 ft. was then made up by 1 :2 : 4 mix, using gravel screened to ¾ in. and working the mortar against the forms so that no stone would show after the base was rubbed.

Vertical joints were made to prevent the development of cracks in the concrete at the corner of the steel grillages where it joined the large mass of heart concrete, by using a steel plate nailed to the forms in a narrow V shape, this plate being removed with the forms and the opening pointed up after the concrete had set. The horizontal construction joints were made at any coursing joint, the latter being formed by triangular nailing strips spaced about 2 ft. 2½ in. apart vertically. The care used in the location of the con-



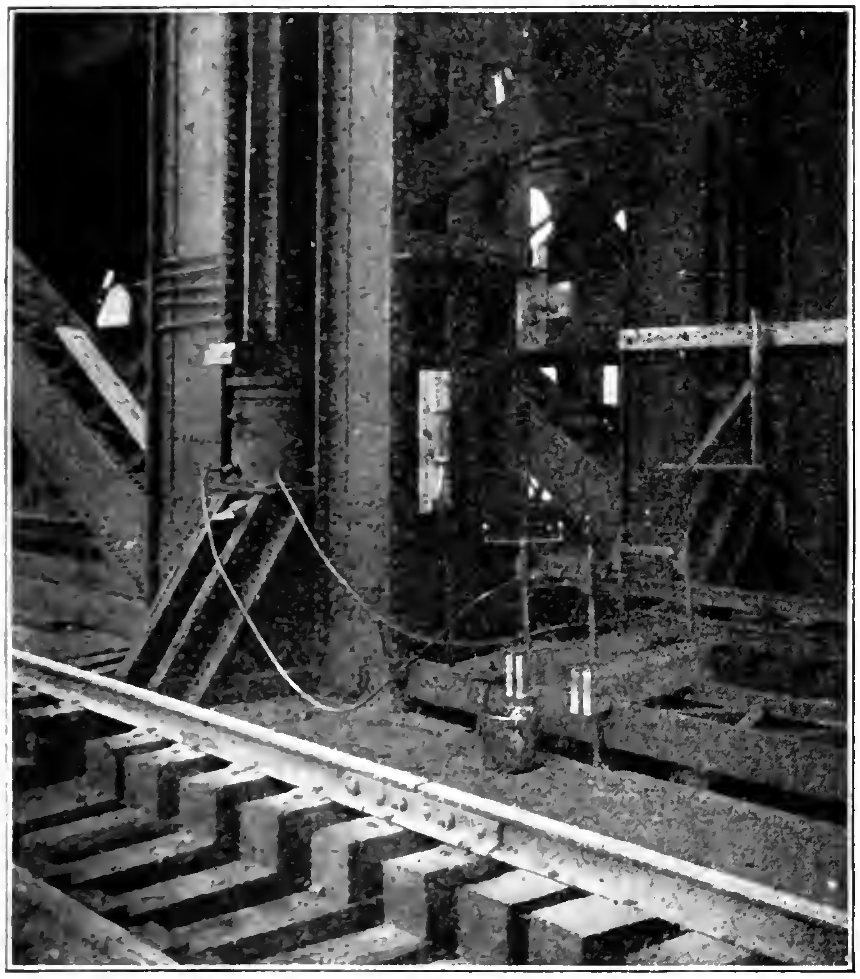
GRILLAGE BEAMS IN PLACE UNDER THE FOUR MAIN TRUSSES AT PIER NO. 4

struction joints has resulted in the fact that no crack whatever has appeared, although several months have elapsed since the work was completed.

Repairing Corroded Struts and Floor-Beams—The locomotive gases and blast were found to have caused very severe loss in section of the transverse struts and floor-beams on the upper level above the floor tracks. It was therefore found necessary to replace the 4 x 4-in. angles of the struts by splicing in new sections in both flanges, usually 3 to 4 ft. long, and spliced by 3½ x 3½ x $\frac{7}{16}$-in. angles. In some cases plates 10⅝ x ⅜ in., about 5 ft. long, were riveted to the lower strut angles. Cast-iron protection plates to prevent future corrosion were bolted to the bottom of these struts in the upper

deck throughout the length of the bridge. The corroded floor-beams were rebuilt by adding web plates to both sides of the old webs and reinforcing the lower flange angles.

The work was performed under the general supervision of J. C. Bland, engineer of bridges, Pennsylvania Lines West of Pittsburgh, and was carried out by the Seaboard Construction Co., Philadelphia, Penn., under the personal supervision of S. P. Mitchell, president, with H. S. Goodloe as superintendent in charge of field operations. W. W. Priest, assistant engineer of bridges,



JACKS ON JACKING GIRDERS—INDICATOR TUBE AND VALVE CONTROLS

Pennsylvania Lines West, was in immediate charge of all field work. The grillages and other steel work were fabricated at the site by the Seaboard Construction Co., and bracing, column extensions, miscellaneous steelwork, etc., were furnished by the McClintic-Marshall Co. and the Fort Pitt Bridge Works, both of Pittsburgh. The estimate of the cost (made April, 1917)

NEW BASES SPLICED TO VIADUCT COLUMNS
Jacking brackets are seen on far columns to the right

was $500,000, but owing to the increase in the costs of all kinds of labor and material during the progress of the work, and loss in efficiency due to the unusually severe cold of the winter of 1917-18, the final cost was from $750,000 to $800,000. The exact cost is not known, as accounts are not yet closed.

Physical Properties of Marbles

ELABORATE tests on marbles were carried out by the Bureau of Standards during the past year to determine the relative value of the different available types and grades for building and for other uses. They covered 52 different marbles, and dealt with strength, water absorption, porosity, specific gravity, loss on repeated freezing, thermal expansion, electrical conductivity, and the like.

In compressive strength (dry) the marbles ranged from 7850 to 50,205 lb. per square inch. After immersion in water for two weeks most of them showed a slightly lower strength, the greatest loss being over 25%. Resistance to freezing and thawing, as determined from 30 cycles, showed equally variable results. But some samples showed little or no loss, and a few actually showed a gain in strength. To put the matter to the test of a longer series of freezing-and-thawing cycles, a device has been set up which will automatically shift a specimen back and forth between a cold chamber and a warm chamber at fixed intervals. By this means it will be possible to expose a specimen to a large number of cycles, and determine the effect of freezing more accurately. The same machine is to be used for testing other building stone.

The heat expansion of marble exhibited a varying rate even at ordinary temperatures, so that a single coefficient cannot be given. More important, however, is the fact that after expansion under heat the marble did not return to its original dimensions after cooling, part of the increase of size being permanent; and successive heatings showed a continuous effect; that is, a progressive increase of dimension.

Measurement of electrical resistivity of different marbles showed a large range of values, so that marble for electrical uses must be specially selected.

Rough Faces Do Not Strengthen Glue Joints

Comparative strength tests of glued joints made with smooth and tooth-planed contact surfaces at the Forest Products Laboratory of the United States Forest Service at Madison, Wis., last year showed that there is no advantage in roughening the faces. It has been commonly believed among woodworkers that scratched or tooth-planed surfaces make a stronger glued joint than smoothly planed faces, but the tests distinctly disprove this belief. Pairs of hard maple blocks were used as the test specimens. They were glued together with a high-grade hide glue, allowed to stand for a week, and then sheared apart in a testing machine. Eleven sets of tests, each test comprising four joints of the smooth and four of the tooth-planed type, gave practically identical average strengths for the two types. In seven of the eleven sets the smooth joints showed the higher strength; the average of all the smooth joints was 2040 lb. per square inch, and that of the tooth-planed joints 1988 lb. per square inch. The area of wood on the fracture surface was counted in every case; the average wood face percentage for the smooth joints was 47 and that for the roughened-face joints 45, which would indicate if anything a greater glue strength for the smooth-face joint. With respect to strength, the 11 tests gave quite consistent results. The figures for the smooth-face joints (each figure an average of four test-pieces) ranged from 943 to 3086 lb. per square inch, those for the roughened-face joints from 1366 to 2409.

Engineering Societies Organize to Push Public Works Department Bill

Seventy-Four Societies Represented at Conference in Chicago—Principles Adopted With Reference to Character of Proposed Department

REPRESENTATIVES of seventy-four engineering societies, having a combined membership of over 100,000, met in Chicago last week and as a result of discussions occupying two full days formed an organization to promote the passage by Congress of a bill creating a Federal Department of Public Works. Principles were adopted for determining the character of the proposed department, and specific recommendations were made as to the services and bureaus to be incorporated therein. The drafting of the bill itself was left to a committee with full power, and the management of the organization to an executive committee, which was authorized to appoint a finance committee to which, in turn, will be left the problem of raising the necessary funds. A campaign committee was also authorized, and, in part, appointed.

Sessions were also devoted to a consideration of Government coördination in mapping the United States and to the relations of nonmember organizations to Engineering Council. Reports of these sessions will be found in the news section of this issue.

A dinner was given to the delegates by the General Committee of the Technical Societies of Chicago, F. K. Copeland, chairman, while the Western Society of Engineers placed its meeting hall, with stenographic and other facilities, at the disposal of the conference.

The Conference

J. Parke Channing, as chairman of Engineering Council, whose National Service Committee called the conference, set forth in a brief introductory speech, reprinted in full on an adjoining page, the purpose of the conference and the general reasons why engineers had repeatedly urged the formation of a Federal Department of Public Works. He made it clear that Engineering Council desired, in connection with the conference, to afford only the means of bringing the delegates together, and that it had no desire to be a determining factor in the conclusions reached. For that reason. Engineering Council, and its members who happened to be present, would have no voice in the proceedings.

Thereupon, upon a call for nominations, M. O. Leighton, chairman of the National Service Committee, was elected chairman of the conference, and E. S. Nethercut, secretary of the Western Society of Engineers, was elected secretary. It was unanimously voted that the members of Engineering Council and the National Service Committee, who were present but did not hold delegates' credentials, receive the privileges of the floor, without, however, the right to vote. The chair was authorized to appoint committees on resolutions, text of bill, Government engineering activities, and credentials.

Upon completion of the organization details the designated work of the conference was taken in hand, the initial step being the presentation by Philip N. Moore, of St. Louis, of the report of the National Service Committee on the project for a Department of Public Works. The report will be found in full on an adjoining page. The burden of it was that the public good demanded the coördination of the engineering activities of the Government, and that this demand was so fundamental that sooner or later it was sure to be complied with. It would be better, he contended, that engineers should be instrumental in bringing about the necessary coördination than that it should be left to others.

Principles Governing Constitution of Proposed Department

From the outset it was apparent that the delegates were unanimous in the belief that a Department of Public Works should be formed, and all of the speakers addressed themselves rather to the principles to govern its formation than to the question of the advisability of its creation. Almost the first question raised was as to the amount of engineering work included within the activities of a given service or bureau necessary to make it eligible for inclusion in the proposed department. It was apparent that the general sentiment was in favor of including only those services and bureaus whose work is *chiefly* of an engineering character. There was some sentiment in favor of the proposal to separate the engineering functions from bureaus which had acquired engineering activities which are, plainly, not essentially connected with their main work, such as the supervision of hydro-electric licenses on the public lands by the Forest Service. Eventually the sentiment prevailed that services and bureaus should be transferred *in toto*, and that those having primarily a function other than engineering should at the outset be left where they are now rather than be transferred to the new department. W. D. Blair, representing the American Institute of Architects, stated that the architects favored the formation of a department with broad scope, which should cover all construction work, including the design and erection of buildings. Speaking for the American Chemical Society, Julius Stieglitz declared that the chemists desire that the chemical bureaus of the Government should be transferred to the proposed department. He pointed out that chemistry was not engineering, but that the alliance of the two was such that the chemical bureaus properly belonged in a department of public works.

The ideas and principles thus developed in the discussion were referred to the resolutions committee, which brought in the following report covering the subject:

"This conference of the delegates from engineering and related organizations respectfully recommends to the public and to Congress that legislation be enacted covering the following principles:

"1. That the services and bureaus of the national Government having to do chiefly with matters of engineering and architecture be grouped in one department to be known as the Department of Public Works.

"2. That the Department of Public Works comprise those works which are built and operated for the use of the public.

"3. That the Department of Public Works be made available when desirable for the performance of special engineering and architectural work for the use of other Government bureaus.

"4. That there be a systematic classification and organization of engineers, architects and other emp'oyees, whose status shall be such that they may be recruited and maintained on merit."

These resolutions were discussed very fully, the chief discussion centering about the drawing of a distinction between military and nonmilitary work. The sentiment was plain that the de'egates believed that only nonmilitary work should be handled by the proposed department, and the question revolved merely about the desirability of including the terms "military" and "nonmilitary" in the statement of principles. The resolutions committee explained that the second principle, as it had been drafted, was intended to exclude military works, because they obviously are not built and operated for the use of the public, and after full discussion the conference decided that this was a full and sufficient distinction. In the discussion, it was also pointed out that the heads of practically all Government services and bureaus having to deal chiefly with engineering work had already been approached with reference to the proposal to form the department and that no opposition had developed.

Services and Bureaus To Be Included

Following the adoption of the statement of principles, discussion was taken up in committee of the whole as to the specific services and bureaus which should be included in the proposed department. The purpose of this discussion, and any action that might be taken, was not to bind the conference, but to serve as information for the benefit of the committee on Government engineering activities, which was directed to bring in at a later session a report on details regarding the formation of the department.

By constant reference to the principles reported above, the conference rather quickly decided the disposition of the various bureaus and activities having engineering functions. The results of the votes are shown in the accompanying table.

Rather full discussion took place with reference to the disposition of the Public Health Service, the Construction Division of the Army, the Forest Service and the Bureau of Standards. The Public Health Service was eliminated because its duties were considered not to be chiefly engineering, while the Construction Division of the Army was included because its work was plainly that ordinarily performed by civilian rather than by military engineers.

The Forest Service was included chiefly because of its important engineering function of supervision over water-power development on the public lands, and also because of the large mileage of roads which it builds. The proposal was considered to recommend the splitting of the work, the silviculture and the strictly agricultural features remaining where they now are, and the engineering features being transferred to the new department. On motion, however, the view prevailed that the whole service should be transferred.

Final decision that the Bureau of Standards would best be in the new department was reached on representation by a number of the delegates of the important engineering functions of the bureau. The Panama Canal was not to be included because its work now is that of maintenance rather than of engineering design and construction.

It was also decided that it would be best to advocate the changing of one of the existing departments into a Department of Public Works rather than to work for the creation of a new department, making a new cabinet position. A motion also prevailed that no changes be made in the personnel, organization and methods of operation of the various bureaus, but that they be taken over into the proposed department just as they now are.

A motion to include in the proposed department a bureau whose purpose would be to promote by means of publicity the construction industries of the country, similar to the promotional and educational work that the Department of Agriculture does for agriculture, was lost.

BUREAUS TO BE INCLUDED IN PROPOSED PUBLIC WORKS DEPARTMENT AS DETERMINED IN COMMITTEE OF THE WHOLE

("Yes" means that it should be included; "No" that it be excluded)

Department of the Treasury	
Public Health Service	No
Supervising Architect	Yes
Department of War	
Public Buildings and Grounds	No
Construction Division of the Army	Yes
Rivers and Harbors	Yes
Mississippi River Commission	Yes
California Débris Commission	Yes
Department of the Interior	
General Land Office	Yes
Indian Affairs	No
Geological Survey	Yes
Reclamation Service	Yes
Bureau of Mines	Yes
National Park Service	Yes
Alaska Engineering Commission	Yes
Department of Agriculture	
Forest Service	Yes
Weather Bureau	No
Public Roads	Yes
Department of Commerce	
Bureau of Standards	Yes
Bureau of Lighthouses	No
Coast and Geodetic Survey	Yes
Unattached Functions	
The Panama Canal	No

(*N. B.*—Some of these decisions were reversed by vote on report of committee on Government activities, which see.)

Report of Committee on Government Engineering Activities

Basing its conclusions upon the discussion which had taken place in the committee of the whole and upon the statement of principles which had been adopted, the committee on Government engineering activities on the following morning presented the following report which, with minor amendment (said amendments being incorporated in the report as printed below) was adopted. The report, as adopted, is as follows:

Your committee charged with a consideration of the question which Government activities should be coördinated in a national Department of Public Works recommends:

1. That the establishment of a national department of public works should be accomplished by grouping those Government bureaus, services, commissions and other activities whose functions are predominantly of an engineering or architectural character in what is now the Department of the Interior, and thereafter designating that department the Department of Public Works.

2. That the transfer of any bureau, service or commission from any other department to a Department of Public Works should be accomplished without change of personnel, compensation and general plan or organization, leaving the coördination of the several activities, the simplification of organization and the establishment of additional bureaus—such, for example, as a bureau of chemical engineering—to be effected as the need for the same may from time to time become apparent.

3. That in transferring river and harbor work and other work nonmilitary in character, but now in charge of the Engineer Corps of the United States Army, to a Department of Public Works, the relation of the Army engineer to such work be not changed, and that there should be no relinquishment of nonmilitary duty by the Army engineers now on such duty until transfer of these engineers to military duty can be made without detriment to the public interests.

Your committee finds that among the bureaus, services and activities which logically belong in a Department of Public Works are the following:

A Bureau of Public Roads.

The United States Reclamation Service.

The Alaska Engineering Commission.

The Construction Division of the United States Army.

A Bureau of River, Harbor and Canal Work, including such functions as are now exercised by the Mississippi River Commission and the California Débris Commission.

A Bureau of Architecture.

A Bureau of Surveys, including the Coast and Geodetic Survey.

A Bureau of Mines.

The Geological Survey.

The Forest Service—at least until the same is divorced from the supervision of water-powers and road building.

The Bureau of Standards.

Your committee believes it would be unwise to determine at this time to what extent the proposed department of public works should control the engineering activities of the General Land Office, of the National Park Service, of the Bureau of Lighthouses, of the Bureau of Indian Affairs, and of the Public Health Service and of various commissions, such as commissions on buildings and grounds, and therefore suggests that such matters may well be deferred for consideration to a later date, preferably until the department has been organized.

Permanent Machinery for Pushing Bill

Much time was given to the discussion of the permanent machinery that should be established in order to promote the passage of the proposed bill. There was general appreciation of the necessity for organizing the profession down to the last Congressional district, in order that the merits of the proposed measure might be brought home to members of Congress through the public and through engineers resident in each Congressional district. The lack of national organization of the profession was brought up repeatedly and much deplored, the discussion at times broadening out to include suggestions for the coördination of all elements of the profession. J. Parke Channing, chairman of Engineering Council, pointed out that the council was still in its formative stage, and so far had included only national engineering societies. An amendment was pending, however, which, if adopted, would permit the affiliation of local societies as well. He was of the opinion that engineers might learn from the American Federation of Labor, which is very loose in its organization and admits all bodies that can contribute to its ends—not merely the craft unions, but the industrial unions as well. In fact, the headquarters organization of the federation has the power to organize unions on its own initiative, without having them subordinate to state organizations or to general craft unions. This permits all classes of labor organizations to come in under the coördinating influence of one body. Concluding, he offered the services of the National Service Committee to the conference in its work of promoting the Public Works Department bill. This offer was promptly accepted, with hearty thanks, by the conference.

With reference to methods of promoting the bill, W. H. Hoyt, of Duluth, maintained that there was need for a journal devoted to the public and civic interests of engineers. Mr. Channing agreed with Mr. Hoyt on the need for such a paper, pointed out that it had been considered by Engineering Council but that the council could do nothing in the matter for lack of funds. E. J. Mehren, on behalf of the McGraw-Hill Co., Inc., offered to the conference space in the journals controlled by that company in the promotion of the bill, as much space as necessary being allocated weekly to the committee. A similar offer was immediately made by the *American Architect*, and similar offers were received at later sessions from the *Railway Age* and from the International Trade Press, Inc., the latter controlling a number of papers.

On the question of financing the campaign, J. L. Harrington, of Kansas City, proposed that an appeal be made to all local engineering societies to pledge an appropriation of $1 per year per member for this work. Philip N. Moore of St. Louis, on the other hand, believed that the financing could and should be done by the four national engineering societies, and urged that to that end the members of those bodies impress upon their directors the importance of the Public Works Department movement, and the advisability of appropriating the necessary funds. Leonard Metcalf, of Boston, pointed out the condition of the treasuries of some of the national societies, and recited how necessary activities had been curtailed because of the shortage of funds. He felt, therefore, that the funds should be raised by an appeal to the profession generally, rather than by asking the national societies alone to shoulder the burden.

As the result of the discussion on organization and financing, a resolution was presented by F. A. Vaughn, of Milwaukee, providing that the conference be made permanent and that the object be the promotion of this bill. The resolution was referred to the resolutions committee and was finally adopted by the conference in the following form:

"Resolved, that this conference be known as the Engineers', Architects' and Constructors' Conference on National Public Works, that it continue in existence until dissolved by its own action, and that its officers and committees be empowered to further the organization and development of a national department of public works."

Three Committees Appointed

Upon motion by Frederic H. Fay and Leonard Metcalf, the conference adopted as its machinery of permanent organization the following three committees: (1) An executive committee, which was empowered to appoint a finance committee and also to add to the other committees to be authorized; (2) a committee on text of bill; (3) a campaign committee.

A committee to determine the personnel of these three committees was then authorized, and after recess brought in the names reported at the close of this report, making it clear, however, that in the time available there was not opportunity to canvass the situation thoroughly by geographical districts and by branches of the profession, and that the personnel committee expected that the executive committee would fill the necessary gaps by enlarging the campaign committee, particularly.

The method of financing the work of the organization was left entirely in the hands of the finance committee.

The advisability of the conference's indorsing the formation of the proposed Department of Transportation was discussed, and while many views favorable to such indorsement were expressed, two successive resolutions introduced thereon by the resolutions committee were tabled, and no action was taken.

At the concluding session resolutions were adopted thanking the Western Society of Engineers and the General Committee of Technical Societies of Chicago for their hospitality and for the facilities they had provided for the handling of the details of the conference. The thanks of the conference were also extended to the McGraw-Hill Co., Inc., the *American Architect*, the *Railway Age*, and the International Trade Press, Inc., for the offer of magazine space to the conference in its work of promoting the passage of the proposed bill.

The following committee appointments, reported by the personnel committee, were approved:

Executive Committee: M. O. Leighton, Washington, D. C., chairman; Francis H. Blossom, D. A. Garber, Cass Gilbert, W. H. Nichols, New York; F. K. Copeland, C. F. Loweth, C. B. Burdick, Chicago; C. E. Grunsky, San Francisco; P. Junkersfeld, Morton C. Tuttle, Boston; Philip N. Moore, St. Louis; F. H. Newell, Urbana, Ill.; W. O. Winston, Minneapolis.

Committee on Text of Bill: M. O. Leighton, Washington, D. C., chairman; J. W. Alvord, A. S. Baldwin, E. H. Lee, I. K. Pond, Isham Randolph, Chicago; Charles T. Main, Boston; Lincoln Bush, New York; G. S. Williams, Detroit; W. K. Hatt, Lafayette, Ind.; H. V. Winchell, Minneapolis.

Campaign Committee [to be enlarged by Executive Committee]: M. O. Leighton, Washington, D. C., chairman; J. Parke Channing, F. S. Cranford, G. W. Fuller, E. J. Mehren, Robert D. Kohn, A. T. North, H. W. Buck, W. D. Blair, New York; C. H. Blackall, Boston; R. A. S. Penrose, R. H. Fernald, Philadelphia; Morris Knowles, Pittsburgh; W. C. Beahan, Cleveland; E. G. Bradbury, Columbus; Julius Stieglitz, W. A. Rogers, Chicago; Baxter L. Brown, E. J. Russell, St. Louis; W. H. Hoyt, Duluth; W. O. Hotchkiss, Madison; Lloyd B. Smith, Topeka, Kansas; W. C. Armstrong, St. Paul; Hennen Jennings, Washington, D. C.; H. S. Crocker, D. W. Brunton, Denver; R. H. Thompson, Seattle; C. F. Swigart, Portland, Ore.; W. L. Huber, Louis Mulgardt, Robert Sibley, F. W. Bradley, San Francisco; P. M. Norboe, Sacramento; J. C. Ralston, Spokane; R. C. Gemmel, Salt Lake City; George A. Damon, J. B. Lippincott, Los Angeles; J. C. Greenway, Bisbee, Ariz.; J. J. Knoch, Fayetteville, Ark.; J. L. Harrington, Kansas City; T. U. Taylor, Austin, Tex.; F. A. Jones, Dallas; W. B. Gregory, New Orleans; Wilmer Waldo, Houston, Tex.; J. F. Coleman, Mobile; L. C. Datz, Birmingham; E. F. Scott, Atlanta; S. B. Earle, Clemson College, S. C.; C. E. Ferris, Knoxville, Tenn.

Roster of Delegates to the Conference and Societies They Represented

Following is a list of the delegates to the conference:

W. L. Abbott,	Am. Soc. Mech. Eng'r
W. C. Armstrong,	Eng'rs' Soc. of St. Paul and Minn. Surveyors' and Eng'rs Soc.
Warwick M. Anderson,	Eng'rs and Architects' Club of Louisville
Bion J. Arnold,	Soc. Automotive Eng'rs
A. S. Baldwin,	Am. Soc. Civil Eng'rs
W. D. Blair,	Am. Inst. Architects
E. G. Bradbury,	Eng'rs Club of Columbus and Ohio Engineering Soc.
Baxter L. Brown,	Eng'rs Club of St. Louis
Chas. Brossman,	Indiana Eng'rg Soc.
Webster B. Bushnell,	Eng'rs Club of Quincy
J. P. Channing,	Mining and Metallurgical Soc. of America
H. H. Clark,	Ill. Gas Ass'n and Am. Steel Treaters' Soc.
Louis Clousing,	Eng'ng Club of Minneapolis
F. K. Copeland,	Am. Inst. Mining and Met. Eng'rs
W. W. DeBerard,	Eng'ng Committee, Chicago Ass'n Commerce
Geo. C. Dent,	Soc. Industrial Eng'rs
F. W. DeWolf,	Am. Ass'n State Geologists
C. E. Drayer,	Nat'l Drainage Congress
W. H. Emmons,	Geological Soc. America
Frederic H. Fay,	Boston Soc. Civil Eng'rs
W. H. Finley,	Am. Ass'n Eng'rs
H. G. Gardner,	Am. Soc. Refrigerating Eng'rs
Lloyd Orr Goble,	Soc. Constructors of Federal Bldgs.
S. A. Greeley,	Am. Public Health Ass'n
W. B. Gregory,	Louisiana Eng'ng Soc.
C. E. Grunsky,	Pacific Ass'n Consult. Eng'rs
R. B. Harper,	Am. Gas Ass'n
Chas. H. Hammond,	Illinois Soc. Architects
Jas. N. Hatch,	Struc. Eng'rs Ass'n of Illinois
John L. Harrington,	Eng'rs Club of Kansas City
W. K. Hatt,	Am. Concrete Inst.
Jas. Herron,	Cleveland Eng'rs Soc.
C. J. Hogue,	Oregon Soc. Eng'rs
W. H. Hoskins,	Am. Inst. Chem. Eng'rs
W. O. Hotchkiss,	American Ass'n State Highway Officials
W. H. Hoyt,	Eng'rs Club of Northern Minnesota and Duluth Eng'rs Club
Peter Junkersfeld	Nat'l Elec. Light Ass'n
W. G. Kaiser,	Am. Soc. Agricultural Eng'rs
Lewis H. Kenney,	Eng'rs Club of Philadelphia
Frank B. Knight,	Brooklyn Eng'rs Club
E. H. Lee,	Am. Ry. Eng'rs Ass'n and Soc. Terminal Eng'rs
D. B. Luten,	Scientech Club of Indianapolis and Indiana Eng'rs Soc.
C. H. Mayer,	Swedish Eng'rs of Chicago
E. J. Mehren,	Am. Road Builders' Ass'n
Leonard Metcalf,	Am. Water-Wks. Ass'n
E. C. Millard,	Am. Civic Ass'n
F. H. Newell,	Washington Soc. Eng'rs
A. T. North,	New York Soc. Architects
C. E. Paul,	Nat'l Lumbermen's Mfg. Ass'n
E. T. Perkins,	Illinois Soc. Eng'rs
Willard F. Pond,	Rochester Eng'n'g Soc.
W. B. Powell,	Eng'n'g Soc. of Buffalo
Isham Randolph,	Franklin Institute and Western Soc. Eng'rs
A. M. Richter,	Indiana Limestone Quarry Ass'n
W. A. Rogers, Edw. Haupt (alternate),	Assoc. General Contractors of America
W. F. Schulz,	Memphis Eng'n'g Club
E. C. Shankland,	Am. Inst. Consulting Eng'rs
C. E. Skinner,	Am. Inst. Elec. Eng'rs
Lloyd B. Smith,	Kansas Eng'n'g Soc.
Julius Stieglitz,	Am. Chem. Soc.
F. W. Ullius,	Eng'n'g Soc. of Wisconsin
F. A. Vaughn,	Illuminating Eng'n'g Soc.
B. C. Wheeler,	Portland Cement Ass'n
G. S. Williams,	Detroit Eng'n'g Soc.
Sylvester N. Williams,	Iowa Eng'n'g Soc.

Engineering Council:

A. N. Talbot	Ira N. Hollis
C. E. Skinner	Philip N. Moore
C. F. Loweth	M. E. Cooley

N. A. Carle

National Service Committee:

Charles B. Burdick	M. O. Leighton
E. J. Mehren,	*Engineering News-Record*

On the following pages will be found the introductory remarks by Mr. Channing and the report of the National Service Committee on the projected department:

Introductory Remarks at Conference on the Proposed Department of Public Works, by J. Parke Channing, Chairman of Engineering Council

This is the latest of a large number of conferences called together during the past half century for the purpose of considering and prosecuting a plan for a national department of public works.

The plans wrought by previous conferences have in many cases been admirably conceived, but they have come to naught for several reasons, the controlling one being that the engineers, architects, builders and constructive thinkers of the country have not given united support and have exerted no strong and persistent push behind the movement.

This conference is in many respects the greatest that has ever been brought together to consider an engineering project, being a conclave of 74 organizations representing a total strength of 99,304 men [revised figures put it at over 100,000], not mere idealists and exhorters given to the exploitation of intangible ideas, but practical, flat-footed men who know what they want and are accustomed to achieve. When we say that this is the latest of a series of conferences, we hope that if we are of determined mind this conference is the last that will be needed.

The last few months have created new conditions and emphasized new necessities—we shall never again tread the paths we trod two years ago; that the changes and reforms that we considered merely desirable then have become the real necessities of the present; that in the present and future urgencies and complexities our Government and our people can, if they would survive, tolerate only those methods and policies that are the most efficient, most business-like and most purposeful and must tear asunder from those which, however old and revered, are but the expedients of a former time inadequately expanded to render present-day service.

Our Government has become the greatest industrial plant in all history—investigating, surveying, building and operating—and its various functions are being conducted with practical independence one with another, and with so little coördination and so complete a lack of common purpose that practically the only occasions when the various elements become conscious of each other is when they overlap and attempt to crowd each other off the map; that any private or corporate business conducted according to the methods of Government would speedily become bankrupt and would deserve such fate. There are twelve Federal organizations engaged in making surveys, more than a score in chemical investigations, some of them competing and quarreling for preference under the same departmental roof. In the Congressional Directory there are listed 29 bureaus and agencies of Government engaged in construction of one or another kind. Four Government departments are engaged in fuel tests, while four Government bureaus are maintaining coast fleets each independent of the other, in the same waters, and engaged in work that has so many points of contact that not one person in twenty realizes that they are separate. These are only a few illustrations of a condition which can be tolerated by no considerate person.

We have come together, each qualified in his own line, to render service to the people, to point out the wastes and extravagances, the chaos and inefficiencies, and to offer some sane and practical solution to the country—so practical and so self-evident that it will carry its own conviction. To do this it will be necessary for each delegate to bear an open mind, and, while expressing freely the convictions that are his, to take part in that mutual concession which alone can bring concerted action among full-grown men.

Engineering Council has invited these conferees to meet for a common purpose and extends welcome, but it does not seek to dominate the deliberations—not even claiming the right to send a voting delegate. As chairman of the council I merely call the conference to order and preside until it effects its own organization.

Report of National Service Committee on the Project for a Department of Public Works, Presented by Philip N. Moore, of St. Louis

For a generation the dream of the civil engineers of this country, using the word in its ancient contrast with the first known form of the profession, represented by our military brethren, has been that one great department of our executive government, under the trained control of an experienced engineer, might achieve charge of all the nonmilitary engineering tasks of the nation. Time and again great engineer presidents, from their official pedestals, in salutatory and valedictory have voiced this vision. Time and again civilian subordinates doing civil-engineering work under military domination have raised their protests and complaints in the professional press and at our gatherings.

But, due to increased specializing of the profession and the engineer's desire, after he differentiated himself, to foregather with his colleagues, he has multiplied societies; and, while increasing their dividends to himself in personal acquaintance, relative influence and gratified vanity, he has not built up any organization with sufficient political potence to achieve in legislation the ideals of the profession.

Of the merits of some plan that shall coördinate under one head the vast engineering activities of the United States Government which now function through a dozen or more bureaus, directed by six secretaries, there will probably be in this meeting few opponents.

That opponents will be found elsewhere, fortified in power, we who favor shall soon realize.

Time Opportune for Realization

Never before were conditions so favorable for realization of this ideal. Reconstruction is a common thought and word. Engineers have borne a great and honorable part in the closing contest. Never before have their services been so publicly and generally recognized. Never before has there been so keen realization of the complexity and unsystem of engineering bureaus of the Government. Bureaus which in the past have competed with one another and grasped jealously for new activities and accompanying appropriations now approve a more logical system, while realizing that unification must leave some heads without bureaus.

Even one cabinet minister, head of more civilian engineers than any other officer in the world, has expressed the opinion that the change is not alone logical and economical but inevitable.

More than two years ago the United Engineering Society, representing the four great national bodies of the profession, with headquarters in New York, established a committee representative of all four to deal with all public matters affecting the engineering profession at large, to be called Engineering Council. That council, serving at first as a convenient referee for all the crank propaganda which came to the founder societies, and spending hours of its supposedly valuable time in saying "No" to impossible propositions, limited in its constructive work by financial resources so narrow that it could scarcely buy a new broom with which to sweep the ancient cobwebs from the windows of the engineering structure, where they had been accumulating since the days of Leonardo da Vinci, at last determined on a constructive task of the first order.

There was established a National Service Committee, with headquarters in Washington, for the purpose of finding opportunities of service to the nation on the part of the organized profession.

It chose ts first task—the establishment of a national department of public works. Such action has, of course, met criticism. Particularists unfortunately abound among engineers. Possibly the intense specialization of our training inevitably leads that narrow way; but one of the penalties thereof, equally inevitable, is restricted vision. Disregarding such protests in the interest of the profession at large (enabled by the generous and broadminded underwriting of one of our far-sighted brethren), the National Service Committee is functioning.

Its first effort to that end is the gathering to which I have the honor of speaking. If I be not mistaken, it is more representative of the profession than any hitherto assembled. Upon its decisions, and upon the support of the societies which it represents, will depend the speed with which we achieve our object. Engineering Council seeks support of the entire profession throughout the nation. If the unanimously expressed will of the council be followed by the founder societies, it will offer membership to every dignified recognized engineering society in the United States, and thereby become the true and powerful voice of the profession.

If we undertake it forget not, gentlemen, tnat our task will be successful in direct proportion as it is patriotic and unselfish, and that results which may come to the profession, of dignity, of national recognition, and of reward, will come more surely if we conduct our campaign with dignity and unselfishness. Engineering Council has opened the way. It has undertaken the task; it has climbed the barbed fence of false ethics; and has put the profession squarely into the great field of national policies or, if you choose to call it, national politics. In that field grow thorns and briars, as well as good grain. Engineering Council has put the hand of the profession to a new plow. It will not look backward; it will plow no crooked furrows. Some of them may be shallow; some of them may be faulty; but, from that field, unless the speaker be mistaken, gentlemen, there will come a harvest of efficient grain, which, but for the service of the profession, would never have been planted.

Upon you, gentlemen, and on those whom you represent, will rest the result. From you must come the power which keeps that plow in the furrow. Without your support the tough clay of poverty or the ancient stumps of professional particularism and conservatism may halt it.

Unless your speaker be a false prophet, it can be halted only for a time. Under some other impulse, the action will be renewed. Coördination and simplification of the present complex situation in national service must come in the end. It can be delayed. It cannot be stopped. It is inevitable. It were better for the honor of the profession, for our own self-respect, that we, and we alone, carry it through. In your hands, gentlemen, the task abides. To its discussion, broadminded and without selfishness, the National Service Committee invites you.

Miami Conservancy Construction Work Not Damaged in Flood

A HEAVY storm over the valley of the Miami River in Ohio, Mar. 15-17, with a total precipitation of 3½ in., caused a sharp flood in the Miami River and its tributaries, where the conservancy district flood-protection works are now being built. The conservancy construction plans had from the start been developed in such a way as to take account of the likelihood of floods of every magnitude (up to that of the extreme 1913 flood); the five dams of the project are the critical points, both with respect to damage to the work under construction and damage to the property in the valley, while the levee and channel-widening operations are a minor factor. The precautions taken in the planning proved to be ample for all conditions imposed by the March flood. A description of the storm and of its effect on the work in progress is given in the April, 1919, issue of the *Miami Conservancy Bulletin.*

Forecaster and flood-warning service provided by the district gave effective notification of the coming storm and probable flood to the construction offices and to the communities and inhabitants of the valley. All construction plant was promptly made safe or, as in the case of excavators in exposed positions, moved back to safer ground.

Pump installations at the construction cofferdams were in most cases so low that the motors were likely to be flooded. Provision for this risk had been made at the time of building the pump houses, by setting beams over the motors so that at any time these machines could be lifted up above flood level. At Taylorsville this was done after the first 24 hours of rainfall, the motors being hoisted up 4 or 5 ft. and lashed in place. Elsewhere extra pumping was done to cut down excessive seepage through cofferdams and permit the resumption of concreting without delay.

The dragline excavators on channel work at Dayton and Hamilton, three or four of which were at work in the channel, were not underscoured or otherwise injured. Slight wash of the new levees occurred in both cities at the level of the top of the flood.

In substance, the effect of the flood upon the construction work was limited to producing from one to five days' delay in the operations, and calling for a small amount of extra work to make plant and materials safe before the water rose.

Reorganization of the Engineering Standards Committee

Effect of Engineering Standards Movement on Technical Societies—Reorganization to Give Broader Representation—Association May Be Formed To Elect the Committee—Formulating Safety Codes

By Edward B. Rosa
Chief Physicist, Bureau of Standards, Washington, D. C.

For the first time an explanation of the American engineering standards movement is presented to engineers. Dr. Rosa, to enlist general support of the movement, tells of the organization of the committee formed last October, and of its proposed broadening into an association. This proposal, now before the councils of the societies, is to be acted upon in the near future. Together with Prof. C. A. Adams and H. W. Forster, Dr. Rosa served on a committee which prepared plans for consolidation of the safety-code conference with the standards committee. Having been intimately concerned with all phases of this planning, he writes from the fullness of knowledge. In the absence abroad of Professor Adams, the leader in the standards committee movement, no more commanding utterance on the subject could be offered to engineers than the present.—Editor.

Two recent editorials in *Engineering News-Record* (April 10 and 17, 1919, pp. 700 and 751) discuss the relations of engineering societies to the American Engineering Standards Committee, particular reference being made to the American Society for Testing Materials. The suggestion is made that the influence upon this and other societies of the Engineering Standards Committee, especially as it is proposed to be reorganized, would be harmful, and that these societies would do well to reconsider their action in establishing this committee.

If participation in the work of the committee and closer coöperation with other engineering bodies should lead to a decline in the influence and usefulness of the American Society for Testing Materials, it would be unfortunate; if it had the same effect also on all the other strong and useful engineering societies concerned, it would be a calamity. But I believe the result will be the opposite, and that these societies will be strengthened, and not injured. Without question, the work of engineering research and standardization in this country will receive a powerful impetus if the present plans for the reorganization of the American Engineering Standards Committee are approved by the founder societies and carried out in the spirit in which they are conceived. Unfortunately, these plans, so very recently formulated, are not yet generally understood.

Principles of the Standards Association

The cardinal principles of the proposed American Engineering Standards Association are fair play and coöperation. Each society retains its integrity and initiative, and yet recognizes the existence and the rights of others; each society or Government body manages certain work of research and standardization itself as now, but with the coöperation of representatives of other agencies invited to participate because of their interest in the subject and the information they can furnish. The practicability of this method of standardization has been abundantly demonstrated by the American Society for Testing Materials itself, as well as by the American Institute of Electrical Engineers, the Society of Automotive Engineers and other engineering bodies. Indeed, one can truly say that the procedure of the proposed new organization is almost identical in principle with that of the American Society for Testing Materials, but expanded and applied to a large number of organizations acting in harmony, with a definite method for preventing or dealing with conflicts, and with a democratic spirit pervading the whole.

Need for a Coördinating Agency

The authority of the American Society for Testing Materials and other societies, which they enjoy by virtue of the representative character of the men composing their committees and the quality of their work, will remain undisturbed by the new organization. The Engineering Standards Committee will approve a standard because it is certified by some sponsor society and its coöperating committee, not because the central committee has itself examined it and passed an independent judgment upon it, which that committee will not attempt to do. The quality standards of the American Society for Testing Materials, the electrical standards of the American Institute of Electrical Engineers, the codes and standards of the Bureau of Standards, will derive their authority largely from the reputation of the sponsor bodies that prepare and certify them. They will, however, possess the added advantage that the Engineering Standards Committee, made up of representatives of all engineering and commercial interests and the Government, will certify that the procedure of the committee has been complied with, that all interests concerned have been heard and there is every reason for accepting the sandard and putting it into general use. This guarantee by a thoroughly competent and authoritative body will be worth much, even in the case of the strongest societies and Government bureaus.

In addition to a few conspicuous societies and Government departments concerned in the making of standards, there are scores of others that coöperate in and to some extent initiate such work. Heretofore each has had to find out for itself what work other societies were doing or contemplating, and establish connections as best it could for coöperation or for adjusting matters of conflict. There has been no central agency to keep a record of all standardization work in progress or being organized, to assist in securing the proper degree of coöperation and to avoid conflict and duplication of effort. The need for such a central coördinating agency has been felt for years; it was only a question of how it should be realized. The present committee has not yet attempted to meet this need. The reorganization proposed looks toward accomplishing this important result in an adequate manner.

The British Engineering Standards Committee has been in successful operation for a number of years and

has been carefully studied by American engineers. It largely initiates research, appoints the chairman of the committee for a particular piece of work and nominally, at least, supervises the work. It was generally agreed that conditions here in America favored a different method of procedure. Engineering and commercial organizations and Government departments were already active in standardization work, and were in many cases coöperating in a very satisfactory manner with one another, as has been pointed out by *Engineering News-Record*. It was desirable to continue and extend the methods that had been found successful rather than to set up a new method.

The procedure adopted by the American Engineering Standards Committee leaves the initiation and management of the work, and the selection of the coöperating committee, with the sponsor society. This sponsor society may be any responsible agency competent to do the work and entitled to do so by virtue of its relation to the subject. The Standards Committee advises and approves, and having done so will support and encourage the sponsor body in its work. But it does not control the sponsor body, and should not in any way embarrass it.

Reasons for Reorganization

The present Engineering Standards Committee is composed of 15 men of the highest standing who represent five leading engineering societies; it was planned also to have representatives of the Government. If no one objected to having so restricted a committee perform the important functions of coördinating and encouraging engineering standardization by all private and Governmental agencies, and dealing with similar organizations in other countries on questions of international standardization, there would have been less occasion to reorganize the committee.

To be sure, a larger representation would secure a more generous financial support and better coöperation in creating standards and getting them into use. Nevertheless, if everybody was satisfied and the small committee had the confidence and good will of all the interests concerned, and was willing to give it the requisite amount of time, it could have gone along with its work successfully and satisfactorily. It appeared, however, that such was not likely to be the case.

Ours is a democratic country, and this is a democratic age. We believe in equitable representation. To be successful in the performance of its important functions an engineering standards committee should be representative of all the interests concerned and should be supported by a strong public sentiment.

This, it appeared, could only be secured by giving representation to all organizations and Government departments interested in the preparation of engineering and industrial standards. The larger societies should, of course, have a larger number of representatives than the smaller. Since there are many scores of societies and Governmental agencies that may be expected to desire representation in such an organization, it would obviously soon become too large for a working standards committee. The evident procedure was to call the large representative body an association instead of a committee, and let there be formed within the association a standards committee.

The association should then be subdivided into groups or divisions. The details of such subdivision have not been agreed upon, but for the sake of a clear conception of the work of the association there can be no harm in describing one plan that was submitted to the committee for consideration.

Suggested Divisions of the Association

According to this plan, there would be 10 divisions of engineering and industrial organizations and two representing the Government, as follows:

1. Electrical engineering and electrical industries.
2. Mechanical engineering and allied industries.
3. Mining and metallurgy and allied industries.
4. Civil engineering, architecture and building.
5. Chemical engineering and chemical industries.
6. Materials of construction (A. S. T. M. division).
7. Miscellaneous manufactures.
8. Steam and electric transportation.
9. Automobiles, aircraft and other automotive vehicles.
10. Fire protection and safety engineering.
11. Federal bureaus and commissions.
12. Associations of state and municipal agencies.

The divisions would contain in some cases five to 10 and in other cases as many as 20 or more national societies and manufacturers' organizations having a certain common interest. Two or three examples of such divisions may be mentioned, to illustrate its working.

Electrical Division—There would be from 10 to 20 national engineering societies and manufacturers' organizations in the first division, of which the Amercan Engineers is most conspicuous and most active in matters of electrical standardization. Its Standards Committee has a splendid record of achievement and carries on its work in a spirit of fair play and coöperation. The institute invites into its Standards Committee as coöperating members representatives of the Illuminating Engineering Society, the Institute of Radio Engineers, the Electric Power Club, the Bureau of Standards, and other organizations having an interest in the subjects covered by its standardization rules. Sometimes general agreement is difficult to secure; in such cases discussion and study of the question are continued, investigations are undertaken if necessary, and the subject is not considered settled until substantial unanimity is reached. Some of the members of the committee represent large or small manufacturing interests, others are consulting engineers, college professors, Government officials. It would be difficult to find, anywhere, a finer example of a standards committee which is thoroughly representative, competent, energetic and imbued with high ideals.

If the standards association comes into existence with its central standards committee, the committee of the Institute of Electrical Engineers would go on with its work just as now, reporting to the board of directors of the institute as heretofore. The board would approve the work and transmit it to the association for its approval, having previously submitted the names of the men representing other organizations which sit in its Standards Committee, so that it would be evident that all interests are represented and that standards prepared by such a committee deserve to be approved and to be labeled "American Standards." In fact, the procedure of the American Engineering Standards Committee was devised expressly with this in view, for it was recognized that any requirement that seriously embarrassed the work of the large engineering societies would be fatal to the success of the movement.

(*To Be Concluded*)

Cost-Plus Contract Incentive To Close Management

Contractor Creates a Clientele of Customers and Not Merely a Chance to Bid Again, Says Prominent Cost-Plus Advocate

(Editorial Interview)

IS THERE a greater incentive to good construction management in the cost-plus contract than in the lump-sum contract? Discussing this question with the editor, Morton C. Tuttle, of the Aberthaw Construction Co., developed a line of thought which, though possibly not new, will repay attention by contractors. For the concern performing the whole or a large part of its work on a cost-and-profit basis, there is, asserted Mr. Tuttle, a tremendous incentive to satisfy each engineer or owner for whom work is done. Then he continued:

It is clear that the anxiety which a contractor feels for his own financial interests may vary greatly as between a lump-sum and a day-work contract. If he is satisfied to do one job for one customer and to leave that customer dissatisfied, he undoubtedly has a chance on a cost-plus contract to pile up cost, and, short of provable negligence, will be reimbursed for all expenses incurred. At the end of the job he will receive the agreed profit and will be left with an impaired good-will. A few repetitions of this situation should remove him completely from the field of cost-plus work. It is inconceivable that large jobs will be placed with any contractor until after his references have been thoroughly looked up.

One dissatisfied customer will prevent a great deal of future profit. In one case which has received rather wide publicity a dissatisfied customer had a considerable part in ultimately bankrupting a once prominent building concern

Builds Up a Clientele—It is apparently not clearly understood in the building trade that a reputation for carrying on honestly and successfully—and, above all things, economically—a cost-and-profit business leads to the establishment of a clientele of customers who turn all their work to a concern which has once satisfied them. In the case of my own company 58% of our business in the past five years has come from concerns for which we have worked before, and very commonly we do all building work for many of these customers. Had our business been done on a bid basis we should have earned with each of these customers simply a chance to bid again. To establish business relationships as intimate as this, leads necessarily to vigilance as to each detail of every operation. A concern carrying on cost-and-profit work primarily must be honest, and it must have vision enough to understand the necessity of carrying on its work satisfactorily to each and every engineer and owner. It is so easy to start a reputation for extravagance, for inefficiency or for careless workmanship that vigilance has to be exercised at all times. To allow slackness on any one job, or to allow higher costs than are justifiable, would be suicide.

The two types of contract are really difficult of comparison. Under the percentage form of contract it will be assumed that the engineer or architect has specified exactly what he wants and is entitled to exactly that which he has described. Under the lump-sum form of contract an attempt is commonly made to see how far it is possible to depart from the more expensive items specified. The questions of allowances and extras are always troublesome and generally are not frankly handled. With the lump-sum contract there is a tendency to give less thought to the quality of the work and more thought to the first cost—a procedure which shows up later in the cost of upkeep. With the lump-sum contract there is less coöperation between the engineer and the builder, a condition which has again and again resulted in needless expense, loss and faulty workmanship.

That the quality of work should be better under the cost-plus form of contract is undoubted. As to cost, it would be interesting to see a tabulation showing the bid prices and the final costs of, say, twenty-five jobs. Very commonly the original bid and the final cost would not be recognizable as applying to the same work.

No Perfect Lump-Sum Contract—Some day, so close to the millennium that the question of building shelters may be neglected, some engineer or some architect will make an absolutely clear set of plans and specifications which will describe accurately some big job from start to finish. Then he will invite a limited number of perfectly honest and perfectly competent contractors to make independent and honest estimates, each estimate to contain a reasonable item of profit, and with these estimates will come an honest statement of the length of time each of these contractors will require to carry out that work. Under these conditions, we shall all agree, the lump-sum contract is a most excellent thing because an honorable concern has employed an infallible engineer and architect to describe exactly what it will require and an honest and able contractor has agreed to furnish these things, and has assured himself of a reasonable profit for furnishing them exactly without substitution.

Until this combination is secured there will be a good chance to argue with any owner that he is more likely to get what he wants in the time in which he wants it by some arrangement which secures the coöperation of his contractor with his engineer, with the assurance on the part of both that they will be reasonably compensated for the work that they do.

Efficient Labor Due to Efficient Supervision—The common explanation of any slackness of labor on a cost-plus job is that the laborers know that their employer's interest will not suffer if they loaf upon that particular job. To anyone familiar with the building trade, how much anxiety labor feels toward the financial interests of its employer is a subject for profound speculation.

As to the performance of the labor under the two forms of contract, it seems reasonable to suppose it will produce the most economical and satisfactory results on the job where it is best directed and best led, regardless of the contract arrangements. C. S. H.

British Women Engineers Organize Union

British women engineers, one of the war discoveries, have banded together in the Women's Engineering Society, a trade union. The women want, among other things: Admission to the Amalgamated Society of Engineers; to become members of institutes of civil engineers, naval architects, iron and steel and other bodies now closed to women; to serve on the boards of universities, and to become eligible for technical branches of the higher civil service.

A New Principle in the Theory of Structures

Professor George F. Swain Gives Formula for Computing the Rotation in Elastic Distortion Similar to That for Deflection

MAKING use of the principle underlying the Maxwell reciprocal theorem, Prof. George F. Swain of Harvard University gives in the March issue of the *Proceedings* of the American Society of Civil Engineers, p. 75, a new formula similar to that by which the deflections of trusses and other frames are determined, but defining distortional rotation instead of deflection. Like the deflection formula, it may be used in connection with the problem of computing the stresses in constrained (statically indeterminate) frames, by first computing the distortion when the constraint is removed and then finding the moment required to neutralize this distortion. The formula is simple and easily remembered, being a close analogue of the deflection formula.

As first published in this country by Professor Swain in 1883 (in the *Journal of the Franklin Institute*), the formula for deflection at any point of a frame is

$$\Delta = \Sigma \frac{stl}{EA}$$

in which t = stress in a member due to a load of unity acting at the point whose deflection is desired, and acting in the direction of that deflection;

s = stress in the same member from the actual loading.

l, A, E = length, sectional area and modulus of elasticity of the member.

In the case, for example, of an arched roof truss over an assembly hall, where it may be desired to find the horizontal movement of the expansion end due to the loads on the truss, the procedure would be as follows: Apply a horizontal outward force of 1 lb., at the two ends of the truss, and find the stress in each member due to this force, calling such stress t; compute the stresses in the several members under the actual roof loads and call them s; then obtain the product stl for each member, divide by the sectional area and by the modulus of elasticity, and add the resulting figures for all members of the truss. The result will be the horizontal outward deflection of the truss in inches, provided the lengths of the members, l, were taken in inches.

The method implied by this formula is applicable also to solid members in flexure; for this case, if M_t is the bending moment at any section caused by unit force acting at the point of deflection in the direction of the desired deflection, M_s is the bending moment at the same section due to the actual loads, and I is the moment of inertia of that section, then

$$\Delta = \int \frac{M_s M_t dl}{EI}$$

The New Formula—When the angular rotation of any point in a member or a frame is to be computed, the new formula now proposed by Professor Swain furnishes a means. The formula in its simplest form is

$$\alpha = \Sigma \frac{rsl}{EA}$$

in which r = stress in any member of length l and cross-section A produced by a couple of unit moment acting at the point whose rotation is desired and in the direction of the desired rotation;

s = stress in the same member produced by the applied loads.

The formula is derived as follows: Apply at the point of rotation a unit moment, and consider the (external) work expended by this moment in rotation. It equals the product of the moment by half the rotation α_1 (in angular measure), since the moment is bound to increase uniformly from zero to its full value of 1 as the distortion comes into existence; or $W_e = \frac{1}{2}\alpha_1$. The work of the internal forces must be just equal to this amount. If r is the stress in any member of the structure caused by this unit moment, and Δl_1 its change of length, then the internal work of that member will be $\frac{1}{2}r\Delta l_1$, and the total internal work for all members will be $W_i = \frac{1}{2}\Sigma r\Delta l_1$. Equating this to the external work,

$$\tfrac{1}{2}\alpha_1 = \tfrac{1}{2}\Sigma r\Delta l_1, \text{ or } \alpha_1 = \Sigma r\Delta l_1$$

It follows that under the action of this unit moment the rotational distortion α_1 due to the deformation of *any one member alone* is $\alpha_1 = r\Delta l_1$. However, there is a purely geometrical relation between the angular rotation at the point of the structure in question and the change of length of any member, irrespective of the kind of loading. Therefore the change of length produced in that member by any other system of loading will bear the same proportion to the resulting rotational distortion as in the above expression. Then if the change of length Δl due to the actual loads on the structure be substituted for the value Δl_1, the angular rotation α_1 due to unit moment may be replaced by the actual rotation α due to the actual loading, or $\alpha = r\Delta l$. Now the change of length Δl under the actual loads, which produce the stress s in the member, will be $\frac{sl}{AE}$, and upon inserting this value in the preceding expression,

$$\alpha = \frac{rsl}{EA}$$

Summing this expression for all members of the structure the result is the total actual rotation of the point in question, or

$$\alpha = \Sigma \frac{rsl}{EA}$$

In this expression r is the stress on the member of length l and cross-sectional area A produced by a couple of moment unity acting at the point whose rotation is desired, while s is the total stress in the same member due to the applied loads.

As here demonstrated, the formula applies only to the case of direct (axial) stress in every part of the structure. For the general case, where there is bending as well as direct stress in any or all parts, the quantities r and s must be expressed by the products of the actual unit stress at the different points of each cross-section of the member multiplied by the element of area; for example, when the direct stress is T_s and the bending moment M_s, the product in question for a point at distance y from the neutral axis of the cross-section is

$$s = \left(\frac{T_s}{A} + \frac{M_s y}{I}\right) dA$$

and similarly for r. Inserting these values in the above equation and carrying out the multiplication, it will

be found that certain terms of the result vanish because the integral of $y\,dA$ is zero for an axis passing through the center of gravity of the cross-section (the value of the moment of inertia, I, is of course also computed around a gravity axis). The final result is

$$x = \Sigma \frac{T_s T_r l}{EA} + \Sigma \int_0^l \frac{M_s M_r dl}{EI}$$

Because of the way in which the products of the direct stresses under actual and hypothetical loading, and the products of the corresponding moments, appear in this equation, it is evident that the *flexure in any member of the structure may be neglected unless* both the actual loads and the hypothetical unit moment cause flexural stress in it. Similarly, the *direct stress in any member may be neglected unless* both the actual loads and the hypothetical unit moment produce a direct stress in it.

When every member is uniform in cross-section from end to end, the integral sign in the first member of the above expression disappears, and the differential dl is to be replaced by l, the length of the member.

Several illustrations of the application of this principle are given by Professor Swain. One of these may be cited here to aid in understanding the formula.

To find the slope at the right end of a beam of constant cross-section loaded with a single concentrated load P at a distance a from the left end, the span of the beam being l. The left-hand reaction will be $P(l-a)/l$, and the moment at any section to the left of the load, at a distance x from the left end, will be $M_s = Px(l-a)/l$. Similarly, in the right-hand segment of the beam the moment is $M_s = P(l-x)a/l$. For an applied unit moment (anti-clockwise) at the right-hand end, balanced by appropriate vertical reactions of $1/l$ at the ends of the beam, the moment at any point of the beam will be $M_r = x/l$. Using these values in the formula, the first term disappears because there are no direct stresses to be considered. The rotation therefore is

$$\alpha = \int_0^l \frac{M_s M_r dl}{EI} = \frac{1}{EI}\left[\int_0^a \frac{Px(l-a)}{l}\frac{x}{l}dx + \int_a^l \frac{P(l-x)a}{l}\frac{x}{l}dx\right] = \frac{1}{EI}\left[\frac{P(l-a)}{l^2}\frac{a^3}{3} + \frac{Pa}{l^2}\left(\frac{l^3}{2} - \frac{la^2}{2} - \frac{l^3}{3} + \frac{a^3}{3}\right)\right] = \frac{Pa}{6EIl}(l^2 - a^2)$$

Other cases of beams, and cases of trusses, may be dealt with just as simply.

Six Years of Rapid-Transit Progress in New York

Construction Enterprise Greater Than Panama Canal Carried On at Remarkable Rate Despite War Interference—Over Four Times as Much Work Accomplished as On Old Subway

By D. L. Turner

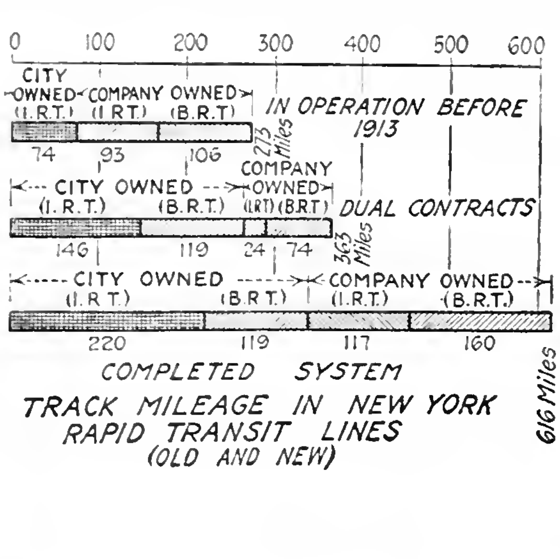
Chief Engineer, Public Service Commission for First District, New York City

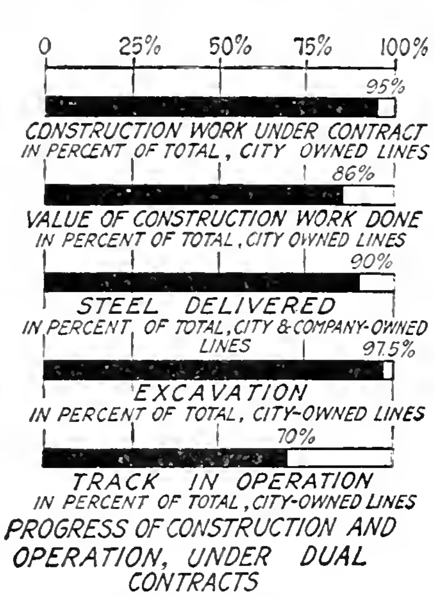
In the six years since the signing of the dual contracts for rapid-transit construction and operation in New York City, the system involved in those contracts has been nearly completed. In terms of total cost for labor and material of city-owned lines (excluding car-storage yards) it is approximately 86% complete; in terms of excavation on city-owned lines, the largest single item of expense in subway construction, 97½% complete; in terms of steel, the largest single item of material, 90% complete. Of the entire mileage, 95% is under contract and 70% of the total track mileage to be constructed or reconstructed is now in operation.

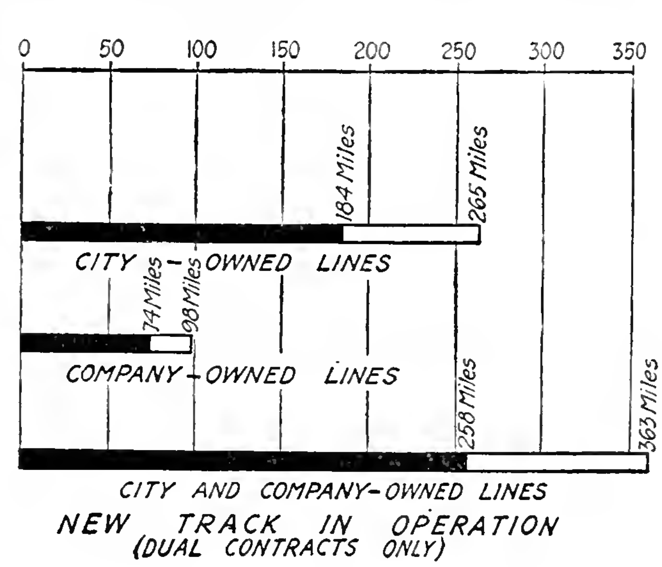
Approximately as much newly constructed track has already been put in operation as was being operated in 1913 in the subway and on all elevated lines in New York and Brooklyn combined.

Under the most favorable conditions this would be a noteworthy accomplishment. But when it is remembered that one year and four months after the dual contracts were signed the world war began, and that for one-third of the six-year period this country has been a participant in the world's greatest war, involving as it did the almost immediate and complete diversion of all kinds of material and manpower to war work, the achievement is nothing short of remarkable.

Old and New Rapid Transit Systems—Under the dual contracts, signed Mar. 19, 1913, six years ago, the city entered into a partnership with two rapid-transit companies whereby city and companies joined in the con-







FIGS. 1, 2 AND 3. 1, NEW YORK'S RAPID-TRANSIT SYSTEM MUCH MORE THAN DOUBLED BY DUAL CONTRACTS; 2, CONSTRUCTION UNDER DUAL CONTRACTS NEARLY COMPLETED; 3, OVER TWO-THIRDS OF NEW MILEAGE ALREADY IN OPERATION

struction of new subways and elevated railways, and in the third-tracking, reconstruction and extension of the existing elevated lines, with provision for pooling receipts and expenses and sharing net returns on the entire unified systems (excepting only the old tracks of the Manhattan elevated lines). To protect the city's interests in this partnership arrangement the Public Service Commission was charged with the direct and full supervision of the construction of all city-owned

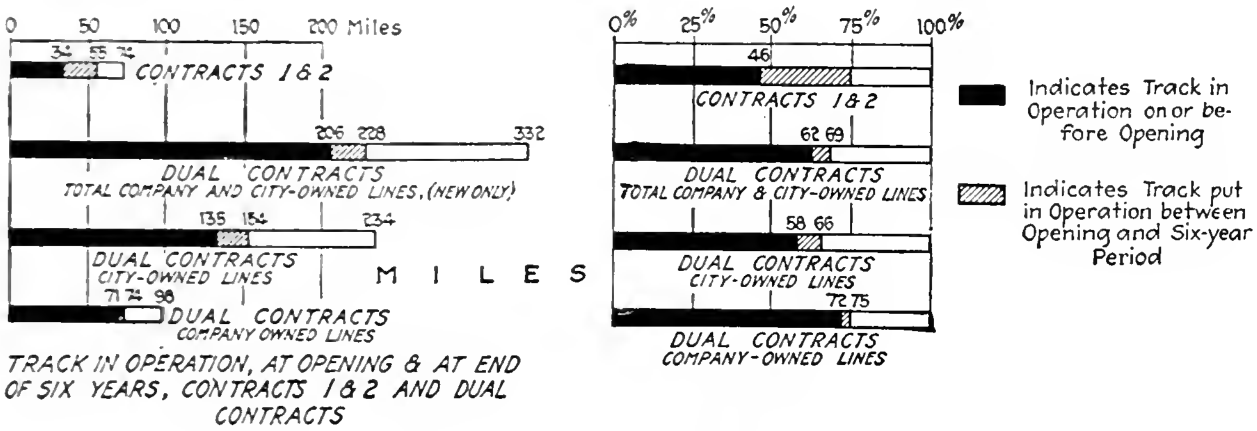


FIG. 4. COMPARISON OF WORK ACCOMPLISHED IN SIX YEARS, 1900-1906 AND 1913-1919

Contract No. 1 signed Feb. 21, 1900; opening, Oct. 27, 1904 or $4\frac{2}{3}$ years after signing. Dual contracts signed Mar. 19, 1913; opening of "H" system, Aug. 1, 1918 or $5\frac{1}{3}$ years after signing. The diagram does not include the trackage on the East River bridges and sections of the Fourth Avenue (Brooklyn) subway and Centre Street Loop under contract prior to Mar. 19, 1913.

lines and a general supervision of all company work, which included reconstructing, third-tracking and extending the company-owned lines, and equipping the entire system. The magnitude of this project and the progress which has been made in the six years since the signing of the contracts are illustrated by the accompanying maps, diagrams and tables.

Six years ago, on Mar. 19, 1913, there were in operation about 273 miles of track on all the rapid-transit

TABLE I. NEW YORK'S RAPID-TRANSIT SYSTEM IN 1913 AND AFTER COMPLETION OF DUAL CONTRACT LINES (EXCLUSIVE OF YARDS AND SIDINGS)

Lines in Operation Mar. 19, 1913	Miles Single Track
City-owned subway and elevated extensions operated by Interborough Rapid Transit Co.	74
Manhattan elevated lines	93
Brooklyn Rapid Transit Co. elevated lines	106
Total, all rapid transit lines	273
New Rapid-Transit Lines According to Dual Contracts	**Miles Single Track**
Company-Owned Lines	
Manhattan elevated lines, third-tracking and extensions	24
Brooklyn elevated lines, reconstruction, third-tracking, and extensions	74
Total, company-owned lines	98
City-Owned Lines	
For Interborough R. T. Co. operation	146
For New York Municipal Ry. Corporation (B.R.T.) operation	119
Total, City-owned lines	265
Grand total under the dual contracts and related certificates	363

lines. Under the dual contracts and related certificates provision was made for about 363 miles of additional track. Both systems are itemized in Table I. The total track mileage on the entire rapid-transit systems will be approximately 616 miles of single track. To illustrate by a comparison with familiar distances, the subway and elevated lines being constructed under the dual contracts are about equivalent to a two-track subway and elevated line from New York to Baltimore or more than a similar four-track line from New York to Philadelphia. The total system (including old and new lines) when complete would form approximately a four-track line from New York to Philadelphia with a two-track extension to Washington. The diagram, Fig. 1, shows graphically the relative magnitude of the project compared with the subway and elevated lines in operation six years ago, which had been constructed piecemeal over a period of nearly half a century.

As Compared With Panama Canal—Heretofore the Panama Canal has been considered our largest construction undertaking. As a matter of fact, the dual subway project, while not as romantic as the joining together of two oceans, surpasses it in size and intricacy. It will cost more, and the engineering difficulties have been greater and more complex. One of the great difficulties in the Panama Canal construction was the sliding of earth into the canal after the excavation had been nearly completed. To picture the relative difficulties of the two projects imagine the catastrophe that would have resulted from even a relatively small slide of earth into a partially completed subway cut. Remember that the foundations of many buildings 20 or more stories in height have been rebuilt. Then add the fact that the subway construction has been carried on under the streets practically without interference with their use, so that few of New York's population passing daily over these streets have had a glimpse beneath the surface at the gas and water pipes, electric

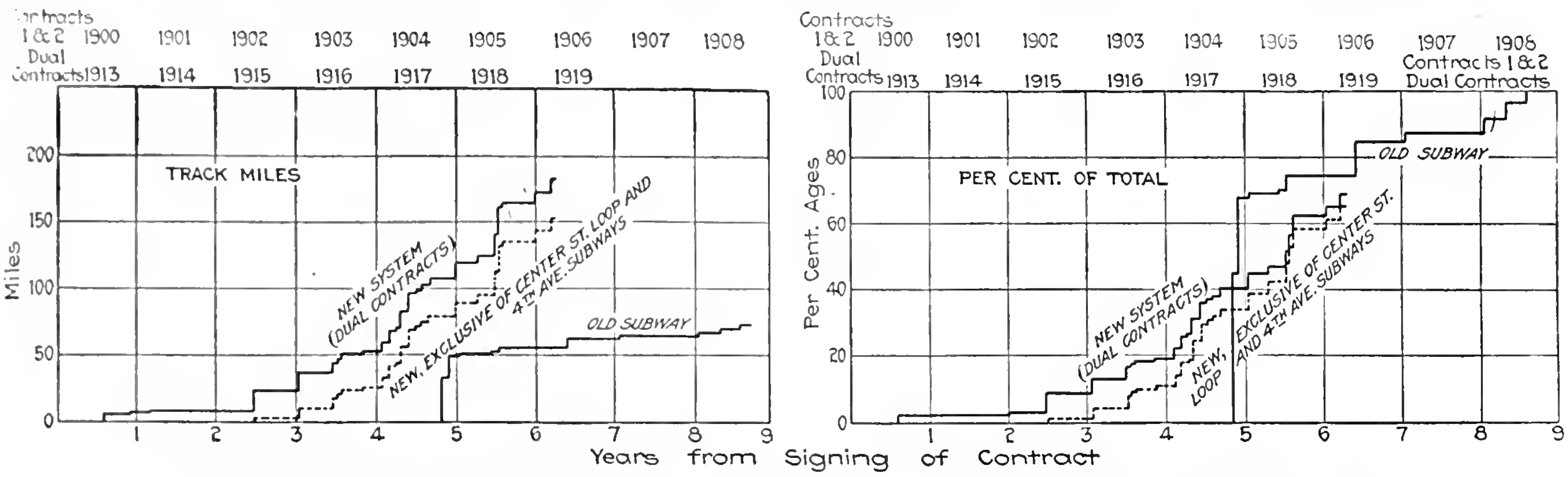
TABLE II. TOTAL MILES OF ROUTE AND TRACK TO BE CONSTRUCTED UNDER THE DUAL CONTRACTS AND THE PORTION IN OPERATION MARCH 19, 1919 (EXCLUSIVE OF CAR STORAGE YARDS, SIDINGS, ETC.)

Including Centre Street Loop and Fourth Avenue (Brooklyn) Subway

	Total Track Miles	Total New Route Miles	In Operation March 19, 1919: Track Miles	Track %	New Route Miles	New Route %
City-owned Lines						
Operated by Interborough R. T. Co.	146	48	104	71	34	71
Operated by New York Municipal Ry. Corporation	119	42	80	67	25	60
Total, City-owned lines	265	90	184	70	59	66
Company-owned lines						
Operated by Interborough R. T. Co.	24	4	21	87	2.5	62
Operated by New York Municipal Ry. Corporation	74	32	53	72	22	69
Total, Company-owned lines	98	36	74	75	24.5	68
Total, all lines	363	126	258	71	83.5	66

Excluding Centre Street Loop, and Fourth Avenue (Brooklyn) Subway, contracted for prior to Mar. 19, 1913, and as in operation Mar. 19, 1919

	Total Track Miles	Total New Route Miles	In Operation March 19, 1919: Track Miles	Track %	New Route Miles	New Route %
City-owned lines						
Operated by Interborough R. T. Co.	146	48	104	71	34	71
Operated by New York Municipal Ry. Corporation	[illegible]8	34	50	57	17	50
Total, city-owned lines	234	82	154	66	51	62
Company-owned lines						
Operated by Interborough R.T. Co.	24	4	21	87	2.5	60
Operated by New York Municipal Ry. Corporation	74	32	53	72	22	69
Total, company-owned lines	98	36	74	75	24.5	68
Total, all lines	332	118	228	69	75.5	64



RELATIVE PROGRESS IN PLACING TRACK IN OPERATION, OLD SUBWAY AND DUAL CONTRACT SYSTEM

FIG. 5. NEW RAPID-TRANSIT LINES PLACED IN OPERATION PROGRESSIVELY DURING CONSTRUCTION PERIOD

Contracts Nos. 1 and 2 include old subway from Atlantic Avenue to Bronx Park and Van Cortlandt Park.

conduits and other structures which had to be maintained in constant use in order that the life of the city might go on unaffected by the gigantic work progressing rapidly under its feet.

For construction, the city-owned lines were divided into 87 major sections, of which 83 sections, or 95%, have been contracted for (Fig. 2). Of the four remaining, the two sections of the Nassau St. line have been temporarily postponed on account of war conditions; one section, extending the Queensboro Subway to Times Square, could not be undertaken until after the opening of the main east-side and west-side subways (Interborough), and its beginning then was deferred because of the war; and on the fourth, the elevated extension of the 14th St. Eastern line, bids were received and rejected for lack of sufficient engineering force to supervise the work properly. Contracts for station finish and track have been let, and the installation of equipment by the companies has proceeded as rapidly as the progress of the work under the construction contracts permitted.

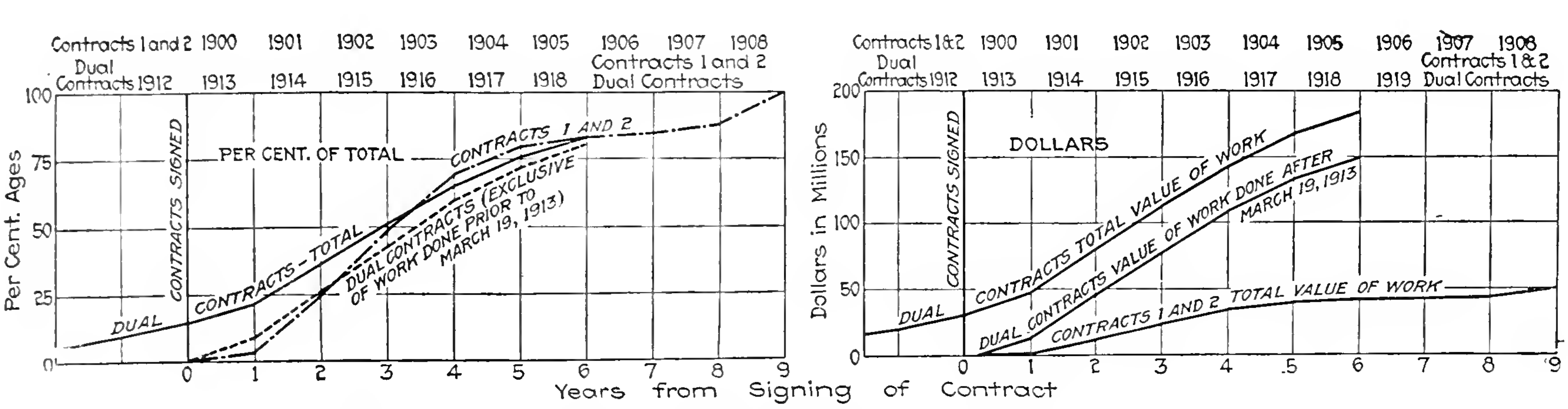
Expenditures to Dec. 31, 1918, for construction, additions, extensions and equipment (including interest and sinking-fund charges, superintendence, etc.), total about $375,000,000, which is between 80% and 90% of the total present estimated cost of all construction and equipment required for full operation under the dual contracts. On city-owned lines the expenditures for labor and material, the truest measure of progress of actual construction, total 86% of the entire estimated cost for these items, excluding car-storage yards, or 84%, including these yards.

A further idea of the actual advancement of the construction may be gained from the progress which has been made on two of the main items, excavation and steel. Excavation is by far the largest single item of expense in subway construction, and steel is by far the largest item of material entering therein (in elevated-railway construction the cost of steel is several times greater than the cost of all other items combined).

Excavation and Steel—Although one elevated and three subway sections have not yet been contracted for, the total excavation required for the city-owned lines is 97½% completed. The total excavation will be approximately 15,100,000 cu.yd. of earth and rock, excavated partly in tunnels under the river, partly in rock tunnels far below the streets, but chiefly immediately under the temporary street surfaces. This excavation is equivalent to a circular hole 3½ ft. in diameter 8000 miles long or a distance equal to the diameter of the earth, and the material excavated, if uniformly spread out over Manhattan Island, would form a layer nearly a foot deep.

The dual project, including city- and company-owned lines, when completed will have required the use of approximately 675,000 tons of steel, of which over 600,000 tons, or a little less than 90%, has already been delivered in New York. This steel would construct 21 buildings similar to the Equitable Building (the largest in the world) and to transport it would require approximately 30,000 cars, which would form a continuous train from New York to Washington.

Progress in placing lines in operation, in terms of miles of single track, miles of new route, and the percentage of each as compared with the total is shown in Table II. It should be noted in this connection that additional miles of track placed in operation indicate in a general way additional service, while additional route mileage indicates in a general way additional territory served.



VALUE OF LABOR AND MATERIALS ONLY — CITY-OWNED LINES

FIG. 6. VALUE OF WORK DONE, COMPARED FOR OLD AND NEW LINES

The figures given for city-owned lines operated by the New York Municipal Railway Corporation, as shown in the left-hand group, include the mileage across the Williamsburgh and Manhattan bridges and also the mileage in the Centre St. Loop and portions of the Fourth Ave. subway in Brooklyn which were under contract for construction when the dual contracts were auguration of the "H" operation on the Interborough system, which may be considered the formal opening under the dual contracts, occurred Aug. 1, 1918, 5⅓ years after the contracts were signed. That this opening was materially delayed by war conditions is beyond question and without doubt under normal conditions could have been advanced at least six months. It is therefore

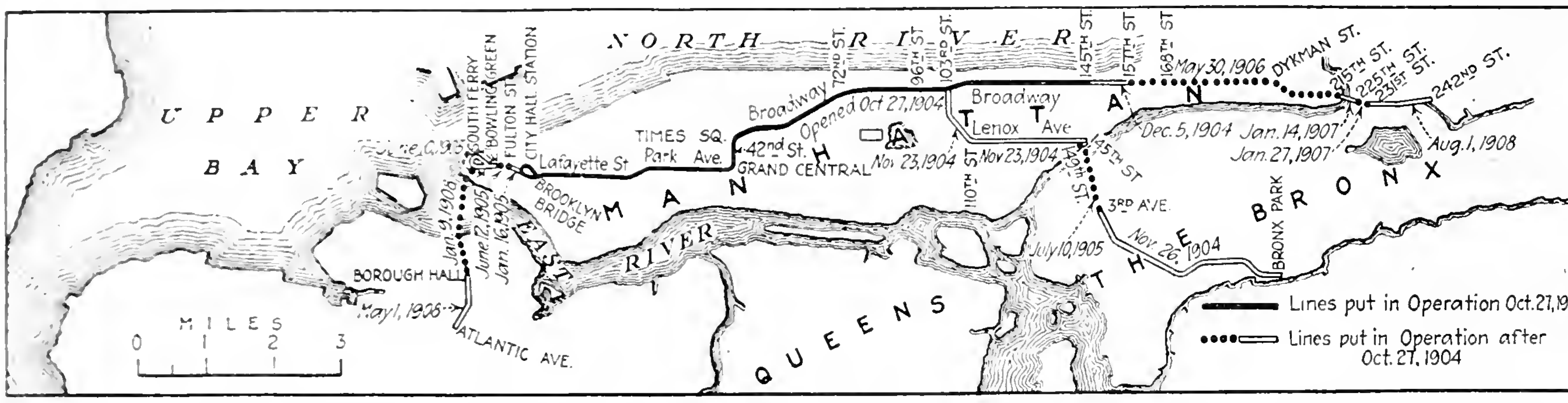


FIG. 7. MAP OF OLD SUBWAY (CONTRACTS NOS. 1 AND 2) WITH DATES OF OPERATION

signed. If these mileages are eliminated the totals and corresponding percentages are as given in the right-hand group.

In other words, of all the track to be constructed under the dual contracts, 70% is now in operation. The situation may be visualized by reference to the map of the dual system, Fig. 8.

On June 22, 1915, two years and three months after the dual contracts were signed, five miles of track, for which construction contracts were let during this period, were put in operation. From that date to the present time additional tracks have been put in operation at a fairly uniform rate, as shown especially in the diagram, Fig. 5.

Construction of the city's old subway, with 73 miles of track, extended over a period of more than eight years, but the formal opening was on Oct. 27, 1904, 4⅔ years after the contracts were signed. In-fair to compare the progress under contracts Nos. 1 and 2 for the 4⅔-year period with the progress under the dual contracts for the 5⅓-year period.

On Oct. 27, 1904, 34 miles of track were put in operation, approximately 46% of the entire project. On Aug. 1, 1918, 135 miles of track on city-owned lines alone (excluding the East River bridges and the portions of the Fourth Ave. subway and Centre St. loop which had been contracted for prior to the signing of the dual contracts) and about 71 miles of company-owned lines, or a total of 206 miles of track, had been put in operation. In percentages of total, 58% of city-owned lines, 72% of company-owned lines, or 62% on all lines, was in operation.

As a large section of track on contract No. 1 was put in operation soon after the opening, it might be fairer to compare these dual contract figures with the track in operation on contracts Nos. 1 and 2 two months

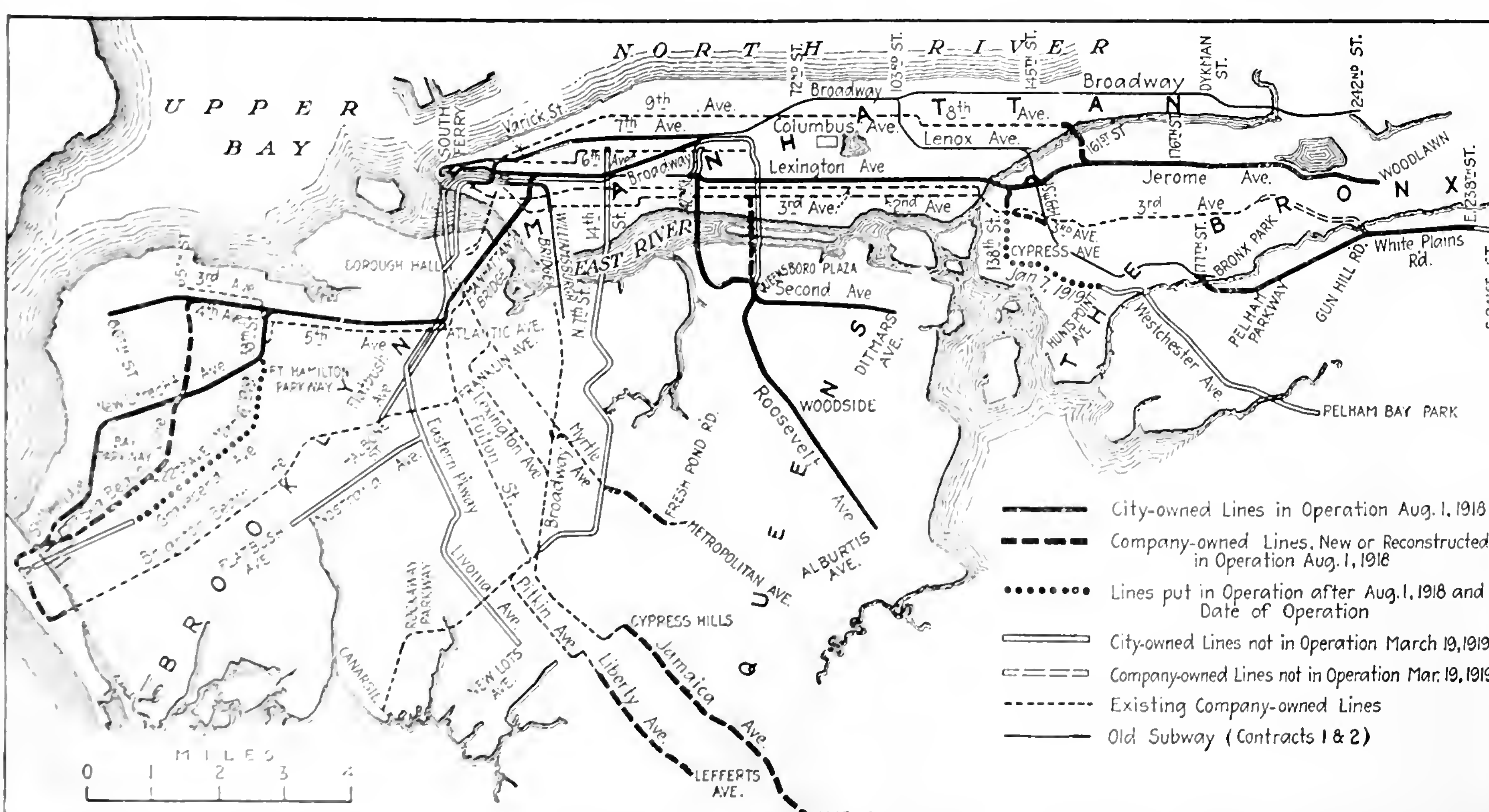


FIG. 8. NEW SUBWAY AND ELEVATED LINES, AND COMPLETED SYSTEM

after the formal opening, when 50 miles of track had been put in operation, or 68% of the total. More than four times as much track under the dual contracts was in operation as on contracts Nos. 1 and 2 for a corresponding period (although the percentage of the total was slightly less). A comparison of the maps showing the old and new systems (Figs. 7 and 8) will help to visualize the relative sizes of the undertakings and the relative progress in getting them in operation.

On Dec. 31, 1918, approximately $185,000,000 had been expended for labor and materials on city-owned lines under the dual contracts, or approximately 84% of the estimated total. On Dec. 31, 1905, the corresponding expenditures under contracts Nos. 1 and 2 had been $42,000,000, or approximately 83% of the total cost. In point of cost, therefore, the work on the old subway was only 23% as large as the work done in a corresponding period under the dual contracts.

Work Done Rapidly—A general impression has been current that the work under the dual contracts has lagged. From whatever angle it is viewed, it is evident from the data herein given that this has not been the case, and that, in fact, extraordinary progress has been made. The progress on contracts Nos. 1 and 2, constructed in normal times and with wide-open street excavations, was considered eminently satisfactory at the time (1900 to 1906), and the initial opening in 1904 was hailed as the accomplishment of a wonderful achivement. *Yet five times as much has been completed on the dual contracts project* in an equal period of time, and this during war, and with all excavations carried on under street decking, thereby greatly increasing the difficulty of the work and retarding progress. Although this new system is five times as large as the first subway enterprise, it has advanced at practically the same rate in percentage of the whole.

In summary, today, after six years, it is 95% under contract, 86% completed and 70% actually in operation.

Fundamentals in the Make-Up of a Concrete Mixture

Thirteen Points Offered by A. N. Talbot Governing the Physical Conditions Which Affect Concrete Making

CLEAR thinking on the subject of concrete as a material will be helped by a study of the remarks made by Prof. A. N. Talbot of the University of Illinois at the recent annual convention of the American Railway Engineering Association. In discussing the report of the committee on masonry, Professor Talbot said in part:

Recently I talked with two engineers concerning improvements in making and placing concrete. Both agreed that changes in procedure might be made with advantage. One described a method which he favored, but said it required an artist to carry it out. The other criticised a proposed specification and said it was "only more of this artists' stuff." I have no doubt there are many who feel that much of what is proposed for the improvement of concrete is unnecessary and impractical — mere "artists' stuff." Familiarity with mixing and placing concrete is likely to breed contempt for rules and regulations, especially when the ill effects of the disregard of proper precautions and workmanlike methods are not apparent to those doing the work. Discussions on how to produce good concrete must add to our information, help to make us better workmen and to secure much better concrete.

Concrete is a complex product. Many elements enter into the development of its strength. As it is well to have some idea of the physical conditions which affect concrete in its making, I have jotted down a number of items which seem to me to bear on the effect of the make-up of the mixture; these are offered as suggestive of the way in which the amount of water used in mixing and the gradation or variation of size of the particles making up the combination of fine and coarse aggregate may be expected to influence the strength of the concrete. These statements may seem elementary; in many respects they are crude. They are presented, however, with the thought that even a general conception of the physical conditions will be helpful in understanding the effect of changes in amount of mixing water and of variations in the size of the fine and coarse aggregate. It is to be understood that there are limitations and qualifications that will not be expressed here. Here are the items:

1. The cement and the mixing water may be considered together to form a paste; this paste becomes the glue which holds the particles of aggregate together.

2. The volume of the paste is approximately equal to the sum of the volume of the particles of the cement and the volume of the mixing water.

3. The strength given by this paste is dependent upon its concentration—the more dilute the paste, the lower its strength; the less dilute, the greater its strength.

4. The paste coats or covers the particles of aggregate partially or wholly and also goes to fill the voids of the aggregate partially or wholly. Full coating of the surface and complete filling of the voids are not usually obtained.

5. The coating or layer of paste over the particles forms the lubricating material which makes the mass workable; that is, makes it mobile and easily placed to fill a space compactly.

6. The requisite mobility or plasticity is obtained only when there is sufficient paste to give a thickness of film or layer of paste over the surface of the particles of aggregate and between the particles sufficient to lubricate these particles.

7. Increase in mobility may be obtained by increasing the thickness of the layer of paste; this may be accomplished either by adding water (resulting in a weaker paste) or by adding cement up to a certain point (resulting in a stronger paste).

8. Factors contributing to the strength of concrete are, then, the amount of cement, the amount of mixing water, the amount of voids in the combination of fine and coarse aggregate, and the area of surface of the aggregate.

9. For a given kind of aggregate the strength of the concrete is largely dependent upon the strength of the cement paste used in the mix, which forms the gluing material between the particles of aggregate.

10. For the same amount of cement and same voids in the aggregate, that aggregate (or combination of fine and coarse aggregates) will give the higher strength which has the smaller total area of surface of particles, since it will require the less amount of paste to produce the requisite mobility and this amount of paste will be secured with a smaller quantity of water; this paste, being less dilute, will therefore be stronger. The relative surface area of different aggregates or combination of aggregates may readily be obtained by means of a surface modulus calculated from the screen analysis of the aggregate.

11. For the same amount of cement and the same surface of aggregate, that aggregate will give the higher strength which has the less voids, since additional pore space will require a larger quantity of paste and therefore more dilute paste.

12. Any element which carries with it a dilution of the cement paste may in general be expected to weaken the concrete. Smaller amounts of cement, the use of additional mixing water to secure increased mobility in the mass, increased surface of aggregate, and increased voids

n the aggregate all operate to lower the strength of the product.

13. In varying the gradation of aggregate a point will be reached, however, when the advantages in the reduction of surface of particles is offset by increased difficulty in securing a mobile mass, the voids are greatly increased, the mix is not workable, and less strength is developed in the concrete. For a given aggregate and a given amount of cement, a decrease in the amount of mixing water below that necessary to produce sufficient paste to occupy most of the voids and provide the lubricating layer will give a mix deficient in mobility and lower in strength.

A certain degree of mobility is necessary in order to place concrete in the forms in a compact and solid mass, the degree varying considerably with the nature of the work, and generally it will be found necessary to sacrifice strength to secure the requisite mobility. It is readily seen, however, that the effort should be made to produce as strong a cementing layer of paste as practicable by selecting the proper mixture of aggregate and by regulating the amount of mixing water.

More thorough mixing not only mixes the paste and better coats the particles, but it makes the mass mobile with a smaller percentage of mixing water, and this less dilute paste results in higher strength. Any improvement in method of mixing which increases the mobility of the mass will permit the use of less dilute paste and thereby secure increased strength.

Cost of Highway Concrete Delivered Wet by Trucks

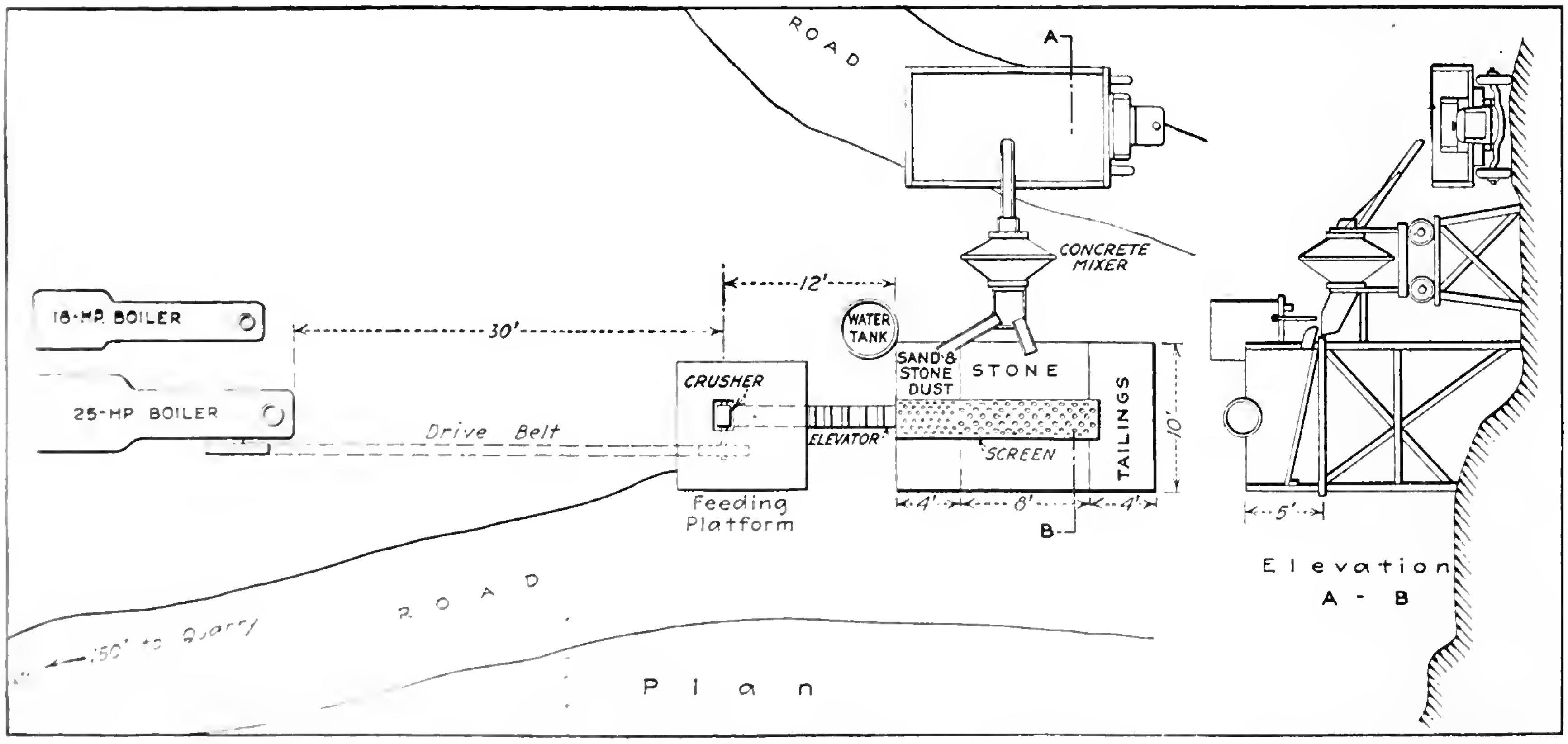
Central Crushing and Mixing Plant Set Up at Quarry — Concrete Aggregate from Crusher Bin Run Directly Into Mixer and Thence Into Trucks

DELIVERY of wet concrete, from a central crushing and mixing plant, to the road surface, by motor trucks, over hauls ranging from ¼ mile to four miles, is being satisfactorily accomplished on the Belair Road of the Maryland State Road Commission. By this method extensive rehandling of materials is dispensed with, thus reducing the cost, and the speed of the trucks is such that for the distances named there is no apparent injury to the quality of the concrete mixture. The maximum time required to transport the concrete from the mixer to the road is 35 minutes.

Most of the roads built by the State Road Commission in the past have been of the waterbound-macadam type. These have since received a surface treatment or have been covered with bituminous macadam. Recently the surfaces of the roads have shown signs of failure where subjected to heavy traffic, such as has been common during the past two years, due to heavy motor-truck freight routes.

While there has been some wearing of the central part of the road, most of the failure has occurred near the edges, accompanied in most cases by a spreading of the road crust. The conditions led to two conclusions: (1) That the roads are too narrow, and (2) that support is needed at the edges to overcome the spreading action of the traffic.

The design finally decided upon to overcome these difficulties was adopted for the Baltimore-Washington Boulevard and was described in *Engineering News-Record* of Nov. 28, 1918, p. 990. It provides for the laying of a 3-ft. strip of concrete 8 in. thick on each side of the macadam road, and connecting it with the old road with new macadam. One of the illustrations shows a stretch of the Belair Road of this design, with one shoulder completed and connected with the old road. After both shoulders are completed, the entire road receives a seal coat of bituminous material and stone chips, which is allowed to cover the concrete shoulder, giving a pavement 20 ft. wide of uniform appearance, as shown in an illustration.



LAYOUT AT CENTRAL CRUSHING AND MIXING PLANT FOR HIGHWAY CONCRETE

As there was excellent stone in most of the hills adjacent to the road, the contractor decided to save handling labor by mixing the concrete at the quarry and hauling it to the road in motor trucks. A location about midway of the contract was selected, a quarry was opened and a crushing and mixing plant was set up.

The general arrangements at the plant are shown in the accompanying sketch. Two portable boilers of the locomotive type were used; one, a 25-hp. boiler and engine, furnished power to run the crusher and mixer, the other, an 18-hp. boiler, furnished steam for the rock drills at the quarry and for pumping the necessary water for the boilers and the concrete.

A jaw crusher was placed under the platform upon which the stone from the quarry was dumped. After being crushed, the stone is elevated into the bin and separated into the desired sizes by a rotary screen.

ONE SHOULDER COMPLETED AND CONNECTION MADE WITH OLD BITUMINOUS ROAD

There are three general sizes of stone: The chips which pass a ⅝-in. screen go into the sand bins; the crushed rock passing a 2½-in. screen goes into the coarse aggregate bin, while the larger stone goes out as tailings. What tailings cannot be used for repairs on the construction road are taken out and again fed through the crusher. As the crusher does not produce enough fine material, sand is also delivered upon the platform and fed through with the stone and elevated into the sand bin.

Gravity is utilized to the utmost throughout the operations, from the quarry to the mixed product in the truck body. The plant is situated at the foot of a hill down which the quarried rock is hauled in carts to the crusher platform. After crushing, the stone and sand are fed directly into the mixer from the bins, care being taken to proportion them properly. Water is supplied from the elevated tank shown in the sketch. The bin and the platform for the concrete mixer are placed at such height that the mixer can discharge directly into the trucks.

On the road the dumping of the concrete follows a different plan than would be employed if the entire road section were being covered, as in the case of constructing a concrete road. As the shoulder which is being constructed is of small section, it is necessary to dump the mixed concrete upon the surface of the old road and shovel it into the forms on the side. One truck load of concrete fills about 35 ft. of forms, and extra handling is necessary, which of course increases the cost above what it would be if an entire road surface were being built.

Convict labor is utilized for common labor upon this road, a camp being built at the quarry to house and feed the laborers. Guards are provided by the prison officials

ITEMIZED COST OF LAYING THREE-FOOT CONCRETE SHOULDERS FOR MACADAM ROADS

Quarrying and Crushing Stone per Day	
1 foreman at 65c. per hour	$5.85
1 engineer at 44 4/9 c. per hour	4.00
1 blacksmith at 44 4/9c. per hour	4.00
17 laborers at 27 7/9c. per hour	42.50
3 carts at 55 5/9c. per hour	15.00
Equipment at $7.50 per day	7.50
25 lb. dynamite at 30c. per pound	7.50
Total cost per day for 36 cubic yards of stone and 4.4. cubic yards of dust	$86.35
Cost of rock per cubic yard in quarry	$2.137
Royalty	.15
Total cost rock per cubic yard	2.287
Sand per Day	
Sand in pit, 13.6 cubic yard at 85c. per cubic yard	$11.56
Hauling sand and cement by truck, $30 per day	30.00
Three laborers at 27 7/9c. per hour	7.50
Total cost per day	$49.06
Total cost per cubic yard	$3.61
Mixing Concrete per Day	
3 men at 27 7/9c. per hour	$7.50
Equipment $7.50 per day	7.50
Total cost per day for 40 cubic yards	$15.00
Total cost per cubic yard	.375
Hauling Concrete to Road per Day	
1 truck at $18.00 per day	$18.00
1 truck at 25.00 per day	25.00
1 truck at 27.50 per day	27.50
Total cost per day for 40 cubic yards	$70.50
Total cost per cubic yard	$1.762
Placing Concrete per Day	
1 foreman at 55 5/9c. per hour	$5.00
2 laborers, build forms 27 7/9c. per hour	5.00
Placing, 4 laborers at 27 7/9c. per hour	10.00
Total cost per day for 40 cubic yards	$20.00
Total cost per cubic yard	.50
Cost of Concrete in Place per Square Yard	
Cement, 1.5 bbl. at $2.50	$3.750
Sand, 0.34 cubic yard at $3.60	1.227
Dust, 0.11 cubic yard at $2.287	.252
Stone, 0.9 cubic yard at $2.287	2.058
Mixing, per cubic yard	.375
Hauling, per cubic yard	1.762
Placing, per cubic yard	.500
Total cost per cubic yard	$9.924
Total cost per square yard, 8 in. thick	2.205
Grading per Square Yard	
1 foreman at 55 5/9c per hour	$5.00
8 laborers at 27 7/9c per hour	20.00
Total for 180 sq.yd	$25.00
Cost per square yard	$0.138
Total cost per square yard	2.343

for watching the convicts, but the contractor furnishes the foremen to supervise the work. The contractor reports that this labor is quite satisfactory. In the construction of the shoulders steel forms are used, and the finishing is done as described in the article published in *Engineering News-Record* of Nov. 28, 1918.

Approximate costs for carrying work on under this

COMPLETED ROAD HAS UNIFORM APPEARANCE

system are given in the accompanying table, the basis used being an average haul of 3½ miles for 6975 ft. of shoulder laid in a period of 13 working days. The average day's work was thus 535 lin.ft. or 179 square yards.

Quarrying and crushing the rock cost about $2.29 per cubic yard, while the mixing was about 38c. per cubic yard. Sand cost $3.61 per cubic yard and the hauling for the average haul was $1.76 per cubic yard. The total cost of the concrete shoulders, including the grading, was about $2.34 per square yard. These costs include interest on investment and depreciation of equipment.

No figures are available as to the cost of connecting up the concrete shoulder with the old surface, this depending largely on the amount which it was necessary to excavate, due to the ravelled condition along the edge. In all probability, this would be about the same as patching with this material.

Comparison of the relative cost of laying shoulders by hauling the wet concrete as against that of distributing the materials on the road and mixing at the site shows on the Maryland work a considerable saving in favor of the former method. The table shows that the cost per square yard by the wet-hauling method was $2.34 for the section for which costs are given, while the cost upon the Baltimore-Washington Boulevard constructed by the other method was $3.24 per square yard.

The large saving was in handling materials. Mixing, placing, forms, curing and protection on the boulevard cost 84c. per square yard, while the same operation on the Belair Road cost about 20c. per square yard. The average haul for the entire road is about 2½ miles, and the costs given were taken for an average haul of 3½ miles. This would also decrease the average cost per square yard in place for the entire road.

The work on the Belair Road is being done by the Maryland State Roads Commission, of which Frank H. Zouck is chairman, and J. N. Mackall is chief engineer. Edwin Friese is resident engineer for the commission, and the American Paving and Contracting Co., of Baltimore, is the contractor for the work.

Factors Governing Selection of Industrial Site

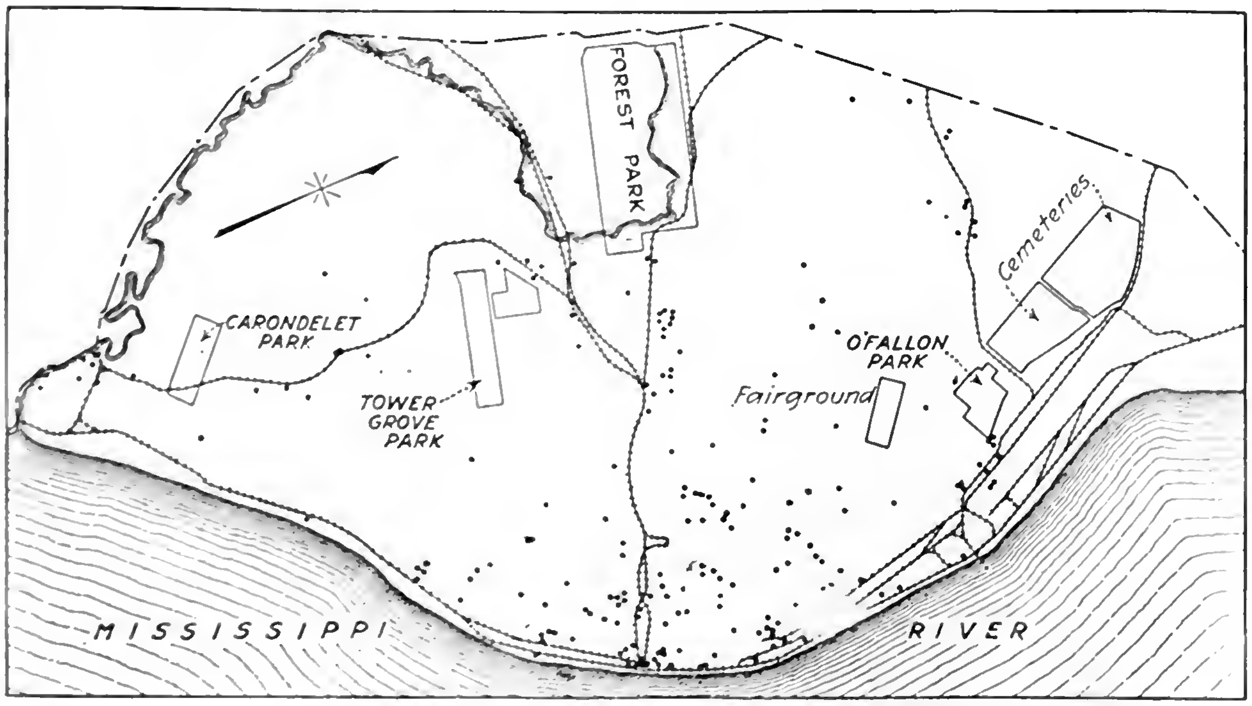
Railroad Facilities and Land Values Have Little Effect on Choice—Motor Trucks Supply Transportation Needs

By Harland Bartholomew
Engineer, City Plan Commission, St. Louis, Mo.

THAT the location of industrial plants appears to depend less upon direct railroad connections than is generally supposed is indicated by maps and figures prepared in connection with the St. Louis zone plan. Studies of the location of all industries in the city show that probably 50% have no direct railroad facilities and are more or less removed from what are generally termed industrial districts. In fact, there is increasing evidence that the motor truck is meeting transportation needs.

Many other considerations such as prevailing prices of land for industrial purposes, source of labor supply, local transit facilities, switching charges, water-supply, character of industry, etc., enter into the matter of locating industrial plants. However, knowledge of local conditions in St. Louis indicates that a relatively small number of plants have selected their sites solely from the standpoint of low land value. This being the case, the necessity of regulating the location of industries in the interest of sustaining land values is readily seen.

Among the maps mentioned above, there is one showing the distribution of new industrial plants located in St. Louis during the five years from 1913 to 1917. This map, which graphically illustrates the conditions as stated, is reproduced herewith. Only plants having a structural cost of $5000 or more were considered—warehouses, power plants, additions to existing factories, etc., being excluded. Of 170 such plants, 106, or 62½%, did not have direct railroad connections. The map shows that the majority of these were located in the central eastern section of the city, which is already largely built up. In other words, they disregard land values in favor of proximity to labor supply, inasmuch as the densest population is in the central eastern part of the city. One concern which manufactures a line of commercial electric specialties and employs several hundred operatives, including many women, recently erected a plant just west of Grand Ave., an important business street, this being the first large factory to invade this residential section. The location was chosen in preference to several other less expensive sites considered because it offered better surroundings than the usual industrial district, making it attractive to women workers, and because it was adjacent to the car line which



DISTRIBUTION OF NEW INDUSTRIAL PLANTS LOCATED IN ST. LOUIS FROM 1913 TO 1917 WITH RESPECT TO RAILROADS

gave quickest access to all residential sections. These considerations, in the opinion of the owner, were more important than direct railroad connections or a less expensive site. In other words, the owner figured that the extra cost of land and of transporting his product to the railroads by motor truck was more than offset by the advantageous labor conditions to be obtained. And the conclusions of this manufacturer seem to be typical of those of the majority.

Congestion of railroad terminals in large cities has caused shippers to depend more and more upon the motor truck for short-haul traffic, either for direct delivery to the consignee or to the railroad. One of the largest shippers in an Eastern city, though located on a railroad, found it cheaper to carry all of his freight by motor truck to the terminal of another railroad, a distance of three or four miles, than to load the freight upon railroad cars at his plant and wait for them to be switched to the railroad over which they were to go. In this particular city there exists no belt-line or connecting railroad, and switching charges may be unusually high, but it is a well known fact that the terminals of the railroads in most large cities are being taxed to their capacity, and shippers undoubtedly are finding the motor truck a time saver as well as a money saver.

One of the limiting factors in the capacity of a railroad terminal or of a railroad itself is the number of tracks that exist or that can be built and maintained economically. Certainly, no terminal or railroad can provide as many tracks as there are streets in a city. If the streets are well planned and well paved, so that transportation by motor truck is unimpeded, the transportation problem is greatly simplified, the burden on the railroad terminals is reduced and the capacity of the railroads for through traffic increased.

Regulation of the location of industries in the interest of the welfare of the city is therefore necessary. To permit industries to invade residential districts, especially just now when labor supply is a large factor, would be to invite economic disaster, since no residential district would long maintain its values under such conditions. If invasion of residential districts is allowed to proceed without abatement, the city becomes the loser in taxes, while new residential districts farther away from the city's center are built, and the cost of providing additional utilities, such as water, transit, pavements, lighting, etc., must be met in greater or less part from the city's treasury. To establish certain well defined industrial districts, on the other hand, should prove advantageous, since an intensive development would permit cheaper services, such as power from a centralized station or stations; and the presence of such a district, with its large opportunities for employment, would tend to attract a more or less adequate supply of labor to the adjoining residential districts.

Cities as well as manufacturers must give more than casual thought to the communal problems of industry. When these are properly solved, there is much more economic value in the solution for both the city and the manufacturer, than in many of the wasteful, haphazard methods of the past. Here is a reconstruction measure worthy of serious consideration.

Line Revision on Cincinnati Southern Railroad

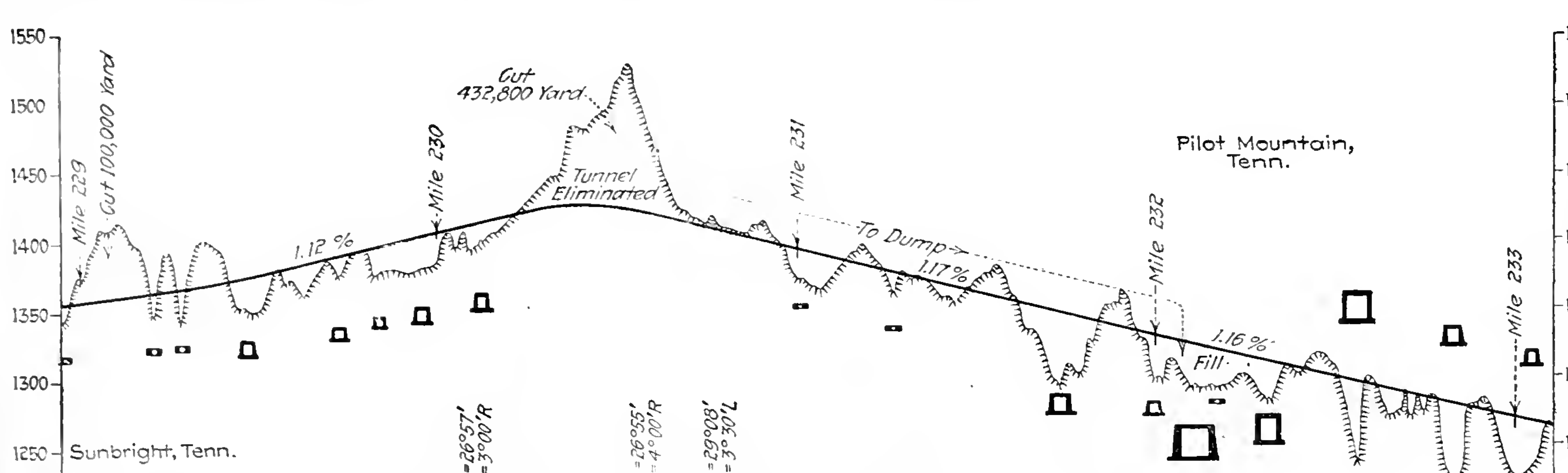
Heavy Rock Cuts, but Few Bridges—Stream Diverted Through Old Tunnel to Avoid Crossings

SINGLE-TRACK and double-track relocations or cutoffs, to improve alignment and profile and to eliminate tunnels, are part of the improvements being made by the Southern Railroad Lines in the extension of double-tracking on the Cincinnati Southern line between Cincinnati, Ohio, and Chattanooga, Tenn. One of the abandoned tunnels will be utilized in stream diversion to avoid a double crossing. Heavy rock excavation, with long and deep cuts and fills, is a feature of the revision, the heaviest work being in mountain country between Helenwood and Lancing, Tenn.

A 4000-ft. stretch of line revision south of Helenwood eliminates two tunnels 364 ft. and 367 ft. in length, reduces curvature and brings the grade above flood level. The old line here followed the west bank of Phillips Creek, and was at such an elevation that after heavy storms the water occasionally rose over the tracks and flowed through the second tunnel, beyond which it returned to the natural channel. In the fall of 1917 such an occurrence caused interruption to traffic.

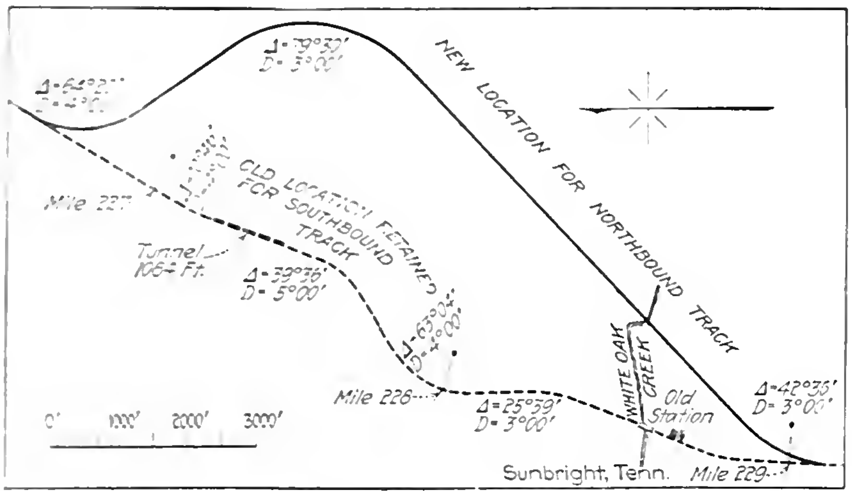
The new location here, as shown in one of the drawings, is on the east side of the creek, the line being straightened and put at an elevation of about 15 ft. above the old grade. To avoid two stream crossings on the relocation, a cut-off channel is excavated, thus eliminating a sharp bend of the creek. The second abandoned tunnel is utilized as part of this channel, its floor being lowered 6 or 8 ft. below the original grade.

Relocations requiring the heaviest construction on



TYPICAL HEAVY GRADING ON RELOCATION OF CINCINNATI SOUTHERN RAILROAD

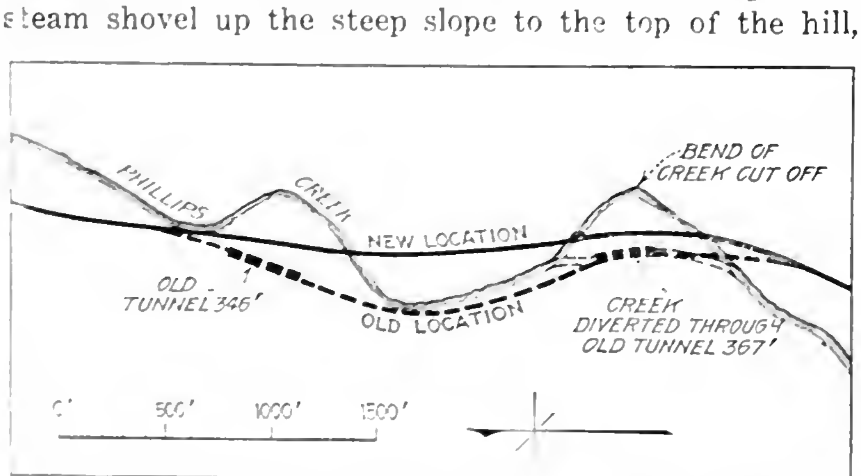
the whole of the present improvement are included on the 12-mile stretch between Huffman and Lancing. In the first place, there is a single-track cutoff for northbound traffic only, the old line being satisfactory for southbound trains. This is shown on one of the drawings. It is nearly three miles long and keeps about half a mile from the old line, avoiding one tunnel and several curves, besides giving a more favorable profile. Following this is a double-track revision for about 2½ miles, which closely parallels the old line, but is on the opposite side of the valley. This eliminates one tunnel and several curves of five and six degrees, but the old line here will be retained for use as a passing track. Two other revisions of about 2000 ft. each avoid tunnels 630 ft. and 403 ft. in length. Another tunnel only 204 ft. long will be eliminated by a double-track cut. Elimination of these old tunnels reduces the smoke nuisance and avoids difficulties due to the limited clearance for large modern equipment.



DOUBLE TRACKING AT SUNBRIGHT, TENN., HAS NEW LOCATION FOR SECOND TRACK

Long and deep cuts, having 90% of the excavation in hard sandstone, are encountered on these relocations; part of a typical profile on this section of the line is shown in an accompanying drawing. Although the work is along steep sidehill slopes, through cuts are generally required. The largest cut is about 435,000 yd., with a maximum depth of 100 ft. and a length of 2500 ft. Two others are of 200,000 yd. and 125,000 yd., both about 90 ft. deep and 900 ft. long.

Well drills are used to open up the cuts, with steam drills to finish them to shape and grade, and steam shovels to remove the material. Blasting is done mainly with 40% and 60% dynamite, in order to get quick and shattering action in the hard rock. Usually a narrow through cut is made first, the shovel then returning to the starting point to widen this along one side. At one deep cut a hoisting engine was used to get the steam shovel up the steep slope to the top of the hill, and this engine also operated the dump-car trains by cable on a steep incline. At another similar cut it was proposed to build a switchback track on the hillside, in order to obtain a grade enabling the dump-car trains to reach the steam shovel.

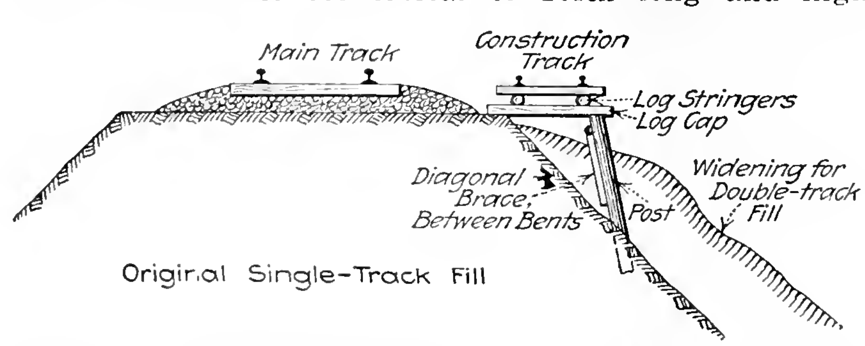


LINE REVISION INCLUDES DIVERSION OF CREEK THROUGH ABANDONED TUNNEL

Narrow-gage construction equipment was installed by the contractor on this section, using 8-yd. double-truck dump cars and four-wheel dinkey locomotives. With a haul of two or three miles, however, these dinkeys could not handle the work satisfactorily. In fact, the engineers considered a haul of 3000 to 4000 ft. the economic limit for such engines. The railway then handled this work with standard-gage 16-yd. cars and 50-ton locomotives. This equipment was not operated on the main track, however, as traffic conditions necessitated keeping the work trains almost exclusively on the construction tracks.

Temporary trestles of round timber were used for most of the fills. Peg-leg trestles were used mainly in starting to widen existing fills, thus carrying the construction track clear of main-line traffic. Each bent had a single batter post set in the old slope and supporting one end of a cap whose other end rested on the edge of the old fill. These bents were spaced about 12 ft. apart, carrying log stringers and being braced longitudinally by pole diagonals. The widening was then completed with the construction track on the new fill.

Structures of importance are relatively few on the new lines, partly because the roadbed is largely benched in solid ground and partly because the amount of excavation made it economical to form long and high



PEG-LEG TRESTLE CARRIES TRACK FOR WIDENING FILLS

fills with culverts to accommodate drainage. At Phillips Creek, where the grade necessitated a low and wide opening, the necessary waterway was obtained by a six-barreled concrete box culvert having rectangular openings 6 ft. wide and 12 ft. high.

A five-span, single-track bridge with 100-ft. plate-girder spans on concrete piers 90 ft. high is the largest new structure. This has its center line 40 ft. from that of the old steel viaduct, which will remain in use for the northbound track. Solid rock, almost at the ground level, forms the foundations. For the piers the mixer plant was located at the bottom and served an elevator tower with chutes. For the abutments the mixer was placed beside the track, and the concrete was wheeled to the forms. Another structure was a concrete bridge having two 43-ft. spans composed of two side girders and two center girders supporting a deck slab. This design allowed building of half the bridge first without interference with traffic. A general contract for the work described above was awarded to H. H. Thrasher, of Knoxville, Tenn., and a part of the work is being done by company forces. Labor shortage has been serious, as floating labor is very limited, and negroes are not found in this section. Few of the white natives care for this kind of work, although they will work on

the section gangs. Camps with houses are provided at a few points, but as a rule the men live in boarding trains.

All construction work is under the direction of E. M. Durham, Jr., chief engineer of construction, Southern Railroad Lines. R. W. Jones, Jr., is district engineer, at Lexington, Ky., with P. R. Shields and R. H. Small as assistant engineers.

Rainfall, Absorption and Run-off on Small Rural Drainage Area

Study of Heavy Rain, Total Run-off With Soil Absorption and Run-off for Small Plats —The Hydraulic Jump

By Ivan E. Houk
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

INTERESTING data on rainfall, soil absorption, and run-off were obtained on Moraine Farm, the home of Col. E. A. Deeds, during a flood that occurred in September, 1916.

Moraine Farm is situated among the hilly, glacial deposits, known as moraines, about five miles south of Dayton. The greater part of the farm, with some area to the south and east—amounting to about 2.6 square miles in all—is drained by a small creek having an average fall of about 100 ft. per mile in its total length of about two miles. The approximate natural slope of the ground over the drainage area varies from 1 to 20 ft. per 100, averaging 3 or 4 ft. About 7% of the surface is wooded. The surface soil, which is a clay loam, containing some sand and gravel, is underlain by comparatively thick glacial deposits of sand and gravel. Careful records of rainfall, run-off and soil absorption have been maintained on this watershed by the Morgan Engineering Co. and the Miami Conservancy District since March, 1915.

The observations and studies will later be published in detail in the "Technical Reports" of the Miami Conservancy District.

Rainfall Observations

The flood for which the data are here given occurred on Sept. 5. Although some rain fell over a considerable part of Ohio on that date, the precipitation did not seem to be unusually heavy, except in the Miami Valley.

At the Dayton coöperative Weather Bureau station the total for the 24 hours which ended about 10:30 a.m., Sept. 6, was 4.85 in. At the local office of the United States Weather Bureau, about two miles west of the former station, a total of 3.83 in. was recorded; and at Moraine Farm, about five miles south of the Weather Bureau office, the readings of the three gages maintained by the Miami Conservancy District were 4.09, 4.30, and 4.33 in. for the same period of time. Of the last three gages, the two reading 4.30 and 4.33 in. are within 100 ft. of each other and are about a quarter of a mile northwest of the one reading 4.09 in. At the local office of the United States Weather Bureau the maximum intensities, determined by the triple register, were 0.43 in. for 5 min., 0.79 in. for 10 min., and 1.75 in. for 30 minutes.

The periods and amounts of rainfall as shown by the same instrument were as follows:

P. M.	In.	P. M.	In.
3:03 to 4:00	0.97	7:00 to 8:00	0.99
4:00 to 4:41	0.89	8:00 to 9:00	0.05
4:57 to 6:00	0.47	9:00 to 9:40	0.01
6:00 to 7:00	0.13		
		Total	3.51

While the rain began at 3:03 p. m., as noted above, the heavy rain did not begin until 3:44 p. m. From 3:44 to 4:16, 1.75 in. fell; from 5:01 to 5:11, 0.32 in.; from 7:16 to 8:00 p.m., 0.96 in. About 0.27 in. fell in 10 minutes about 9 a. m. the following day.

The ground was comparatively dry when the rain began. There had been only a normal amount of rainfall during August, and this had been well distributed through the month. About 0.06 in. fell from Aug. 26 to 28, inclusive. There was no precipitation on Aug. 29, 30, or 31. On Sept. 1 about 0.33 in. fell. Then there was no more rain until Sept. 5.

The amounts of moisture in the soil in percentage of the dry weight were determined both before and after the heavy rainfall. Soil samples, weighing about 2 lb., were taken where the ground was nearly level, by digging with a spade. No attempt was made to secure an exact volume. The samples were carefully weighed on scales weighing to the nearest tenth of a gram, and were then dried in the furnace room at the farm and reweighed until their weight became constant.

The samples taken Aug. 28 and Sept. 6 showed the following percentages of moisture:

Depth Below Ground Surface, In.	Moisture Content, Per Cent 8-28-16	9-6-16	Remarks
6	3.1	15.1	Under cultivated cover
12	3.3	5.4	Under cultivated cover
18	4.1	6.8	Under cultivated cover
24	4.4	8.7	Under cultivated cover
6	8.0	13.9	Under sod cover
12	8.2	15.9	Under sod cover
18	10.3	15.3	Under sod cover
24	10.6	16.5	Under sod cover
Average	6.5	12.2	

These results show an average increase in moisture content of about 5.7%. Assuming the weight of 1 cu.ft. of earth in place to be 100 lb. when perfectly dry, 5.7% of moisture would correspond to about 1 in. of rain per foot of depth or to about 2 in. in the total depth in which the samples were taken. This amount does not represent the total absorption of the soil, however, since the material deeper than 2 ft. is almost entirely gravel, and the water could move downward at a comparatively rapid rate once it reached this stratum.

Run-off from Small Plats

Measurements of the total run-off during the flood were obtained on four small plats, each 5 ft. square. Two of these were situated on the side of a hill within a few feet of the rain gage reading 4.30 in. The other two were situated on level ground close to the rain gage reading 4.33 in. In each case the surface covering in one of the plats was kept spaded up, in a cultivated condition; while the surface in the other consisted of a heavy bluegrass sod.

No run-off at all occurred in either of the plats in which the sod covering existed. The grass, which was from 3 to 6 in. long, held back the water so that it could soak into the ground. Considerable run-off occurred on the plats in which the surface was cultivated.

In the plat on the level ground the total amounted to more than 1.9 in., or over 44% of the rainfall. The can in which the run-off is caught was filled entirely full and some water ran over, the amount of which there was no way of determining. In the plat on the hillside the total run-off amounted to 1.66 in., or 37% of the rainfall—somewhat less than on the level ground, probably due to differences in cultivation.

The maximum rate of run-off from the total drainage area was determined from high-water marks and cross-sections taken a few days after the flood. The survey covered a length of about a half mile, where the creek had been diverted into an artificial ditch. This ditch was straight, and was lined with concrete through a length of about 1300 ft. Six cross-sections were taken, three of the concrete-lined channel and three of the earth channel. In calculating the discharge, corrections in slope were made to allow for changes in velocity, and the parts of the cross-sections occupied by trees, in the earth channel, were omitted. Kutter's formula was used, taking a value of n of 0.015 for the concrete channel and of 0.045 for the earth sections.

The computations gave an average maximum rate of run-off of 900 sec.-ft., or 346 sec.-ft. per square mile. This is equivalent to a rate of run-off of about 0.54 in. per hour.

The Hydraulic Jump

An interesting hydraulic jump of about 2 ft. occurred at the lower end of the concrete-lined channel. Following the notation used by Professor Woodward (Miami Conservancy District, "Technical Reports," Part III, "Theory of the Hydraulic Jump and Backwater Curves," by S. M. Woodward) the conditions of flow were as shown in the table at the head of the next column.

Immediately below the end of the concrete channel, before the jump occurred, the actual depth was 2.55 ft., the neutral depth was 3.80 ft. and the critical depth was 3.41 ft.; that is y was less than y_c and y_c was less than y_n. These conditions correspond to Professor Woodward's Case C. According to his theory, then, the surface, on leaving the concrete channel, would slope upward until the depth became equal to the critical depth, the curve approaching a condition of verticality as y approached y_c; and then, since there is no curve by which the water can flow smoothly with the depth increasing from y_c to y_n, the increase in depth, which had to be made since the water could not flow through the earth channel at a depth equal to y_c, must be made by the transformation known as the hydraulic jump.

CONDITIONS OF FLOW IN CONCRETE-LINED CHANNEL

	Average Condition: In Concrete Channel	Average Condition: In Earth Channel
Actual depth y	3.04	4.30
Neutral depth y_n	2.96	3.80
Critical depth y_c	4.07	3.41
Surface curve	Case E	Case A

While the high-water marks obtained were not sufficiently accurate or in sufficient number to show the curvature of the surface in the different sections of the channel, they showed definitely that a rise in water surface of about 2 ft. did occur abruptly as soon as the water entered the earth channel, this rise taking place within a length of 50 feet.

Progressive Erosion in a Dredged Drainage Channel

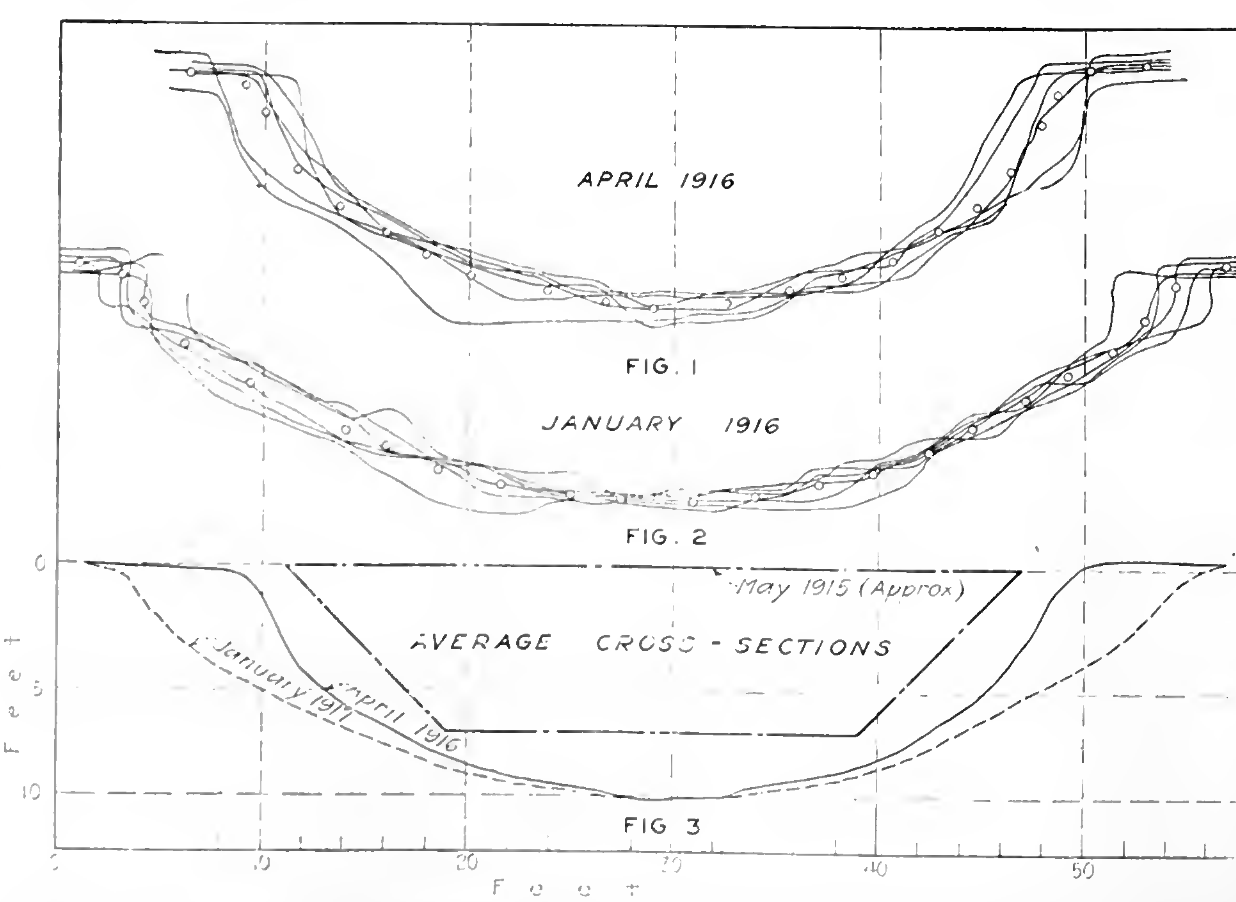
Observations on Enlargement and Effect on Capacity, Together With Computations of Value of n in Kutter's Formula

By C. E. Ramser

Senior Drainage Engineer, Office of Public Roads and Rural Engineering, United States Department of Agriculture. Washington, D. C.

IT IS generally known that drainage channels enlarge under certain conditions of soil and slope, due to the erosive action of the moving water. Very little information has been obtained to show the rate and amount of the enlargement, or the effect of the enlargement upon the capacity of the channel. To obtain definite data on this subject, measurements of the cross-sectional areas and computations of the values of n in Kutter's formula were made on the North Forked Deer River drainage channel, near Trenton, Tenn.

The portion of the channel selected for observation was constructed in May, 1915. Measurements of six cross-sections of the channel along a course of 700 ft. were made in April, 1916, and again in January, 1917. The hydraulic gradient and the discharge of the channel were also measured for use in the computation of values of n.



FIGS. 1 TO 3. EROSION ENLARGEMENTS OF CROSS-SECTION OF DREDGED CHANNEL OF NORTH FORKED DEER RIVER, TENNESSEE, FROM APRIL, 1916, TO JANUARY, 1917

Figs. 1 and 2 show the cross-sections of the channel in April, 1916, and May, 1917. The platted points represent the average of the six cross-sections. A comparison of these figures shows in this particular instance that, after a certain amount of erosion had taken place in a dredged channel erosion does not tend to increase the irregularity of the channel.

The average cross-sections represented by the platted points in Figs. 1 and 2 are platted together in Fig. 3. It is apparent from this figure that very little increase in the depth of the channel occurred after April, 1916, and that the greatest amount of enlargement occurred near the top of the channel on both sides. The original cross-section of the channel at the time of construction, May, 1915, is also drawn in Fig. 3 according to the specified dimensions as given in the engineer's report. It is likely that the channel was dug somewhat deeper than these dimensions show, but some increase in depth of channel occurred since construction, due no doubt to a natural adjustment of the bottom slope along the channel.

As given in the report of the engineer, the channel was designed for a slope of 0.0007, or a fall of about 3.6 ft. per mile. The maximum slope of the water surface as actually measured was found to be 0.00052, or about 2.75 ft. per mile.

Figs. 4, 5 and 6 are views of the channel taken during April, 1916, November, 1916, and January, 1917. Figs. 4 and 6 were taken looking downstream along the course of the channel where the cross-sectional measurements were made. Fig. 5 was taken just below the course but is, however, representative of the condition of the channel along the course. The caving of the banks as shown in Fig. 5 occurred during the fall season after the last high-water stage, some time in July. The first high stage that occurred at the end of this low-water period washed away all of the loose earth in the channel and left the channel clean and fairly smooth, as shown in Fig. 6. The soil in the channel varies in character from a silty loam at the top to a heavy, silty clay at the bottom.

Between April, 1916, and January, 1917, the average cross-sectional area of the channel increased from 331 to 409 sq.ft. The values of n in Kutter's formula obtained for high stage during the years of 1916 and 1917 were 0.0271 and 0.0267, respectively, from which it is seen that the roughness coefficient was practically the same before and after the erosion occurred. Using these values of n, the average cross-sectional areas and a slope of 0.0005, the capacities of the channel for these two sets of values were computed by Kutter's and Chezy's formulas and are given in the following table:

Date	Cross-Sectional Area, Sq.Ft.	Hydraulic Radius, Ft.	n	c	Mean Velocity, Sec.-Ft.	Discharge, Sec.-Ft.
April, 1916...	331	6.69	0.0271	77.0	4.45	1,473
January, 1917..	409	6.95	0.0267	78.3	4.60	1,881

From the table it is seen that the mean velocities in the channel were about 4½ ft. per second, and that the discharge capacities for 1916 and 1917 were 1473 and 1881 sec.-ft., which represents an increase of 27.7% for the period from April, 1916, to January, 1917. The increase in cross-sectional area was 23.5%, which is less than the percentage of increase in capacity.

The engineer who designed this drainage channel foresaw the probable effect of erosion, and accordingly did not attempt to provide for a rate of run-off that would give satisfactory drainage at the start. A considerable financial saving was thereby effected. The bottom lands benefited by this channel are now very satisfactorily drained, and in the meantime much of the land was being made ready for cultivation.

Some of the factors that were favorable to the erosion of this channel and to the absence of silting were a straight alignment, a good slope with resulting high velocity in the channel, soil susceptible to erosion, the absence of retardation in velocity due to backwater, and only very little vegetation in the channel. Special attention is called to these factors to avoid the possibility of a general inference being made that all drainage channels enlarge due to erosion. On the other hand, the conditions may be such that practically no erosion takes place and, instead, silting or filling up of the channel occurs. For instance, erosion is often prevented or its progress checked by the growth of vegetation in channels, which growth in turn often promotes the rapid silting of channels. Cross-sectional measurements of a large number of drainage ditches, where the conditions affecting erosion have been quite varied, have been made by the Bureau of Public Roads and Rural Engineering for the purpose of obtaining reliable data on silting and erosion. Reports on these investigations will be prepared and then can be obtained from the bureau.



FIGS. 4 TO 6. REPRESENTATIVE VIEWS TO SHOW EFFECT OF EROSION ON DREDGED RIVER CHANNEL

Vault Will Hold Two Freight Cars

To foil thieves who make a practice of stealing raw silk from freight cars—a very common practice—the Cheney Bros. silk firm at South Manchester, Mass., is building a vault big enough to hold two freight cars. The structure is 90 x 16 ft. in plan, with brick walls, a concrete roof and regulation vault doors at either end. The builder is the Aberthaw Construction Co.

Defects in Surface of Bituminous Pavement Due to Concrete Base

Data Collected at Oak Park, Ill., Indicate That Cracks and Other Objectionable Features Are a Minimum Where Flexible Foundations Are Used

By H. W. Skidmore
Construction Engineer, Department of Public Works, Oak Park, Ill.

PRACTICALLY all the defects in bituminous pavement, as now constructed in Oak Park, Ill., may be traced to the concrete base. Investigations by the engineering department show that these defects are greatly reduced where flexible foundations, such as macadam, have been used. This has led to the conclusion that homogeneity and a certain amount of resiliency are far more valuable in bases for such pavements than rigidity. The question arises as to whether bituminous concrete bases, which have been employed with great success in many cities, should not be substituted for the rigid form. Whichever type is used, good drainage is essential, as cement concrete has failed to bridge over weak subgrades.

Much has been said recently regarding changes in design of bituminous pavements, and observation of the action of these pavements has led many engineers to consider these changes seriously. For years the presence of cracks in pavements has been treated lightly by engineers with the statement that, as a rule, cracks are not a serious defect; but now the cracks seem to be receiving considerable attention, and efforts are being made to minimize or prevent them. In all these discussions there has been a significant lack of actual data. Just what effect cracks, depressions due to failure of base, upheavals, etc., have on the life of the pavement, and the cause of these defects, with the remedies therefor, are still matters of conjecture, and there are about as many different answers as there are engineers giving the problem thought.

With the idea of collecting accurate data the writer decided during the winter of 1916-17 to start an investigation. Plans were made for conducting a thorough inspection about twice a year. The kind of information needed was determined, and forms for recording such data were devised.

Inspections are made in the early spring and in the hot summer weather, the latter to determine the tendency toward hot weather cracking and the extent to which the subgrade retains moisture throughout the year. At first, the data obtained in the field and the subsequent deductions were tabulated on one large tracing which contained the record of all pavements. After making an analysis of the information obtained in our first inspection, it was decided that an individual record of each job would prove more satisfactory. A sample of the forms now used for record is shown herewith. These cards are easily filed and may be sorted and arranged, so that any specific set of figures may be taken off easily. Such data as may not be tabulated in columns by means of numbers are included in the "remarks."

In connection with these files we also have a complete card index of all pavement repairs which have been made during the writer's connection with the department. This record includes repairs made from 1914 to date. No record was kept prior to that year; consequently, analyses are somewhat imperfect so far as the older pavements are concerned.

As soon as the 1918 inspection was completed, summaries were made of the results. These summaries include various groupings of pavement, and also consider the various groups in relation to one another on the basis of length of service, the kind of asphaltic cement used in the wearing course, contractors, etc. The table given groups the pavements as to the type of consruction, and analyzes them with reference to the kind of asphaltic cement used and the age.

A comparison with relation to the kind and character of the subgrade was desired, but this could not be made, comprehensively, owing to a lack of necessary data concerning the older pavements. Such studies will be made, however, as pavements laid within the past few years become older, and with a more complete record of later years, analyses may be made on any number of different bases. It will also be possible to trace in-

FILE No. 468

St. Washington Boul. From Austin Boul. To 72nd Ave. Spec. No. 308 Contr. Am. Asph. Pav. Co.
Kind Pav't 2" Asph. Conc. Kind Base 4" Conc. over old macadam Kind A. C. Trinidad Kind Flux No Record
Kind Cem. in base No Record Kind Aggregates in Base Crushed limestone & Screenings Kind Soil Black Top - Clay Sub.
Aver. Penetration No Rec. Length 8173' Sq. Yds. 35359 Date base laid June 1913 Date top laid June & July 1913
Remarks Oak Park Mix with squeegee & 1/4" granite chips. Very heavy Boulevard Traffic.

INSPECTION		Trans. Cracks		Longitudinal Cracks	Cracks showing "heave"	Depressions ½" or more deep	Depr. due to failure of base	MAINTENANCE		REMARKS
Date	by	More than ½ width	½ width or less					Sq. Yds.	Year	Out of Reserve Aug. 1918
Mar. 17	H. W. S.	20	54	12						Considering Heavy Traffic - in excellent shape
Mar. 18	H. W. S. R. Y. P.	124	67	31	31		3	123.9	1918	Repairs made Aug. 1918 as follows:- Acct. pushing = 85.1 yds.; ~~acct. heaved cracks =~~ 13.6 yds; acct. failure of Base = 21.2 yds; and acct. miscl. = 4 yds.

CARD RECORDS OF EACH PAVEMENT CONTRACT ARE KEPT AT OAK PARK

ANALYSIS OF CONDITION OF ASPHALTIC PAVEMENTS AT OAK PARK, ILL., WITH REFERENCE TO KIND OF ASPHALTIC CEMENT USED; FROM INSPECTION MADE IN MARCH, 1918

				Cracks												Depressions						Maintenance		
				Transverse More Than Half Width			Transverse ½ Width and Less			Longitudinal			Showing Heave			¾ In. or More in Depth			Due to Failure of Base					
Year Laid	Kind of Asphalt Used	Lgth. Miles	Sq.Yd.	No.	Per Mile	Per 1000 Yds.	No.	Per Mile	Per 1000 Yds.	No.	Per Mile	Per 1000 Yds.	No.	Per Mile	Per 1000 Yds.	No.	Per Mile	Per 1000 Yds.	No.	Per Mile	Per 1000 Yds.	Sq. Yds.	Per Mile	Per 1000 Yds.
	1½-inch Sheet Asphalt on 1½-inch Binder on 6-inch Concrete Base																							
1906	No record	0.50	6,968	52	104	7.5	101	202	14.4	38	76	5.4	9	18	1.3	569	1,138	81.8	403	806	5.8	63	126	9
1907	No record	0.77	11,669	58	75	5.0	125	163	10.7	3	4	0.31	10	13	0.9	206	268	17.6	48	62	4.1	53	69	4.5
1908	No record	1.21	18,396	215	177	11.7	146	121	8.0	22	18	1.2	83	69	4.6	237	196	12.9	41	33.9	2.2	60	50	3.3
1910	No record	1.49	23,539	109	73	4.6	205	138	8.7	25	17	1.0	61	41	2.6	255	171	10.8	102	69	4.3	83	56	3.5
1914	Mexican	2.76	43,667	133	48	3.0	31	11	0.7	0	0	0	50	18	1.1	15	5.4	0.3	0	0	0	24	8.7	0.6
1916	Trinidad-Mexican	0.26	2,574	0	0	0	0	0	0	0	0	0	0	0	0	2	7.7	0.8	0	0	0	0	0	0
	2-Inch Asphaltic Concrete on 6-Inch Concrete Base																							
1911	No record	0.91	14,543	37	41	2.5	47	52	3.2	18	20	1.2	4	4.4	0.4	23	25	1.6	1	1	0.07	338	372	23
1912	California	2.00	33,971	70	35	2.1	371	186	11.0	93	46	2.7	0	0	0	43	22	1.3	1	0.5	0.03	528	264	15.5
1913	Trinidad	1.10	17,160	20	18	1.2	34	31	1.9	0	0	0	4	3.6	0.23	20	18	1.2	4	3.6	0.23	2.8	2.5	0.16
1914	Trinidad	0.13	2,028	13	100	6.4	10	77	4.9	0	0	0	4	31	2	0	0	0	0	0	0	0	0	0
1914	Mexican	7.59	122,172	510	67	4.1	150	20	1.2	50	7	0.4	183	24	1.5	145	19	1.2	11	1.5	0.09	235	31	1.9
1915	Mexican	2.38	38,150	78	33	2.8	27	11	0.7	8	3	0.2	31	13	0.8	74	31	2.0	7	3	2	174	73	4.6
1915	Trinidad	0.78	13,648	28	36	2.6	10	13	0.7	9	11.5	0.66	10	13	0.73	6	8	0.4	0	0	0	0	0	0
1916	Trinidad-Mexican	1.25	19,292	37	30	1.9	25	20	1.3	0	0	0	11	9	0.57	31	25	1.6	7	5.6	0.36	0.5	0.4	0.03
1916	Aztec	1.49	23,680	123	83	5.2	21	14	0.9	5	3	0.2	30	20	1.3	1	0.7	0.04	0	0	0	1	0.7	0.04
1916	Trinidad	6.32	97,244	253	40	2.6	64	10	0.66	7	1	0.07	99	16	1.0	22	3.5	0.2	3	0.5	0.03	0	0	0
1917	Trinidad	1.46	26,716	32	22	1.2	9	6	0.34	4	3	0.15	4	3	0.15	1	0.7	0.04	0	0	0	0	0	0
	2-Inch Asphaltic Concrete on 4-Inch Concrete Base Over Old Macadam																							
1913	Trinidad	1.55	35,359	124	80	3.5	67	43	1.9	31	20	0.88	31	20	0.88	0	0	0	0	0	0	0	0	0
1916	Trinidad-Mexican	0.48	7,823	21	44	2.7	2	4	0.25	0	0	0	2	4	0.25	0	0	0	0	0	0	0	0	0
1916	Trinidad	2.36	38,536	49	21	1.3	12	5	0.3	8	3	0.2	2	0.85	0.06	3	1.3	0.08	1	0.4	0.03	2	0.85	0.06
1917	Trinidad	0.53	10,142	2	4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2-Inch Asphaltic Concrete Over Old Macadam																							
1912	Trinidad	0.13	2,480	0	0	0	0	0	0	0	0	0	0	0	0	2	15	0.8	0	0	0	23	177	9.3
1914	Trinidad-Mexican	0.39	6,232	0	0	0	0	0	0	0	0	0	0	0	0	5	13	0.8	0	0	0	0	0	0
1915	Mexican	0.49	8,057	0	0	0	0	0	0	0	0	0	0	0	0	6	12	0.7	1	2	0.12	23	47	2.9
1915	Trinidad	0.14	1,509	0	0	0	0	0	0	0	0	0	0	0	0	2	14	1.3	0	0	0	16	114	10.6
1916	Mexican	0.06	1,125	0	0	0	0	0	0	0	0	0	0	0	0	1	17	0.9	1	17	0.9	2	33	1.8
1917	Trinidad	0.79	12,285	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

dividual paving jobs through consecutive years, thus providing interesting comparisons between the average results in individual jobs and those here presented.

In considering the data collected, the significant absence of cracks in pavements laid on reshaped macadam roadways is at once apparent, indicating that the defects in those on concrete base are due to the base. A 4-in. concrete base laid upon old macadam, likewise, shows much less tendency to crack than do pavements on 6-in. base, laid directly upon the natural soil. The conclusion is that the presence of the macadam facilitates drainage immediately beneath the concrete.

We have found on the average that 14% of all cracks in asphaltic concrete pavements, up to seven years old, cause an upheaval of pavement. Most of the heaving is apparent in the late winter and early spring, during periods of alternate freezing and thawing. This leads to the conclusion that the heave is caused by the freezing of water which is admitted through the cracks at each thaw.

The presence of the binder course in sheet-asphalt construction apparently has some effect in delaying the surface reproduction of cracks occurring in the concrete base. With a bituminous mixture serving as an absorbing medium, cracking of the wearing surface is not prevented; it is merely delayed.

Another significant fact is that asphaltic concrete pavements laid over old macadam have shown no sign of "pushing" or "rolling" under heavy traffic, while the same pavements on concrete have given considerable trouble in this respect. In one instance, on a street having both types of construction, this difference has been very marked. Sheet asphalt, including boulevard pavements, has shown almost no tendency to push.

Tendencies toward longitudinal cracks, and cracks resulting in subsequent upheaval of pavement, seem to show the same relation between the types of pavement as those toward transverse cracks. The kind of asphalt used had practically no effect on the number of cracks.

In studying the maintenance rate for the four types of pavement, it is necessary to call attention to the fact that all the maintenance on pavements laid directly upon old macadam could have been prevented, as most of it, with the exception of a few yards of surface replacing of scorched material, was due to settlement of backfilling over trenches. Had these trenches been filled as they now are in Oak Park, this maintenance would have been unnecessary. Our experience with bituminous-concrete pavement has shown that those laid directly upon old macadam not only cost less for construction and maintenance, but also are in much better general condition after several years' service.

In order to minimize the movement of the wearing surface, the concrete base, for those having one, is finished rough. We have found that these pavements are inclined to assume, in a measure, the rough surface of the concrete. In comparison with those laid on old macadam, this feature is quite noticeable. This fact has led the writer to reduce, considerably, the roughness of the concrete surface.

It is well-nigh impossible to repair cracks in a bituminous pavement on a concrete base, so that they will not reappear and again provide means of admitting water. However, it is possible to relieve, in a measure at least, the upheaving at a crack by means of replacing the cement concrete base with bituminous concrete of sufficient extent to waterproof the structure. This, however, is expensive, and contractors dislike very much to make such repairs. Moreover, the practical value of the method is not firmly established. The repair is effected by digging out the base under the crack to a width of 6 or 8 in. and filling with bituminous concrete, upon which a new surface is placed.

That cracks are serious defects, in so far as bituminous pavements are concerned, is evident, and the older the pavement becomes the greater will be the frequency of the cracks as shown by this investigation. Undoubtedly, poor subdrainage is often the cause of cracks in concrete bases and concrete pavements; and, by providing proper drainage and expansion joints, they

may largely be eliminated. The cost of this, however, is often so high that it would mean the death of the proposed improvement, and a cheaper construction with less efficient drainage would be adopted. Furthermore, expansion joints in concrete base under a bituminous pavement cause cracks in the surface material at each joint. Therefore, with three joints to each 100 ft. of base, or 160 per mile, cracks in the surface would be produced at the same rate.

The number and seriousness of defects which result in maintenance expense should be considered as an index to the serviceability and cost of the pavement. If these defects are inherent in the pavement, they may be expected to appear at a certain rate, depending largely on local conditions, as long as specifications and construction comply with good practice. If it be true that certain defects are inherent and unpreventable, but two courses are open—the one to abandon that type of construction, the other to continue the use of the pavement, knowing that certain results must follow.

It has been said that if bituminous concrete is used as a foundation material we must exercise special care in the preparation of drainage and subgrade, and while present practice lays little stress upon these points in concrete-base construction, it is nevertheless true that equal care should be taken, if we are to expect first-class results. The chief argument in favor of concrete has been that it bridges over unstable subgrade. As now laid, concrete has failed in this regard under the stress of modern traffic. There would seem to be no reason for laying the concrete base, save that special effort in subgrade preparation is avoided. Given an ordinarily dry subgrade, good results should be obtained from the use of an all-bituminous pavement.

Large-Capacity Well Installation and Operation

Tuning-up Process with Gravel Insertion Stabilizes Yield—High Overall Efficiency Obtained With Six-Stage Pump

CAREFUL records of methods used in tuning up a 30 to 36-in. bored well having a maximum capacity of 1000 gal. per minute, at the University of Illinois, as well as subsequent data, are given in a paper presented by Prof. M. L. Enger to the Illinois Section of the American Water-Works Association. Early intermittent operation to increase capacity, insertion of gravel, with resulting high yield per foot of draw-down, unusual hydraulic behavior during long-time tests, a clay seal at the top to protect the water from pollution, a recording water-level gage and a simple vertical jet apparatus to measure the flow, are points emphasized in the paper.

Water for the university is obtained from this well and five others, the latter being 8 and 12 in. in diameter, sunk into the glacial drift to a depth of about 140 ft. and yielding 6 to 80 gal. per minute. The new well is 36 in. in diameter for 160 ft. and 30 in. for the next nine feet.

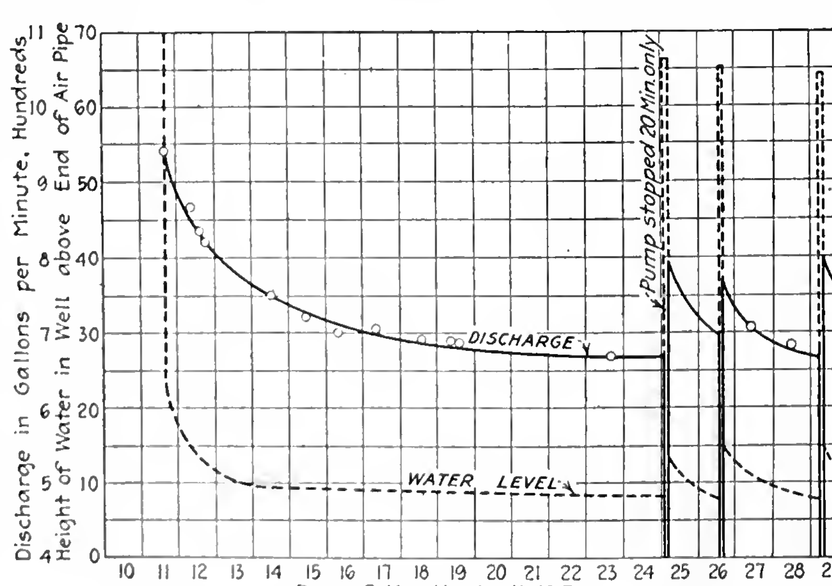
It was drilled in 1916 by the Layne & Bowler Co. by the rotary process in 3½ months, and the payment was on the basis of $19 per gallon per minute after one year's operation, with a guaranteed minimum overall efficiency for motor and pump of 55%. The cost of the previously drilled wells, motor and reciprocating pumps ranged from $934 to $2106.

The driller furnished the following log of the new well: Clay and gravel mixed, 50 ft.; clay and rock, 15 ft.; hard clay and sand mixed, 30 ft.; hard sand and gravel, 47 ft.; very hard and fine sand, 26 ft.; hard sand and little clay, 5 ft. The well was completed by putting in 98 ft. of 24-in. casing; 70 ft. of 24-in. Layne patent shutter screen, and 4 ft. of 16 x 22-in. shutter seal with a 6-in. cypress bottom. The space between the screen and casing and the wall of the well was filled with 1-in. gravel.

The tuning-up process consisted of alternately starting and stopping a temporarily installed turbine pump, in order to break down and wash away the mud wall left by the drilling process, and also to carry out the finer sand in the water-bearing stratum near the well. It was hoped in this way to form a cavity under the heavy clay roof, indicated in the above log, into which the gravel would flow and thus increase the capacity of the well. The driller stated that 30 cu.yd. of gravel were fed in at the top.

A preliminary test showed a yield of more than 1000 gal. per minute with a draw-down of 53 ft., or a specific capacity of more than 19 gal. per minute per foot of draw-down. The well now has a specific capacity of 21.5 gal. per minute. A 12-in. well at the university, tested immediately after its construction in 1906, showed a yield of 108 gal. per minute with a draw-down of 15 ft., or a specific capacity of 7.2 gal. per minute. In 1916 its yield was 4.9 gal. per foot of draw-down per minute. That is, the 10 years of operation reduced its specific capacity more than 30%, while the new well in about two years of normal use has had its specific capacity increased by about 10 per cent.

It was soon found that a yield of 1000 gal. per minute could not be maintained for any length of time without gradually lowering the water level in the new well and in the older wells. A test was begun Apr. 11, 1917,



TEST TO DETERMINE CONSTANT LEVEL

in which it was intended to run the pump continuously until the water level in the well should become constant. The water went down quite rapidly during the first two days of the test and continued to go down slowly until the morning of Apr. 25, when some trouble at the switchboard caused the circuit breaker to blow out, stopping the pump. It was started again about 20 minutes later, but during the interval the hydraulic con-

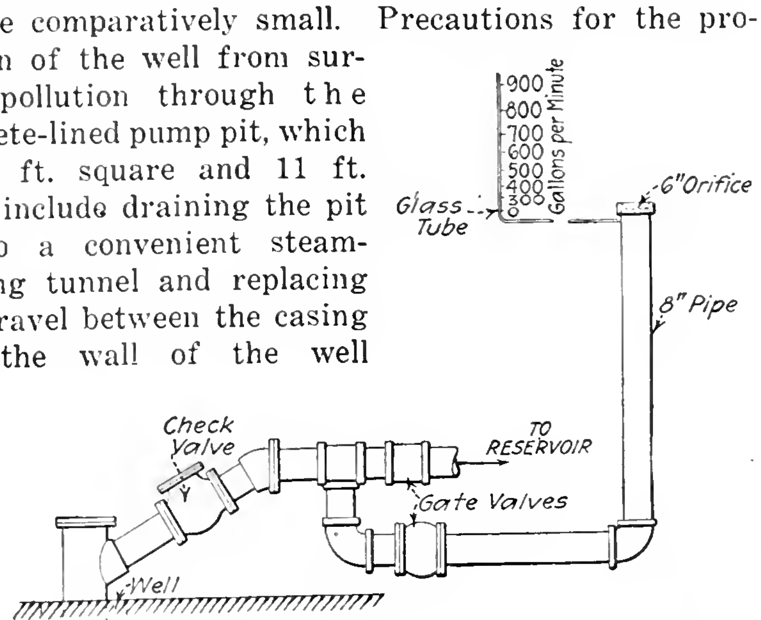
stants of the well had been changed greatly. The discharge had been about 670 gal. per minute for several days. When the pump was started again the discharge was about 790 gal. and 24 hours later was about 710 gal. per minute. The rapid change in the hydraulic constants is attributed to the behavior of the fine sand drawn toward but not into the well during the continuous operation, which by readjustment during the brief cessation of pumping was allowed to wash into the well upon resumption of pumping, thereby leaving the water passages less restricted.

In the acceptance tests made Dec. 28, 1918, the permanent installation, consisting of a six-stage, 15-in. pump, driven by a 50-hp. two-phase induction motor, showed an overall efficiency of 55.6% when delivering 587 gal. per minute against a head of 136.9 ft., and of 59.3% delivering 536 gal. against 156.4 feet.

Compared with the other well equipment at the university, the new one has the disadvantage of 15 ft. greater draw-down. But since it has never been possible

FOOTPIECE PERFORATED IN CASE BOTTOM OF WELL BECOMES SEALED

to maintain the average efficiency of the reciprocating well pumps as high as 50%, the turbine pump will get the water out of the ground with a smaller power consumption than the reciprocating pumps. With the older equipment the cost of maintenance has amounted to about 0.8c. per 1000 gal. The new equipment has not been in use long enough to draw definite conclusions, but the indications are that the maintenance cost will be comparatively small. Precautions for the protection of the well from surface pollution through the concrete-lined pump pit, which is 12 ft. square and 11 ft. deep, include draining the pit into a convenient steam-heating tunnel and replacing the gravel between the casing and the wall of the well with clay to a depth of 6 ft. below the floor of the pit. Frequent tests indicate the water is of excellent sanitary quality.



PIPING IN VERTICAL JET APPARATUS

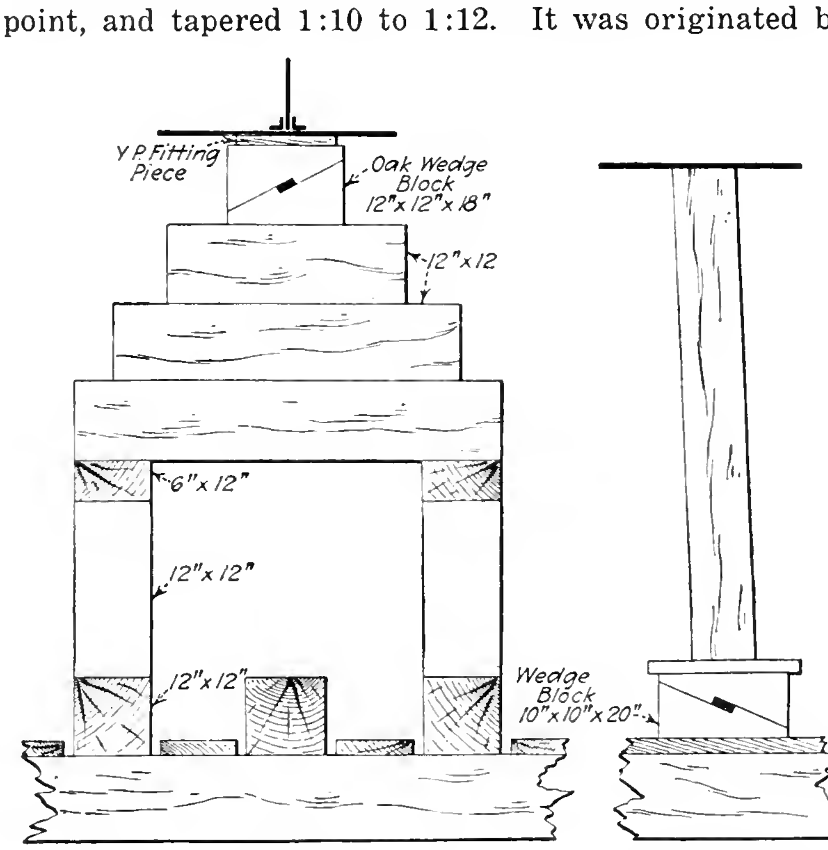
To obtain continuous records of the water level in the well, a recording gage is used to record the pressure required to keep a small quantity of air bubbling from the end of a 1½-in. pipe which hangs in the well and extends below water level at all times. The pressure in the air pipe is equal to the head of water above the end of the pipe, hence the gage shows the submergence of the end of the air pipe. The records show when the pump is started and stopped and are found very useful in the preparation of statistics of operation.

Discussion of the paper brought out three other means of determining the water level. A weighted, small-bore rubber tube is dropped between the casing and the inner pipe. By connecting the top end with a glass U-tube filled with water, the instant at which the lower end strikes water is readily noted. Electrically the level may be determined by protecting the ends of two insulated wires dropped from the sides of the pipes. A telephone battery and buzzer equipment complete the outfit. If the space between the inner and outer pipes is too small to insert anything, the whole concentric space may be sealed off and used as an air pipe, as Professor Enger used his 1½-in. pipe.

A New Quick-Release Keelblock

A WEDGE keelblock of new form, invented by a shipwright at the yard of the Federal Shipbuilding Co., Kearny, N. J., was tried out recently in the launching of the hull of the "Waukegan," a 9600-ton steel ship. The block was used on one of the keel supports and also under a shore, as sketched herewith. It worked successfully.

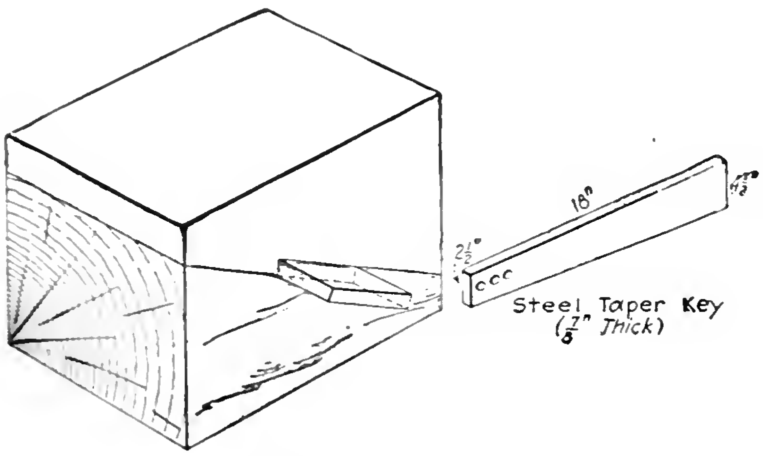
In construction, the block is a pair of wedges with the inclined faces rabbetted to receive a steel taper key holding the halves of the block from sliding. The block itself is 12 x 12 x 18 in. over all, and is cut with an inclination of about 1 on 2 for the wedge faces. The key is about 1 in. thick, 2 to 2½ in. wide at the point, and tapered 1:10 to 1:12. It was originated by



NEW WEDGE KEELBLOCKS AND SHORE BEARING

Eugene Lantz, of Jersey City, N. J., who has applied for a patent on the device.

In the launching of the "Waukegan" the wedge keelblock and a nearby shore supported on a similar but smaller (10 x 10-in.) wedge block were left as the last



QUICK-RELEASE WEDGE BLOCK DEVISED BY E. LANTZ

supports to be removed. They had been placed under the heaviest part of the ship, near the engines, and the gradual settling of the vessel as the shores were knocked out and the keelblocks split away subjected them to an abnormal load. Nevertheless, the shore released itself promptly, with a sharp kick, when a blow with an 8-lb. hammer knocked out the taper key. Thus the use of the self-releasing block eliminated the need for the heavy ramming required to knock out shores as ordinarily supported, which delays the launching and destroys a large number of shore timbers at each launching. In releasing the keelblock wedge the operation was not as quick and automatic, but a light blow dropped the two halves of the block apart after the key had been knocked out.

As a strength test, a model block made one-sixth the size of the original, or 2 x 2 x 3 in., was subjected to compressive load in a testing machine at the mechanical laboratory of Columbia University. The block, made of oak, carried a maximum load of 14,000 lb., at which stage signs of crushing appeared along the lower edge of the block. No sign of failure was noticeable at the taper key recess, and the sliding faces of the wedges showed no effect. The block released under load the moment the key was driven out.

The taper key permits the adjustment of the height of the block, in the laying of a new keel. As a means of locking the block against accidental disturbance of the key, there is a series of holes in the tail of the key to receive a ½-in. bolt.

With a block similar to that shown, but fitted with a double key, a 14-ton stern post was easily lifted off its blocking, and as easily lowered again. The block is not intended for such service, however, and is designed primarily for use as a releasing support on keelblocks and bilge cribs and under shores.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Effectiveness of Strike Weapon in Raising Salaries

Sir—The railroad engineers' conference on salaries, described in your issue of Mar. 27, p. 612, is a marked forward step in this important matter and reflects much credit upon the American Association of Engineers for promoting the conference and presenting the well-worked-out schedule of salaries, but it appears that the conference expressed a temporizing attitude toward a very important question put by one of the conferees.

The account tells that, during the course of an address by W. W. K. Sparrow on "How Shall Proper Recognition Be Obtained?" the question was asked as to what the speaker proposed should be done in the event of the railroads' refusing to accept the salary schedule presented. Mr. Sparrow replied, "I would not strike," and his declaration was greeted with applause.

No positive answer was given to the question except this, "After the lessons of the war I believe men will get what, in justice, they are entitled to get."

It is perfectly true that men, and especially engineers, will get what injustice (written as a single word!) they are entitled to if they still persist in holding to a long since out-of-date standard of ethics which has been taken advantage of by the large employers of engineers.

The proposed salary schedule and all other matters pertaining to the standing and welfare of technical railroad engineers is still, and always will be, for the railroad companies to accept or reject as they choose, unless the engineers are organized and fully prepared to exercise the one final and only really effective weapon of the strike. We should, by all means, use every other possible device to obtain adequate recognition before resorting to the extremity of striking. But if engineers were so organized that they could, and would, strike effectively, it would lend very great weight indeed to fair and just representations that might, from time to time, be laid before the employers of engineers.

Mr. Sparrow suggests that the proper line of action is to organize to give the whole profession a single voice, with licensing and broader education. These are all proper and commendable plans, but they will take a long time to mature, and still longer to bring about the urgently needed increases in engineers' salaries.

Niagara Falls, Ont. REX P. JOHNSON.

Apathy in National Society a Cause of Unionization

Sir—There are two rather significant items in your issue of Apr. 10, 1919, bearing on the present status of engineers. The first is your editorial indicating the apathy of the members of the Am. Soc. C. E. toward the Development Committee of the society, an apathy probably born of the years of hopelessness that any suggestion to make the society a little bit human or to increase the number of its red corpuscles is doomed to failure. The second item, on p. 737, is that Boston engineers have joined the American Federation of Labor.

A matter of somewhat similar interest developed at a recent meeting of the Am. Soc. C. E. when it was asked that the members present discuss a proposed en-

gineering project of importance (the vehicular tunnel to New Jersey) with a view to an expression of opinion as to the feasibility, or otherwise, of the project; in other words, they were to give an opinion for nothing.

In connection with the war, engineers, in common with men in all walks of life, freely gave of their time and experience for little or no compensation of a monetary nature, but in time of peace it seems to me that if our national, state or municipal authorities need engineering advice they should pay for it at the regularly established rates, and not attempt to get it gratis under the guise of reconstruction or any other form of camouflage. Engineers, whether of the national railroads, employees of Public Service Commissions, or others, should be recognized as at least of equal importance with the labor unions, without resorting to strikes to enforce their demands.

Personally, I do not at all like the idea of unionizing under the American Federation of Labor any body of professional civil engineers. There are other ways of succeeding, and engineers really worthy of the name (who realize that their profession is much broader and needs a much broader outlook than the mere technique of running a transit, making a plan, or calculating the stresses in a bridge) will succeed without the aid of any labor union; in fact, the generally understood attitude of the labor union is fatal to the necessary vision of the successful engineer. In order, however, to avoid forcing the younger members into the labor unions, there can be no question that the national engineering societies should be vehicles for the continual promotion of the interests of the engineering profession, not merely by the formal presentation of technical papers but also by such action as that recently taken by the Engineering Council in regard to the wages of railway engineers, and the stimulation of interesting meetings.

I suggested, several years ago, the study of methods of other societies, with a view to making the Am. Soc. C. E. more human. The late J. E. Johnson, Jr., pointed out very recently (see *Engineering News-Record* of Apr. 3, 1919, p. 688) the need for directors chosen for their ability to direct rather than as a pension for past services. The secretaries, particularly, need to be in touch with the world, with the current activities of the profession and in sympathy with the members—not merely editors of technical papers, reporters of meetings and guardians of the treasury, all of whom are necessary and desirable but far from meeting the needs of the profession.

I believe that unless our leading technical societies find a solution of the many social problems confronting the engineer; help him to reëmployment if he needs it; see, so far as it is possible to do so, that he receives adequate compensation; take up actively such questions as those recently developed in connection with the Public Service Commission of New York, etc., many of the younger members will be forced into the ranks of the labor unions. This will be, in the long run, as unfortunate for them as for the whole profession.

I think there is at least beginning to be a realization of the need of this help to younger engineers by the established societies, and I believe that *Engineering News-Record* could do perhaps more good than any other agency by keeping the need, the efforts made to meet it, and the results obtained, prominently before all members of the profession. F. LAVIS.

New York City.

Economic Betterment of the Engineer

Sir—Has this war with all its intrigue and violence been sufficient to awaken us from our apathetic, mesmeric belief that we were too professional to consider the economic betterment of our profession? It is safe to assume that it has, in the majority of the profession. Then, taking it for granted that we are sufficiently awake to realize the new order of world progress, we can no more go back to that sluggish, self-satisfied, every-man-for-himself system, than the oak can return to the acorn.

Now, the problem that confronts us is the obtaining a fair day's pay for a fair day's work. Can we look to the societies and associations for the solution of this problem? Judging from past experiences, No. They in the past have been stupefied by an exaggerated sense of self-importance, dreaming away the hours, unmindful of an economic betterment for members or co-workers; publishing voluminous papers for which no real, live worker can spare the time to extract the useful from a mass of matter. Let us hope that the societies and associations synchronize with the new order of things, and become more progressive, for the complete betterment of all.

Can the individual worker do anything to promote his economic betterment? No. Not while he works alone. Those of us who during the war were connected with Government and municipal work had a chance to realize how insignificant we were individually. In one instance there were about 250 engineers, working from 10 to 14 hours a day and seven days a week, who felt that they were not being treated fairly as regarding pay, and hours of work. They decided to see if there were not some means of obtaining a decrease in the hours of labor, if nothing more; held a meeting; sent a letter to the "chief pundit" asking for an explanation of the Government's attitude in requiring excessive hours of labor, but only eight hours' pay per day.

After waiting an unreasonable length of time for an answer, the committee decided to have a personal interview with the "chief pundit"; and in answer to their demand for a reason for utter disregard of their previous requests they were told that there was not time to take the matter up, and to rest assured that there would be a just settlement, either in shorter hours of work, or a possibility of their being compensated for all overtime.

This seemed satisfactory to all, until it was discovered that every week men were leaving, credited with numerous hours of overtime without receiving compensation for the same. It soon became apparent that something more drastic should be done.

The carpenters on this job decided that they needed a substantial increase in pay; and when their request failed to meet their expectations, about 80% of their number started to leave the works. They were stopped by headquarters and assured that they would be given all they demanded, and that the increase would start from the time they commenced work on that job.

The only possible solution of the problem seemed to be in unionization. When you say "unionize" to a professional man you are sure to meet that threadbare argument; that we are professional men, not laborers. Even so, what, may we ask, have we received in return for all our professionalism? John M. Goodell in *Engineering News-Record* of Mar. 6, 1919, p. 482, says: "It may be found that a very large part of the

work done by engineers is really little more than skilled labor." Assuming he is right, one would naturally suppose that their compensation would be a little more than that of the skilled laborer, instead of being less than that of the so-called common laborer.

After many meetings the engineers of Boston and vicinity decided to obtain a charter from the American Federation of Labor, and now have a union that can give a good account of itself, and which will need to be reckoned with in the future. We know that, in so far as our demands are just they will be granted; that the Golden Rule is applicable to business, and the business that does not apply it in some measure is bound to fail. It is time for us to get together in one strong unit for the economic betterment of all, and in doing so we may dim the fires of Bolshevism, I. W. W. and O. B. U.

LOUIS FISHER.

Waltham, Mass.

Another Formula for Weights of Steel Roof Trusses

Sir—The article in your issue of Mar. 20, 1919, p. 576, entitled "Weights of Steel Roof Trusses by Empiric Formulas," by R. Fleming, was read by the writer with much interest, in view of the fact that he has prepared a table to give close approximate weights of steel roof trusses, for the purpose of preparing preliminary estimates on factory buildings. A print of this table is herewith inclosed.

The basis of this table is the formula shown thereon, which was devised by the writer by combining the two well known formulas of Ketchum and Ricker, referred to in Mr. Fleming's article. Having at hand some accumulated data on the weights of steel roof trusses, which had been detailed by our office, and on others for which we had prepared detailed lists of material for estimates, the writer applied a number of the textbook formulas, hoping to find one which would agree fairly well with our estimate data. But no single formula gave results even approximately close. It was found that the Ricker formula gave weights which were too low and the Ketchum formula gave weights which were too high to agree closely with our data. After making a study of the two formulas, and carefully reading the explanation of the Ricker formula in the University of Illinois Bulletin No. 16, it occurred to the writer to combine the two formulas, thereby making use of the span factors in the Ricker formula and the distance center to center of truss factor and variable load factor in the Ketchum formula.

This was tried and a coefficient for the variable load factor was determined by trial with a slide rule. The following formula resulted, and gave weights which were surprisingly close to our data:

$$W = \frac{P}{92}\left(1 + \frac{S}{25} + \frac{S^2}{6000} + \frac{S}{5\sqrt{A}}\right) SA$$

in which W = total weight of truss; P = carrying capacity of truss, exclusive of its own weight in pounds per square foot of horizontal projection; S = span in feet; A = distance center to center of trusses.

Again referring to Mr. Fleming's article, the weights for the three trusses of 40-, 60- and 80-ft. spans, bays 16 ft., load equivalent to 40 lb., given by this formula are 1356, 2920 and 5156 lb., respectively; and for those trusses of similar spans and bays, but with a load of 56 lb., the weights are 1898, 4088 and 7218 lb., respectively.

It will be noted that in general these weights more nearly agree with the estimated weights than those of either the Ketchum or the Ricker formula, especially for the shorter spans.

The table of weights of steel roof trusses prepared from the formula is self-explanatory. It has proved a reliable guide in checking estimates, in giving the weight of trusses for design purposes, and has been used a number of times by the writer in preparing a preliminary estimate without making any design of trusses.

It would be interesting as well as instructive to have others of your readers apply it to their roof-truss data and report the results obtained.

MARSHALL L. MURRAY,

Steel Superintendent, Concrete Shipyard, The A. Bentley & Sons Company.

Jacksonville, Fla.

Who Can Solve This Contractor's Problems?

Sir—We of course are interested in looking through the "Hints for the Contractor" in your estimable journal, and for a long time have expected to see some contractor come to the front with certain much-needed devices.

One is a device for spreading screenings on water-bound macadam-road work. This work is nothing less than drudgery. All specifications provide that the screenings "shall be whipped on." Dropping or shoveling on will not do, and on any work of this kind you will hear the contractor moaning for some such device.

The writer has an idea and believes it is practical. As now required, screenings must be piled along the work at intervals, say of 15 to 20 ft. My idea is to pile them in large piles 50 ft. apart and then use a mounted blower with a receiving hopper large enough for two

WEIGHTS OF STEEL ROOF TRUSSES

The table gives weight of truss for a capacity of one pound. To find total weight of truss, multiply value in table by capacity of truss in pounds = P.

Span of truss in feet, out-to-out of bearings (S)

A*	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	110	120
6	4.6	6.8	9.4	12.5															
8	5.7	8.4	11.7	15.5	19.8	24.7	30.2												
10	6.8	10.2	13.9	18.3	23.5	29.3	35.8	42.9	50.8	59.4									
12			16.0	21.1	27.0	33.6	41.1	49.3	58.4	68.3	79.0	90.5							
14				23.8	30.5	37.9	45.6	55.6	65.[illegible]	76.9	89.0	102.0	116.0	131.3					
16					33.9	42.1	51.4	61.7	73.0	85.4	98.8	113.2	128.9	145.7	163.6	182.6	202.7		
18						46.3	55.4	67.7	80.1	93.7	108.5	124.1	141.4	160.2	179.5	200.4	222.5	271.1	
20							61.4	73.6	87.1	101.9	117.9	135.0	153.8	173.7	195.3	218.1	242.1	295.0	353.8
22								78.8	94.7	110.0	127.2	145.7	166.0	187.6	210.7	235.1	261.4	318.5	382.0
24										117.8	136.4	156.1	178.0	201.1	226.2	252.2	280.3	341.6	409.5
26												166.9	189.9	214.6	241.1	269.3	299.8	364.7	437.7
28														228.5	256.0	286.0	317.8	387.2	465.0
30															271.1	302.7	336.3	410.2	492.1

For general purposes, P = 60 lb.

*Distance c. to c. of trusses in feet = A.

men to shovel into, the blower to have a flexible metal hose say 35 ft. long. The power plant could be a gasoline or oil motor. Mud, muck, sawdust, concrete and a number of other commodities are blown through hose and pipes, why not screenings? Two men shoveling from piles and one on the hose will do more work than six men carrying one shovelful at a time a distance of from 5 to 30 ft. and spreading it. A shovelful of screenings has considerable weight, and, when it is carried all day it doesn't take long for a worker to begin to look for another job.

The other item is a turntable for motor trucks. When the truck owner sees his expensive equipment being nosed into ditches and over rough fields for turning purposes, see-sawing to make the turn in narrow places or backing long distances from places fit to turn in, and realizes the time lost as well as the wear and tear on equipment, it is patent to him that a turning base is an absolute necessity.

We are bringing this to your notice in the hope that you may be able to present something practical on the two subjects. Someone will do real business with contractors if he will bring out practical devices on these lines. FRED C. BEAM.

Lima, Ohio.

The Engineer As a Physical Economist

Sir—May I offer something between definition and discursion?

Engineering is the science of cost analysis. An engineer is a physical economist. Everyman knows the engineer as one who evaluates, although the word evaluate, perhaps, will not occur in Everyman's vocabulary. The engineer is fundamentally an estimator, a man with a mathematical pencil, and is a prover rather than a speculator. He calculates stresses and strains, tests materials, records performance of men, machines, and forces of nature, derives and applies formulas. Why? To arrive at development or production costs by a method superior to cut-and-try, or rule-of-thumb.

Engineers, now as formerly, are military or civil; the former, waymakers for the forces of war and inherently destructive; the latter, always taking the element of economy into account and inherently constructive. When military engineers construct, expediency is paramount to economy. Mining, structural, electrical, mechanical, chemical, sanitary, agricultural, also architectural, are terms which designate the field of activity of the civil engineer. A competent mining engineer, for example, must have at least a working knowledge of hydraulic, mechanical, electrical, and perhaps other branches of civil engineering: yet he is essentially a physical economist, and although he may fancy himself ever so self-contained, he can never fly very far from the parent body on his own tangent.

As between those who toil and those who spin, classify engineers with the latter. A civil engineer usually spins for another, and ever must needs be compensated with a stipend, rational rule ignored. He is neither a producer of wealth directly, narrowly considered, nor yet a parasite on humanity. An outlander in the business world, he is requisitioned, like Daniel, to visualize and interpret dreams; but no one expects him to promote or participate. Does the gambler, or banker, dream of a fertile valley replacing an arid waste? His engineer will interpret the dream in terms of a specified dam and irrigation works. Does the trader dwell in a mansion? His architect schemed it. Utility and efficiency gaging the engineer, utility and beauty guiding the architect. A 4H for the one, a crayon for the other, and in either case "How much will it cost?" and "Good morrow, professor."

Comparing Socialists with engineers, the former expect to reduce work and eliminate profits; the latter are expected to work hard and forego profits. The engineer may be likened to a medieval grist miller grinding corn and retaining barely enough meal for supper. What miller nowadays is satisfied with one little mill, and grinding only? An engineer sometimes gets above (at least more potent than) the purely professorial and single-phased class which remains untouched by the lucre of gain—and becomes successful as a contractor or other master spinner. Whenever he arrives, discovers himself, plays his initiative, his fellows are no longer solicitous as to his status, and seldom bother themselves about his ethics.

Engineers as such do not engineer. They design, construct, valuate, report, or what not that is decent; while promoters, politicians, or schemers, engineer. The noun is honest, but the verb implies astuteness and is taboo.

It seems to me engineers could and properly should engineer, and that without any lowering of ethical standards. At least, they should endeavor to engineer their own fortunes, but there appears to be small hope so long as they remain deficient in everything but efficiency and oblivious to the uses of imagination. Instead of being satisfied when they have determined what it will cost, if they will step over the threshold and interest themselves as to what it will win, realizing that the word "win" implies "venture" and "contest," if they will move their standard up from responsible charge to responsibility, perhaps they may be expected to represent something.

Question: Has the engineer anything that he can capitalize or even enterprise, or is he inherently a peon? What is his logical status? C. P. KEYSER.

Portland, Ore.

Correction

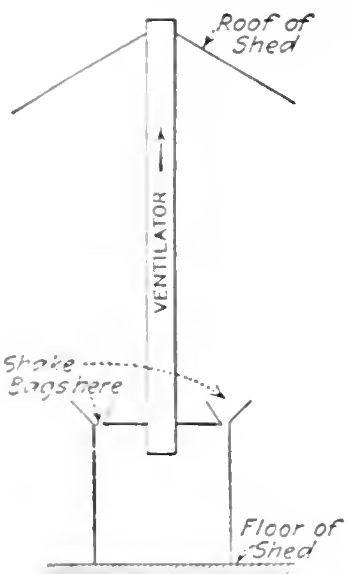
The following corrections should be made in the article, "Field Methods on Rapid Stadia Surveys at Columbus," published in *Engineering News-Record* of Apr. 17, 1919. Starting at line 8, column 2, p. 776, it should read: "Primary traverses averaging 15 miles in length were easily kept within an error in minutes of angle of one-half the *square root* of the length of the traverse in miles, and within a linear closure of 1 in. 1500, while levels always checked between United States Geological Survey bench-marks *in feet*, as well as five-hundredths *times* the square root of the miles of levels." Starting with line 7, column 1, p. 777, it should read: "If the level reading were taken *after* the distance had been read on a shot, it would be taken first on the next shot, thus saving the time necessary to reset the bubble." Loose-leaf notebooks were not used on this work, as indicated by the perforations shown in the illustration, but two ordinary transit notebooks were used alternately, so that the notes in one could be plotted while the other was in use.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

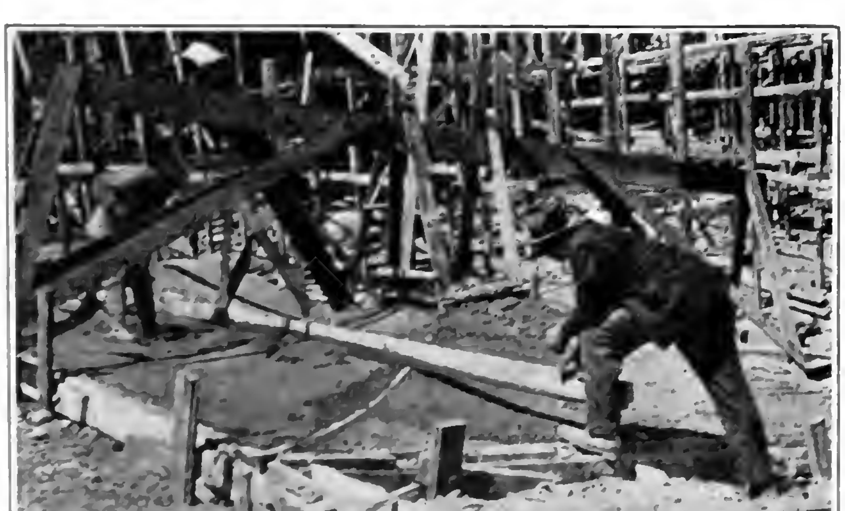
Dust-Bin for Shaking Out Empty Cement Bags

JOHN OWENS, foreman of the Englewood gravel-washing and concrete-mixing plant of the Miami Conservancy District, recently rigged up a simple bin with ventilating stack, in which empty cement bags can be shaken out without the raising of a cloud of irritating dust. The device is shown in the April *Miami Conservancy Bulletin* by the sketch reproduced herewith. It not only does away with dust, but it reclaims fully twice as much cement as shaking out the bags on the shed floor or in an open box, and allows the work to be done twice as fast. From 1500 bags shaken out, 11 bags of cement were reclaimed. The device consists of a box 6 ft. long, 3½ ft. wide, and 3 ft. deep, with a wooden air shaft running from the top of the box up through the roof of the cement shed. Three inches from the top of the box the two long sides flare out, as shown, at an angle of about 45°. The box has a lid narrower than the width of the box, so as to leave an open space about 2 in. wide between the long edges of the lid and the sides of the box, as shown. The empty cement sack is dropped mouth down through this 2-in. slot and shaken into the box. The effect of the ventilator is to prevent dust rising through the slot into the cement shed.



Suspended Angle Irons Form Screeds for Groined Floor

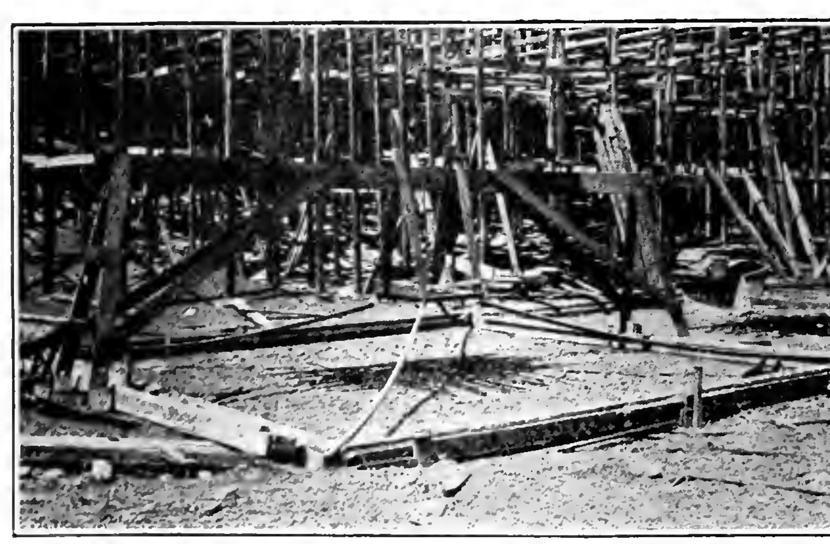
IN THE construction of the low-service reservoir for Dayton, Ohio, last year, the Danis-Hunt Co., contractor, used a special form of screed for the groined floor which is shown in the accompanying views. These



ANGLE IRONS HUNG FROM FRAME FORM SCREED

Other Articles in This Issue of Interest to Contractors:

floor groins were 20 ft. square at the bottom and 30 in. deep, resting on the ground over a reinforcing mat. A timber horse was placed over each groin location, and suspended therefrom was a wood frame carrying a steel frame to the size and shape of the groin. This steel frame was made of angle irons, with an upper square and four dependent corner angles bent to the curve of



SCREEDING THE GROINED FLOOR TO THE ANGLE IRON

the groin, which angles rested at their outer ends on timbers laid to the proper dimensions on the ground.

Concrete was piled into the groin and screeded off against the angles, as shown in the second view. Just as soon as this concrete would hold its position the frame was lifted, and the small opening left by the angle, being pulled out, was filled in and troweled to surface. The work was under the general direction of H. C. Wight, superintendent of water of the City of Dayton.

Cutting Concrete Piles at Port Terminal

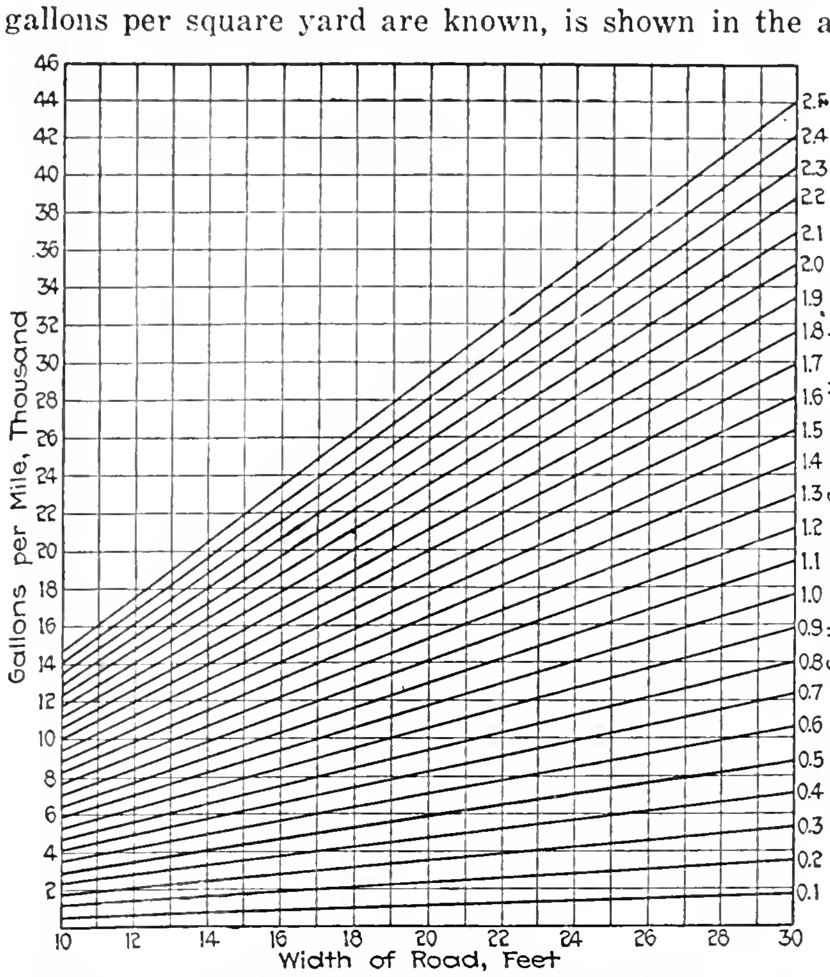
IN THE United States Army base at Charleston, S. C., precast concrete piles were used for a portion of the dock structure. These were cut to proper elevation, as shown in the accompanying view, by sledging off the surface concrete about 3 ft. above the cut-off level and cutting the rods with a gas torch. The concrete shaft

GAS TORCH CUTS RODS ABOVE CUT-OFF, AND PLUG AND FEATHER SEVERS SHAFT AT PROPER LEVEL

was then severed at the cut-off level with plug and feather, and the upper section pulled out by a derrick, leaving the projecting rods, as shown at the left of the view, for bonding purposes.

Number of Gallons of Road Oil Per Mile for Known Width and Rate

A HANDY chart for determining the number of gallons of road oil required to treat one mile of highway, when the width of the road and the number of gallons per square yard are known, is shown in the accompanying illustration. The chart was put out by the Union Oil Company.



GALLONS OF ROAD OIL REQUIRED PER MILE OF ROAD AT GIVEN WIDTH AND RATE

Knowing the width of the roadway, follow vertically upward until the line intersects the diagonal line of gallons per square yard as indicated at the right; then read the number of gallons per mile at the left. Thus, with a 20-ft. roadway and a rate of 1.8 gal. per square yard, 21,000 gal. would be required.

Grease Pump Is Useful to Dry Diaphragm Pumps in Cold Weather

A GREASE pump of about 1-in. diameter and 12-in. length has been used by William G. Cooper, contractor, on the Gravesend Ave. elevated line, Brooklyn, N. Y., for removing water from pumps of the diaphragm type each evening when they might be damaged by freezing during the night. By the sucking of the water into the pump and discharging it on the ground the water is removed quickly and with much greater ease than by the tipping up of the pump to dump it. The pointed nose of the grease pump can reach the smallest crevice and so gets all the water on top of the diaphragm.

Contractor's Canopy Need Not Be Ugly

SEVERAL times in *Engineering News-Record* there have been shown good-looking contractors' structures. The one here illustrated is another proof that these structures need not be eyesores. It was erected

EFFECTIVE CONTRACTOR'S CANOPY COMBINES GOOD APPEARANCE AND ADVERTISING VALUE

on Chestnut St., Philadelphia, by F. L. Hoover & Sons, contractors, at the new store for the A. H. Geuting Co., shoe dealers. The structure speaks for itself, and is a credit to the contractors who erected it.

NEWS OF THE WEEK

New York May 1, 1919

Engineers Want Topographic Maps of Country Completed

Expedition in the completion of the topographic maps of the country by the United States Geological Survey was urged Apr. 25, at Chicago, by the conference on a national department of public works. The conference by unanimous vote asked Engineering Council to present to the President and Congress facts as to the economic necessity of completing the maps at an early date. Already the National Service Committee has taken the matter up with the Secretary of the Interior who is in accord with the idea. He accepted the proposal to ask Congress for an increase in the pre-war estimate of $350,000 per year to $500,000. It is expected that the states will meet this amount with an equal sum.

F. W. De Wolf stated that only 42% of the country was mapped and at the present rate the completion would not be achieved within 80 years. A crisis has arisen in the topographic service because the last Congress cut the $425,000 asked for to $289,000. Fortunately the sundry appropriation bill did not pass and there is still time to amend it.

Meeting of United States Good Roads Association

The seventeenth national convention of the Good Roads Association, combined with the seventh United States Good Roads Show and the third annual convention of the Bankhead National Highway Association, was held at Mineral Wells, Tex., during the week of Apr. 19, and was well attended. The highway association elected the following officers: President, Senator John H. Bankhead, of Alabama; first vice-president, Gov. Charles H. Brough, of Arkansas; second vice-president, Gov. C. A. Larrazarole of New Mexico; third vice-president, R. M. Hubbard, of Texas, and director general, J. A. Rountree, of Birmingham, Ala. The Bankhead association elected the following officers: President T. S. Plowman; treasurer, L. G. Jones; general secretary, J. A. Rountree, and director-at-large, W. W. Heaton.

Competition for Illinois Road Contracts Not Active

Bids were scattered and bidders were comparatively few on the first two groups of sections of Illinois state-aid roads, the construction of which this year was announced. On the nine sections of the Dixie Highway, aggregating slightly over 42 miles of 16- and 18-ft. road, there were eight bidders, only one of which made prices on all nine sections. The largest number of bidders for any section was four, and on four sections only one bid each was submitted. On the Lincoln Highway, aggregating 20 sections and about 70 miles of road, there were 15 bidders. Four bids were the maximum number on any one section; on four sections there was only one bid each.

Itemized prices are not yet made public, but lump-sum prices ran from $17,500 to $29,000 per mile for these concrete roads 16 and 18 ft. wide. Generally, the bids ranged around $21,000 to $24,000 per mile.

Among the bidders were several large construction firms, such as Bates & Rogers, James O. Heyworth and the Foundation Co., which heretofore have not gone into road construction. A large number of constructors attended the lettings and watched closely the run of prices.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

The Federal director of the United States Employment Service in New York State announces the receipt of a letter from J. P. Morgan & Co., in which $100,000 is offered for the purpose of continuing the work of the service up to July 1 of this year. The Professional and Special Section in New York will therefore be continued, but will be located at the main office, 469 Fifth Ave., New York City.

Engineering Council and Nonmember Societies

Chicago Conference Discusses Need for Federation of Engineering Organizations

Following the discussions on the proposed Federal Department of Public Works, the main topic set for the conference of engineering societies in Chicago last week, a session was devoted to the discussion of the relation of nonmember societies to Engineering Council. At times the subject was broadened to cover engineering society activities generally. The drift of the remarks was that a federation of engineering societies was needed, and that federation should come about through such amendment of the rules of Engineering Council that it could admit local societies. J. Parke Channing, chairman of the council, announced that such an amendment was pending, and both he and Dr. Ira N. Hollis, past chairman of the council, expressed the view that it would soon pass and receive the approval of the founder societies.

Veto Power Discussed

Mr. Channing, in opening the discussion, pointed out that even after the passage and approval by the four founder societies the amendment above referred to would still leave it in the power of any one of the founders to veto a measure. He asked whether that should be permitted to stand or whether, if locals are admitted, there should be a change whereby proportionate voting power is established. A number of delegates said they felt it would be unfair to new societies taken in, to allow the veto to repose in any one society.

Dr. Hollis expressed the view that the purpose of all worth-while engineering societies is to teach their members to serve the public. He urged that we learn to use what we have in the way of engineering societies rather than establish new ones, and that thought was heartily indorsed by C. F. Loweth, of Chicago. Gardiner Williams, of Detroit, while admitting that the national societies had done good work, believed that they should confine themselves to technical activities, letting Engineering Council organize the locals for civic work, since civic influence must be exercised locally. He advanced the view, seconded by others, that engineering practice is so complex and local conditions such that there is warrant for the existence of a large number of engineering societies, and that the new ones, so long as they had a good reason for being, would not harm the existing organizations. All should be tied to-

gether, however, by some coördinating agency.

Replying to a query whether the American Association of Engineers would consider affiliation with Engineering Council, C. E. Drayer, secretary of the association, said that he could not speak for his board. He did feel certain, though, that Engineering Council could neither absorb nor take the place of the association. He urged that the two organizations should not duplicate work.

The question of the attitude toward the union movement being raised, a number of speakers expressed the view that union methods were not consonant with professional ideals. One chief engineer of a railroad was cited who believed that his young men could get fair compensation only by organizing. Reference was also made to a prominent engineer who deplored the movement, but felt that no antagonism should be developed against the men who joined unions, so that when they have learned that the unions cannot satisfy their needs in a professional way they will not feel that the older societies have turned from them because of their earlier union affiliations.

Two-Way Flat-Slab Patent Invalid

Another flat-slab reinforced-concrete floor patent has been declared invalid in a district court. This one is the Sinks patent, U. S. No. 1,005,756, on a two-way construction. The decision was rendered Apr. 16, 1919, by Judge A. L. Sanborn in the United States District Court, northern district of Illinois, eastern division. Suit was brought by the Condron Co., present holders of the patent, against the Corrugated Bar Co. for infringement in the construction of buildings at Fort Wayne and Chicago.

Judge Sanborn concluded his decision as follows: "The patentee may have made a better flat-slab or shallow-beam construction than prior inventors, but the patent itself, apart from simplifying computation, simply proceeded along lines suggested by engineering skill. I think the patent is invalid and that the bill should be dismissed."

Pending a decision on this case in the United States Court of Appeals, the Condron Co. announces that it will make no royalty charges to its patent licensees, or to those who accept licenses from them for the use of the Sinks invention in flat-slab buildings erected or contracted for between Apr. 30, 1919, and the date of such decision, regardless of whether the decision, on appeal, sustains the Sinks patent or not. Under the Condron Company's agreement with the owners of the Norcross patent, which expired Apr. 29, 1919, all licenses granted by the Condron Co. for the Akme System have protected the company's patrons from claims of infringement of the Norcross as well as the Sinks patent.

Registration Law in Michigan Passes Legislature

Architects, Engineers and Surveyors Included Under Bill as Amended

The act for the registration of architects, engineers and surveyors has been passed by the Michigan legislature as an amended form of one of the alternate bills introduced into the legislature, and discussed in *Engineering News-Record* of Feb. 27, 1919, p. 423. It provides as follows:

All persons desiring to practice or to be be known as architects, engineers or surveyors, as principals or in responsible charge of work, must be registered by a board, to be appointed by the Governor and to consist of three architects and five engineers. All persons who have been engaged in practice as engineers or surveyors as principals or in responsible charge of work for a period of two years preceding the adoption of the act shall be registered without examination in the branch in which they show themselves to be qualified.

Registrants shall be designated as registered architects; or as registered engineers of such class as the work they may have done or for which they may be qualified may determine, particularly as of classes of less general qualification than that indicated by the title civil, mining, mechanical, electrical or chemical engineer; or as registered surveyors. No plat of the subdivision of land shall be received for record by any public official unless it has been prepared by a registered engineer or a registered surveyor and signed by him as such.

Persons desiring hereafter to begin practice as above shall pass an examination in the English language and in such other appropriate subjects as the board shall determine. Engineers and architects of recognized standing as specialists, resident in other states, shall be admitted to practice without examination, and engineers registered under laws of other states and countries providing equivalent requirements, and in good standing thereunder, shall be admitted to practice, provided that similar privileges are extended to the registrants under this act.

After the end of the construction season of 1919 no public work of an architectural or engineering character shall be undertaken by the state or any county, township, municipality or village thereof, the estimated completed cost of which shall exceed $2000, unless the plans therefor shall have been prepared by a registered architect or a registered engineer, and the work shall be supervised by a registered architect or registered engineer.

No time limit is set within which registration must take place for those now qualified to register under the act. No restriction is put upon the performance of architectural or engineering work for private parties by persons who do not call themselves architects or engineers. The act repeals the preëxisting act for the registration of architects, and provides that all registrants under that act shall be considered as registered under the new act.

The act requires an examination fee of $5 and a registration fee of $15 from those taking examinations, and a registration fee of $20 for those registered without examination, and a fee of $5 for renewal of certificates which are renewable, upon not less than 30 days' notice on Jan. 1, 1925, and on the first day of January every fifth year thereafter. The members of the board are appointed to hold office for eight years, one member to be appointed each year.

Executive Secretary for American Chamber of Commerce, London

Appointment of George P. Toby as executive secretary of the American Chamber of Commerce in London has been announced by its president, G. M. Cassatt. The membership of the London organization contains representatives in England of American manufacturing and exporting interests and also prominent British manufacturers, exporters and importers. It is equipped to handle inquiries expeditiously, and desires American business men to utilize the service.

Mr. Toby, the new executive secretary, has been long connected with banking and industrial corporations in this country and is well known as an investment banker. In this capacity he has made a careful study of the operation of American industries and public utilities. For over a year during the war he was connected with the Treasury Department at Washington on the preparation of plans for coöperation between the various Government departments and the business world, including studies of the markets for products, methods of distribution, etc. His visits to Europe in this connection and other extensive travels in Europe and Canada have given him a broad view of the field.

Consulting Engineers Honor French High Commissioner

The American Institute of Consulting Engineers gave a dinner in honor of M. de Billy, deputy high commissioner of France, on Apr. 24 in New York City.

The dinner was held immediately before the departure of M. de Billy. It was felt that the good will of the engineering profession should be evidenced, as the commissioner himself is an engineer. In speaking of his experiences in this country, M. de Billy dwelt upon the aid that American engineers had extended to the commission in the work it has been doing during the war.

The following guests were present: M. de Billy, deputy high commissioner, French Republic; Controleur H. Johannet, Colonel Dulauroy, Colonel Duvaux, Captain Vaneufville, Lieutenant Mittaine, all of the French mission; S. M. Felton, formerly director general of military railways, United States Army;

Consul General Romolo Tritoni of Italy; Consul General Pierre Mali of Belgium; E. G. Spilsbury, M.E.; Nelson P. Lewis, C.E.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, $1200-$1440 per year, May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District, $1501 to $2100 per year. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

Philippines.—Wireless engineer, Bureau of Posts, Philippine Government, $3000 per year, June 10. Apply for form B. I. A. 2, to be filed before June 10, filled in by medical officer in the service of the United States.

Tennessee.—Assistant highway engineer, $1800 to $2100 per year, May 7, at Nashville. File applications as soon as possible.

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States.—Expert patent investigator, $1800 to $2400 per year, and technical patent expert, $2400 to $3600 per year, May 20.

United States.—Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

United States.—Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

United States.—Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

United States.—Scientific assistant in public health work, Public Health Service, $1500-$2500 per year, June 3. Apply for form 2118, to be filed before June 3.

United States.—Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File applications before June 10.

United States.—Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

United States.—Junior recreational engineer, Forest Service, Denver, Colo., $1800 to $2400 per year, May 6. Apply for Form 2118.

United States.—Statistician, Department of Interior, $1800 per year, May 13. Apply for Form 2118.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 12-13, Chicago.

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

The San Francisco Association of Members of the American Society of Civil Engineers was addressed Apr. 15 by W. Lewis Clark, an engineer of the California Highway Commission, who spoke on experience in that state in highway construction. Mr. Clark spoke for A. B. Fletcher, chief engineer of the commission. Among the subjects discussed were engineers' licensing laws, the trend toward union organization of draftsmen and engineers, the Development Committee program, and means of strengthening the influence of the parent society.

The Engineers' Society of Milwaukee held its regular monthly meeting Apr. 29 under the auspices of the Milwaukee section of the American Institute of Electrical Engineers. The meeting was addressed by A. A. Oswald, of the Western Electric Co., who read an illustrated paper on "Wireless Telephony and Telegraphy in War."

The Montana Society of Engineers voted to make eligible for membership all members of the national engineering societies, without restriction to any single branch of engineering. This action, in the form of an amendment to the constitution of the society, was taken at the annual meeting held in Great Falls Apr. 11-12. The following officers were elected for the coming year: President, Samuel Barker, Jr., Butte; vice-presidents, Charles A. Lemmon, Anaconda, and George T. McGee, Helena; secretary and librarian, Clinton H. Moore, Butte.

The Pittsburgh Chapter of the American Association of Engineers will hold an open meeting for railroad technical engineers May 3. Among the speakers will be **D. A. Tomlinson**, assistant secretary of the national association.

The Engineers' Club of Minneapolis was addressed Apr. 21 by B. S. Moodey, of the Minneapolis Steel & Machinery Co., who spoke on the heat treatment of steel.

The Engineers' Club of Trenton was addressed Apr. 24 by J. F. Lincoln, vice-president of the Lincoln Electric Co., Cleveland, who spoke on "Electric Arc Welding as Applied to Present-Day Commercial Manufacturing and Repairs."

The Oregon Society of Engineers was addressed Apr. 25 by G. C. Wells, who spoke on "Engineering and Exploration Experiences on the Malay Peninsula."

The New York Chapter of the American Association of Engineers held a meeting Apr. 23, at which Robert M. MacBride spoke on his experiences while in Europe with the party of journalists who accompanied President Wilson in the inspection of the devastated districts. The next meeting of the chapter will be held May 14.

Personal Notes

H. ELTINGE BREED, who has resigned as first deputy commissioner, New York State Highway Department, as mentioned in *Engineering News-Record* of Apr. 24, 1919, p. 840, has opened offices in New York City at 507 Fifth Ave., for the private practice of engineering, specializing in highway work and organization. Mr. Breed was graduated from Colgate University in 1900 and soon afterward entered the service of the Newport News Shipbuilding & Dry Dock Co. A year later he entered the department of the State Engineer and Surveyor of New York State, passing through various civil-service grades to the rank of assistant engineer. In 1911 he was with the State Highway Commission engaged in design work, and in the following year he had charge of the Coleman du Pont road in Delaware as assistant chief engineer. After visiting Europe to study

highway conditions he engaged in private practice until 1915, when he was appointed first deputy commissioner of the New York State Highway Department. He served in that capacity until his recent resignation.

COL. JAMES SCRUGHAM, who resigned the position of state engineer of Nevada, to enter Government service, has been reappointed to his former position by Governor Boyle. SEYMOUR CASE, who filled the position of state engineer in Colonel Scrugham's absence, has been appointed assistant state engineer.

PROF. CHARLES A. HOLDEN, who for the past year has served as acting director of the Thayer School of Civil Engineering, Dartmouth College, has been appointed director. He was born in 1872 and was graduated from Dartmouth College in 1895, and six years later from the Thayer School of Civil Engineering. He afterward entered the engineering department of the Boston & Albany R.R. In 1900 he became instructor of civil engineering in the Thayer School and was later appointed assistant professor of civil engineering and assistant professor of mathematics. From 1900 to 1904 he acted as resident hydrographer for the United States Geological Survey, at Hanover, N. H.

CAPT. R. S. MOORE, Engineers, U. S. A., who was with the 209th Engineers when demobilized at Camp Sheridan, Montgomery, Ala., has entered the service of the Shipyard Plants Division, Emergency Fleet Corporation, Gulf district, with headquarters at Houston, Tex.

H. G. COUTTS, general superintendent of the housing division, United States Shipping Board, Emergency Fleet Corporation, has resigned to become associated with the Free-Luce Land & Building Co., Cleveland.

HERMAN ROEMER, Baltimore, who has recently been engaged in Government work, has been appointed superintendent of the paving division, highway engineer's department of that city.

W. C. HARTMAN, Construction Division, U. S. A., has received his discharge from the service and has returned to his former work as designer of reinforced-concrete structures, Widmer Engineering Co., St. Louis.

A. L. DABNEY, consulting engineer, Memphis, Tenn., who has been engaged in Government work at Muscle Shoals, Alabama, has returned to his office in Memphis to resume private practice. In 1917 he was commissioned as a major of engineers and attended an officers' training camp, later resigning his commission, being physically disqualified. He was then stationed at the Air Nitrates Plant No. 2, Muscle Shoals, for more than a year, in charge of the construction of water-works, sewers and drainage, and later in charge of operation.

ERNEST G. EAGLESON, consulting engineer, Boise, Idaho, has been elected mayor of that city. He is a graduate of Nebraska University and for many years has been engaged in irrigation and other engineering work in the West. In 1911 he was elected city engineer of Boise and has more recently been engaged in private practice.

CAPT. E. V. GUYTHER, Construction Division, U. S. A., who recently received his discharge from the service, has returned to his former position in charge of municipal engineering work with the Widmer Engineering Co., St. Louis.

JOHN F. VAUGHAN has resigned as district manager, Emergency Fleet Corporation, New England district, and has resumed his engineering practice at 185 Devonshire St., Boston, which has been in charge of his principal assistant, E. A. EKERN, during his service with the Government.

NICHOLAS S. HILL, JR., and S. F. FERGUSON, consulting engineers, announce the removal of their offices and laboratory from 100 William St. to 112 E. 19th St., New York City.

COL. JAMES B. CAVANAUGH, Corps of Engineers, U. S. A., has been appointed United States district engineer of the Nashville, Chattanooga and Florence, Ala., districts, with headquarters at Nashville.

R. C. STARR, superintendent of construction, Stone & Webster Corporation, with headquarters in Seattle, has resigned to become construction engineer, San Joaquin Light & Power Corporation, at Fresno, Calif. Mr. Starr has charge of work on the hydro-electric project now being rushed to meet the demand for additional power. Previous to his association with Stone & Webster he had charge of raising the height of three dams at Huntington Lake in Southern California for the Pacific Light & Power Company.

CAPT. GEORGE R. CAMPBELL, Engineers, U. S. A., has received his discharge from the service and has been appointed United States cadastral engineer, Department of the Interior, with headquarters at Olympia, Wash.

EARL WHEELER, O. A. MECHLIN and FRANK RHEA have become associated under the firm name of WHEELER, MECHLIN & RHEA, advisory and purchasing engineers, with offices in the West St. Building, New York City. The work of the firm will consist of furnishing service to foreign and domestic clients, purchasing machinery and engineering materials in the United States to be used to construct, maintain and operate property.

CAPT. EDWARD M. BURD, Coast Artillery, U. S. A., who recently received his discharge from the service, has become associated with the Blaw-Knox Co. of Pittsburgh as designer and salesman in transmission tower and structural work.

PROF. JAMES E. SMITH, Department of Civil Engineering, University of Illinois, has been elected mayor of Urbana. He has been a member of the city council for four years.

E. L. WAGNER, formerly of the firm of ROBINSON & WAGNER, sewage-disposal engineers, New York City, has opened an office at 320 Fifth Ave., for the practice of sanitary engineering.

LEIGH HUNT, consulting engineer, Kansas City, Mo., announces the formation of the Leigh Hunt Co., successor to the Hunt Engineering Co. The new company will engage in general engineering and contracting.

IRA G. HEDRICK and W. W. HUFF have become associated under the firm name of HEDRICK & HUFF, consulting engineers, Kansas City, Mo.

J. C. RALSTON, formerly city engineer of Spokane, Wash., has been appointed consulting engineer of the Columbia Basin Commission.

PHILIP PETRI, district engineer, Baltimore & Ohio R.R. Lines East, with headquarters in Pittsburgh, has been appointed division engineer, with headquarters at Cumberland, Md.

OBITUARY

CHARLES H. JACOBI, assistant engineer, Division of Capital Expenditures, United States Railroad Administration, died in Salt Lake City Apr. 20. He was born in 1883 and was employed for a number of years as assistant engineer, Lehigh Valley R.R., and more recently as construction engineer, Westinghouse Church Kerr & Co. He entered the service of the United States Railroad Administration in July, 1918.

S. SANNE-JACOBSEN, of the firm of Gannestad & Jacobsen, consulting engineers, Pittsburgh, died in Beaver, Penn., Apr. 11. He was a graduate of the technical school of Horten, Norway, and had been engaged in engineering work in the Pittsburgh district for the past 25 years.

Manufacturers' Association Annual Convention in New York

The National Association of Manufacturers has announced its annual convention, to be held at the Waldorf-Astoria Hotel, New York City, from May 10 to 21, inclusive. Topics to be discussed are: Governmental ownership of railroads, Government supervision and stabilizing of trade prices, Federal revenue and tax legislation, employment relations, employers' duty to provide jobs for sailors and soldiers, approaching revision of the patent laws, the industrial legislative outlook, and vocational training.

Among the speakers will be Walker D. Hines, director general of railroads; Daniel Willard, president of the Baltimore & Ohio R.R.; Prof. William Starr Myers, Princeton University; Frank A. Halsey, commissioner of the American Institute of Weights and Measures, and Edward J. Prindle, member of the committee on patent law revision of the Council of National Defense.

Many committee reports will be made; among them will be one by the committee on readjustment after the war, which will make recommendations, having made an exhaustive survey of the present situation.

Motor-Truck Company To Make Large Increase in Plant

Expenditures involving $37,398,000 in new plant will be made during 1919 by the General Motors Corporation, as outlined by W. C. Durant, president and general manager. The additions will be made in office and sales buildings and new equipment in Detroit, Flint, Pontiac, Lansing, Saginaw, Mich., Toledo, Ohio, St. Louis, Mo., Janesville, Wis., Bristol, Conn., and Muncie, Ind. About $12,650,000 will be spent in Detroit, including $5,000,000 for a fifteen-story general office building, with a four-story research laboratory in the rear. The next largest expenditure will be at Flint, where $6,715,000 will be expended. In the latter appropriation a thousand homes for employees, with water mains, sewer systems, paved streets, etc., are provided for.

Unemployment Decreases, Says Federal Employment Service

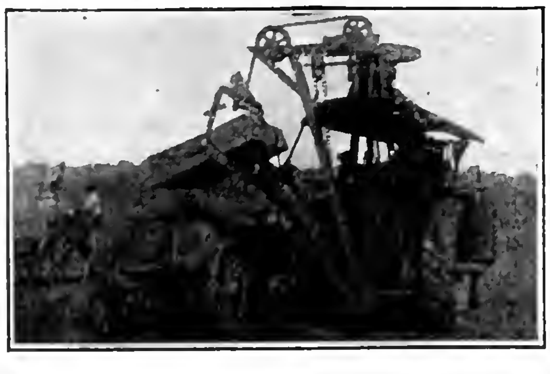
Employment conditions throughout the United States are steadily improving, according to reports received by the United States Employment Service, from 3417 representative concerns in 58 cities. While there is still a surplus in many cities, some report a shortage of skilled and unskilled labor.

Among the cities replying, 27 report a surplus of labor of 59,957 as compared with 73,576 during the previous week. Six of the cities show a combined shortage of 3600 skilled and unskilled laborers. The other 15 report an approximate equality of supply and demand.

The labor surplus has disappeared in New York, and conditions in the New England States show a marked improvement. Several cities which last week reported heavy surpluses reported this week an apparent equality of supply and demand. Of the six cities reporting a shortage of labor all are in the South except Seattle. They are Louisville, Ky., Wilmington, N. C., Charleston and Columbia, S. C., and Memphis, Tenn.

Shoveling Attachment for Road Rollers and Tractors

An attachment for shoveling earth, which may be used upon steam, gas or electric tractors and upon steam rollers, is shown in the accompanying photographs of work at Myers Park, Charlotte, N. C. The device was invented by C. H. Wolfe, of Charlotte, and has been used by the Mecklenburg



CYCLE OF OPERATION OF SHOVEL ATTACHMENT

County government, on road work. With the shovel removed, the attachment makes a useful portable derrick.

Operating in practically a horizontal position, it is said to have proved particularly adaptable to road work in skimming off shallow cutting. The derrick portion allows the shovel to swing through an angle of 180° for dumping, so that the wagons do not have to be placed accurately. It can handle old macadam, gravel, shale, crushed stone, coal, sand and snow. Only a few minutes are required to remove the shovel in order to use the attachment as a derrick. The method of operation is readily seen from the three photographs.

The shovel-pan is 7 ft. wide, 4½ ft. from cutting edge to back, and 1 ft. deep. When level full it holds about 30 cu.ft. and will handle 1½ cu.yd. when heaped. In the two machines which have been manufactured and are in use, the shovel is made the same width out to out as the traction engines to which they are attached, so that the wheels of the engine are always running upon a smooth surface. The weight of the entire outfit, including engine, is 22,000 lb., and it can be operated in all locations and over soil conditions which will support a traction engine of this load.

Under favorable conditions, the machine is reported to have loaded a maximum of 680 loads in a 10-hour day, and the average performance is said to be 450 loads for this period. It is operated by one man who handles all the levers and also fires the engine.

It is understood that Mr. Wolfe holds a patent on the attachment, which is to be manufactured by the Moffatt Machinery Manufacturing Co., of Charlotte, N. C.

BUSINESS NOTES

The Ferro-Concrete Products Co. is the name of a new concern organized by A. M. Fisher, formerly with the Concrete Steel Products Co. of Chicago, and recently discharged as captain from the Fifth Division, American Expeditionary Forces. The offices of the company will be in the Harris Trust Co. Building, Chicago, where it will represent the Witherow Steel Co. and the Electric Welding Co., both of Pittsburgh.

The Chain Belt Co., of Milwaukee, Wis., announces that the J. J. Wernette Engineering Co., of Grand Rapids, Mich., will handle the former company's "Rex" line of concrete mixers and pavers.

The Sullivan Machinery Co. announces the organization of a foreign-trade department, with S. W. Copeland, formerly attached to the St. Louis office, as manager, with headquarters in Chicago. The company has branch offices in London, Salisbury House; Paris, 18 Ave. Parmentier; Santiago, Chili, Casilla No. 27, and at Sydney, N. S. W., Chambers, Martin Place. Agencies are established in various other foreign countries.

The Chicago Pneumatic Tool Co., Chicago, Ill., announces the appointment of T. J. Hudson as acting manager of the pneumatic tool sales division. He succeeds S. H. Waldron, who will return to Minneapolis, Minn., as district manager of sales for that territory. The company also announces the election of Allan E. Goodhue as managing director of its English subsidiary, the Consolidated Pneumatic Tool Co., Ltd., with offices at 170 Piccadilly, Lon-

don, and with plant at Fraserburgh, Scotland. He will also have charge of European sales for the Chicago Pneumatic Tool Co. Mr. Goodhue was for a number of years connected with the sales department of the Midvale Steel Co. and the Midvale Steel and Ordnance Co. of Philadelphia, Chicago and Boston, leaving to enter the Government service in March, 1918, as manager of the steel and raw material section, reduction division, of the Emergency Fleet Corporation, which position he held until Jan. 1, 1919.

The Daly Meter Co. will move its main office and works from Boston, Mass., to Cleveland, Ohio, effective May 1. The Boston office will be retained with H. D. Fisher as manager, to handle sales and engineering service in the New England district. For the present the New York and Philadelphia districts will also be covered from the Boston office. All other districts will be covered from Cleveland.

Trade Publications

The Lakewood Engineering Co., of Cleveland, Ohio, has issued a new bulletin, No. 29-A, describing Lakewood road-construction plants. The first half of the bulletin describes the methods employed in the construction of roads in large contracts, the remainder is devoted to a description of the equipment used.

The Yale & Towne Manufacturing Co., of 9 E. 40th St., New York City, has issued a semi-centennial souvenir in the form of a 76-page booklet, containing a history of the corporation and industrial biographies of various men prominent in the company. The booklet is 5½ x 8 in. and is illustrated.

"Heavy Duty Oil Engines" is the title of bulletin O. E. 20 of the Pittsburgh Filter & Engineering Co., Pittsburgh, Penn. The booklet contains eighteen 6½ x 9-in. pages and deals with the subject of large internal-combustion engines.

"Banking Service for Foreign Trade" and "Trading With China" are the Titles of two pamphlets issued by the Guaranty Trust Co., of New York. The former describes banking connections in foreign countries and the various methods of exchange. The latter is a general booklet dealing particularly with China, and describes the methods found successful in dealing with the Chinese.

The Solar Metal Products Co., Inc., of Columbus, announces the following changes in its organization: G. R. Le Sauvage, who was elected president Jan. 2, 1919, has assumed the duties of general manager, succeeding H. R. Gogay, formerly vice-president, treasurer and general manager, who has resigned; E. C. Camp has been elected assistant treasurer, and assistant to the president, and continues his work as sales manager.

"Highways and Railways for the Defense of Our Nation" is the subject of a 6 x 9-in. 20-page booklet just issued by Sauerman Bros., manufacturers of cableway excavators, car scrapers, etc., Monadnock Block, Chicago, Ill. This booklet deals with a general plan of defense for the United States and lays stress upon the necessity of good highways in time of war. It contains illustrations of various methods of defense, and of heavy artillery apparatus.

The Wallace & Tiernan Co., Inc., 349 Broadway, New York City, has just issued an 8½ x 11-in., 64-page pamphlet entitled "Chlorine Control Apparatus." The book is illustrated with half tones and line cuts showing apparatus, layouts and charts pertaining to the control of chlorination.

Construction Costs Carry On

Changes for Most Part Unimportant—Steel Deadlock Continues—Better Feeling Throughout Country Than Reported Last Month

By Alden W. Welch

In considering present prices of construction materials, one must not see only his little vicinity to the exclusion of the rest of the world. Prices are higher everywhere. They have advanced in sections where the influence of the war was not directly felt. Inflation is general. So much money and its equivalent in the form of bonds has been issued that its buying power has depreciated.

There is one safe highway, but it can be traveled by means of only one conveyance—confidence. What prices were last month, they are the same today. Here and there one material or another has cheapened, just as here and there other materials have advanced.

A general decline is almost as inconceivable as a general rise—though the latter is possible. This is a period when, as never before, the much criticised British slogan, "Business as usual," applies. And by "business as usual" not present business is meant, but the lively business that the needs of the country warrant.

It Is Time To Start Building—Prices Cannot Drop

Probably never in the history of the world was the housing situation more acute. In this, the richest nation, there are insufficient dwellings. Houses are being sold over the heads of people who have nowhere else to go. This serious tension is not being relieved by private initiative. It is a crisis beyond which is some unknown climax, which will be reached unless something is done. The thing to do is to build.

Everybody ought to know that prices cannot return to the pre-war level. Is there any man who will voluntarily submit to a reduction of his income? Organized labor is receiving more than ever it did, but it is demanding still more. The establishment maintained by a salary would collapse if the salary were appreciably reduced. And the same thing is true with those who receive dividends. Pre-war prices should be forgotten, because the world is upon the threshold of a new era.

Inasmuch as steel is the chief material element in the foundation of industry, any uncertainty regarding the future price of this product renders the entire structure uncertain. Last month the only general price movement was in steel, which declined $7 a ton. The new schedule was fixed by the Government's Industrial Board and the manufacturers, in joint session. It was expected that the new prices would be accepted by Government and public alike, but the Railroad Administration refused to do business under these revisions. A month has been consumed in controversy, which ought to be settled forthwith. Until it is settled, the national construction program will remain "in the air."

The latest word at this writing is from George N. Peek, chairman of the Industrial Board. In a letter to Director General Hines he says:

"The prices arrived at were the lowest which the members of the board believed that they could recommend and which would at the same time permit the producers to maintain the existing scale of wages and preserve the average independent producer. . . . If, however, you have any facts, figures or information showing that, on any ground whatsoever, the price recommended was too high, we shall be glad to approach the representatives of the steel producers again, and attempt to secure a modification of their offer in accordance therewith."

It would seem that the logical step would be for the Railroad Administration, the Industrial Board and the producers to get together and remain in session until a satisfactory agreement was reached. The existing uncertainty in the steel situation has a sinister influence upon the whole construction field.

Throughout the Country

New York—There are few price changes to report. The most important is in cement, which is now $2.30 net in cargo lots, alongside dock to contractors, against $2.45 net last month. As elsewhere, the charge for sacks has been reduced to 60c. per barrel instead of $1. The fluctuations on all the materials in the New York market are clearly shown

in the three-page price section that follows this article.

An encouraging sign is the two large building projects about to be got under way at Times Square. In this one neighborhood, it is reported, ground will be broken this week for a 20-story office building to cost $2,500,000, and soon after for a million-dollar structure to house two educational and civic-improvement organizations. The latter building is to be ready for occupancy by January.

Probably nowhere else than in New York is the incentive to build greater. This is not only because of high rents and the fact that the demand for apartments continually increases, but extensive transit improvements that have been under way for a number of years have just been completed, thus giving access to large, open areas, now made convenient to the several business districts of the metropolis. In past times apartment houses were erected largely in the hope that they would eventually be filled. Today they may be built on the certainty of immediate occupation. Just as soon as it is recognized that prices higher than in 1914 are a healthy reflection of the prosperity of the country, capital will become active. It is a very difficult task, however, to convince capital of the fact that today's prices will be tomorrow's.

Chicago—The building situation is improving slowly, as indicated by the accompanying tabulation of permits, which compares the activities of the middle weeks of March and April. From Apr. 5 to Apr. 19 permits issued numbered 127 more than in the corresponding period of March, the improvement amounting to 70 per cent.

Baltimore—Optimism appears to prevail, it being predicted that, beginning July 1, the building trades will be busier than in many years. As Baltimore prices are not included in the monthly price section of *Engineering News-Record*, it may be stated that common brick is quoted at $18 delivered; front-face brick averages $24; sand 50c. and 60c., respectively, for two grades, at railway loading points; gravel, two grades, $1.10 and $1.30 per ton; crushed stone, $1.25 for 2½-in.; fabricated steel, $115 a ton; lumber, common, including pine, fir, hemlock and spruce, $45 to $47.50 delivered from local yards in city; heavier timber, up to $55 delivered.

St. Paul—The most notable feature was the drop in cement, from $2.40 to $2.20 net. Natural cement followed from $1.63 to $1.55, as did also hydrated and lump lime. Lumber is at present the same as last month, but an increase is expected in fir, the principal timber in this market. At a meeting of the West Coast Lumber Manufacturers' Association, Apr. 6 in Tacoma, Wash., costs were analyzed, with the result that there was an apparent loss of $2.80 per 1000 ft. The revised price of fir in St. Paul will likely approach closely the present price of pine in this territory. Sandstone paving blocks are out of the market, owing largely to the shutdown and dismantling, during the war, of the plant at Sandstone, Minn. Bids were recently requested by the City of St. Paul but no response was received from Wisconsin quarries. Building activities are slow, but the general feeling is much more optimistic. Engineers and architects are doing considerably more estimating than a month ago.

Detroit—Several large buildings are planned or are under construction. These include banks, office buildings and mercantile blocks. Several large industrial works are contemplated. For some of these the sites are being purchased and the preliminary arrangements are being made.

St. Louis—Prices carry on in St. Louis. The reductions in triangle mesh and nails are a belated reflection of last month's general decline in steel. The lower price of brick is apparently a further effort to stimulate construction. The increase in the price of 3½-in. wood block is not important, being merely an attempt to establish a current price. It would probably fall if large orders were in prospect. Grading and paving work have started, as have also some sewer work and a small amount of home building. The general situation, however, is what is was in March.

Kansas City—Paving work has just opened up in a large way. Many important contracts are under way and others have yet to be awarded. The Real Estate Board, backed by other organizations, has inaugurated a "Build-a-Home" campaign. Large yellow-pine industries announce a contemplated increase within the next two weeks of from 50c. to $1 per 1000 ft. They report that the supply from the Southern fields is only 60% of normal, while the capacity for output is but 70% efficient. It is asserted that labor, though sufficient, is less efficient than it was before the war. Foreign demand for yellow pine has increased incalculably since the armistice was signed, and shipping facilities have improved to such an extent that heavy export is possible. Previous to the war, lumber shipped to Europe had to be of certain grades and sawed according to specifications. Now, the yellow-pine men say, Europe wants just lumber, and it does not ask the price, taking all sizes and grades standard in this country. Portland cement has been reduced from $2.30 to $2.26 net in carload lots, Eastern lime from $22.80 to $22 per ton. Fir lumber has been increased $2 per thousand. Dynamite is also less in cost.

San Francisco—Price changes in this city are for the most part reflections of the general decline in steel last month. The reduction in the price of Douglas fir is most interesting, in view of the threatened increase elsewhere, and is said to be an effort to stimulate construction.

COMPARISON OF BUILDING PERMITS ISSUED IN CHICAGO IN MIDDLE TWO WEEKS OF MARCH AND APRIL

	Residences	Stores	Factories	Warehouses	Miscellaneous Buildings	Total
March 15	73	4	4	2	4	87
March 22	80	1	3	5	4	93
April 12	160	5	3	2	18	188
April 19	93	2	5	4	17	121

	No. Over $100,000	No. Over $50,000	No. Over $5000	No. Less Than $5000	Total Amount
March 15	None	2	19	28	$521,000
March 22	2	3	19	34	1,370,500
April 12	6	2	54	57	2,509,950
April 19	3	1	41	48	1,261,400

As the greater portion of the present building activity is in small homes, the materials feeling the greatest effects are brick, lumber, etc. Other materials in excellent demand are paints, oils, turpentine and glass, owing to the large amount of building-repair work now going forward.

Boston—Generally the prices are much the same as last month. The principal interest appears to be in lumber. In one week 4,000,000 ft. b.m. were used to construct reviewing stands. This special demand exhausted the stocks of the smaller yards, with a consequent brisk demand, but the situation is only temporary. Two lumber dealers, the Blanchard Lumber Co. and Waldo Bros., profess to see a slight change in favor of opening up work, asserting that conditions in the smaller towns justify their optimism. In Boston, however, there is very little construction, though more than $50,000,000 worth is estimated to be on the drafting board.

General Situation

On the whole, the industrial voice of the country contains a cheerful note. It is frankly admitted that there is not enough construction work under way, but the present quiet seems to be a natural calm immediately preceding unusual activity. Not only is there a vast amount of private building which must be done, but there is an almost incalculable public program that will have to be carried out. Consider just one item—school houses. The Department of Labor estimates that contracts for nearly a thousand public school houses aggregating $100,000,000 have been held up because of the war. Educational demands are superior to material prices, and just as these schools will have to be built, so will sewerage plants and water-works, public improvements generally, and an unnumbered host of residence buildings.

A Consolidation of Engineering News and Engineering Record

McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 NEW YORK, THURSDAY, MAY 8, 1919 Number 19

Catching Up With Deferred Maintenance

DURING the war maintenance was quite generally deferred in every branch of activity, including not merely the industries and the railroads but our homes as well. If the views commonly entertained in the business world are correct, the time is not far distant when we shall face a labor shortage. With the tide of emigration that is expected to set outward when peace is concluded, and with the reawakening of business, it would not be surprising to find this shortage as early as next autumn. Now, however, there is an oversupply of men. Of that we have testimony from the industries as well as from the Government. This, then, is the time for catching up on our deferred maintenance. Prices are high, without a doubt, but there is general agreement that marked retrogression is not to be expected. Moreover, the damage done by lack of maintenance proceeds in a ratio that is geometrical rather than arithmetical. In other words, maintenance that is kept up from time to time proves less expensive than when it accumulates. While, therefore, the cost of catching up on our maintenance now is much above what it would have been if done when first required, it is less now than it will be at a subsequent time. The crucial factor, too, is men, and they are available now.

Departing from Beaten Paths

AS IN every art there are problems and expedients that go beyond the scope of the instruction books, so in engineering by no means all planning and building follow the methods taught as standard. Even in structural practice, which on account of its precision and elaborate literature might appear to be an exception, this truth holds. It is demonstrated in a picturesque way by a piece of bridge reinforcement described on another page of this issue. A fundamental principle requires the members of articulated structures to meet centrally; yet in the present case gross and deliberate violation of this principle was found to be good engineering. A tension chord that should be straight or smoothly polygonal was arranged in zigzagged alignment in order to satisfy most effectively the special stress requirements of the case. Obviously, the engineer's skill and resource are put to a very different test when he creates such a precedent-ignoring construction than when he applies normal methods, no matter how precisely or how efficiently. And it may fairly be said that a command of standard methods alone, without the ability to strike out a new path when occasion demands, is but high-grade mediocrity. Where, however, is the student of engineering to acquire the necessary boldness and constructive power of thought? Do the methods of teaching bring it into being and develop it? Progressive educators, we believe, are keenly mindful of this desideratum and endeavor to provide for it. But unquestionably the study of original work on the part of others, as described in current literature, will prove a powerful aid.

Two Elements of Originality

IN THE remarkable roof-erection work described in this issue, two particular elements of originality are brought into view. One of these lies in the fact that the general method was borrowed from bridge practice. Most minds tend to erect fixed partitions between different fields of activity, preventing them from seeing similarities and analogies; yet those who are readiest to see analogies will surely be most fertile in original expedients. No doubt, it is proper to make separate mental pockets for building erection, bridge erection, and ship erection; there are essential differences between these subjects, to ignore which would breed confusion of thought. But the man who, while appreciating these differences, is able to borrow wisely from the one subject in order to benefit another is the successful originator. Developing their working method by this very procedure, the erectors of the Crucible Steel building have done—or rather, are doing, for the work is still in progress as we write—a remarkably successful piece of work. Yet their method is exceedingly simple, especially so when it is considered that the problem was set by unusually severe demands on the part of the owners. This leads up to the second element of originality which the present case brings out: No matter how well the methods of doing a thing are standardized, the spur of an abnormal demand sets the mind to work finding other ways of doing it. Necessity is the mother, etc.

Eliminating the Side Ditch from the Highway

IT IS generally admitted, as contended in an article by W. P. Blair on p. 914, that the highway side ditch is a nuisance. Evidently, a comprehensive system such as that advocated by Mr. Blair would no doubt satisfactorily take the place of the ditch and solve the drainage problem in many soils and under many conditions. But a large number of engineers still regard a clean ditch as the surest and quickest way of removing water from the highway. It has the advantage, at least, of being open to inspection. Indeed, the problem of inaccessibility is one of the chief arguments used against tile by those who do not favor underdrainage. How to keep the tile from filling up with roots, and how to arrange them to drain subsoils which are practically waterproof, such as clay, appear to some engineers to be

unsolvable problems. If with impervious soil conditions the system proposed will not function, it would be well to consider the plan of covering the entire subgrade with a 3- to 4-in. blanket of gravel or crushed stone. This would carry the water to the longitudinal drain and would make unnecessary the lateral tiling and the consequent trenching of the subgrade, always an undesirable procedure. Obviously, such a design is expensive, but, with the high cost of permanent pavements, would not the additional expenditure be a profitable investment? The growing importance of better drainage, on account of the increased first cost of road surfacings, will warrant the engineer in giving to this problem, upon which the permanence of the improvement most largely depends, his best attention.

Army's Own Construction Is Not Public Works

INCLUDING the Construction Division of the Army in the proposed Department of Public Works was apparently inconsistent on the part of the engineering societies' conference held in Chicago last week. It may prove to be injudicious. The second paragraph of the code of principles set forth by the conference stated that the Department of Public Works should "comprise those works which are built and operated for the use of the public." This distinctly eliminates the Construction Division, which is a war creation charged solely with the construction, maintenance and operation of structures in this country used by the Army itself. Although the war emergency forced this division into most elaborate projects and provided it with an admirable personnel, its essential purpose is the same as was that of the peace-time construction branch of the Quartermaster Corps. So far as the Public Works Department is concerned, it differs in no way from the Bureau of Yards and Docks of the Navy, which was apparently not even considered as a possibility in such a department. Such a distinction will only give a weapon to opponents of the proposed department. The defense of the inclusion seems to be that the great warehouses and port terminals are foreign to the field of the Army engineer. That is true, but that which we propose to create is a peace-time organization. In time of war the War Department might call on it to aid in building construction, but to take out of the Army the doing of its normal building work not only violates the principle that only work for the use of the public is to be included in the proposed department, but opens the proposed bill to unnecessary attack.

Educating the Public On Engineering Matters

DISTRIBUTION of technical information for the instruction of the public is a useful activity of the engineering department of the Kansas State Agricultural College. Technical articles are prepared on subjects of local interest, such as irrigation and drainage, in language easily comprehended, and are sent on request to the local press and to farm journals. This development of the college-extension system may be classed with the well known short courses in highway and drainage work, in their influence on the community. The press is merely a different vehicle. By its means, information may be supplied on matters of local interest, such as good roads, land reclamation, street paving or the water-supply and sewerage facilities of small towns. Articles of that sort do not displace the engineer. Rather, they educate the public concerning the purpose and importance of the engineer's work and its bearing on the welfare of the community. While many universities have publicity agencies, in most cases the bulletins and news sheets inform the public about the work and activities of the institution. The Kansas idea differs in supplying the public with data about engineering matters in which it is directly interested.

Appreciation of the Place of the Local Society

TEN years ago the local engineering society was scarcely a factor in the organization of the profession; five years ago it was just beginning to function well. Today it is one of the chief elements of strength in professional organization. The national societies as such have recognized this, through their support of the local-section movement, but it has remained for the secretary of the American Society of Mechanical Engineers to go full length in support of the local societies. In the March *Journal* of the society Mr. Rice says: "I am unreservedly for developing and supporting the local society first of all. After one has done his full duty locally then he may join that national society which best serves his specialty." That is good doctrine. The profession will become strong nationally by becoming strong locally.

Latin and Greek for the Engineer

DEAN Cooley's views on the place of Latin and Greek in the training of the engineer, reported elsewhere in this issue, will come, we are sure, as a surprise to most members of the profession. Engineering, as it is taught today, has little or no relation to the world that preceded the eighteenth century. If there is no sympathy with the Elizabethan period, why should there be any thought in the minds of the men of science for a world that seems hopelessly ancient? All the more reason, therefore, for the shock that will come to engineers when it is proposed that Latin and Greek be part of the pre-engineering curriculum.

Dean Cooley sees the need for men broadly educated, and, seeing that, he takes the very logical position of pleading for a type of education that confessedly turns out broad men. He does not contend that purely scientific education cannot produce breadth. We take it, however, that he feels very decidedly that such education has not produced breadth. We should like to see the proponents of a purely scientific education cross swords with Dean Cooley on this matter. It would tend, at the very least, to bring home to us some of the fundamentals of education.

For our own part, we must confess that we have seen more breadth come out of the colleges of literature and arts than out of the engineering schools, and we have hoped that in the development of our engineering colleges such methods or such thoroughness might be introduced that would produce the desired result in breadth and culture. So far, however, the literary schools have the better of the argument. Obviously, the problem is a complicated one, and the length of time available for education must be considered.

Dean Cooley has thrown down a gage which, if taken up, should produce a valuable as well as interesting discussion.

Uniform Slab Strength for Heavy-Traffic Roads

WITH the tendency toward heavy, concentrated loads in highway transportation, the problem of design has ceased to be limited to the questions of smoothness of surfacing and of enough mass to resist wear for a reasonable length of time. Sufficient load-bearing and beam strength to resist immediate destruction is now essential. The desirability of determining the maximum loads to be expected, in order to design all types of road subject thereto for equal strength, can hardly be questioned. This principle has been recognized in drafting the new specifications for main highways in Illinois, as discussed by Clifford Older, chief state highway engineer, on p. 905. A standard concrete road has been designed, and all other types have been proportioned to have the same beam strength.

While most engineers will indorse the principle, there is likely to be disagreement as to the correctness of the assumptions made in arriving at designs of other types to approximate the concrete standard. The changes in many, if not most, of the pavements are radical, raising materially the relative cost of some types with respect to others. Questions are bound to arise: Have proper values been assigned to the components of combination slabs? Has sufficient allowance been made for the cushioning effect of certain surfacings? Why are such revolutionary changes necessary in pavements which have given satisfactory service on heavy-traffic city pavements heretofore? Frank discussion of these and allied questions should bring out points of view and data, based on experience, which should be of material assistance to highway engineers. We are certain that Mr. Older will welcome discussion on the technical merits of his method of procedure.

We shall without doubt all agree on one conclusion, as the result of the discussion: That there is sad lack of data on the beam or slab strength of different types of pavement. One other factor has been repeatedly stated —the lack of agreement as to assumed conditions of support which should be accepted as standard in investigating the load-carrying strength of a pavement slab.

Manifestly, we have been injected into a new set of problems by the advent of heavy highway loads. There is need for the sort of inquiries which Mr. Older's procedure stimulates.

Advance in Subaqueous Tunneling

TWENTY years ago the construction of a soft-ground tunnel under a river ranked among the most formidable and hazardous tasks of engineering construction. Interruptions, delays and fatalities were normal accompaniments of such enterprises. The art has advanced greatly within the past generation. Difficulty and hazard have been so reduced that today a subaqueous tunnel is hardly a much more serious undertaking than any open-excavation contract.

With the completion of the fourth pair of rapid-transit tunnels under the East River at New York—a fifth pair is nearing completion—and the opening to traffic of the second pair, the progress of the art has recently received significant emphasis. Three pairs of these tunnels have been begun and completed within the past five years, substantially without incident; high rates of progress have been attained, the finished structures are of excellent character and precise in grade and alignment, and the casualty list has been kept remarkably low. Yet the East River subsoil, comprising rock, sand, gravel and mud, presents all the classic complications of the most difficult problems of tunneling. Compared with the tunnels built a dozen years earlier from the Battery to Joralemon St., the four new pairs, at South Ferry, Old Slip, 14th St. and 60th St., have a history of remarkably greater success. Their completion marks the end of a long development period of cast-iron-lined shield tunnel construction.

Refinements in the application of well known methods, rather than the introduction of new methods, are to be credited for this result. The shield-and-compressed-air method has been known for many decades past, and the shields in use today differ only in minor constructional features from those of prior tunneling operations. Cast-iron tunnel lining and the methods of putting it in place and making it secure also contain nothing new. Nor is the practice of dumping a temporary fill into the water overlying the tunnel in any respect new. But rigid control of the work, and systematic care and vigilance throughout, in the regulation of exposure of men to the compressed air, as well as in the guarding of the face and in the grouting, have permitted the utilization of these elements with increased efficiency.

Thus, it is now recognized that the blanketing of the river bottom with clay has such an important bearing on success as to justify large expenditure for this item. Formerly, tunnel builders were inclined to economize in the first blanketing, and they usually had to reinforce and repair the blanket subsequently, when heavy leaks or blowouts showed it to be weak. The view taken today is that it is cheaper to prevent a blowout than to plug it. To adequate blanketing alone may be given much of the credit for reducing the tunneling hazard as well as for making possible high rates of advance. Consistent care in handling the face work, however, and conscientious survey checking and control of shield movement, are other factors fully as important, influencing the safety and expedition of the work as well as its exactness.

There is a particular satisfaction in contemplating the approximate perfection of tunneling exhibited in the East River work, because it affords a sound basis for the development of future possibilities lying beyond the range of past experience. It is not to be expected that subaqueous tunnel construction will forever be circumscribed by present limits of size and depth. Indeed, the project for a road tunnel under the Hudson River may carry the art quite beyond these limits within very few months, if the project for a tube of 42-ft. diameter, which General Gothals recommended a year ago is adopted for execution. But ordinarily progress is not made by such great leaps into the unknown; it builds up step by step on a foundation of well worked-out experience, constantly venturing ahead but remaining always within reach of the accomplished. In progress of this kind the East River work, together with the pioneer engineering done in the present Hudson Tube tunnels and the Pennsylvania tunnels, will constitute the solid ground of departure.

A record of what was done and learned in the rapid-transit tunneling still remains to be written. In the rush of building, the engineers have not found time to note down their experiences for the use of posterity. As the work approaches its final stages, however, we may hope that the record will be written, and made available, in printed form, to all engineers.

Erecting Long-Span Roof Over Steel Mill By Rolling Trusses to Place

Rebuilding of Crucible Steel Company Mill Involves Remarkable Roof Construction—Erection Method Adapted from Bridge Practice—Trusses Rolled Along Craneway in Groups Weighing 800 Tons

DIFFICULT requirements presented by the reconstruction of a large rolling-mill building at the Crucible Steel Co.'s Harrison, N. J., plant are being met in highly successful manner by methods new to building erection. The well known bridge rolling procedure has been adapted to the case, and by its help a roof of unprecedented proportions is being erected over and around the rolling-mill unit of the plant while furnaces and mills remain in full operation, as indicated by the view, Fig. 1.

Three old buildings, occupying a space about 200 x 380 ft., at present contain the rolling mills and their heating longitudinal trusses; it lacks adequate crane facilities and is not adapted to change or regrouping of the furnaces and mills. Renewal, however, was complicated by the necessity for maintaining the machinery in full operation. Every foot of floor space is in use, and there was no room for placing either columns or falsework inside the building. Moreover, the plans for the future development of the rolling mill, as projected by William H. Taylor, chief engineer, required that the new building be clear of columns, so that it would be possible to rearrange and alter the equipment at all times unhampered by limitations on the use of the floor space.

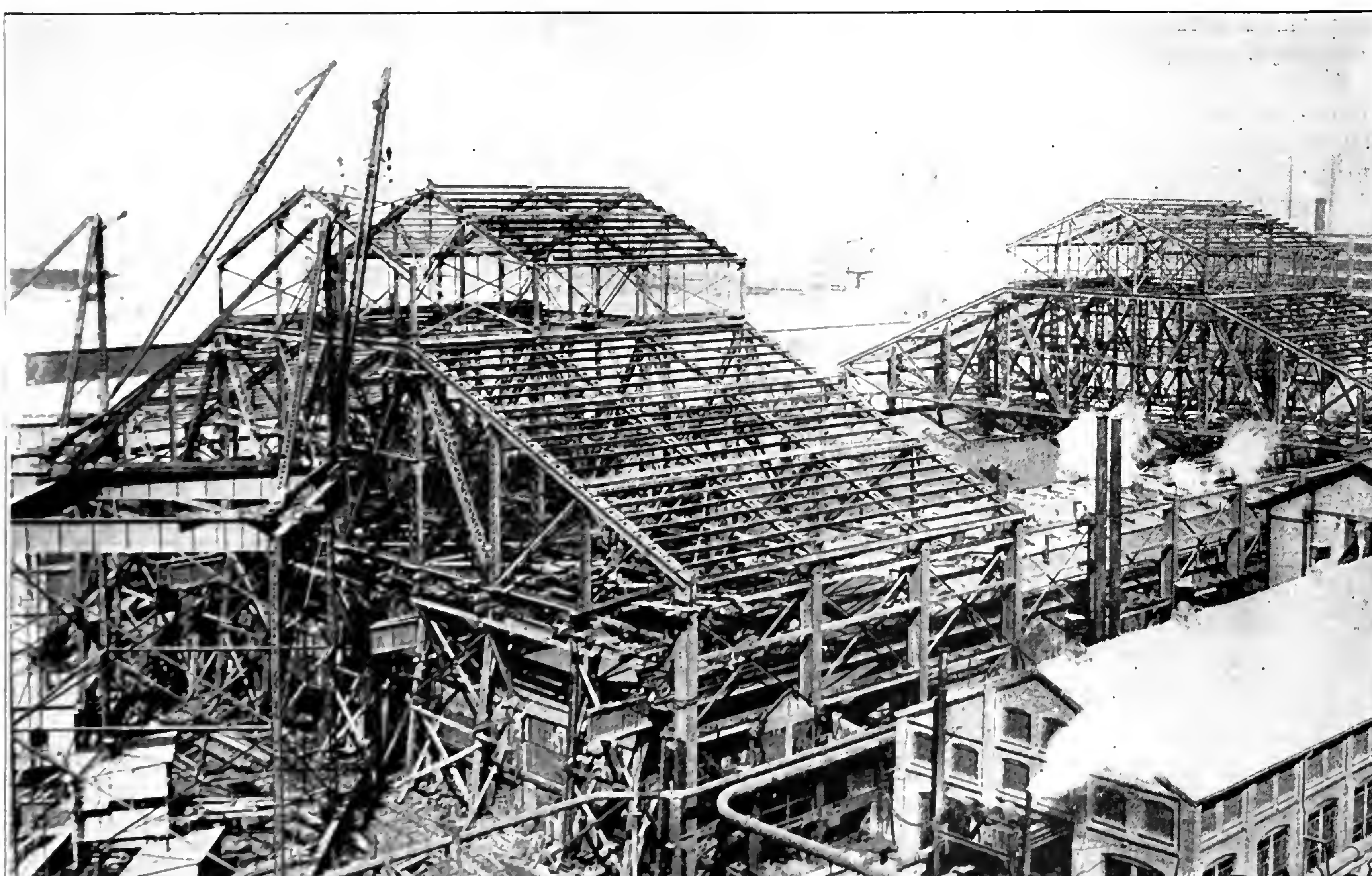


FIG. 1. SECOND GROUP OF FOUR TRUSSES OF CRUCIBLE STEEL COMPANY ROLLING MILL READY TO BE ROLLED TO PLACE—VIEW FROM SOUTHEAST

furnaces. Upon completion of the new building surrounding them, a structure 240 x 390 ft. having no interior columns whatever, they will be taken down with the help of the traveling cranes of the new building. The machinery will remain in service undisturbed throughout the work, and ultimately may be rearranged in the clear floor area as desired to suit the improvement plans.

In the expansion of the plant that has been going on for four years, modernization of the rolling-mill unit formed one of the most difficult items. The old three-bay building which houses it (see sketch Fig. 2) is low, dark and much obstructed by columns and timber

Within the past year a long-span roof of radically novel structural arrangement was designed and built to house a new press and forge shop at the plant. The successful completion of this structure was followed by the design of a long-span structure for the rolling mill. this roof, now being erected, contains the longest simple trusses in any mill-building roof yet built, 235 ft. 9 in. between centers of columns. The trusses carry not only the roof loads but also two pairs of crane-runway girders, which provide three 73-ft. craneways side by side, each running the full length of the building.

It was impossible to put up falsework for erecting these trusses in place, and their size and their great

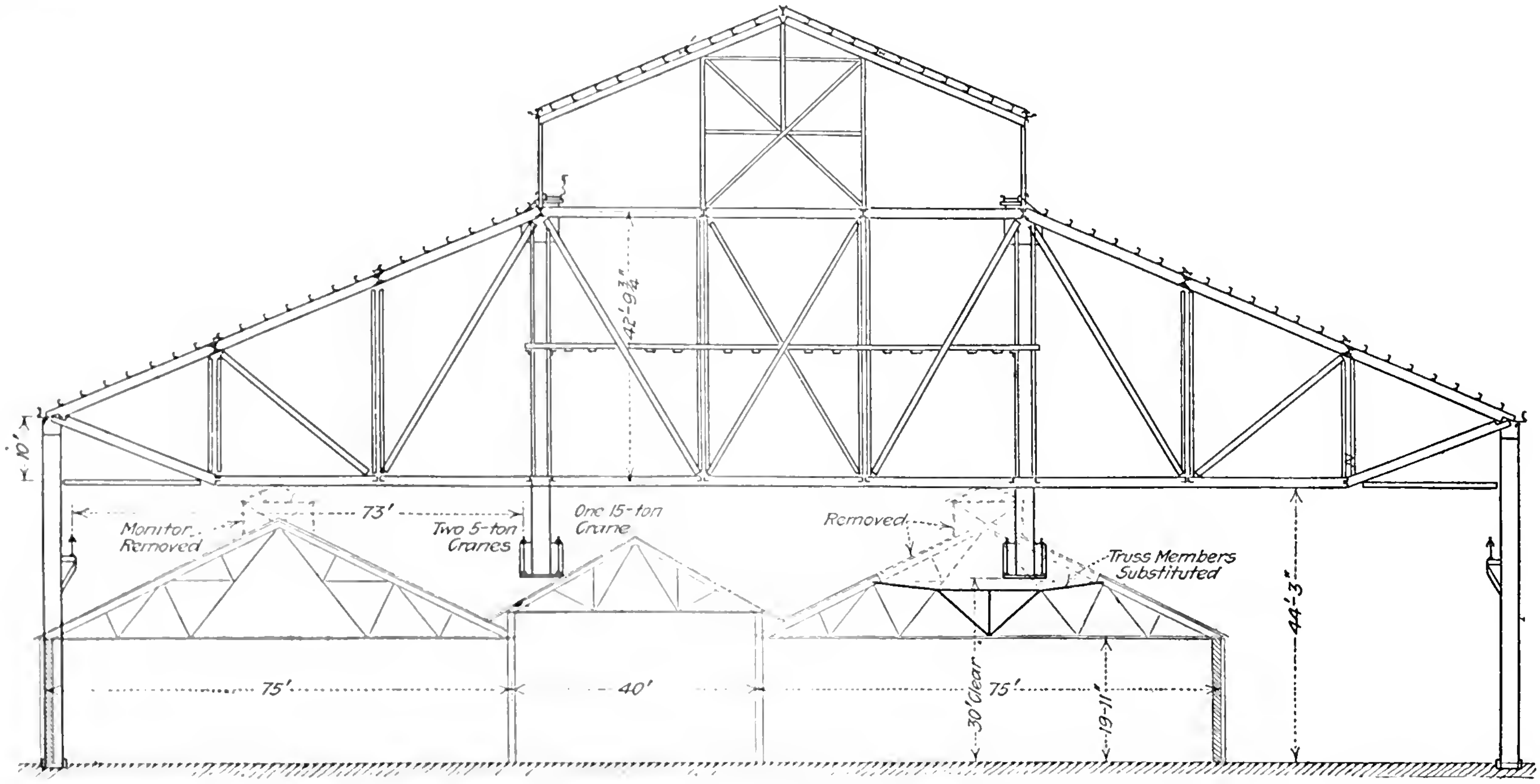


FIG. 2. RELATIVE POSITION OF OLD ROLLING MILL AND NEW LONG-SPAN ROOF; OLD ROOF RECONSTRUCTED TO AVOID INTERFERENCES IN ROLLING

weight—100 tons per truss—made it impossible to swing them to position from the side. The use of the rolling-to-place process often resorted to in bridge renewal overcame the difficulty; in fact, the design was made on the basis of this method, proposed by the erection department of the American Bridge Co., contractor for the building.

The trusses are being erected on staging at the south end of the building (Figs. 4 and 5) and are then rolled along tracks supported on the outer crane runways, sup-

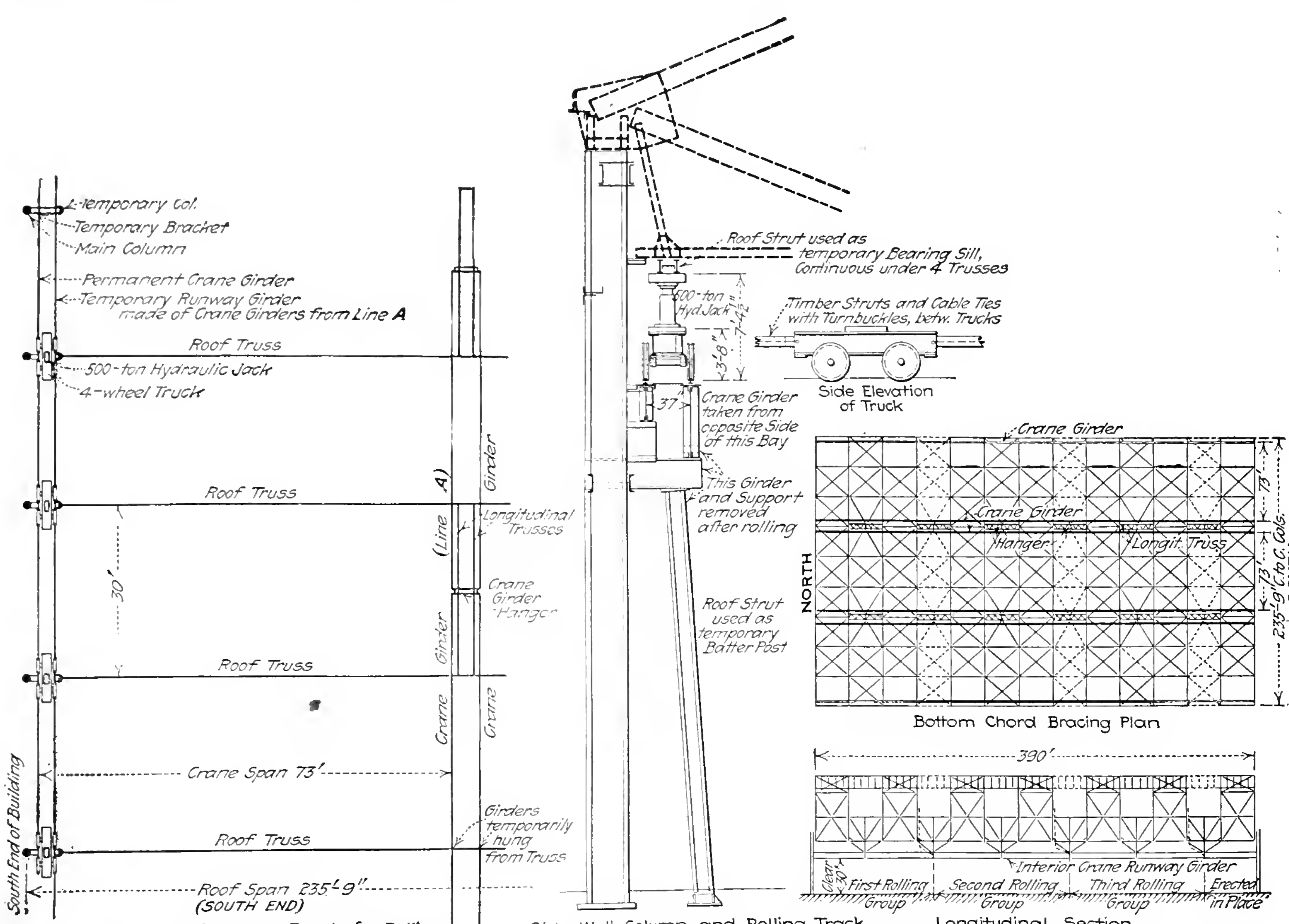


FIG. 3. UTILIZING COLUMNS AND CRANE GIRDERS TO FORM ROLLING TRACK FOR TRUSSES

plemented by additional girders (see sketches in Fig. 3) borrowed from the interior runways. This ingenious expedient of using the side-wall columns and their attached crane girders, supplemented by other girders, for track on which to roll the trusses (see Fig. 4) enables the work to be done very economically and simply. Design and erection procedure being worked out in close coöperation, it was practicable to suit the unusual erection requirements at almost no sacrifice of extra material. J. B. Gemberling, division manager of erection, and J. Sherrard, district erection superintendent, are in charge of the work for the contractor.

At the front of the building, over a low transverse bay, it was possible to set up timber horses, partly within the building, to support an erection platform on an area 30 ft. deep across the full width of the building. This affords room for erecting two trusses. When they are swung, and the bracing, purlins, crane-runway drop brackets and crane girders are in place, the pair is jacked up on four-wheel trucks under the ends of the trusses and rolled back. According to the original plan for the work, this group of two trusses was to be moved back to its final place in the roof. But it was later decided that time could be saved by moving in groups of four trusses. The pair is therefore rolled back only 30 ft., giving room for erecting a third truss and its panel of purlins, and again rolled back 30 ft. for the erection of the fourth truss. The group of four, shown in the view, Fig. 5, is finally rolled back to its intended position in the building, this move proceeding in the same way as the shorter move, but requiring special rigging of the derrick hoist lines to do the hauling. When the group of four trusses is landed it is complete and self-contained, requiring only connection to the columns and attachment of the intermediate crane girders to their truss hangers.

No material could be erected in the final position of the roof trusses except a few light parts such as the purlins of the intermediate panels. It was necessary, therefore, to design the interior crane-runway system in such a way that the 4½-ton panels of girder between successive groups of trusses would be carried by these groups, as they could not be put in place afterward. Reference to the plan in Fig. 3 will show how the design meets this difficulty. Except at extreme front and rear of the building, the crane girders are made in two-panel lengths, 60 ft., joining half way between trusses and here supported by hangers attached to longitudinal trusses between the transverse roof trusses. The hangers occur only in the bays between the braced pairs of roof trusses. This structural arrangement permits the rolling of two panels of crane girder with each pair of trusses, and so avoids the difficulty of intermediate girder panels.

In the erection of a pair of roof trusses on the staging on the front of the building the crane girders are set first, resting on cross sills of the staging bents. The ends of these girders project 15 ft. to rear and front of the respective trusses. The forward longitudinal truss is also erected, cantilevering out from the front roof truss, and its hanger supports the front ends of the girders. The rear ends of the girders are hung to the rear truss by rods. When the two-truss group is swung and moved back, for the erection of the third and fourth trusses, the second 60-ft. girder lengths are put in place similarly, the hangers and longitudinal trusses erected between the pairs to support the junction point

FIG. 4. SIDE COLUMNS AND CRANE GIRDERS FORMING TRACK FOR ROLLING TRUSSES

of the girders, and the rear ends again supported by temporary rods hung from the rear truss. The rear longitudinal truss cannot be erected at this stage because of interference with the erection equipment. In this condition the group of four trusses is rolled; the rear ends of the crane girders do not receive their final support until the next group is rolled forward, carrying the longitudinal truss and hanger of the intermediate panel. The purlins of this panel are placed by a jinnywink set on the roof.

Trucks and Rolling Track—Utilizing the outer crane girders as part of the track on which to roll the trusses made the equipment needed for the operation quite simple. The view, Fig. 4, and the drawing, Fig. 3, in conjunction explain the arrangement.

For steady guiding it was desired to use four-wheel trucks running on a track of two rails at each end of the trusses. One rail is laid on the permanent outer line of crane girders, and the other on a temporary line of girders set 37 in. inside of this and resting on steel shelf-beams and batter posts attached to the main columns. The temporary line is made up of 60-ft. lengths of girder borrowed from the interior runways. The batter posts are top-chord bracing struts of the roof, while the shelf-beams are extra material; the addition of the temporary construction increases the stability of the side columns, reducing the chance of lateral sway during the moving.

The permanent outer crane girders, 36 in. deep, span one panel, or 30 ft., while the interior girders are designed for the 60-ft. span between hangers and there-

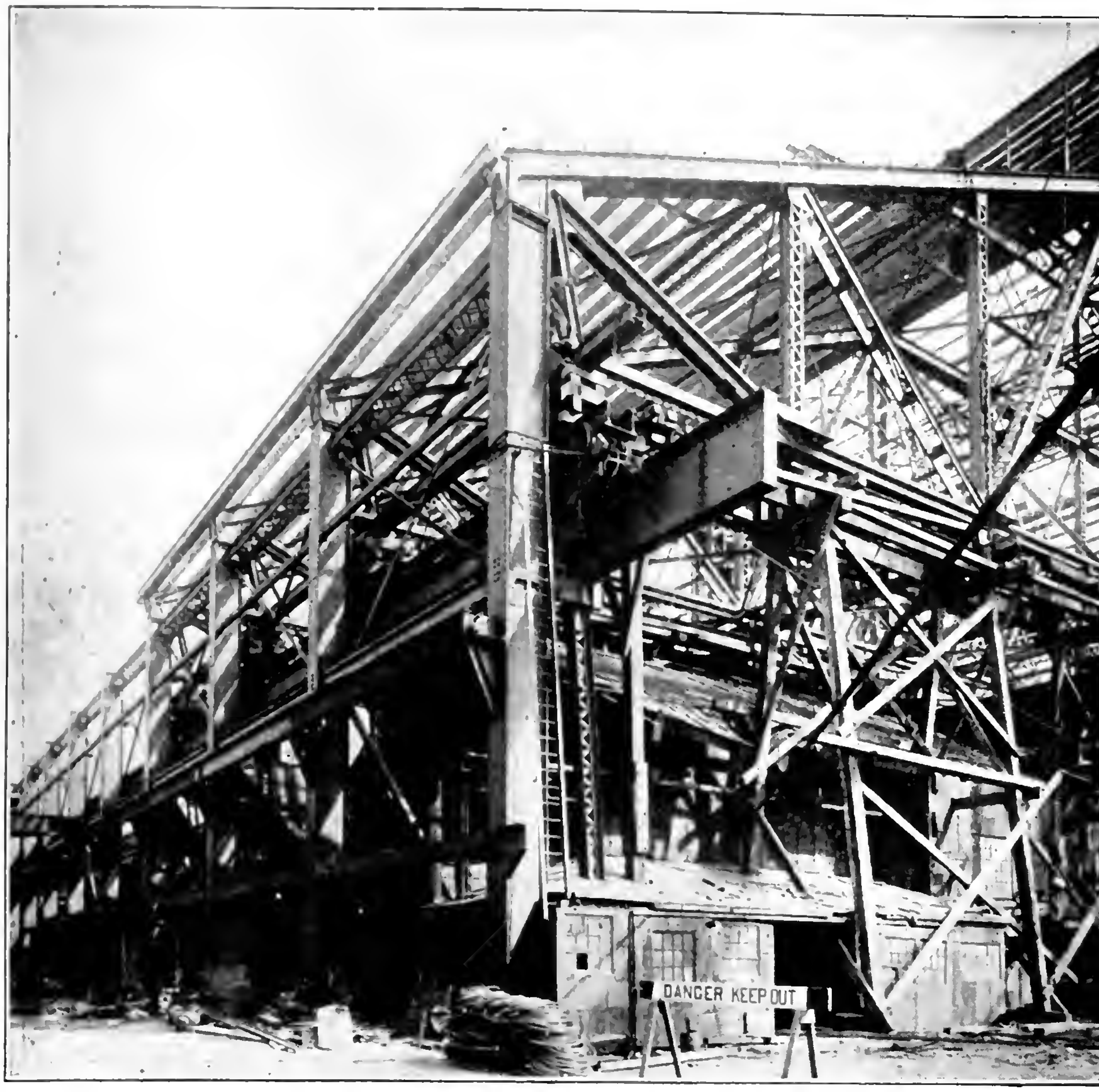


FIG. 5. FOUR-TRUSS GROUP ERECTED AT SOUTH END OF BUILDING, ON FOUR-WHEEL TRUCKS READY FOR ROLLING BACK

fore are made 60 in. deep. When used as part of the rolling track, however, the 60-in. girders are blocked up to bear at the middle as well as at the end supports.

With a truck under each end of each truss, eight four-wheel trucks support one of the 800-ton moving groups (comprising four trusses of about 100 tons weight each, and 400 tons of crane girders, purlins and bracing). Each truck carries a 500-ton hydraulic jack (it happened that smaller jacks were not available), by which the truss end is raised 3 or 4 in. from its seat on the top of the main column and blocked up at this height upon the truck sill, to free it for moving. After the move the jacks similarly lower the group to a seat on the columns at its final location.

Moving the truss groups has turned out to be exceedingly simple and rapid, with this equipment. The hauling line at either end of the truss group is reeved from the hoisting engine through a snatchblock at the front end of the building, thence back to a two-sheave block at the rear end and forward through another two-sheave block attached to the sill of the second truck from the back of the group. This gives a five-part tackle. The four trucks on either side are strutted and tied together by timbers and turnbuckle cables, so that the pull of the line distributes to the four trucks. The two derrick engines at the front of the building handle the east and west lines, and the operators are able to keep the two ends of the group abreast without travel indicators or other special devices.

On Mar. 25, when the first group of four trusses was rolled to place, the move was made in 15 min. The second group was rolled Apr. 15, taking about the same time. The third group of four is to be moved about May 8. This will complete the rolling, as the two southerly trusses will be erected at once in their final position.

Layout for Erection—An unusually convenient erection plant was set up for building the Crucible Steel rolling mill. Fig. 7 sketches the layout. Two derrick towers, built of crane girders and roof-bracing struts in part borrowed from the main structure and in part belonging to a building under contract elsewhere, support two stiffleg derricks fitted with 90-ft. booms. These derricks, regular equipment, are rated at 30 tons capacity, though the extreme lift in this work is 18 tons (end section of top chord) at about 80-ft. reach. The 60-ft. crane girders weigh only nine tons. Because of track interference, these towers had to be set diagonal to the building, but this position worked out very satisfactorily. Material is supplied as needed, coming on cars from a storage space elsewhere in the yard, and is at once hoisted to place. The working space at the front of the building is thus left unencumbered.

A gang of 75 men is employed in the erection work, under Foreman D. McQuarrie and H. Adams.

The side columns, each weighing nine tons, were set

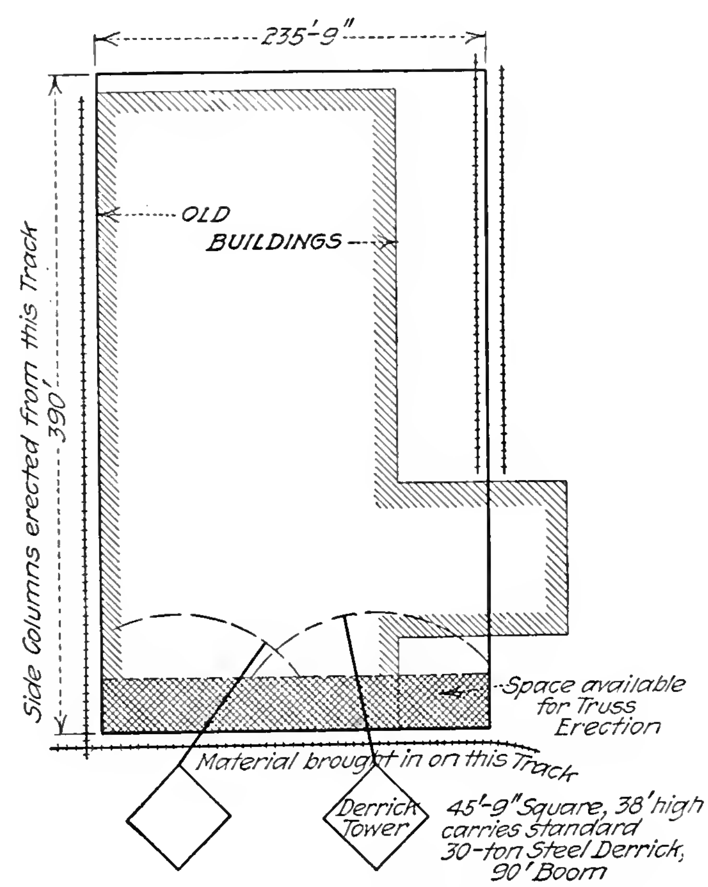


FIG. 6. TRACK AND DERRICK LAYOUT

by locomotive cranes running on tracks along the sides of the building. To give room for preparing the foundations and setting the columns, the building wall was replaced by a temporary shelter partition 6 ft. in, and the old side wall was torn out. In the front bay of the building, staging bents as sketched in Fig. 7 were dropped through the roof of the front part of the building and capped with pairs of 24-in. I-beams.

Camber was provided for in the trusses to the amount of 2½ in., of which 1 in. was designed to be permanent dead-load camber, to allow for deflection under crane loads. The blocking wedges indicated in Fig. 7 were set a trifle high, however, to permit of entering the middle section of the top chord easily, and were then slacked off to let the parts adjust themselves to the natural camber determined by the shop fabrication.

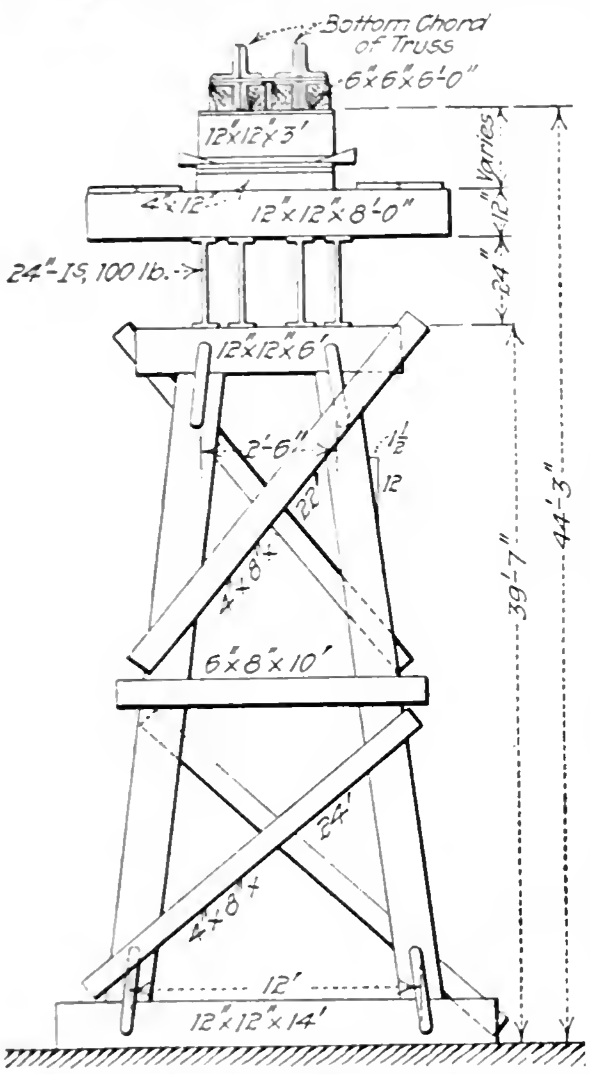


FIG. 7. TYPICAL BENT OF ERECTION FALSEWORK

Returning Crane-Runway Girders—When a group of trusses has reached its final position, the track directly under it is no longer needed. The track girders taken from the interior crane runways must then be moved to the front of the building for erection in a succeeding truss group, since, as already stated, there is no opportunity to set them in position from within.

In part, these girders are dismounted from their seats, lowered, and removed from the building by a locomotive crane running along outside the building. On the larger part of the east wall this is not practicable, however, due to the location of the track and various interferences, and it has been necessary to hang the girders from the roof trusses and telegraph them forward, a rather tedious process in this instance.

As each length of rolling track is removed, short extension brackets originally attached at the rear of the building are bolted to the rear end of the remaining section of track. These brackets are necessary to extend the track beyond the columns at which the rear truss of the next group will be landed, since the rolling truck has an overhang of several feet. Similar brackets are in service at the front end of the building for the outer or permanent line of girders, whereas the inner or temporary line overhangs forward a full 30-ft. panel, since it is made up throughout of two-panel lengths and the building contains an odd number of panels (13).

Reconstructing Old Roof to Clear the New Work—As will be seen from the sketch drawing, Fig. 2, the new trusses foul the monitors of the old roof, and the easterly hangers and crane girders cut into the main trusses of one bay. These conditions made a certain amount of roof reconstruction necessary before the new work could proceed. In the design of the new structure the height was determined by requirements independent of the old building. The monitor interference, amounting to only a foot or so, was easily taken care of by removing the monitor frames and transferring the corrugated-iron roof sheeting of the monitors to the main roof planes.

FIG. 8. ENDS OF TRUSSES CARRIED ON FOUR-WHEEL TRUCKS FOR ROLLING

At the point of interference between the easterly crane girder hangers and the old roof trusses, however, other procedure was necessary. An ingenious reconstruction plan was adopted, involving the substitution of a horizontal chord central section of truss for the peak of the roof truss. The design was such as to permit carrying out the reconstruction operations without shoring. As indicated by the broken lines in Fig. 2, the new chord and web members inserted in the old trusses are so located as to connect to existing gusset plates. Thus they could be attached before the old trusses were disturbed. After they were completed, and capable of taking the load, the ridge members above the new top chord were burned away and removed, and plank sheathing was laid.

Express Trucks—Gasoline and Electric

The American Railway Express Co. employs, in addition to horse-drawn trucks, 1828 gasoline motor trucks, and 1058 electric trucks. The 1828 gasoline trucks are operated in 197 cities—an average of slightly more than nine per city. The 1058 electrics are operated in 23 cities—an average of 46 per city. The ratio is 63% gasoline and 37% electric.

Limestone Rock Asphalt Produces Good Mortar

Tests Show That It Has High Strength, Light Weight and Marked Impermeability—Concrete Results Unsatisfactory

By James R. Nash
Office Engineer, State Highway Department, Austin, Texas

MORTAR made from a natural limestone rock asphalt found in Texas is strong, light and impermeable, according to tests recently made in studying the subject of concretes for ship work. The same aggregate was also used for concrete, but the tests were not very satisfactory, due probably to insufficient mixing and working of materials of this nature. The tests were made with the idea of developing a mortar in which, if incipient cracks should develop due to stresses in the steel, the asphalt in the aggregate would have a tendency to repel water to such an extent that it would prevent sea water reaching the steel.

The aggregate used was a limestone rock asphalt found in Texas, containing approximately 10% of asphalt, the remaining 90% being a comparatively soft limestone. The asphalt is a hard, natural asphalt with a high melting point not unlike the Bermudez natural lake asphalt, but a little harder under ordinary temperatures. The quantity of the asphalt varies from a few per cent. to approximately 14%. The high asphalt content material is called "rich," while that with less than 6% is considered "lean." That which contains about 9 or 10% asphalt is considered "medium."

When heat is applied to a mortar made with this aggregate after it has set and allowed to dry, the asphalt in the stone contiguous to the surface of the mortar becomes soft and is drawn to the surface. A thin covering of a hard asphalt is the result. It is superior to a paint coat of asphalt on the concrete, because the asphalt is part of the aggregate and has therefore a much stronger adherence, and because the heating of the surface tends to melt the asphalt within the mortar, thereby filling up all minute air or water voids in the mortar.

A test made on a mortar disk one inch thick showed it to be impermeable to water under 60-lb. pressure for 48 hours. Three tests were made, and the specimens weighed less after the test than before. The loss was accounted for by the evaporation of water from the specimens; the latter were stored in water until tested.

The strength tests given here are the results of laboratory methods, so it would be necessary to make a field test in a mixer before a definite recommendation could be made. Longer mixing and less water than ordinarily applied to mortar are desirable.

This material is produced commercially by the Uvalde Rock Asphalt Co., of San Antonio, for street construction, by the addition of a flux and heat. For road construction the material is used without heating. The tests were made in the laboratory of the Engineering Division, Bureau of Economic Geology, of the University of Texas.

TESTS OF ROCK ASPHALT MORTAR AND CONCRETE

	Proportions by Volume	Character of Rock Asphalt Screenings	Consistency	Tensile Strength Lb. per Square Inch 7 Days	Tensile 28 Days	Tensile 2 Mos.	Compressive Strength Lb. per Square Inch 7 Days	Compressive 28 Days	Compressive 3 Mos.	Remarks
Mortar	1:3	Rich (¼ in. to No. 48)	Medium	248	410	...	1,040	1,690	.....	
Mortar	1:2	Rich (¼ in. to No. 48)	Medium	367	445	...	3,220	3,450	4,040	Permeability and absorption test made from this mix
Mortar	1:2	Rich (¼ in. to No. 48)	Medium	...	...	...	1,712	2,425	.....	This test made from identical mix as above, except it was mixed with trowel, instead of by kneading by hand. Considerably more water used in mixing
Mortar	1:2	50% Lean (¼ in. to No. 48) 50% Rich (¼ in. to No. 48)	Medium	400	457	545	2,500	3,090	3,980	
Mortar	1:2	Lean (¼ in. to No. 48)	Medium	365	453	538	3,080	4,100	4,840	
Mortar	1:1½	Rich (¼ in. to No. 48)	Medium	435	497	...	2,970	3,540	.....	
Concrete	1:0.67:2.25	Rich (¾ in. to No. 48)	Sloppy	...	...	...	1,350	1,890	.....	Too much water used. Weight per cubic foot of concrete 118¾ lb. used 10.85 sacks of cement per yard of concrete
Concrete	1:0.8:2.25	Lean (¾ in. to No. 48)	Very best	...	...	...	1,815	2,720	3,780	Weight 131 lb. per cubic foot used 10.85 sacks of cement per cubic yard of concrete
Concrete	1:0.9:2.80	Rich (¾ in. to No. 48)	Medium	...	...	...	1,245	1,720	2,050 (2 mos.)	

Comparison of Short-Haul Truck and Rail Shipments

Trucks Reported to Be Efficient for 125-Mile Hauls—Freight Delays, Extra Boxing, Clerical Work Prove Expensive Items

MOTOR-truck transportation on short hauls up to 125 miles, when all the factors, such as delays, extra boxing, weight of boxing, etc., incident to rail shipment are considered, will reduce manufacturers' shipping costs for less-than-carload lots considerably. It will also eliminate a number of transportation evils which are both costly and annoying. These opinions were expressed by W. J. L. Banham, general traffic manager of the Otis Elevator Co., in an address delivered before the National Truck Owners' Conference in New York. The Otis company has effected large savings in this manner, according to the speaker. An abstract of Mr. Banham's remarks follows:

Users of motor trucks should consider to what extent they can operate them in competition with rail movements for short hauls. The principles involved are service and cost. In order to make a fair comparison between the two means of transportation, it is important that the manufacturer shall be in a position to know the cost of moving freight by each method to short-haul points. Some manufacturers figure that when a freight rate is 50c. per hundredweight by rail and 75c. by motor truck, that this means a saving of 25c. per hundredweight.

However, this is not a fair comparison of the total transportation cost, which starts with the boxing of the freight and includes all expenses that are incurred until delivery of the goods in good order is made to the receiver.

While some of these charges are hard to separate from general expense, every effort should be made to do so,

as such separation is important in determining the best method of transportation. The accompanying table shows the variation between rail and truck shipments in the neighborhood of New York.

In computing the cost by rail the following items were included: The first-class freight rate, plus 15c. per hundredweight teaming charges from the shipper's warehouse to the freight house, plus 15c. per hundredweight teaming charges from the freight house to the receiver's warehouse, plus 24c. per hundredweight for increased cost of boxing, plus 17% on account of increased weight due to boxing. There is considerable additional expense, which is not included, but will be referred to later. The rate by way of motor truck covers delivery from shipper's warehouse to the receiver's warehouse. It was averaged, and is believed to be a fair tabulation to be compared with the cost of rail movement.

Factors Making Up Shipping Cost

Taking up the various items responsible for additional expense, the cost of extra boxing may be considered the most important. The amount of this saving, however, will be controlled largely by the amount of material to be boxed or packed, and how much less protection can be used when moving by motor truck as against a less-than-carload movement by rail. In practically every instance it is necessary to prepare material for freight shipment in an entirely different way from that used if it is moved by trucks. This additional packing expense is necessary on account of the number of handlings the less-than-carload shipments received by the railroads and by transfers at both ends. This boxing is generally very much less where truck transportation is used.

Important in connection with this boxing is its weight. This is often increased by moisture from 10 to 25% over the dry lumber weight, where the material is stored out of doors. Also, the extra space required for packing shipments, storing lumber, etc., could generally be utilized to greater advantage for other manufacturing purposes which would produce a profit. Mr. Banham estimated that the Otis Elevator Co. saves $100,000 per year in the cost of boxing, by using motor-truck shipments.

Increased clerical work, delays in transit and, often, loss of shipments are other items which produce extra expense in rail shipment. After the shipment has been properly prepared and the necessary shipping documents have been made out, the shipping department is burdened with an additional expense covering transfer of freight from the shipping floor to the carrier's freight house by truck or other means. If the freight is to be prepaid, the freight bill when rendered must be checked by the shipping department and passed for payment to the interested department. Where thousands are to be handled this checking is expensive. With the use of trucks, this check is made as the merchandise is loaded on the trucks.

It would seem now that the transportation cost has been completed, but in many instances this is not the case. Delays occur in transit, often from six days to six weeks. Where such delays occur it is necessary for the shipper and receiver to locate the freight, and a tracer must be sent out, involving additional expense. Inasmuch as the consignee does not consider that payment is due until the shipment is received, these delays occasion a large loss in capital which might be used for greater manufacturing activities. Where shipments or portions of shipments are lost, as is not uncommon, replacements must be made at further expense.

COMPARISON OF COST OF RAIL AND MOTOR TRUCK TRANSPORTATION FOR SHORT HAULS

Haul	Cost per Cwt. Via Rail	Cost per Cwt. Via Motor Truck
From Yonkers to—		
Newark	$1.04	$0.20
From New York to—		
Newark, N. J.	.91	.15
Passaic, N. J.	.91	.18
Paterson, N. J.	.91	.20
Elizabeth, N. J.	.91	.20
New Brunswick, N. J.	.91	.40
Trenton, N. J.	.98	.60
Philadelphia, Penn.	1.02	.80
Chester, Penn.	1.05	1.00
Wilmington, Del.	1.13	1.20
Coatesville, Penn.	1.15	1.05
Portchester, N. Y.	1.02	.63
Greenwich, Conn.	1.02	.63
Stamford, Conn.	1.03	.65
Norwalk, Conn.	1.06	.68
Bridgeport, Conn.	1.10	.70
New Haven, Conn.	1.13	.73
Derby, Conn.	1.13	.73
Ansonia, Conn.	1.13	.73
Shelton, Conn.	1.13	.73
Naugatuck, Conn.	1.15	.74
Waterbury, Conn.	1.16	.75
Meriden, Conn.	1.16	.75
Hartford, Conn.	1.21	.90
Springfield, Mass.	1.25	1.00
Holyoke, Mass.	1.25	1.10
Worcester, Mass.	1.31	1.50
Boston, Mass.	1.36	1.50
Providence, R. I.	1.32	1.10

Contrast this with movement by truck where delivery from shipper to receiver is made within a 24-hour period, with less than half the handling and greatly decreased packing charges. Practically none of the additional expense incurred by rail shipment is necessary when movement is made by truck. If a fixed rate is agreed upon, the shipper is in a position to know at once what his shipping charges will be.

Is it not to the advantage of the manufacturer to make delivery to his customer within the shortest possible time? If a freight shipment takes 30 days by rail, as against one day by truck, the capital tied up might have been used 29 days for manufacturing. It is the best advertising feature of Marshall Field & Co. of Chicago that they agree to make delivery within 50 miles of their store within 24 hours. Prompt delivery gets the business, and slow delivery would lose it.

Broader Commercial Education for Engineers

As a result of a meeting of a committee composed of administrative professors of engineering and commerce at representative higher institutions of learning, and delegates from the four national engineering societies, called to meet in Washington, D. C., by the Commissioner of Education, the following recommendations were made, to be considered by a general conference proposed for the near future: (1) That from 12 to 18 semester hours be required of all engineering students covering the following subjects: General economics, cost accounting, business organization and business law; (2) that for engineering schools desiring to extend further the commercial or industrial aspects of engineering, the following subjects are recommended as electives: Labor and employment, corporation management and finance, statistics, marketing, scientific management, psychology, transportation, and political science; (3) that the economic phases of engineering be emphasized in engineering instruction wherever possible.

Illinois Adopts a Uniform Basis of Design for All Types of Rigid Pavement

Concrete Standardized, Other Types Designed to Equal It in Load-Carrying Capacity—Flexural Strength To Govern—Brick and Bituminous Concrete on Concrete Base Only Other Types Considered for Main Road

By Clifford Older
Chief Highway Engineer, Department of Public Works and Buildings, Illinois

In view of the rapid development of interurban truck transportation, load-carrying capacity is the logical basis for the design of rigid pavements of different types. In rigid pavements flexural strength is the governing feature, and, having established a standard design for one type, it is sound engineering practice to make all other types conform to it in strength, as nearly as possible. A standard concrete slab, 7 in. at the side and 8 in. at the center for 16- to 18-ft. widths, has recently been developed by a conference of the northern Mississippi Valley states, and this has been adopted by the State of Illinois as the basis for all its rigid surfacings. The only other types considered suitable for the primary road system of Illinois are monolithic brick and bituminous concrete on a concrete base.

Illinois is facing the problem of expending judiciously for road building a state bond issue of $60,000,000, together with about $24,000,000 of Federal-aid appropriation. Practically all of these funds will be used on the main road system of the state, constituting approximately 5% of the total road mileage, and estimated to carry about 60% of the entire state traffic. The design of the pavements to be used on these roads is therefore a matter of the greatest importance.

Rigid Types To Be Used on Main Roads

In this discussion, the rigid types considered are portland-cement concrete, brick on a concrete base and bituminous concrete on a concrete base. Other types of rigid pavement, such as wood-block or granite-block are not considered because they are not available for country road work in Illinois on account of cost. Gravel, water-bound macadam, and the various forms of bituminous macadam are considered to be nonrigid types.

In Illinois, perfect drainage is difficult to obtain in subgrade building. The nonrigid pavements depend almost entirely upon the solidity of the subgrade for their stability. While every reasonable effort will be made to secure good subgrade drainage, yet experience in this state has shown that nonrigid pavements require an excessive expenditure for underdrainage, if serious rutting under heavy traffic is to be avoided.

This condition also necessitates the use of thicker nonrigid pavements than commonly used, and more thorough rolling with heavy rollers to secure the required density of pavement. The stone available for macadam road building in Illinois is a comparatively soft limestone which crushes under heavy rolling. Internal wear under heavy traffic is also a serious matter. These considerations lead to the conclusion that macadam or bituminous-macadam roads, as they may be built practically under Illinois conditions, are essentially light-traffic roads, and cannot be made to bear even moderately heavy truck traffic, except at a first cost which is practically equal to that of the rigid pavements. Gravel roads are subject to the same criticism. The high cost of maintaining nonrigid types under heavy traffic is well understood. These conclusions have led to the adoption of rigid pavements for the main roads.

Any of the three types of rigid pavement considered —namely, concrete, brick and bituminous concrete on a concrete base—has sufficient wear-resisting qualities to make this factor comparatively unimportant. Disintegration due to weather or other natural causes may also, as far as we know, be disregarded in the case of any of the three types mentioned. Available data on maintenance cost do not indicate that this element would be a controlling factor. It therefore follows that the main factor to be considered in the design of such pavements is load-carrying capacity.

It is not the primary function of rigid pavements to span soft spots in the subgrade. The subgrade should be as uniform and unyielding as can be obtained at reasonable cost; but, regardless of the care used, all subgrades are more or less yielding. The function of rigid pavements, therefore, is to provide means for the transmission of traffic loads to the subgrade without exceeding the capacity of either the pavement or the subgrade.

It is fundamental that the load-supporting capacity of a rigid pavement is dependent upon its transverse strength, and its transverse strength is measured by its thickness and the modulus of rupture of the material of which the surface in tension is composed.

Pavement Design Not Subject to Exact Mathematical Analysis

It is generally admitted that with our present knowledge the design of a rigid pavement is not subject to exact mathematical analysis. The forces of traffic, character and moisture content of the subsoil, frost action and other factors are so variable and complex as to defy exact analysis, and any computations must be used merely as a guide to the judgment. *It is reasonable to assume, however, that all types of rigid pavement, provided they are to be used interchangeably under the same soil and traffic conditions, should have equal flexural or transverse strength.*

Under the abnormal motor-truck traffic of last year, failures were observed in practically every type of rural road. In view of these condtions and the increasing use of concrete as a paving material, a conference of the engineers of the highway departments of the northern Mississippi Valley states was recently held for the purpose of standardizing the design of concrete pavements. The aim of this conference was to provide a concrete pavement which, under average soil and drainage conditions, would have sufficient strength to withstand the expected increase in volume and weight of traffic.

For 16- and 18-ft. pavements the design adopted calls for a thickness of 8 in. at the center and of 7 in. at the sides. The concrete to be mixed in the proportion of 1 part of cement, 2 parts of fine aggregate, 4 parts of coarse aggregate, and only sufficient mixing water to give maximum strength. Illinois has adopted this stand-

ard except that a 1:2:3½ mix will be used at least for 1919 construction. This design has also been adopted by Illinois as a standard of strength or traffic-supporting capacity on which to base the design of all other types to be used under the same conditions.

Comparison of Other Pavements With Standard

A standard of strength having been adopted, it is relatively simple to compare it with other rigid pavements. Assuming traffic loads to be equal, the moments producing flexure of the slab will be equal. Also, the results will be relatively correct whether the pavement is considered as a slab or simple beam. For convenience the latter assumption is made.

The modulus of rupture of the pavement may then be expressed by the common flexure formula $S = Mc/I = K/d^2$, where K is a constant which is equal to $6M/b$, and is equal for all slabs of equal strength and proportionate for all slabs of unequal strength, S is the modulus of rupture and d is the thickness of the slab. Then

$$K = Sd^2 \qquad (1)$$

$$\text{or } d = \sqrt{\frac{K}{S}} \qquad (2)$$

For the standard road $K = 459 \times 8 \times 8 = 29{,}400$, using a modulus of rupture for 1:2:3½ concrete of 459 lb. per square inch. Substituting this value of K and the modulus of rupture for any given concrete in formula (2), the thickness at the center line of a pavement of equal strength may be determined. Or, determining K for any pavement by formula (1) will enable a comparison of transverse strength to be made.

The accompanying table gives a comparison of some of the properties of common concrete mixes:

Proportions of Concrete	Modulus of Rupture * Lb. per Square Inch	K for Pavement 8 in. Thick at Center	Per Cent. of Strength of 1:2:3½ Mix. (8-in. Slabs)	Thickness at Center Line (d) for Strength Equal to 1:2:3½ Concrete
1:2:3½	459	29,400	100.0	8.0
1:2:4	439	28,100	95.6	8.2
1:3:5	285	18,200	61.9	10.1
1:3:6	226	14,500	49.3	11.4
1:1:2	710	45,400	154.5	6.4
1:1:1½	709	45,300	154.0	6.4
1:2½:4	375	24,000	81.7	8.9

* Obtained from "Concrete, Plain and Reinforced," Taylor and Thompson p. 258.

The results given are independent of the exact values of modulus of rupture, providing these values are relatively correct.

Brick Pavements

Brick pavements have been constructed in many different ways. For several years the Illinois department has favored the monolithic type, as it seems to be giving excellent results. In a report of tests of monolithic brick slabs made at the University of Illinois (see *Engineering News-Record*, of Nov. 1, 1917, p. 820), Prof. C. C. Wiley states, in effect, that the modulus of rupture of the concrete base of monolithic brick slabs is approximately the same as that of plain concrete of the same quality, and that such slabs are fully equal in strength to concrete slabs of the same thickness. The tabulated results of these tests would seem to indicate that a higher modulus of rupture might be expected for the base of a brick slab than for the base of a concrete slab of the same thickness and quality of concrete. However, in the few tests recorded where the brick surface was in tension and with transverse courses (a condition which applies near transverse joints or cracks), a very low modulus of rupture was noted. Although this fact would seem to indicate an element of weakness, yet the number of tests made was so low that the tests could hardly be considered conclusive. The Illinois department has assumed that, in the light of our present knowledge, it is reasonable to consider the combined concrete and brick slab to be equivalent, from a flexural standpoint, to a homogeneous concrete slab having the same quality of concrete. Under this assumption a monolithic brick road may be considered in exactly the same class as a concrete road, in so far as traffic-supporting capacity is concerned.

Since the transverse strength of a concrete slab is measured by the modulus of rupture of the concrete, it is evident that, under the above assumption, a monolithic brick pavement should have a base of the same quality of concrete as would be used in a homogeneous concrete slab of equal thickness, in order to have equivalent strength. It is also evident that, if we should make the total thickness of a brick road 8 in. and use a lean mixture in the base, its traffic-supporting capacity would be reduced in proportion to the modulus of rupture of the base. Illinois has, therefore, adopted as one standard a 3-in. brick laid on a concrete base 5 in. thick, and having the proportions 1:2:3½.

This will result in a pavement having practically the same carrying capacity as the standard concrete pavement heretofore described. The problem is somewhat different if 4-in. brick are used, because if the same total thickness is maintained the base would be so thin as to require a finer aggregate and more care in construction. It has therefore been considered advisable to use a base of 1:2½:4 concrete, 4 in. thick at the sides and 5 in. thick at the center, making a total thickness at the center of 9 in. An examination of the table will show that this pavement should also have a load-supporting capacity equal to that of the standard concrete road.

If asphaltic or sand fillers are used instead of cement grout, it is evident that the pavement can no longer be considered to act the same as the homogeneous concrete slab. It is probable that brick surfacing with a soft filler has some strengthening effect which may be added to the carrying capacity of the base, but the amount of such effect cannot be determined definitely. In the absence of definite data, we have assumed that the strength of the combined concrete and brick slab would be equal to a homogeneous concrete slab having a thickness equal to the thickness of the base plus one-half the thickness of the brick wearing surface. For example, if 4-in. brick are used with a soft filler, the concrete is to be 2 in. less in thickness than if no surfacing were used.

Bituminous Concrete on a Concrete Base

It seems logical that the bituminous-concrete type of pavement on a concrete base should be considered in somewhat the same class as the brick with the soft fillers, so far as traffic-carrying capacity is concerned. Two designs for bituminous-concrete surfacing have been adopted by the Illinois department: (1) A 2-in. Topeka type of bituminous concrete laid directly on a concrete base; (2) A 1½-in. binder course of bituminous concrete on which is laid a 1½-in. Topeka-type wearing surface, making a total thickness of 3 in. of wearing surface on a concrete base.

Since it is wholly a matter of opinion as to how much weight can be given to the transverse strength and

and cushioning effect of the bituminous wearing surface, it has been decided, for the sake of simplicity, to allow the equivalent of 1 in. of concrete for both the 2-in. and 3-in. wearing surface. This means that a 2-in. Topeka-type wearing surface should be laid on a 7-in. concrete base, if a proportion of 1:2:3½ is used; on a 9-in. base if a 1:3:5 mix is used, or on a 10-in. base if a 1:3:6 mix is used. (See the table.)

A study of cost, taking into consideration the ordinary range in cost of delivered materials, indicates that this type of pavement will be cheaper if laid on the thinner and richer base, rather than on the thicker and leaner base. Any possible saving in cement is more than offset by the cost of delivering the larger volumes of aggregate.

The 7-in. base of 1:2:3½ mix has therefore been adopted.

Objections have been raised to the so-called unprecedented richness of the base for both brick and bituminous-concrete surfaces. The chief reasons for these objections are undoubtedly the prevailing idea that the selection of type will be dependent upon cost, and because leaner bases of about the same thickness have given reasonable service in city streets. Bituminous concrete on a concrete base has seldom been used for rural roads, and the conditions of traffic are so different that previous experience in city streets should not receive undue weight. Practically all types of properly constructed pavement have been a success or failure in city streets, dependent upon the character of traffic on the particular street. Again, all city streets are more or less satisfactorily drained by a sewerage system, whereas on country roads an equally uniform subgrade cannot be obtained at reasonable cost.

A careful analysis of the country road problem indicates that in the future there will be unprecedented conditions to meet. Heavy motor-truck traffic will prevail on all the main improved roads, and this traffic will be confined day after day to the same wheel tracks, because of the limited widths of pavement which can be built with available funds. With these considerations in mind, it seems absolutely justifiable to take this rather drastic stand in the design of pavements for a comprehensive system of roads.

Starting with one well established design of rigid pavement, it is not only feasible but sound engineering practice to design all other principal types of rigid pavement in such manner that, within reasonable limits, each will have the same carrying capacity or transverse strength, under equal subgrade and traffic conditions.

New Classification Proposed for Rock To Be Excavated

Geologist Bases Grading Rules on Ease of Excavation and True Geological Composition

ROCK classification, as used by engineers in excavation work, is not as accurate as a geologist would wish, nor does it serve to prevent many disputes in actual practice. With a view to providing a classification which will better serve, Warren D. Smith, professor of geology at the University of Oregon, has recently submitted to *Economic Geology* for March-April, 1919, the following discussion, which he hopes will receive the consideration of engineers:

The classification of rocks given in geology handbooks is too technical and too clumsy, as now arranged, for the use of the field engineer, and we find in the literature nothing very adequate which the engineer can use. In some cases he has fallen back on a classification something like this, which all geologists will recognize as being a very loose and unsatisfactory classification. For instance, I found the following classification in use by the engineers of a railroad company in Oregon: (1) Solid rock; (2) sandstone; (3) cement; (4) shale; (5) earth.

Now, all geologists know that there are many different kinds of solid rocks and many different kinds of sandstones, and so on. No regard is paid in this classification to the differences in cementing materials in the sandstones; there is nothing in here about structure, or texture, which determine the ease or difficulty in excavating the material. No attention is paid to whether the material is weathered or to the degree of alteration. For instance, the word cement may include many different kinds of cementing substances, silica, calcium carbonate or iron oxide, and it makes a great difference which one of these is the binding substance.

A good classification will probably have to include terms generally used by geologists, but these must be so grouped that we get in any one group materials which can be excavated with about the same degree of ease or difficulty, as the case may be. In the following proposed classification very heterogeneous substances are grouped together, but, taking into consideration texture, structure and composition, we think there are included those materials which, from our experience, we judge ought to be classed together for similar rating in regard to excavation.

We realize that this classification is open to criticism, but criticism is what is invited, for an excellent way to develop a good classification is to propose one, have it criticized, and then make a new one, or, if necessary, several new ones.

In the case of a small job, involving little financial outlay, where not very much can be either made or lost by the contractor, the old, loose classification as now used might be retained; but with a big piece of work, where thousands of cubic yards of rock have to be moved, it will pay both the company and the contractor to have a geologist. If the company retains no geologist on its staff then let it secure the temporary services of one, and have him classify the material to be excavated. In this particular case I know that several hundred dollars could have been saved.

For use in connection with this classification we think that Pirsson's "Rocks and Rock Minerals," with the tables there included for rock determination, should be used. There is no escaping the fact that the engineer must know the common rocks and minerals. If he does not know them now, he must either take a course where he can learn these, or a geologist must be retained.

The following classification has four main groups, and is as follows:

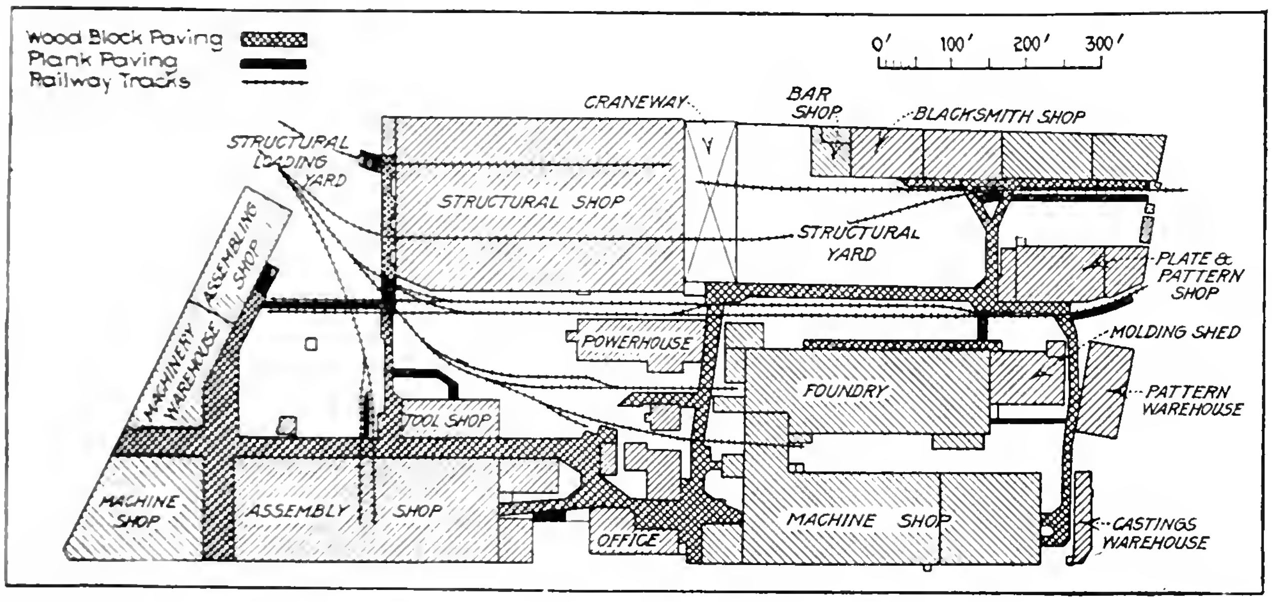
Name	
All granitic rocks, granites, diorites, etc. Sandstones (siliceous cement) Quartzites and quartz masses Traps (basalt) porphyries and volcanic glasses Conglomerates and agglomerates Gneisses, breccias	GROUP I. Solid and unweathered rocks.
All rocks of Group I. badly weathered Sandstones (lime or iron cement) Limestones and marbles Serpentines, schists, slates and argillites Hardpan (glacial, etc.)	GROUP II. Intermediate rocks.
Shales Rubble limestone Loose sandstone Coquina Marls Travertine Tuff Glacial till	GROUP III. Soft rocks.
Silt Mud Sand Gravel Volcanic ash (loose)	GROUP IV. Unconsolidated (earth)

Tractors Reduce Service Cost at Machinery Plant

Dispatcher System with Truck Trains on Paved Roadways Handles More Material with Fewer Men Than Old Teams

NEARLY 80% reduction in cost of intershop distribution of material has been effected by the Minneapolis Steel & Machinery Co. by means of electric tractors and trucks operated on paved roadways under the control of a dispatcher system.

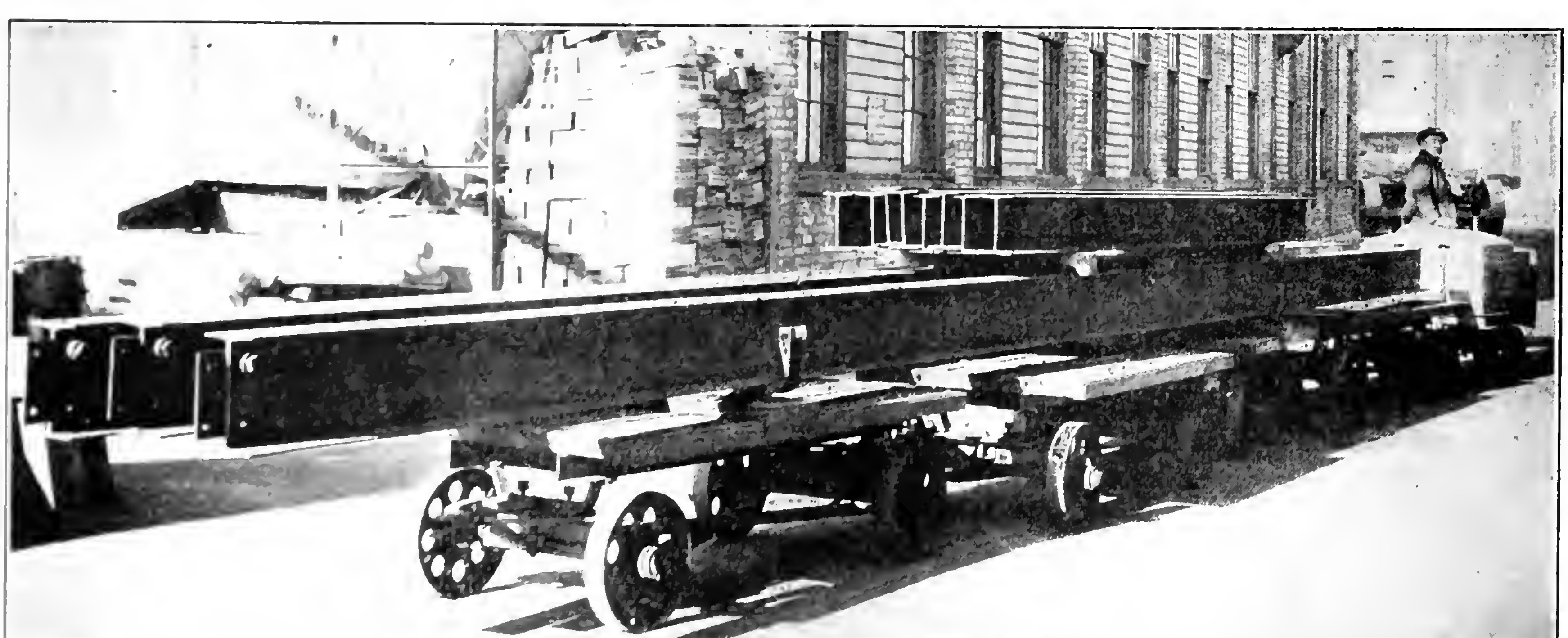
The old intershop service was operated by 14 hired wagons and teams, each with a driver and two helpers, under the direction of a foreman and four assistants, making a total of 47 men. For 100 tons moved daily the cost averaged $1.50 per ton. By paving the roadways and organizing a dispatcher system to control the movements, the cost was reduced to about $1 per ton. With the introduction of tractors hauling trains of trailer trucks, accompanied by further development of the dispatcher system, the cost was reduced to 31 to 35c. per ton for a daily business of 200 tons and with a force of 14 instead of 47 men. The average daily mileage has not been determined yet.



PAVED ROADWAYS FACILITATE DISTRIBUTION OF MATERIALS BY TRACTORS

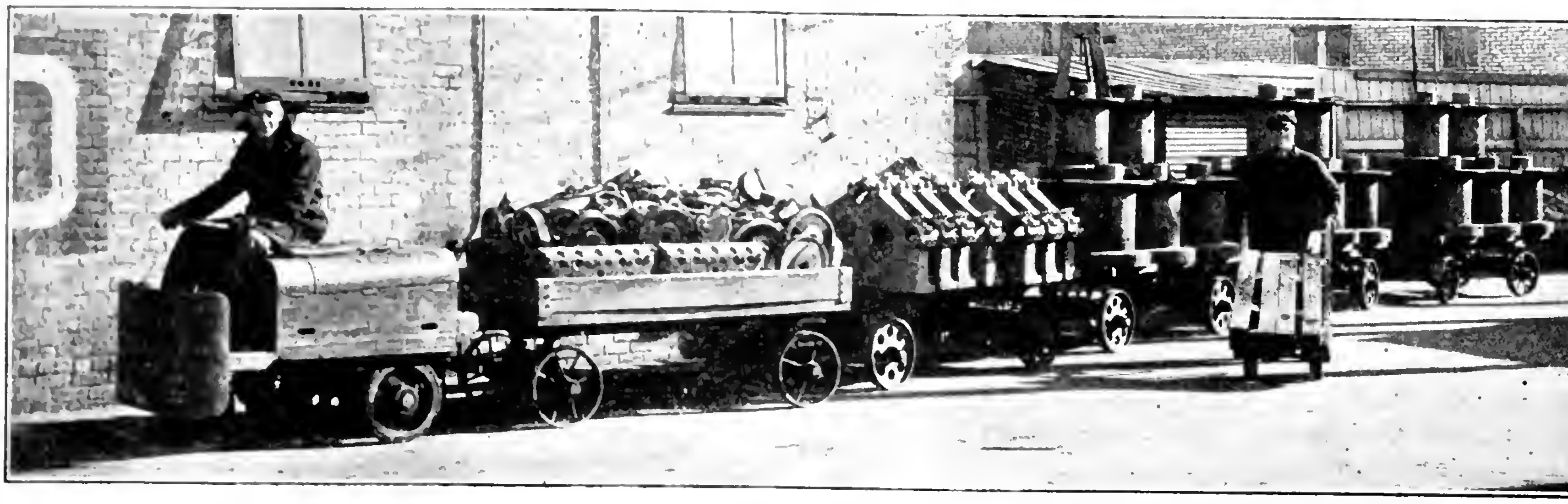
It is expected that by equipping the tractors with recording speedometers the charts will permit close analysis of the situation and still further reduction of the cost by 5 to 8c. per ton, through the elimination of weak points in the service. The system is similar to that at the Topeka shops of the Atchison, Topeka & Santa Fé Ry., described in *Engineering News-Record* of May 30, 1918, p. 1038. The intershop transfer system is headed by a superintendent, who has a chief dispatcher, assistant chief dispatcher, five sectional dispatchers, four tractor operators, one truck driver and one helper, a total of 14 men. There are three electric tractors, 53 trailers, one electric lifting truck and one motor truck with trailer.

All movements of material are recorded by the chief dispatcher, while his assistant looks after the field or outdoor service. The sectional dispatchers are in charge of five designated portions of the plant and see that all incoming material is delivered promptly to the departments in their respective sections, and that finished material is removed promptly and dispatched to its destination. With each movement there is a delivery slip showing the weight, pattern number, description, order number, by whom shipped and to whom and to which department the material is shipped. One copy is kept by the shipper, while the receiver keeps the second copy and signs the third copy, which is returned to the shipper. The last named in turn sends the original slip to the chief dispatcher. From these slips a record is made at the end of each day, showing the material moved and the operating cost. Material is now handled more rapidly, while delays and losses in transit, formerly encountered, are eliminated.



TRACTOR-TRAILER TRAIN HANDLES STRUCTURAL STEEL AT MACHINERY PLANT

Creosoted-block paving is used for the greater part of the paved roadways, which aggregate about a mile in length. The balance is of 3-in. plank. The width is from 16 to 27 ft. for the block-paved portion and 5



MACHINERY SUPPLIES HAULED BY TRACTOR-TRAILER TRAIN

to 10 ft. for the plank paving. The only concrete paving is that inside the buildings. Two electric tractors weigh about 2400 lb. each and have a hauling capacity of 8 to 15 tons. The third tractor weighs about 2275 lb. and hauls from 6 to 12 tons. The plant investment of $30,200 includes $17,000 for paving, $9100 for trucks and $4100 for trailers. The only overhead figured in the cost is that which is sufficient for the operation of the trucks to cover repairs, renewals and depreciation, as the whole interplant delivery system is an overhead on productive labor at the plant. No comparison can be made between the present investment cost and that under the old system, as the company did not own the teams formerly used.

The new system was devised and developed by George H. Anson, superintendent of the intershop transfer and warehousing department, and James B. Gilman, chief engineer of the company.

Low Labor Output in War Work Not Due to Cost-Plus Contract

Interviews With Contractors Prominent in War Work Indicate Low Efficiency of Labor Resulted From Long Hours and Excessive Demand

(*Editorial Interview*)

WAR construction was extravagant in the expenditure of labor. Workmen of all classes were inefficient. Did the cost-plus contract encourage this inefficiency? The word is being passed among construction men that it did. It is being repeated that cost-plus contracting reduced the productiveness of labor and did away with the incentive for close management. A sentiment which was keen for the extension of cost-plus methods is therefore growing indifferent and to some extent turning reactionary.

Inquiry made of a contractor who ranks high because of his successful work of many years, and who carried out important war contracts, elicited the astonishing response that cost-plus contracting was unqualifiedly detrimental to efficiency in construction. The question was then divided into two:

"Is it your experience that labor is less efficient in cost-plus construction?

The answer was "Yes."

"Is the fact due to the form of contract or to some other cause?" was then asked.

The reply was, "The cost-plus contract takes away the incentive to good work and good management."

Merely as personal opinions, these statements were impressive because of their source. They prompted the extension of the inquiry. Interviews were obtained from six contractors, of large experience in peace-time construction, who had been prominent in war work. All freely admitted that the output of labor had been below normal in war construction. All strenuously denied that cost-plus contracting was the cause. Responsibility was placed on overtime work, long hours, scarcity of labor, unwise publicity and the disposition of labor to profiteer. Promise of anonymous publication elicited candid expressions of opinion, on various features of cost-plus contracting, which are deserving of the most serious consideration by contractors who are uncertain of their attitude toward the movement to extend the practice to public-works construction generally.

Causes Affecting Efficiency—Indulgence in excessive overtime was a prolific cause of inefficiency of labor in war construction. It reduced the output of the workman and it lowered his morale and excited his greed for "big money." Undoubtedly, knowledge that overtime must be employed decreased in many instances the output of the workman during straight-time hours. This, coupled with the anticipated and realized decrease of 25 to 50% in efficiency in the overtime hours, amounted to a serious reduction in output per man per hour. Also without doubt, the emergency of war warranted the employment of overtime work even at the sacrifice indicated, but its detrimental results should not be held to be a normal effect of cost-plus contracting.

In much war construction the management worked long hours under great pressure. Opinion differs as to effects. Some assert that supervision was just as efficient and painstaking as it is under normal conditions. Others assert that superintendence and foremanship were less keen; long hours depleted the energy of the men, and the constant demand for quick decision prevented the consideration which some questions needed for wise decision. The success of cost-plus contracting hinges very largely upon the spirit imparted to workmen through their executive superiors. With its energy sapped by long hours, supervision was less inspiring. A portion of labor's inefficiency was traceable to this cause.

Scarcity of labor, and constant newspaper publication of the fact that contractors were borrowing, begging

and even stealing workmen wherever they could be found, gave labor a feeling of independence which often expressed itself in "loafing on the job." Independence was further increased by a weekly wage greater than many workmen required to meet their normal living expenses. The effect of this unusual affluence was in some cases to encourage dissipation and a disposition to lay off, while in other cases it aroused a greed for accumulation which led the men to dole out their energy so that credits for overtime would mount up.

Inefficiency was not peculiar to cost-plus work. Contractors who during the war were doing work for the Construction Division of the Army under cost-plus-limited-fee contracts, and at the same time had work for private concerns on a unit-price basis, were unable to see that there was any greater inefficiency in one case than in the other. Labor was very inefficient in both cases.

War Results Not Criteria—There is no reason to believe that conditions which contributed to inefficiency of labor during the war will continue a controlling influence after the war and particularly after the lapse of a period of readjustment in living standards. The labor market will approach normal conditions, and haste in construction will cease to be the supreme requirement. As stated by one contractor, "It would be manifestly unfair to consider the cost of emergency war contracts or the efficiency of labor on these contracts as a criterion of what might ordinarily be expected in peace work when efficient labor can be obtained or a laborer who is not efficient can be replaced by one who is."

C. S. H.

Poor Plumbing and Unruly Temper Cause Institutional Water Waste

HIGH consumption of water at the Illinois State Reformatory is attributed largely to poor plumbing and the unruly character of the inmates, according to a recent report made to F. J. Postel, supervising engineer of the State Department of Public Works and Buildings by H. G. Thomas, assistant engineer, following an exhaustive water-waste survey.

No underground leakage from the mains was found that would register on a ¾- or 1-in. meter. Meters were then installed on leads to the various buildings or groups of buildings, seven in all. In the past three years the consumption has varied from 91 to 235 gal. per capita. The average since February, 1916, has been 170 gallons.

Quoting Mr. Thomas: "I attribute this solely to the condition of the plumbing and the temper of the inmates. The north cell-house is the older, and the cocks on the cell fixtures are of poorer construction than in the south cell-house. Incoming inmates are also first assigned to the north cell-house as well as all third grade or most unruly inmates.

"The cocks being of poorer construction, are more easily put out of commission, and the per capita consumption in the north cell-house runs about 140 gal.. as against 72 gal. in the south cell-house. Most of the inmates are in the shops or on the farm or grounds for about eight hours of the day, and wash up for their noon and night meals in the shops and make use of the shop fixtures for toilet purposes during that period."

Some of the groups gave the following daily per capita rates: Chain shops, store, machine shop, blacksmith shop, carpenter shops, foundry, print shop, inside barn, south cell-house, bathroom, south towers and all of the farm, 30 gal.; superintendent's houses and offices, 99 gal.; north cell-house, 140 gal.; school, receiving and discharging department, tailor, shoe and paint shops, yard gang, toilets and showers, captain's office, library and most of the offices and inmates' kitchen demand, 10 gal. per capita of the whole population; peeling room of inmates' kitchen, officers' quarters, and bakery, 4 gal.; south cell-house, 72 gallons.

A favorite habit of the inmates is to balance the self-closing cocks open so as to wash in running water. Temporary relief is being tried by putting on a stop to prevent opening the valve wide. It is estimated that all the present outlet cocks in the cells can be replaced by positive self-closing cocks at a cost of $4800 and reduce the use of water to 40 or 50 gal. per capita, also largely reducing the annual water bill.

Education for Intelligent Industrial Production

Addressing a body of students and professors at the State University of Iowa recently, Prof. J. H. Dunlap stated that the primary purpose of all education in applied science was more intelligent industrial production.

The state is furnishing educational facilities to the end that there may be in this country and in the world trained engineers who will make a return of a thousandfold in terms of intelligence. He said that the two fundamental elements of production are materials and men, yet the engineering school of the past has been largely concerned with materials, their physical properties and the laws by which they can be utilized in the service of mankind. The second factor of production—namely, the human factor—cannot be neglected longer.

The war has brought mankind to the firm determination that the square deal shall be given it, or else no deal at all. The world today is divided into two camps. One camp is seeking the upbuilding of mankind through the destruction, root and branch, of our capitalistic society. The other camp is seeking the upbuilding of mankind through the beneficent operation of an applied science which will make surveys, determine causes, design and build in human society an immortal structure which shall be forever founded on those elementary principles of justice to all men, for which we have been fighting in time of war, and for which we must continue to struggle in time of peace. The problem, in its final analysis, is an engineering problem.

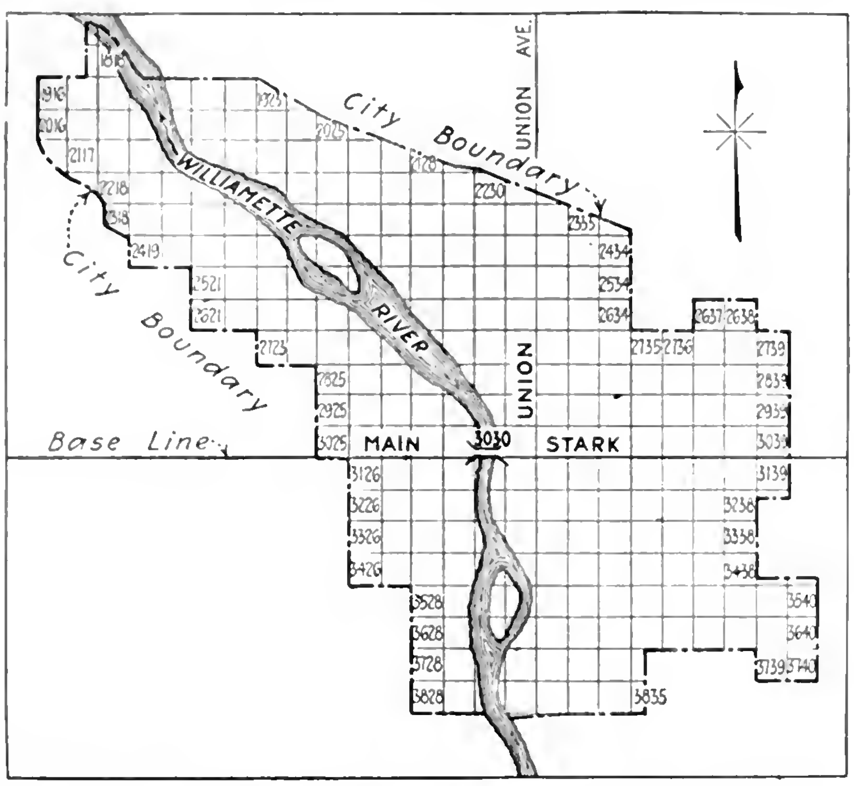
Its solution rests with men trained in methods of scientific investigation and in the application of law to every problem of life. Such men are to be the engineers of the future, the builders of a new world.

Reference Maps More Accessible With New Numbering

Quarter Section Sheets of City Map of Portland Oregon, Numbered with Reference to Base Line and Meridian

By Orrin E. Stanley
Sewer Engineer, Portland, Ore.

PORTLAND has recently substituted a logical system of numbering the "quarter-section sheets" used as reference maps in the city offices, in place of the old and cumbersome manner of designating them, which apparently "just happened." By the new system, the city is divided into half-mile zones extending east and west, and the half-mile squares in these zones are numbered consecutively from west to east, a hundred numbers being assigned to each zone. The zones themselves are



NUMBERING ARRANGED IN ZONES WITH REFERENCE TO A MERIDIAN AND BASE LINE

numbered from north to south, their numbers being the first two figures of the sheet numbers, while the last two figures indicate the position of the quarter section with reference to a meridian.

By the old, discarded method a map of the city was divided into half-mile squares. Those of the top row were numbered from west to east, beginning with No. 6; the second row started at the east with No. 7; while the third row began at the west with 15, each row ending at the city boundary. In this manner sheet No. 172 was reached at the south edge of the city. Additional territory was annexed to the city from time to time, and the sheets showing these annexations received consecutive numbers, from 173 to 244, these higher numbers appearing at most unexpected places around the edge of the guide map. No copy of a law limiting the numbers used for this purpose to 244 can be found, but for some reason (or lack of reason) the use of figures stopped there, and additional sheets were designated by letters. The entire alphabet was used for this purpose, and by means of primes was used as far as T″ a second time through. Fortunately, the expedient of using Greek or Chinese characters does not seem to have occurred to the draftsman.

These sheets are arranged by consecutive numbers in book form for use in the various offices, and under the old arrangement much annoyance was experienced in trying to follow a street beyond the limits of one sheet. Several draftsmen in the city engineer's office felt that a reform was desirable and set about bringing order from chaos by giving the sheets numbers from which their relative position in the city might be readily determined.

The first plan suggested was to have 50 zones of 50 squares each; another proposed zones of 40 numbers each, a third plan called for the use of letters to designate the zones and numbers of one or two figures to indicate the position of the sheets with reference to a meridian. Each of these plans was fully discussed in the drafting room and finally got to the city engineer, but they were all rejected in favor of "hundred-number" zones.

For purposes of computing the haul of heavy materials such as sand, gravel, etc., the "official" center of the city is assumed to be the center of the drawspan of the Burnside St. bridge. The quarter-section sheet which shows this point near its center received the number 3030. This allows for the growth of the city to a point 15 miles to the north and the same distance to the west of this place without getting beyond the limits of the numbering scheme, and it was thought by those who discussed the matter that topographical conditions are such that a greater extension of the city in those directions is very improbable. The arrangement of numbering is shown on the accompanying map, with the intermediate numbers omitted. Sheets having 30 as the first two figures lie along the north side of the Willamette base line, and those having 30 for the last two figures lie along the west side of Union Avenue.

The entire city is mapped on these quarter-section sheets, the original scale being 100 ft. to 1 in. Blueprints or white prints on cloth are used in many of the city offices, and additional information—such as the location of houses, the house-numbering outline, the sewer system showing house branches, the water system with all connections, survey monuments with corrected measurements between them, street-grade elevations, curb distances, etc.—is drawn on them for use in the offices where such information is desirable.

Rectograph prints of the tracings, reduced to a smaller scale, are used in several of the offices where only such information as is shown on the original tracings is required.

This numbering scheme was worked out in the city engineer's drafting room some time ago by L. F. Schuele and the writer, but it was not made effective until the present city engineer, O. Laurgaard, ordered the necessary changes made on the drawings.

Engineers' Registration Act for Oregon Amended

The engineers' registration act for Oregon, discussed in *Engineering News-Record* of Mar. 27, 1919, p. 616, has been amended to include the insertion of a sentence which makes the Board of Engineering Examiners consist of two civil engineers, two mechanical engineers, one electrical engineer, two hydraulic engineers and two mining engineers

Reinforcement of Bridge by Means of an Eccentric Chord

Floor Span Over Railway Tracks Weakened by Corrosion — War Conditions Delay Renewal — Erection Conditions Necessitate Placing New Chord Above Floor—Panels Offset to Balance Eccentricity

A DIFFICULT problem was presented recently by the necessity of strengthening a steel bridge span in Chicago without infringing on the underclearance and without using falsework. It was solved by the ingenious expedient of adding a second bottom chord above the floor of the bridge, and, as this chord was far off center of the web connections, neutralizing the eccentricity moments at the connections by irregular alignment of the chord. At the same time the floor of the bridge was strengthened in effective manner by placing new hangers and by supplementing the steel stringers by wooden stringers.

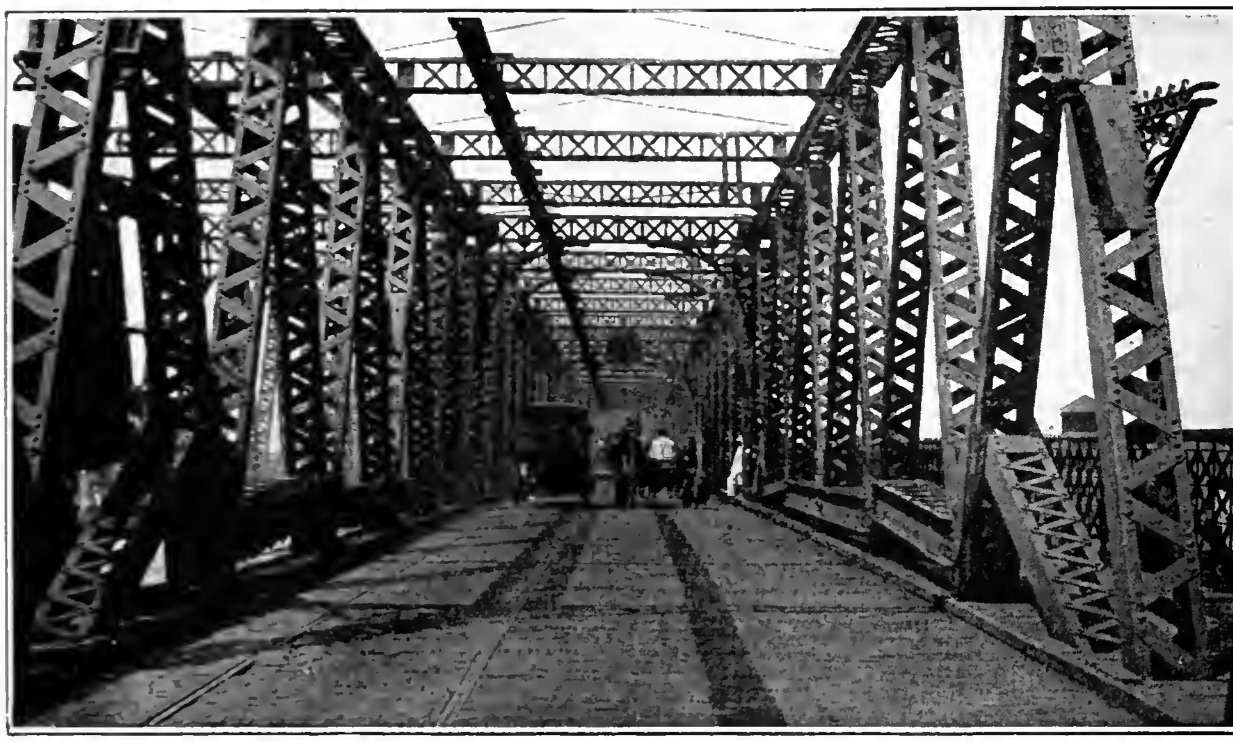


FIG. 1. SPAN OF TWELFTH STREET VIADUCT, CHICAGO, REINFORCED BY ADDING BOTTOM CHORDS ABOVE THE FLOOR

Twelfth St. crosses a group of important railway tracks by a viaduct 810 ft. long, composed chiefly of wrought-iron truss spans, built in 1886. In the course of time corrosion had destroyed large parts of the floor and bottom chord members exposed below the floor, and within the past four or five years replacement or repair had become an urgent matter. Designs for a larger and more substantial viaduct were prepared three years ago, and the expectation was that construction could be undertaken in 1917 or 1918. The state of the steel market, however, made it impossible to obtain material, and the work was postponed indefinitely.

On account of the great importance of the crossing with respect to street traffic, some method of reconstruction had to be devised to keep the structure in service, and the plan had to be such that the work could be done under traffic. Twelfth St. is the only thoroughfare across the tracks in a distance north and south of nearly a mile. It carries important vehicle traffic and a street-car line, so that closing the street during the repairs could not be considered. The railway traffic is equally important, and could not be interrupted.

The chief difficulty was presented by a through-truss span of 110 ft. 9 in., crossing a group of New York Central R.R. and Rock Island R.R. tracks, including the four main tracks of the New York Central R.R. The span has three trusses, the middle one separating eastbound and westbound roadways. The underclearance here is only 17 ft., so that no space was available for either staging or supports under the bridge. On account of the low clearance the blast action of the engine exhaust had been of particularly severe effect. The stringers and bottom chord for the entire length except the panel at either end were seriously weakened; the bottom chord, for example, had been reduced in section nearly one-half. Furthermore, some of the bars of the pin-connected lateral system had been cut in two. Corrosion had also been active, and the top flanges of the stringers were materially reduced in section. It was necessary to replace all these parts entire. The floor-beams, on the other hand, had not suffered greatly. In these circumstances the main problem was how to replace the bottom chord under the hampering space and traffic conditions. Replacement of the stringers offered less difficulty.

It was decided to leave the old bottom chord undisturbed and add a new chord just above the floor, 30 in. above the old one, carrying it down in the end panels to connect centrally at the end pins. As the web members intersect on the center line of the old chord they would be several feet apart at the level of the new chord, and thereby would develop very large rotational moments. To neutralize these moments the chord was offset in successive panels, as shown in the diagram elevation, Fig. 2.

Below the truss diagram in Fig. 2 is given the graphical stress polygon for full live load, from which it will be seen that the chord and web stresses are in equilibrium under this load condition. The inclination of the short chord sections between adjacent web members was worked out by analytical computation to produce this result, and the stress polygon is merely a check. The rotational tendency of the web stresses at each eccentric panel point is just balanced by the opposite rotational tendency of the tensile stresses in the bottom chord.

As detailed, the short sections of chord at the panel points are formed by large gusset plates, which make

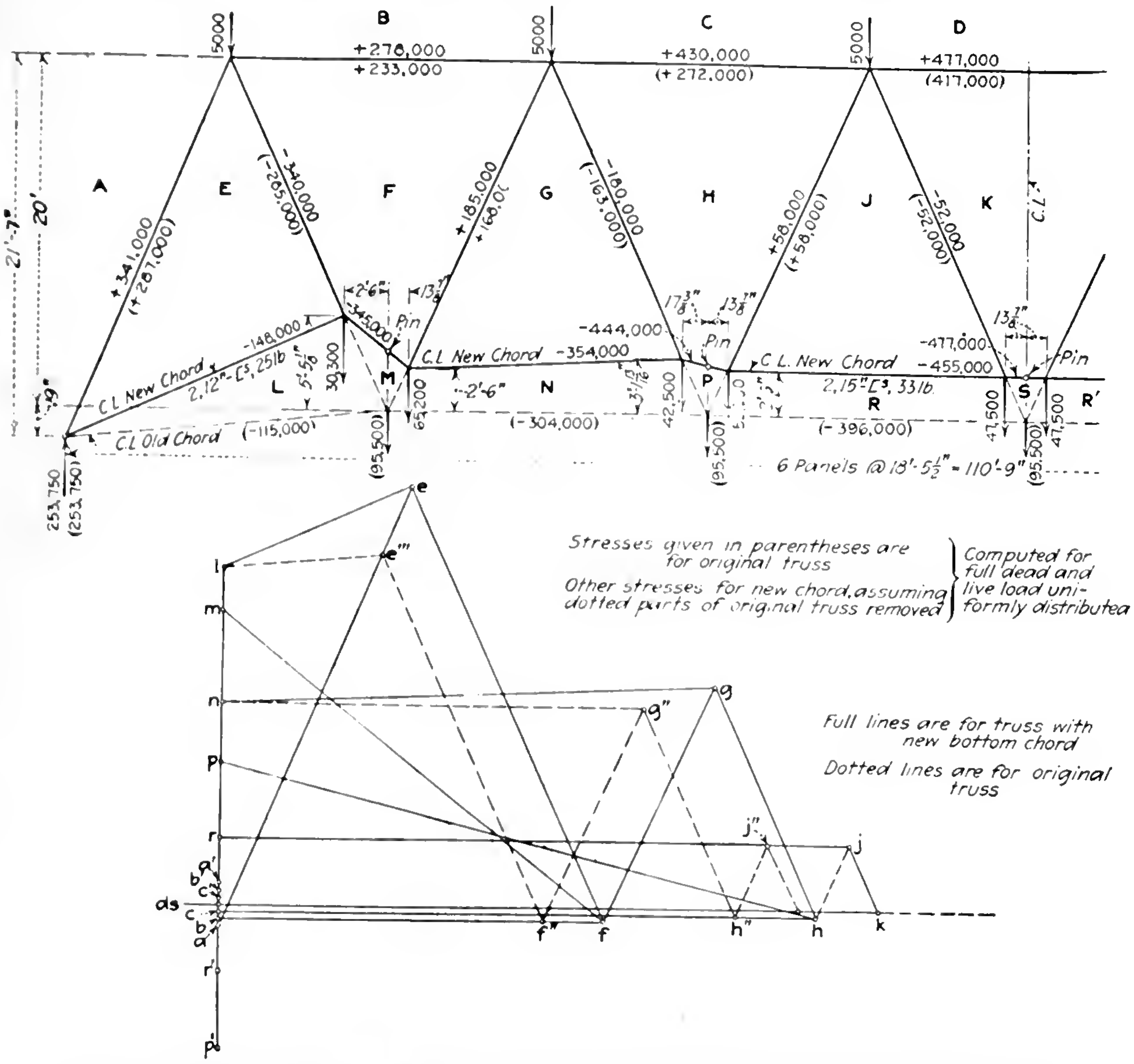


FIG. 2. TRUSS DIAGRAM AND FORCE POLYGON FOR REINFORCED TRUSS—CHORD ALIGNED SO AS TO NEUTRALIZE ECCENTRICITY MOMENT

the connection between the new chord and the old web members. The panel point, therefore, is a stiff assemblage, and the secondary stress moment occurring under partial live load are distributed equally to the members, without strain in the connection.

As the truss with the new chord (considering the old chord out of action) is shallower than before, the primary stresses in most of the truss members have been increased about 10% by the change; but as these members are in good condition the extra stress is not of serious consequence.

In strengthening the floor the main item was placing 9 x 18 timber stringers between adjacent steel stringers. The timbers were designed to carry the full floor load without assistance from the old stringers. A special stirrup support was designed for carrying them, consisting of two 3 x ½-in. steel bars passing over oak saddles on top of the floor-beam and engaging anchorage angles under the new and old stringers, all as shown by a detail in Fig. 4, which is shown on the following page.

At each truss panel point the gusset plates of the new chord carry a 4-in. pin on which are hung two U-rods (Fig. 4). The lower threaded ends of these rods carry bearing plates on which the old floor-beams are seated; stiffener angles riveted to the ends of the beams engage the rods in such a way as to prevent lateral movement.

In carrying out the work, the first step was to reinforce one of the outer trusses, street traffic being diverted to the other roadway to give working room. The reinforcement of the other outer truss was the second step. The middle truss then had to be reinforced while both roadways were in service. Throughout the whole operation the street-car service on both roadways was maintained.

With the trusses reinforced, it was an easy matter to place the floor-beam hangers, then the new timber stringers and their stirrup connections. This work was done first on one roadway, then on the other, vehicle traffic being diverted to a single roadway. The weakened or severed bottom laterals were not replaced, as the structure was believed to be stiff enough to require no lateral system.

Under the contract with the city, requiring that repairs to the viaduct be made by the railway whose tracks are crossed, the work was paid for by the New York Central Lines West and the Rock Island Lines, at a total cost of about $11,000. The planning and execution of the work, however, were in the hands of the New York Central R.R. B. R. Leffler, bridge engineer, New York Central R.R. West of Buffalo, worked out the scheme of reinforcement, and decided upon the use of a secondary chord. The idea of offsetting

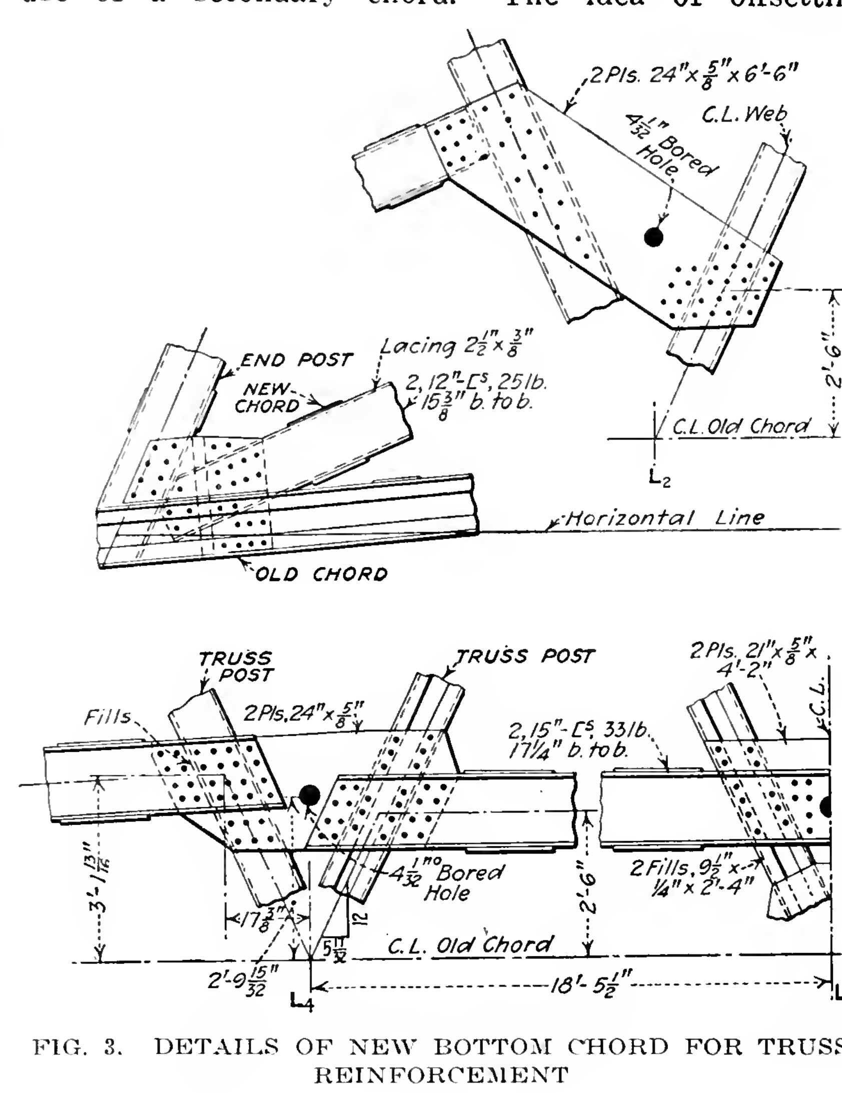


FIG. 3. DETAILS OF NEW BOTTOM CHORD FOR TRUSS REINFORCEMENT

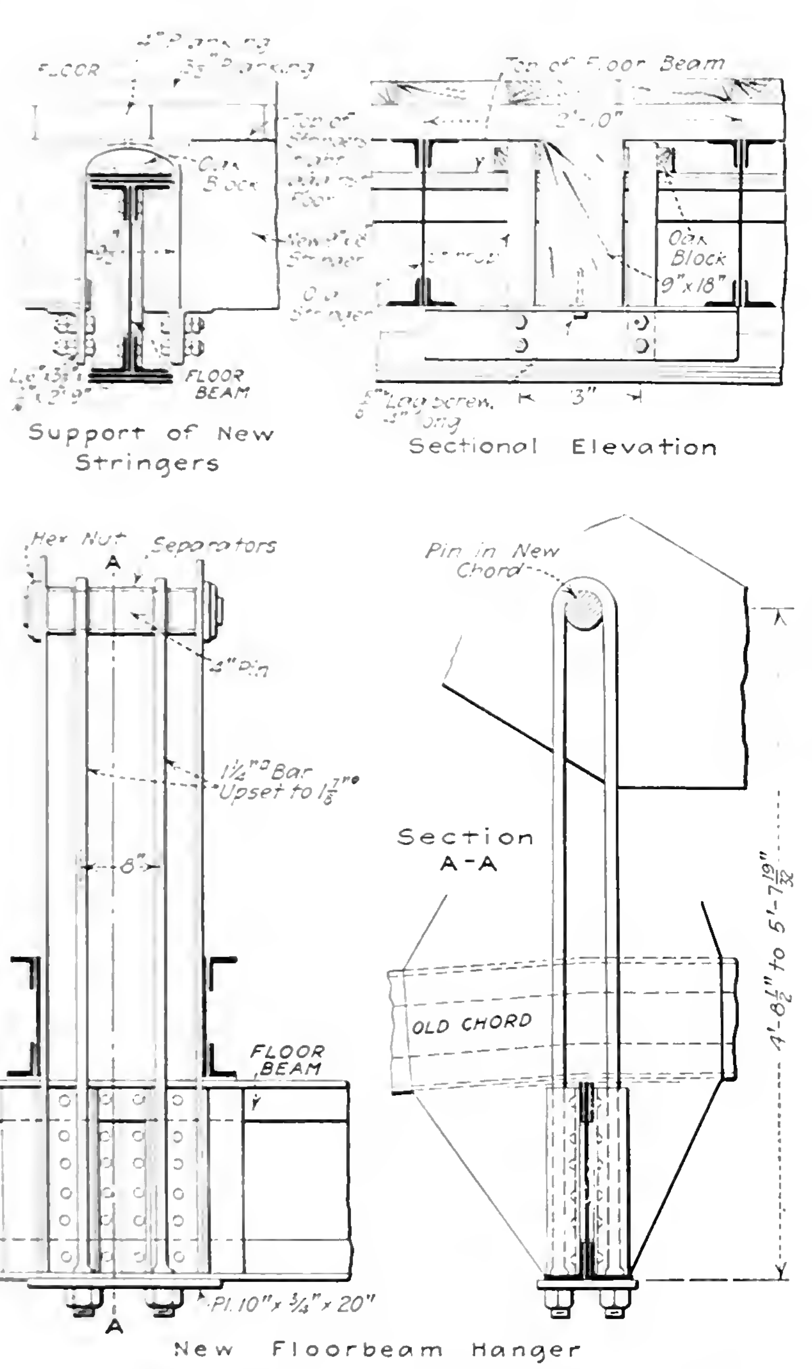


FIG. 4. FLOOR-BEAM HANGER AND STRINGER STIRRUP

the chord in such a way as to neutralize the rotational moments at the joints was developed by H. Grytness, chief draftsman in Mr. Leffler's office. The reinforcement work was carried out by the Strobel Steel Construction Company, of Chicago, on a force-account basis.

Patch Worn Paving with Concrete

Concrete patching for cuts and wornout places in brick, asphalt, concrete and other paving is being used extensively at Terre Haute, Ind. It was adopted on account of low cost, and is said to be entirely satisfactory.

The worn spot of the pavement is first cleaned out to the base of the original pavement, all dirt being removed, and then a thin layer of cement grout is sprinkled on and worked with a brush or broom till it covers the bottom and sides of the hole, which is then filled with concrete.

The most important part of the operation, according to John W. White, secretary of the board of public works, is to have proper concrete. This should be a 1:2:3 mix, using washed material with coarse aggregate ranging from ¼ to ¾ in. The surface is finished with a wood float ½ in. above grade to allow for shrinkage in setting, and traffic is kept off for several days. Large and small patches are made, there being no limit as to size.

Drainage System for Improved Country Highways

Tile Underdrainage Would Protect the Surface, Decrease the Cost of Roadside Maintenance, and Remove Dangerous Ditches

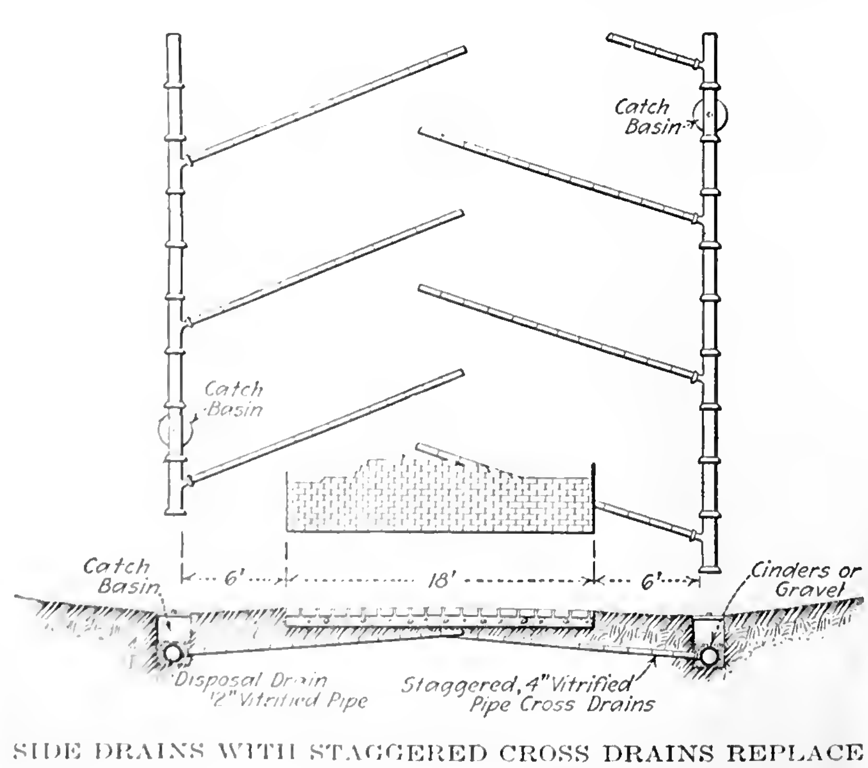
By Will P. Blair
Vice-President, National Paving Brick Manufacturers' Association, Cleveland, Ohio

ADEQUATE drainage systems consisting of tile underdrain should supplant the obsolete ditch for improved country highways. If this were done the road would not only be better drained, but, by the elimination of the unevenness of the right-of-way, keeping it in good condition would be easier, thus saving a large portion of the expense of roadside maintenance, which often costs more than maintenance of the wearing surface. Aside from protection of the wearing course by more effective drainage and greater economy in maintenance, the danger from deep side ditches would be removed—to the great advantage of traffic.

The need for proper drainage continually confronts the engineer when designing and planning a road improvement, but it is as constantly ignored. In fact, drainage neglect is so common a fault that the most illuminating examples fail to impress deeply. We have echoed and preached in meetings and at conferences its necessity. Reference to the subject so often made has put it into a trite class, so that its consideration has merely followed a rut, rather than receiving any really constructive treatment. It has not been made the subject of research or experiment, or of serious thought.

The most common road-drainage design is to provide open gutters or ditches at the roadside. City streets are seldom underdrained at all. The practice has scarcely been called in question. Water-disposal pipes are frequently placed underneath and lengthwise of the roadbed, resulting in injury to the road. The use of open side ditches may almost be regarded as a universal practice. For what reason? They do not drain.

Can the function intended be provided for by a different plan? I believe so. Not that it might be universally employed, but always wherever other means are less efficient. The plan is shown by the sketch diagram and cross-section. The side disposal drains are



SIDE DRAINS WITH STAGGERED CROSS DRAINS REPLACE DEEP SIDE DITCHES

placed below the frost line where water can flow continuously, unhindered by either ice or dirt accumulation. The side drains should also be placed at such depth that the lateral drains will receive sufficient fall, so that the subgrade can be freed promptly from excessive moisture, thus insuring against damage by heaving due to freezing. Where the road surface is impervious an entirely dry base can be maintained. The entire right-of-way can be graded, providing only for a gentle flow of the surface water into occasional catchbasins located at proper intervals. The sides can then be mowed and cleaned at the least possible expense.

Comparing this condition with the open ditches, the latter require constant attention to keep them from clogging up and retarding the flow of water. Instead of real drainage, we usually have a system of frog ponds—reservoirs which feed the moisture by capillary attraction into the roadbed—resulting in more or less but constant injury to and ofttimes destruction of the wearing surface.

While the fact that the cost of maintaining the berms and embankments imposed by the open ditches is often greater than the cost of maintaining the wearing surface has been perfectly apparent to experienced observers, actual data have but recently become available for its confirmation.

In Illinois, 59 miles of improved brick road surface cost $5.36 per mile to maintain. The shoulders of the same road cost $51.20 per mile. Maintaining the surface of other roads was found to cost $30.25 per mile, while their shoulders cost $51.20 per mile.

In Ohio, 302 miles of brick road surface cost $10,351.99 to maintain. The roadsides of the same mileage cost $27,183.53. Other road surfaces covering 381 miles cost $39,825.17 and the roadsides cost $52,522.78.

Underground Drains Easy to Maintain

It is known from experience that underground disposal drains are maintained in constant working order with scarcely any cost whatever for an indefinite number of years. The cost of installation in many instances is less than that of the open ditch. Cost of drainage is often made the reason against its installation, yet a single case, to which Fred R. Williams, paving engineer, of Cleveland, will bear testimony, demonstrates the unsoundness of the excuse.

The case in point came about in the construction of Woodhill Road in Cleveland. The specifications provided the drainage plan herein advocated. In spite of frequent rains, the installation of the drainage system enabled the contractor to proceed with his work of laying the pavement. Other street contracts held by the same contractor, but not calling for such drainage, were held up, awaiting a sun-dried condition. The lesson of economy was so plain that the contractor, without other compensation than that of being able to proceed with his work, installed this very system as a matter of construction economy.

Aside from the economy in construction, durability of the road and the great reduction in maintenance cost due to establishing a drainage system that will drain, we must be alert to the fact that open ditches on the roadside are often a menace to life. In case of fatal accidents there is but little difference in results whether your team or auto goes into the ditch, down the mountainside or over a precipice.

But a greater reason than all else in support of drainage which wiii drain is the increased durability which it adds to the life of the pavement, thereby lessening maintenance cost and increasing efficiency and satisfaction in use.

Kentucky Sump Holes Materially Reduce Flood Flows

By R. W. Spear
Chicago

Underground conditions in Kentucky on the site of the water-supply for Camp Henry Knox, a field-artillery firing center located at Stithton, are such that the flood flows are as much as 40% less than the calculated maximum. This is due to sump hole areas, common in Kentucky, which are connected with caverns in the soluble limestone and afford temporary storage.

Otter Creek empties into the Ohio River about 30 miles downstream from Louisville. The drainage area above a proposed dam is 150 square miles. From 25 to 50% of this area is composed of sump holes, which are so deep that even in prolonged rainy seasons they have no surface outlet. The location of the outlets is generally unknown; but the writer learned during the course of his study that a particular sump hole was the source of Big Springs, outside the Otter Creek drainage basin about five miles from the sump hole. This fact was established in a crude but efficient way by farmers who poured corn cobs in the sump hole and later observed them coming out at the Big Springs.

It is probable that some water is carried into and some outside of the drainage basin, through these channels. By comparing the Otter Creek watershed with others having similar shapes and sizes and having approximately the same character of rainstorms both in intensity and duration, it was found that the probable maximum run-off at the dam would be 19,000 cu.ft. per second. By calculations made from high-water marks, a maximum flood of 11,000 cu.ft. per second was obtained.

Reason for Discrepancy

In the writer's opinion, the entire discrepancy in the above figures cannot be attributed to the mere possibility that more water is carried out of than into the watershed by the outlet of the various sump holes. The major portion of this discrepancy must be attributed to the fact that a very considerable portion of the total rainfall finally reaches the channels of Otter Creek and its feeders through the sump-hole channels—a route that is much slower than the surface drainage routes. The distance from sump hole to creek is often as much as five miles, and the water in passing through the underground channel has such a sluggish flow that the sump holes empty themselves only at a considerable period of time after the cessation of a storm. In many instances this underground flow is so slow that the sump holes become ponds.

Geologically, a sump hole is a tumbled-in cavern formed originally in a porous stratum near the surface. These sump holes and caves hold back that portion of the storm water which would contribute to the peak load stream flow, until after the surface drainage has reached the streams and passed on.

Reorganization of the Engineering Standards Committee

Effect of Engineering Standards Movement on Technical Societies—Reorganization to Give Broader Representation—Association May Be Formed to Elect the Committee—Formulating Safety Codes

BY EDWARD B. ROSA
Chief Physicist, Bureau of Standards, Washington, D. C.

(Concluded from "Engineering News-Record" of May 1, 1919, page 862)

Opening to discussion the vitally important subject of centralized standardization, the first part of Dr. Rosa's article asserted that existing technical societies will not be harmed, that the movement is founded on principles of fair play, and that a coördinating agency is needed in standardization. After telling why reorganization on a democratic basis became necessary, he undertook to sketch one idea of the possible ultimate form of organization. Continuing this subject, Dr. Rosa proceeds to point out why the Bureau of Standards and other Government agencies are concerned in the movement.—EDITOR.

DIVISION 6 would consist of the American Society for Testing Materials and a considerable number of national associations concerned with materials. The American Society for Testing Materials would be the leading society in the division, and would carry on its work substantially as now. It would be in close association with the other societies of its division, with lines of connection with other divisions through members of its coöperating committees. This division would contain representatives of many other societies besides the American Society for Testing Materials, but probably most of them would also be members of the American Society for Testing Materials. Division 6 would, in fact, be an American Society for Testing Materials family, as Division 1 would be an electrical family in which the American Institute of Electrical Engineers would naturally take the lead. Similarly, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Mines and Metallurgy, the American Chemical Society, the Society of Automotive Engineers, the American Railroad Association and other large societies and associations would presumably take a leading position in their respective divisions. The influence of these leading societies and the recognition accorded them would be enhanced by this relation.

SCOPE OF ACTIVITIES

Most of the business of the Standards Committee would probably be done by an executive committee and the paid general secretary and assistant secretaries acting under it. The various sections of the Standards Committee would be advisers to the executive committee on matters pertaining to their respective subjects. The Standards Committee would report annually to the American Engineering Standards Association, which, as a great self-determining national body, would authorize changes of procedure, provide for the selection of the Standards Committee and approve its budget and plans. Such an organization would be businesslike and effective, and as simple as that of any large national organization. The office staff should include some competent editors and draftsmen to assist in putting standards into good form for publication, in as uniform style as possible.

It would be desirable for the association to publish all standards prepared under its supervision in a uniform edition, fully indexed, and thereby make them readily available at small expense to the general public. In connection with such publication, they would be carefully studied to see whether there were conflicts or inconsistencies among them, and useful references would be made from one code or standard to another. Such publication in uniform style, with explanatory footnotes and cross-references, would be of enormous value. It would be the greatest step ever taken toward general acceptance and national uniformity in engineering and industrial standards. This would, of course, not interfere with the publication by each society of its own work in its "Proceedings."

BUDGET OF THE COMMITTEE

The American Engineering Standards Association should have an annual income of not less than $50,000, in addition to the cost of publishing standards, which work would be self-supporting. This income would be derived from a large number of memberships in the association. These memberships would not be personal, but every member would represent some engineering or industrial organization or Government department. If one member were appointed for every 500 members of an engineering society, and a membership fee of $50 were paid, this would amount to 10c. per year per member of such society, and would not be a heavy tax for so important a matter. It would yield $1000 (with 20 members appointed to the association) from a society of 10,000 members, and would give $50,000 per year when the association had 1000 members. As yet, however, no provision has been made for a large membership, and this proposal is only a suggestion for future consideration.

WHY THE BUREAU OF STANDARDS IS INTERESTED

The Bureau of Standards has been greatly interested in the plans of the Engineering Standards Committee from the start, and hoped to see them realized at an early date. The reasons for this were, first, that the committee would be able to render a service of tremendous importance in promoting engineering and industrial standardization, and, second, that it would aid the bureau in getting into closer contact with engineering and industrial organizations and secure a better understanding of the bureau's work. It is impossible for the bureau to explain its work and its plans in detail to every agency that is interested. Although bureau representatives do a large amount of traveling and participate in a large number of conferences and committee meetings, and although the bureau has a large number

of coöperating committees assisting in its work, it is beyond its power to consult everyone who thinks he ought to be consulted in advance of taking up work, or to communicate results from time to time to everyone interested.

We have earnestly wished for years that there was some agency or mechanism that would provide a better connection than has existed between the bureau's research and standardization work and that of the engineering societies and industrial organizations. It appeared that the Engineering Standards Committee, especially if reorganized as proposed so as to be democractic and thoroughly representative and supported by a strong public sentiment, afforded an ideal method of coöperation between the agencies of Federal, state and municipal Government and the technical and commercial organizations concerned with engineering and industrial standards.

Neither the Bureau of Standards nor any other Government department was concerned in the organization of the Engineering Standards Committee, except that the bureau was consulted occasionally, and promised its support when the proper time should come. The bureau has recently been drawn into the discussion in connection with the proposed reorganization of the committee, and believes that the present plans are wisely drawn and deserve general support. The bureau offers its full coöperation in establishing and carrying on the work of the association, and invites the coöperation of the Engineering Standards Committee in return.

Why the Government Is Interested

There has not yet been opportunity for discussion by all departments of the Government of the new plans of the Engineering Standards Committee. It is easy to see, however, why the Federal Government should participate in the formation of an American Engineering Standards Association, within which there is to be an able and representative Standards Committee on which the Government departments will be represented and which will aid in securing the coöperation that is essential in the preparation of standards and specifications. The departments will, of course, be free to act independently of the committee when they see fit, just as any society may do, as there will be no compulsion exercised. But the advantages of coöperation are so great that the committee will without doubt be utilized to the full, and important and far-reaching results in the direction of better and more uniform specifications, leading to economy and simplification in buying, may be expected.

The war has taught many lessons, not the least being the feasibility and advantage of producers coöperating with and helping the Government. Another lesson is that standardization and simplification of sizes and styles are practicable, and go far in the direction of reducing costs and investment in stock. When one thinks of the immense opportunity for improvement in these respects in all the purchases by Federal, state and municipal Governments, and the equally great influence such standardization will have on business generally, it is hard to refrain from extravagant language as to the duty of the hour and the obligation resting upon those in authority to act promptly in this matter.

Some months ago the Bureau of Standards outlined a plan for the preparation of a series of national industrial safety codes. They were intended to meet the needs of a very large number of industries, and to be suitable for adoption by the state accident and industrial commissions. It was planned to secure in the preparation of these codes the active coöperation of engineering and industrial associations, manufacturers, engineers of state and municipal agencies, inspectors, etc. A large and representative committee would be formed to advise the bureau as to the general plans, and many small working committees to assist in the preparation of the various codes, of which there would be fifty or more.

A conference of representatives of all the interests concerned, to discuss the question and to advise with respect to plans for the work, assembled in Washington on Jan. 15. The bureau did not feel warranted in assuming the leadership in so large an undertaking without the strong support and promise of coöperation of the various interests concerned; and it wished to have approval in advance of its plans for securing this coöperation, if the work were to be undertaken. The bureau had frequently been requested to take it up. There was no doubt that the work ought to be done. Industrial accidents to the number of 750,000 each year (not counting the railroads and other industries outside the range of the proposed codes), including perhaps 20,000 fatalities, and millions of dollars paid annually in compensations for accidents, constituted a powerful argument for action.

The questions put to the conference were, "Should the Bureau of Standards take the lead?" and, "Should the work be done under the auspices of the recently created Engineering Standards Committee?" (which, however, was not yet functioning). This brought up the question of whether this committee was sufficiently representative to serve in such capacity, and after a discussion within the committee and between it and a limited number of representatives of other interests, which discussion has continued for three months, the committee has prepared for recommendation to the five founder societies a revision of its constitution which provides for a broadening of its membership and functions and a change of name to the American Engineering Standards Association.

A Referendum on the Question

The Washington conference of Jan. 15 appointed a committee of three (of which the chairman of the Engineering Standards Committee was one) to prepare a report of the conference to be sent to all the engineering, industrial and Governmental bodies represented and to ask for a written reply to the above questions, on which no vote was taken at the conference. This report was held up at the request of the chairman of the Engineering Standards Committee, pending the result of its discussion on the question of reorganization. It has recently been sent out, with a brief statement of the proposed plan of reorganization and a recommendation by the bureau that the work of creating industrial safety codes be carried on under the auspices of the reorganized committee.

No Conflict of Interest

The chairman of the American Engineering Standards Committee, Prof. Comfort A. Adams, now president of the American Institute of Electrical Engineers, with whom I have worked in full accord on the committee

of three, sailed a few days ago for Europe. The third member of the committee, H. W. Forster, representing at the Washington conference the National Fire Protection Association and the National Safety Council, is now in the West. It therefore seems to devolve upon me to give a brief account of the events that led to the proposed reorganization of the American Engineering Standards Committee, in order that the referendum vote of the Bureau of Standards may not be prejudiced by published articles based upon what I believe is a serious misapprehension of the situation.

The matter is of great and far-reaching importance, and there is no need for haste in coming to a conclusion. Full and sympathetic consideration should be given to the question. If anyone doubts the wisdom of the proposed plan, he should attempt to formulate a better one for accomplishing the end in view. Fortunately, there is no conflict of interest to confuse the issue. Everyone desires to see engineering and industrial standardization promoted. Everyone desires to see a large degree of coöperation in such work among the various societies and between such societies and Governmental agencies. Everyone wishes to see fair play, with the recognition of the rights of all, and to discourage the spirit of autocracy either in engineering societies or in Government departments. Since we are in full accord as to all the ends in view, it is only a question of method; and when the circumstances are understood alike by all, it is believed that full agreement will readily be reached.

The American colonies found grave difficulties when they combined as a nation because they had to surrender some of their independence. Engineering societies cannot coöperate systematically without recognizing each other's rights and therefore surrendering some of their own independence. But they cannot exercise their functions independently, in the absence of such coöperation, without frequent conflicts and duplication of effort. We must choose between conflict and coöperation. The members of the American Engineering Standards Committee have recognized the logic of the situation, and have proposed a wise and generous action.

They have outlined a plan, for presentation to the founder societies, whereby the present organization can proceed with business at once but take in new organizations as they apply and qualify (when the constitution is amended), and, when the membership has increased sufficiently to justify it, divide up into divisions and create a smaller Standards Committee with a central executive committee. It will thus gradually become the great national body it should be.

Neurasthenia a Growing Disease in Engineering Work

May Be Caused by Accident, Overwork, Grinding Routine or Outside Worries—Expert Care Imperative

By Chesla C. Sherlock

Des Moines, Iowa; formerly Secretary of the Iowa Industrial Commission, Workmen's Compensation Service

NEURASTHENIA is a disease which is becoming more and more common in the civil engineering field. It is already grounded in contracting work and seems to be gaining a foothold in the structural iron and steel trades. This fact is causing large employers, as well as those engaged in administering the workmen's compensation acts, to demand more of a knowledge of this unusual disorder.

Neurasthenia means "nerve weakness." In medical terms, it is "a condition of nervous debility supposed to be dependent upon impairment in the functions of the spinal cord."

Some think malingering is due to a neurasthenic condition and others consider malingering and neurasthenia as the same thing. Malingering is not necessarily dependent upon the state of the nerves. In fact, the malingerer is generally a fraud. He knows that he is able to do an honest day's work, but he prefers to loaf while making others believe that he is incapacitated. While we have a plain case of deception and fraud in malingering, the sufferer from neurasthenia is so impaired in his nerve forces that he honestly believes that he is incapacitated and unable to resume his employment.

Viewed from the exterior, the two conditions may at times appear to be identical. Without the aid of medical science we probably would have no means of discriminating between the two. A clever malingerer is worse than a neurasthenic; he may prolong his fancied condition for an indefinite period, while the neurasthenic may become himself at any time and return to work.

Neurasthenia may be caused, in an industrial sense, by a number of conditions. I venture the suggestion that "shell shock," as it is known in the trenches, is closely allied to certain conditions arising in industrial employment which might be characterized as "industrial shock." The latter we have called neurasthenia in the past. It may be caused by overwork, too much of a "grind" which exhausts the nerve forces of the worker, rendering him nervous, sensitive, high-strung and an easy prey to mental ills. However, it is accidents and injuries that more often lead the individual of weak nerve force to neurasthenia. Then, again, it may develop from sources entirely outside the employment, such as domestic worries or financial distress. One authority states that it is the result of "misplaced imagination."

Employers should treat the neurasthenic with consideration and not be too ready to class him as a malingerer. Oftentimes the charge that "there is nothing wrong with you" has caused the neurasthenic to suffer greater mental and physical distress than was warranted.

It seems that the neurasthenic condition can arise from all manner of injuries which a workman may commonly receive in normal industrial employment. One man slipped under a heavy load; another lost a hand, still another wrenched his back, and another received a blow on the head which caused him to have ringing sensations in his head for several months. Only experts should be allowed to handle such cases. As neurasthenia is a nerve disorder, it may extend over a period of several years and absolutely incapacitate a man from carrying on his trade. During that time he is subjected to a diseased mind and disordered nerves, rather than to physical disability. He is, none the less, incapable of work.

Neurasthenia is as interesting, as dangerous and as powerful as "shell shock"—and as pitiable. Both cause losses that are unavoidable and both can be corrected if taken in time.

Reinforced-Concrete Culverts Under Irrigation Canal

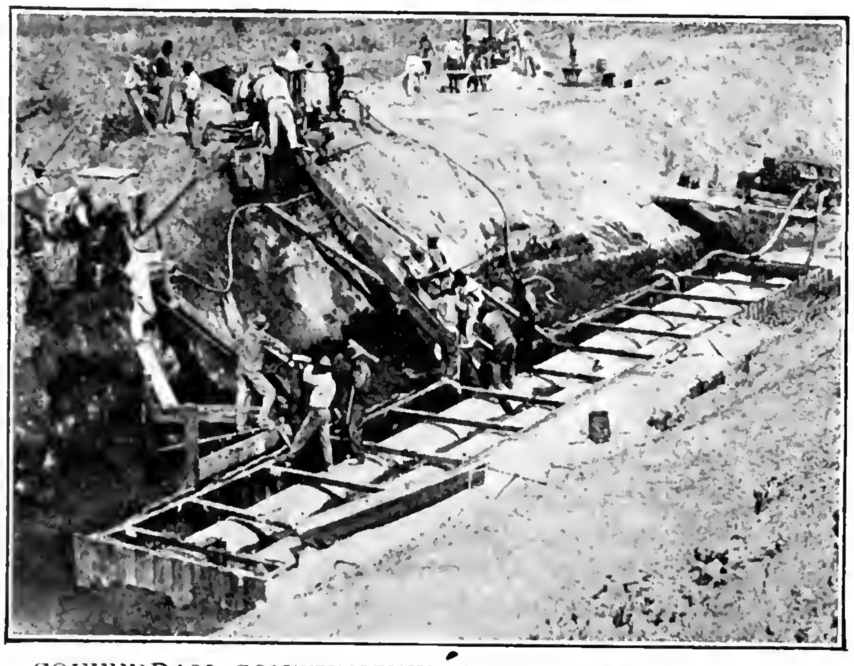
After Many Experiments Engineers on Rio Grande Project Adopt Cradle Construction for Drains in Quicksand

By D. C. Willett
El Paso, Tex.

After much experimentation and many failures in the construction of drains under irrigation canals, there has been developed a type of reinforced-concrete culvert, for use in sandy soil, which is proving satisfactory.

This design has been developed by the engineers of the Rio Grande project in New Mexico and Texas, a special timber cradle being used in connection with the construction of the pipe. A standard drawing has been adopted, as reproduced here, the variable dimensions being lettered and tabulated on each sheet for use in the field.

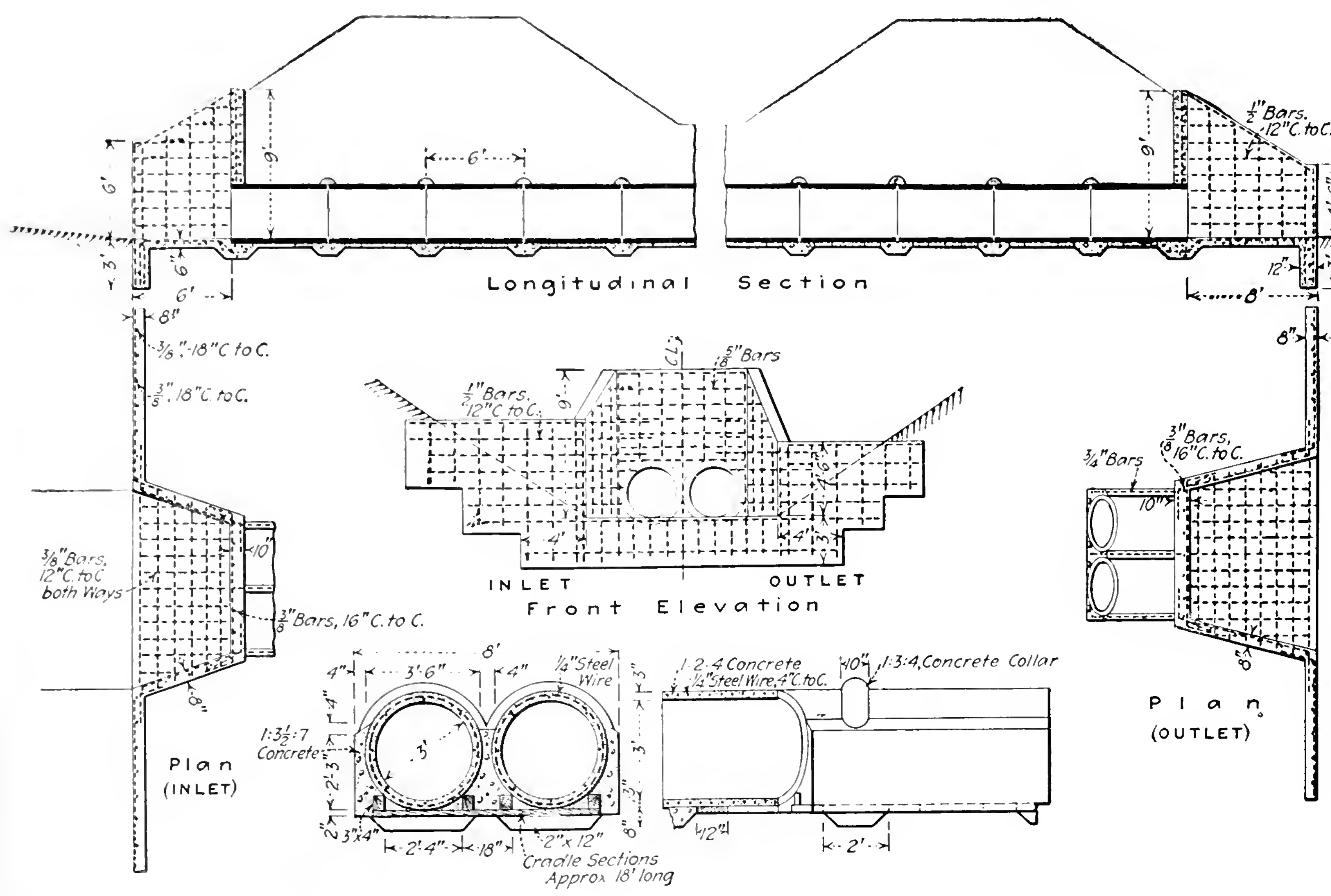
After the timber cradle is laid, to hold the pipe in place, the precast reinforced-concrete pipe are laid by the use of a dragline. A cofferdam is then built, as illustrated in the photograph, with space on one side for the passage of the water from the drain. A small centrifugal pump is set up in a convenient position to pump out the cofferdam and keep it clear of water while the 1 : 3½ : 7 concrete is poured around the pipe. Hand-molded concrete collars, 6 ft. apart, as shown, are added for stiffening the pipe and to prevent leakage of water from the canal above. The concrete used in these collars is a 1 : 3 : 4 mix.



COFFERDAM CONSTRUCTED TO ALLOW PLACEMENT OF SUPPORTING CONCRETE

It will be noted from the dimensions of the inlet and the outlet that the latter is designed 18 in. lower than the former, but the thickness of the walls and the spacing of the reinforcing steel are the same at each end.

The picture shows the Franklin drain at Franklin canal crossing, which was 72 ft. long, with an inlet 6 ft. wide and an outlet 8 ft. wide, the wing walls being 12 ft. long. The total cost was approximately $2800, complete.



DETAILS OF REINFORCED-CONCRETE CULVERTS DESIGNED FOR QUICKSAND FOUNDATION ON RIO GRANDE PROJECT, NEW MEXICO AND TEXAS

Computation of the Time Required To Fill a Graving Dock

Based on the Method of Filling From an Upper Orifice as Well as From Usual Gate Openings at Bottom of Dock

By Eugene E. Halmos
Designing Engineer, Barclay, Parsons & Klapp, 60 Wall St., New York City

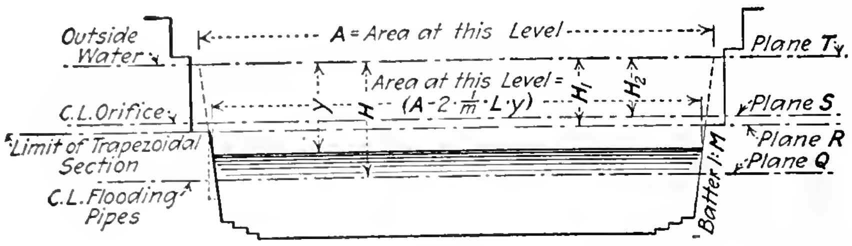
For the purpose of filling a graving dock it is customary to provide a series of flooding pipes located near the bottom of and passing through the caisson gate which closes the entrance of the dock. The pipes are equipped with gate valves which are operated from the deck of the caisson. The number and size of these pipes, however, are limited by stability and structural considerations, and if they are the only means for flooding the dock, the filling of the uppermost few feet, as a rule, takes a very considerable time, due to the constantly decreasing head and the increasing area of the dock.

As time is a very valuable element in the operation of dry docks, it is good practice to install an additional opening in the side wall of the dock, located as high as tidal conditions permit and connected with the outside water by means of a culvert. The top of the orifice should be at least two feet below low tide. The filling of the dock is then performed in the following manner: After the keel blocks are properly placed in the empty dock, first only two or three valves are opened in the gate so as to avoid damage to or displacement of the keel blocks due to the inrush of water. When the water reaches a depth of about 3 ft. on the floor, all pipes are opened in the gate. When the water is up about 5 or 6 ft. above the floor a sufficient cushion is created to dissipate the energy of the water falling from the side orifice, and this is opened and kept open, together with all the pipes, until the dock is filled.

Dock Emptied in Three Stages

Until the water inside the dock has reached the elevation of the pipes, the computation of the time lapsing in filling the dock is a very simple matter, both the pipes and the orifice in the sidewall discharging water under constant head. The discharge per second can be readily determined if the proper coefficients are applied. The volume of the dock at any elevation being known, the quotient of the volume and the rate of discharge will give the number of seconds required to fill the dock to the elevation of the flooding pipes or to any intermediate depth. From this elevation on, however, the determination of the time for filling the dock to any greater depth becomes difficult, because the pipes will discharge under a varying head while the orifice still discharges under a constant head. Moreover, the sides of the dock being, as a rule, carried up on a batter, the horizontal sectional area of the dock is also changing from elevation to elevation. The writer has not found, in textbooks on hydraulics, formulas applicable to these conditions, and therefore believes that his method of computation, hereinafter shown, will be of interest, as this problem is met in practically every case of dry-dock design.

In plan, a graving dock is a long rectangle, finished by a tapering or rounded head. By transformation of areas the equivalent length of a dock of the same volume, possessing the normal cross-section throughout, can be easily found with sufficient accuracy. The accompanying figure shows a cross-section typical of masonry graving docks. It can be seen that the determination of the time necessary to fill the dock, from the elevation of the pipes (Plane Q) to the level of the outside water, will have to be done in three steps. Between planes Q and R the pipes discharge under variable head, the discharge of the orifice is constant, and



CROSS-SECTION OF GRAVING DOCK SHOWING DIMENSIONS USED IN FILLING COMPUTATIONS

the horizontal area of the dock is changing. Between planes R and S the conditions of discharge are the same as before, but the horizontal area of the dock is constant. Between planes S and T both the pipes and the orifice are subjected to the same variable head and the horizontal area of the dock remains constant.

Step No. 1. Filling time between planes Q and R. Let

L = The transformed length of the dock with uniform cross-section.

A = The horizontal area of the dock at the level of the outside water, obtained by producing the batter (1 on m) of the sides of this elevation.

Σa = The cross-sectional area of all flooding pipes.

K = The discharge coefficient of the pipes.

b = The area of the orifice in the sidewall.

K_1 = The discharge coefficient of the orifice.

H = The initial head on the pipes.

H_1 = The head on the pipes when the water in the dock is at plane R.

H_2 = The initial head on the orifice and the head on the pipes when the water in the dock is at plane S.

C = The constant discharge of the orifice under head H_2, being $= K_1 b\sqrt{2gH_2}$ volume units per second.

y = The distance of the inside water level from the outside water plane at any instant.

t = The time required to fill the dock between any value of y to any other value (between H and H_1).

The horizontal area of the dock at any depth y below the headwater is expressed by

$$A_y = A - 2Ly/m \tag{1}$$

The discharge of the pipes and the orifice during an infinitely small time element will produce an infinitely small increment in the height of the water inside the dock, the volume of discharge and the volume of the increment being equal.

Thus:

$$(K\Sigma a\sqrt{2g}\,y^{1/2} + C)dt = (A - 2Ly/m)dy \tag{2}$$

$$dt = \frac{Ady}{K\Sigma a\sqrt{2g}\,y^{1/2} + C} - \frac{2Lydy/m}{K\Sigma a\sqrt{2g}\,y^{1/2} + C} \tag{3}$$

Making the following abbreviations:

$$\left.\begin{aligned} \frac{A}{K\Sigma a\sqrt{2g}} &= B \\ \frac{2/m}{K\Sigma a\sqrt{2g}} &= D \\ \frac{C}{K\Sigma a\sqrt{2g}} &= C_1 \end{aligned}\right\} \qquad (4)$$

Equation (3) may be written:

$$dt = B\frac{dy}{y^{\frac{1}{2}} + C_1} - D\frac{ydy}{y^{\frac{1}{2}} + C_1} \qquad (5)$$

The integration of equation (5) between the limits H and H_1 will give the time required to fill the dock between planes Q and R.

$$t^{H}_{H_1} = B\int_{H_1}^{H}\frac{dy}{y^{\frac{1}{2}} + C_1} - D\int_{H_1}^{H}\frac{ydy}{y^{\frac{1}{2}} + C_1} = I - J \qquad (6)$$

Put $y^{\frac{1}{2}} + C_1 = z$, then

$$y^{\frac{1}{2}} = z - C_1$$

$$y = z^2 - 2C_1 z + C_1^2$$

$$dy = (2z - 2C_1)dz$$

$$\frac{dy}{y^{\frac{1}{2}} + C_1} = \frac{2z - 2C_1}{z}dz = \left(2 - \frac{2C_1}{z}\right)dz$$

$$\int\frac{dy}{y^{\frac{1}{2}} + C_1} = 2\int dz - 2C_1\int\frac{1}{z}dz = 2z - 2C_1 \log z + const$$

$$= 2[y^{\frac{1}{2}} + C_1 - C_1 \log (y^{\frac{1}{2}} + C_1)] + const$$

The first member on the right-hand side of Equation (6) will then become

$$I = B\int_{H_1}^{H}\frac{dy}{y^{\frac{1}{2}} + C_1} = 2B[H^{\frac{1}{2}} - H_1^{\frac{1}{2}} - C_1\{\log (H^{\frac{1}{2}} + C_1) - \log (H_1^{\frac{1}{2}} + C_1)\}] \qquad (7)$$

And

$$\frac{y\,dy}{y^{\frac{1}{2}} + C_1} = \frac{(z^2 - 2C_1 z + C_1^2)(2z - 2C_1)}{z}dz$$

$$= \left(2z^2 - 6C_1 z + 6C_1^2 - \frac{2C_1^3}{z}\right)dz$$

$$\int\frac{y\,dy}{y^{\frac{1}{2}} + C_1} = 2\int z^2dz - 6C_1\int z\,dz + 6C_1^2\int dz - 2C_1^3\int\frac{1}{z}dz = \frac{2}{3}z^3 - 3C_1z^2 + 6C_1^2z - 2C_1^3 \log z + const$$

$$= \frac{2}{3}y^{\frac{3}{2}} - C_1y + 2C_1^2y^{\frac{1}{2}} + \frac{11}{3}C_1^3 - 2C_1^3 \log (y^{\frac{1}{2}} + C_1) + const$$

The second member on the right-hand side of Equation (6) will become

$$J = D\int_{H_1}^{H}\frac{y\,dy}{y^{\frac{1}{2}} + C_1} = D[\tfrac{2}{3}(H^{\frac{3}{2}} - H_1^{\frac{3}{2}}) - C_1(H - H_1) + 2C_1^2(H^{\frac{1}{2}} - H_1^{\frac{1}{2}}) - 2C_1^3\{\log(H^{\frac{1}{2}} + C_1) - \log(H_1^{\frac{1}{2}} + C_1)\}] \qquad (8)$$

The value of (8) subtracted from (7) will furnish the solution, i. e.,

$$t^{H}_{H_1} = I - J \qquad (9)$$

Step No. 2—Between planes R and S the horizontal section of the dock is constant. The second term of the right side of Equation (6) therefore vanishes and formula (7) will represent the time of filling if in $B = \frac{A}{K\Sigma a\sqrt{2g}}$, A is taken as the horizontal area of the dock above the level of plane R, and if H_1 and H_2 are put for H and H_1, respectively.

Step No. 3—Between planes S and T both the pipes and the orifice are subjected to the same variable head ranging from H_2 to zero.

Let

A = the constant horizontal area of the dock,

f = the sum of cross-sectional areas of the pipes and the orifice $= \Sigma a + b$

K' = the combined discharge coefficient of the pipes and orifice =

$$\frac{K\Sigma a + K_1 b}{\Sigma a + b}$$

then the formula

$$t^{H_2}_{o} = \frac{2A}{K'b\sqrt{2g}}H_2^{\frac{1}{2}}$$

well known from the textbooks, will apply.

It will be noted that in the above discussion the distance from the outside water plane to the center of the pipes and the orifice was used as the pressure head. With the dimensions actually given to these openings, this assumption is entirely justified and introduces a negligible error only. Attention is called also to the fact that the pipe openings become "large orifices" when the head is reduced below perhaps four times the diameter of the pipes, resulting in a corresponding change of the discharge coefficient. It may become necessary, to account for this change, that the steps above shown be subdivided, which, however, can be done without difficulty.

Conservation in the Drafting Room by Simple Methods

Women Without Technical Training Are Readily Adapted to Railroad Work—Economies Effected in Lettering and Blueprinting

By James G. Wishart

Office Engineer, Chicago, Rock Island & Pacific Railway, Chicago

While the world war has affected all lines of business more or less, probably no line or profession in civil life has been crippled to a greater extent than railroad engineering, from whose ranks have been drawn the engineering forces required for operating the many miles of American-run lines in France. The selective service acts affected the forces employed in drafting rooms to a considerable extent, taking large numbers of draftsmen. Therefore, the drafting room of the average railroad engineering department afforded a first-class field for the practice of conservation. To offset the loss of men, steps were taken to increase the efficiency of those left on the work, employ and train inexperienced help not subject to war service, and conserve time and labor by the adoption of labor-saving methods and devices.

In some of the railroad drafting rooms the employment of women for drafting work was inaugurated. As a rule, women engaged in the past in drafting work were employed as artists or in the architectural line, and consequently very few had the technical training required to make competent railroad draftsmen. For this reason women employed in this capacity can be used primarily only as tracers or for copy or coloring work, the original detailing being left to the experienced men in the force. With a competent man in charge of a squad of these women, coaching and instructing them, they can soon be trained to handle practically any class of work which the average draftsman in a railroad drafting room is called on to do.

Specializing the members of the force on different

classes of work also gives good results. For example, estimating, yard design, frog and switch plans, mileage reports, rail and ballast records, recording of completion reports, can each be assigned to certain men. This specialization, however, should not be carried to the extent that but one man in the force is familiar with any class of the work; an understudy should be in training at all times for each one, for the purpose of filling vacancies as they occur. Architectural, bridge and signal work are distinctive classes of work and should be handled by men specially trained in these branches of engineering.

Titles, certificates, specifications, prominent lettering, etc., can be applied to tracings in a very short time and at small cost by the use of a small hand printing press. By the use of a special printing ink which is manufactured for use on tracing cloth, work done by this process can be made permanent and sufficiently opaque for blueprinting. A press of this kind has been in the chief engineer's drafting room of the Rock Island for the past 17 years, and in that time has amply demonstrated its usefulness as a labor-saving device. The one referred to is an ordinary hand press capable of printing sheets up to 8 x 12 in. Standard lead type is used, the assortment of styles of letters having been selected to meet the requirements of the work handled.

The work of setting the type and printing on the drawings is performed by the file clerk, who gets a much lower salary than those paid to the draftsmen. It is, of course, desirable where possible to obtain for this work a young man who has had some experience in a printer's shop. Anyone familiar with the time consumed by a draftsman in lettering a single title by hand where something more elaborate than plain lettering is desired can readily realize the saving in time and money made by the use of the printing press, when he learns that little more than half an hour is required by a boy with a little experience to set up and print the most elaborate title on one sheet, and that it requires only a minute or two to reproduce it on other sheets as often as is desired. In addition to the economy effected, uniform work, neat in appearance, is obtained on all drawings. Electrotypes for commonly used phrases, such as the company name, scale, department name and map headings, effect further savings in the time required for setting the type. Standard blank forms can also be printed from electrotypes at low cost in any spare time which the printer may have.

Making of Blueprints

Blueprints can be made from tracings printed in this way immediately after the printed matter is applied, this being accomplished by sprinkling a light film of fuller's earth over the damp ink and immediately dusting it off lightly with a feather duster. While this may give the ink a grayish appearance it does not detract from its opaqueness. Where possible, however, it is preferable to allow the ink to dry for about 12 hours.

Statements, estimates, specifications and similar matter of which a considerable number of copies are desired can be typewritten on a thin, white transparent paper with a black ribbon and a sheet of fresh black carbon paper reversed on the back. Blueprints or blueline prints of first-class quality can be made in any amount from sheets made up in this way. This method is of particular value where the number of copies desired is not large enough to warrant sending it to a printer. We have accomplished a large saving in our valuation work by writing up all of our land schedules in this way and having them placed on the original right-of-way tracings by the lithographic reproduction process at the time when our reproductions of the maps were made for filing with the Interstate Commerce Commission, thus eliminating lettering of these schedules by hand on the tracings. The money saving by this scheme averaged about 75c. per sheet, which on 2500 sheets, the approximate number we made, amounted to \$1875, or practically the time of one draftsman for 16 months.

Lithographic Reproduction

The lithographic reproduction process of making copies of tracings offers many opportunities for saving time and expense in making duplicate copies. By this process copies can be obtained on tracing cloth or paper which, provided the originals are in good shape, are practically as good as hand-made tracings, and as true to scale as the originals. In this process it is possible to eliminate portions of the original from the copy or to insert additional details. This makes possible the use of a set of plans made up for one purpose for making plans for a similar structure where changes are desired in the details. By the reproduction of the original plans with such features eliminated as are not to be incorporated in the new plans, and making the desired changes and additions on the reproductions, most of the time of retracing can be saved and a great saving in expense accomplished. This is particularly adaptable to the duplicating of floor plans in architectural work, and also to the producing of plans of structures where a standard plan can be used as the basis for the reproduction. Where there is any amount of work on the original, the cost of the reproductions is but a small fraction of the cost of retracing by hand, and the chance of errors in copying is entirely eliminated.

The practice of photographing standard plans effects a large saving in blueprint paper and time of printing, and can be applied to any large drawings of which a large number of copies are required, or copies of which are to be incorporated in reports, attached to contracts or put to other similar uses. On our prints of standard plans we save approximately 90% on blueprint paper by using prints of the photo negatives instead of the large-size tracings for filling all current requests, and in addition make a noticeable decrease in the size and weight of packages of prints for mailing. These photograph negatives are made on a 9 x 14-in. film which can be blueprinted in a continuous blueprinting machine just as tracings are. When properly made they will print at the same speed as tracings, and they can be used to fill up open spaces on the paper, thus utilizing what would otherwise be waste paper. With a first-class camera and lens, a dark room and an illuminating frame, these negatives can be made at comparatively small expense by any one with the average amateur photographer's knowledge of photography, and with ordinary care in handling they will last indefinitely. We have made as many as 2000 prints from a negative at an average cost of 1c. each, the negative costing about 80 cents.

Possibly the blueprinting department affords a greater opportunity for practicing economy than any other department in the office end of the engineering

forces, especially at the present time, when the prices of blueprinting papers, chemicals and other supplies are more than 200% above normal. The continuous electric printing, washing and drying machines speeded up the blueprinting considerably more than 100% over the old method of printing with a sun frame, but at the same time they also increased the possibility of waste in paper, and raised the repair bills on equipment. The preventive for these is the employment of an experienced commercial printer in charge of the blueprinting equipment—one who will watch to see that the tracings are fed to the machine in such positions as will best cover the entire width of the paper, and without spaces between their edges, and who can also take care of the minor repairs necessary from time to time on the equipment. While it is necessary to pay a larger salary to such a man than to a boy or inexperienced man, the saving he will effect in materials and repair bills, to say nothing of the increased life of the equipment, will more than cover the increase or difference in salary. The use of 100-yd. rolls of paper, by decreasing the number of joints, reduces the waste in paper due to joining the ends of succeeding rolls. The attachment to the washer of a device for recovering the bichromate of potash solution after it has been sprayed on the exposed paper reduces to a minimum the waste of this chemical. Such a device, which is nothing more than a galvanized-iron tray and drain pipe, can be made in the company shops at very small expense, and, considering the high price of potash at the present time, will pay.

Graphical Map Index

The installation of a graphical index for station maps, right-of-way maps and profiles has been the means of saving a great deal of time in our drafting room, by eliminating the necessity for referring to card or book indexes to find the required index number for these drawings, which are the most frequently used in the files. Briefly described, this system consists in filing such records by states, all the right-of-way maps for Illinois, for instance, being filed in one compartment, the door of which is labelled with large letters on the outside, "Right-of-Way Maps 61, Illinois" and a diagram map of the lines in Illinois showing the portion of line covered by each roll of map, with its index number, is placed on the inside of the door. Profiles are filed in the same way, while station plans have an alphabetical list on the inside of the door instead of the diagram map.

By this system of filing, all that is necessary to find a map or profile is to know the state it is in and then to go directly to the compartment labelled for that state and class of map in the filing case and obtain the index number from the diagram on the door of the compartment. This system can be applied as easily to a line with 10,000 miles as to one with but 100, and if desirable the subdivision can be made by operating divisions instead of by states. In the writer's opinion, however, the states plan is preferable, as state boundaries seldom change, while operating divisions are not so stable.

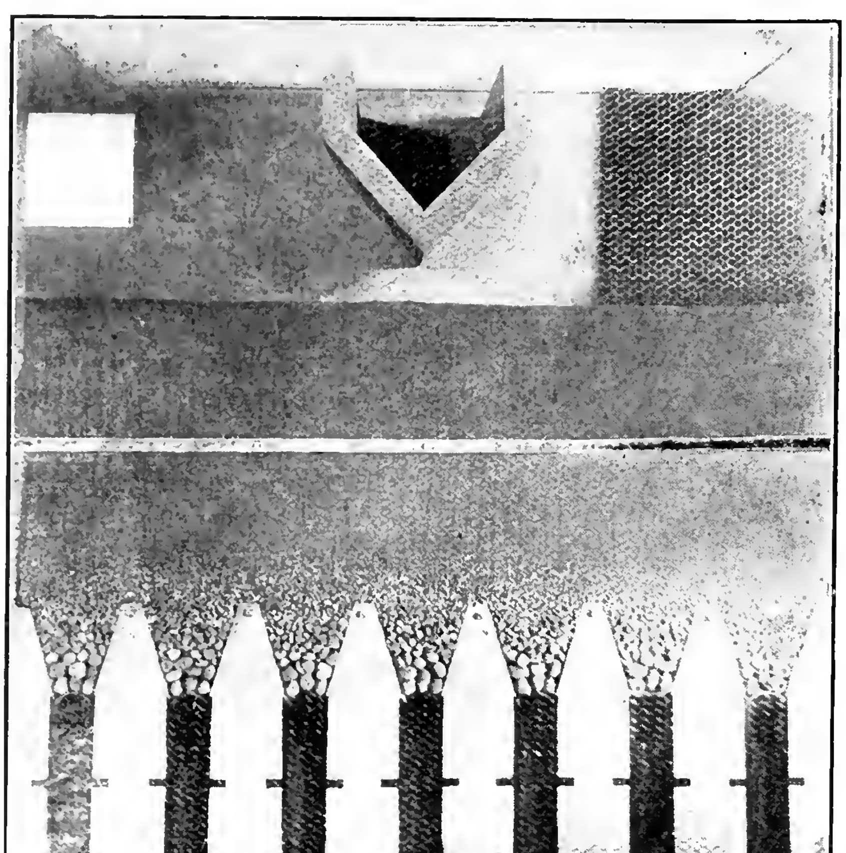
One of the most convenient appliances of which use can be made in the drafting room is a paper cutter such as is used in job-printing offices for cutting large numbers of sheets of paper at a time. We installed one of these cutters capable of cutting sheets 16 in. wide, about five years ago. It has proved a time-saving machine and is in constant use, not only by our own office but by nearly every other department in the general offices. Scrap paper from various sources suitable for scratch pads has been trimmed by this machine to pad size and made up into pads by the office boy, padding cement being used, in such quantities that we have not included a single scratch pad on our stationary requisitions in more than four years. Use can be made in this manner of obsolete report forms, circulars, specifications, etc., printed on one side only.

A drawing pencil just now is a fairly expensive article. The pencil holder is the best known medium for saving pencils and reducing pencil bills.

The last and possibly the most important item that the writer has in mind is *esprit de corps*, or what is more universally known as "team work." The force of men who are receiving the fair and square treatment which is due them and who are being accorded the small privileges it is always possible for their superior to extend them will develop the spirit of team work, and its effect will be to produce better and more work.

Model Explains Water Filter to Visitors

ONE of the difficult things to explain to laymen visiting water-works filter plants is the construction and operation of the underdrain system. At the Minneapolis filters a full-size model has been constructed with a wire-glass front to retain the 30 in. of sand and the six supporting gravel layers 14 in. deep. The model is 18 in. thick and shows seven troughs with the monel metal screens leading to 3½-in. cast-iron risers which were split with a power hack saw to show the section. Wood is used for the ridge blocks and wash-water



WIRE GLASS CONFINES SAND IN FILTER MODEL

trough, being painted the color of concrete. Two sheets of 44 x 88-in. wire-glass form the front, the joint being covered by a metal strip held by three ¼-in. rods. The glass is held also by No. 10 screws driven into the ridge blocks, holes being bored through the glass with file and turpentine. The model was built under the direction of W. N. Jones, engineer in charge of the filter plant and new construction.

History and Use of Easement Curves for Railroads

Review of Bibliography of Subject Indicates Great Variety of Curves Proposed—How Practice Developed

By Philip O. Macqueen
Baltimore, Md.

At the very beginning the writer wishes to state definitely that he has no intention of bringing forward any new theories or formulas for easement curves. The various methods now in practical use are explained clearly in a great many handbooks and other sources of reference, and it is the general opinion that a new method is entirely unnecessary. However, a short time ago the writer had occasion to make a brief study of the subject. In this connection he reviewed all of the bibliography to which he had access, and the following discussion may lead to a more uniform practice in the use of easement curves.

An idea of the extent of this lack of uniformity is gained by a summary of the names now in use, as follows:

The cubic spiral easement curve; the transition curve; the easement curve; the taper curve; the true transition curve; the elastic curve; the railroad spiral; the six-chord spiral; the ten-chord spiral; the railway transition spiral; the cubic spiral; the true spiral; the cubic parabola; the railroad taper, and the curve of adjustment.

In addition, the following complete curves have been suggested: The curve of sines; the parabola; Carnu's spiral, and the spiral of Archimedes. As is well known, however, all of these various curves, with the exception of the second class, can be divided into a very few groups in which the fundamental principles are the same, so that the actual confusion is much less than appearance would indicate.

Earliest Reference to Subject

The earliest important reference which the writer was able to find on the subject of easement curves is in Prof. W. J. M. Rankine's book, "A Manual of Civil Engineering," published in London, 1862. Professor Rankine gives a description of two curves, one proposed by Mr. Gravatt in 1828-1829 and one by Dr. William Froude about 1841. The first proposed the use of the curve of sines or harmonic curve. The second method deserves careful consideration, as this method is undoubtedly the foundation upon which the present accepted theories of easement curves are based.

Dr. William Froude, a well known English engineer and naval architect (1810-1879), during the period 1837-1844 was employed as construction engineer on the Bristol & Exeter Ry., England, when he proposed his "curve of adjustment."

Dr. Froude's rules, using his own words, are as follows: (1) Locate the center line of the railroad, using simple curves and tangents; (2) determine the length of the curve of adjustment by means of the formula $L = 300$ multiplied by greatest change of cant (in feet); (3) compute the shift as follows: Shift $= L^2/24 \times$ radius; (4) set out the curve by use of the formula $y = 4bx^3/a^3$, in which a = length of curve of adjustment; b = shift or gap; x and y = ordinates. The important similarity between Dr. Froude's curve and the curves now in use will be seen immediately. However, a period of nearly 40 years elapsed before the principles of this curve were put into into practical use. In fact, the use of easement curves began just a year after Dr. Froude's death.

During the period between 1830 and 1880 no practical use was made of easement curves on railroads, either in England or in the United States. In France, according to W. M. Gillespie, the parabolic curve was generally preferred. A simple method of locating the curve is given in his book, published 1849. It was recognized, however, almost in the beginning, that there was a decided element of danger in the use of simple curves—or, in fact, in the use of curves in general. It was also recognized that, in general, it was not the curvature but the change of curvature that presented the chief difficulty. Laws were made to fix the minimum radius for curves.

On the early English main lines no curves of less than 80 chains (about 1°) were allowed, but later this was reduced to 40 chains and then to 30 chains or about 3°. In the United States the minimum radius allowed on the Hudson River R.R. was 2062 ft. The superelevation of the outer rail was calculated by the same method as is now in general use and applied carefully. When consideration is taken of the easy curves and the comparatively low speed, 15 to 30 miles an hour, customary from 1820 to 1840, it will be seen that railroad travel was quite safe in this respect.

After 1840, however, a higher speed became customary, and practical methods were put into use to overcome the shock due to the almost instantaneous change of direction and sudden development of centrifugal force as the train passed from tangent to curve and curve to tangent. The first practice was to begin to elevate the outer rail on the tangent at a point from 100 to 200 ft. from the point of curve and point of tangent. The superelevation was changed gradually and reached its correct maximum at the point of curve or a short distance beyond the point of curve. This method, however, was only a partial solution of the problem, and the curious and interesting development of allowing the trackmen to "ease" off the curves soon became prevalent. As described by A. M. Wellington, this method is as follows: "The trackmen extend the curve back on the tangent usually 200 or 300 ft. by throwing the line inward at the tangent point, thus sharpening the curve beyond the tangent point, but easing the approach." This method is still in use by a few railroads both in this country and abroad.

Easing-Off Method Criticized

The result obtained by allowing the trackmen to "ease" the curves was a decided improvement over previous methods, but very naturally it caused considerable discussion among the more theoretically minded. William Airy in the *Engineer* of Nov. 27, 1868, deplores the custom and says that he saw two cases of derailment due entirely to the kinks in the curve caused by the easing-off process. In the discussion which followed this article one critic recommended that he "sack the platelayer." Nevertheless, the platelayers in gen-

eral were not sacked, and this method of curve easement was used with a fair degree of success for a period of almost 40 years, or from approximately 1840 to 1880. Dr. Froude's curve of adjustment, the cubic parabola, the elastic curve, and many others were advocated continuously, but the general opinion among construction engineers was that the adoption of these curves would simply be a case of too much refinement. In their turn, the locating engineers adhered strictly to the circular curve, on account of the simplicity with which it could be applied. Mr. Airy very amusingly notes that the "platelayers" considered it part of their duty to correct the mistakes made by the engineers.

That there existed a great necessity for correctly established easement curves was strikingly shown by C. D. Jameson in a series of three articles on the cubic parabola in the *Railroad and Engineering Journal* of May, 1889. Mr. Jameson says: "The author made a survey of 271 miles of railroad, which had been in operation for about 25 years. The survey was made with the idea of getting the alignment of the railroad exactly as it was at the time. All of the curves showed clearly upon being plotted that their ends had been eased off and a sharp point created a certain distance beyond the curve point. This was so in all cases and was due to the impact of the train and also to the work of the section men. The movement had been from 3 to 4 ft. from its original position, thus necessitating a continual widening of the roadbed upon the outside of the curves near their ends. This excessive width of roadbed was the first thing which called the author's attention to the condition."

First Practical Use

The first practical use of easement curves is accredited to E. Holbrook, in 1880. The curve is known as the "Holbrook spiral" and was used originally on the Pan Handle R.R. This curve gained recognition immediately, and is now in use on many railroads. The first engineer other than Mr. Holbrook to use the formulas extensively was G. W. Kittridge, who put spirals on many of the curves on the Pan Handle R.R., both east and west of Steubenville, Ohio. The general formula for the Holbrook spiral is given in the *Railroad Gazette* of December, 1880, and *Engineering News* of June 13, 1901, p. 429, and is $RL = A$; in which R = radius of curvature of spiral at any point; L = length of spiral measured from its origin; A = constant which determines the rate of transition.

The success attending the use of the Holbrook spiral created a renewed interest in the subject, and many new methods and formulas were soon brought forward, both in books and periodicals. An important article by A. M. Wellington was published March 11, 1881, in the *Railroad Gazette*. The "railroad spiral" by William H. Searles was published in book form in 1882, and it is one of the best known of all of the easement curves. In many cases, however, the railroads themselves used easement curves which were developed in their own offices and which were given only to employees in the form of blueprints. With the exception of the Searles spiral most of the new methods and tables were published during the period from 1890 to 1900. It is important, however, to note at this point that, although a renewed interest in easement curves was taken after 1880, nevertheless the railroads were slow to adopt them, and it was not until after 1900 that their use became general.

In 1911 a subcommittee of the American Railway Engineering Association made an examination of all of the different forms of easement curves in use. Their final report, which is published in the "Manual," 1915, contains the following: "Any form of easment curve is satisfactory: (1) In which the rate of increase in degree of curve can readily be changed to suit particular cases so that the length of easement curve shall be the same as the distance in which the outer rail is raised from nothing to full elevation; (2) which can be run in by deflection or by offsets with chords of any desired length; (3) which is of the general type of either the Searles spiral, the cubic parabola, or the Holbrook, Crandal, Talbot, and ten-chord spiral." The ten-chord spiral was recommended by the committee.

At the present time no railroad of any size is located or built without proper allowance being made for curve easement. The larger problem, however, is to "ease" the curves of roads in operation. In the *Railway Age Gazette* of June 17, 1910, the editor discusses at length the answers to a series of questions sent to 56 of the large railroads of the United States. On 20 railroads easement curves had been put in on all main lines and some branches, on nine railroads 75% of this work had been done, on 22 railroads more or less work had been done, and on five railroads no work had been done. The methods used varied considerably, but nearly all of them were based on the Searles spiral, the Holbrook spiral, the Talbot, Hood, and Stevens six-chord spiral, and easement was applied to all curves requiring an elevation of 2 in. or more for the highest possible speed. The consensus of opinion of the railroads in question was that the easing of curves resulted in, first, increase in comfort in riding and avoidance of swerving and unpleasant shocks to passengers; second, economy in track maintenance and reduced flange wear, and, third, reduced drawbar pull.

Strength of Waterproof Glues Wet and Dry

IN A recently issued sheet of "Technical Notes," the Forest Products Laboratory, Madison, Wis., gives information on the resistance of waterproof glues to water. Two types of such glues are in the market, those made from blood albumen and those made from casein.

The former must be used in a hot press, while joints made with casein glue are clamped together cold, for which reason the former are generally used only for thin material, such as veneer. Both kinds of glue are materially weaker wet than dry. Tests of casein-glued joints of wood showed generally only 20 to 40% of dry shearing strength. Similar tests of joints made up with blood glue showed strengths of 50 to 75% of the dry strength. However, when plywood made up with these glues is redried after being soaked, the original strength of the glue is very largely recovered.

The water-resistant qualities of both kinds of glue are so high that the acceptance test for plywood made up

with these materials requires no separation of the plies to be shown after either boiling in water for eight hours or soaking in cold water for 10 days. Airplane manufacture has called for the development of the highest attainable requirements by glues for making built-up structural members out of layers of thin stock. Under present commercial conditions, casein glues, when used to join maple test pieces, show shearing strength of 2000 to 2500 lb. per square inch. Blood glues show higher average strengths (no figures are given), but the laboratory expresses the belief that casein glues will in time be developed to the point of equalling them.

A Universal Weir Chart

By E. Earl Glass
Monrovia, California

IRRIGATION engineers and others using weirs for measuring comparatively small streams may find the accompanying chart valuable for ready determination of the discharges. The formulas are those evolved in the recent experiments conducted at Fort Collins, Colo., described by Victor Cone in Farmers' Bulletin 813 (United States Department of Agriculture, Washington.

The usual precautions must be observed in setting the weir and making measurements. A sufficient pondage should be provided to check the velocity of approach and the head, *H*, must be reared above the sharp-edged crest to the surface of still water. There should be sufficient fall below the weir to prevent any influence of backwater, and free circulation of air below the crest must be provided.

Curve No. 1 gives the discharge of a 90° triangular notch weir for heads to 18 in. The discharges of rectangular weirs for the same range of *H* are indicated by Curve No. 2, and the same for trapezoidal or Cipolletti weirs with length of crest, *L*, equal to 1, 1½, 2, 3 and 4 ft. are shown by the four curves marked No. 3. The discharges read from this diagram in cubic feet per second or in miner's inches agree with the tables in the publication mentioned above.

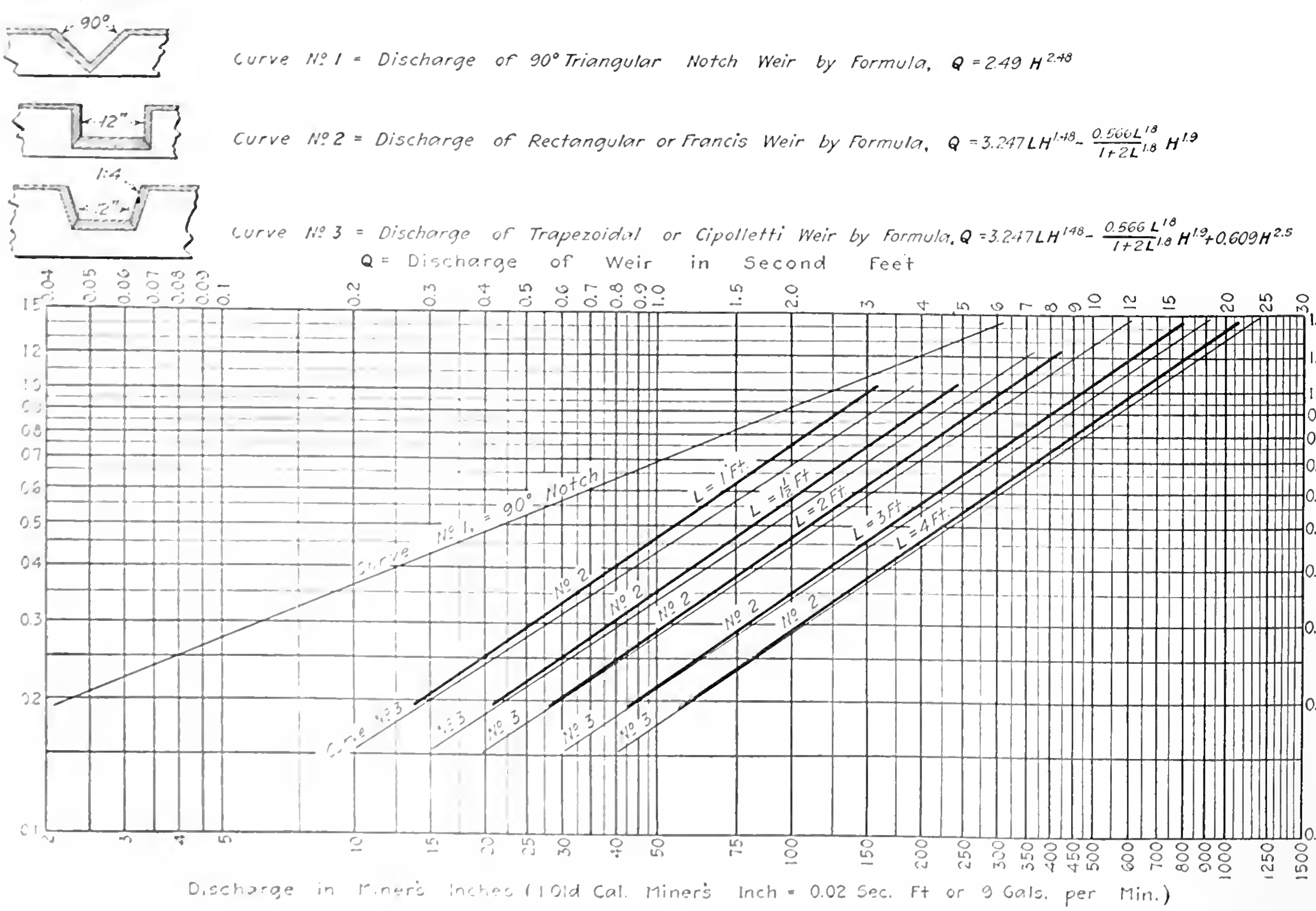
Concrete-Frame Factory Building Has Wooden Roof

Cost One-Half of Steel-Frame Design — Roof Sheathing Made Protection Easy During Severe Winter Weather

By W. E. Turner
Civil Engineer With Villadsen Brothers, Inc., Salt Lake City, Utah

CONCRETE-FRAME construction for factory buildings has so many advantages over steel in permanence, fire-resisting qualities, freedom from vibration, low maintenance, speed of construction and appearance —and, above all, in low first cost compared with steel at present prices—that it is surprising how seldom it was adopted even before the cost ratio became so marked. The main building of the Galigher Machinery Co., Salt Lake City, Utah, was first designed with a steel frame. The bids were so high that an alternative design for a concrete frame with a wooden roof was made, and the new bids developed the remarkable facts that the concrete frame cost one-half as much as the steel frame, and that the chances of delivery favored the concrete materials by 10 to 1.

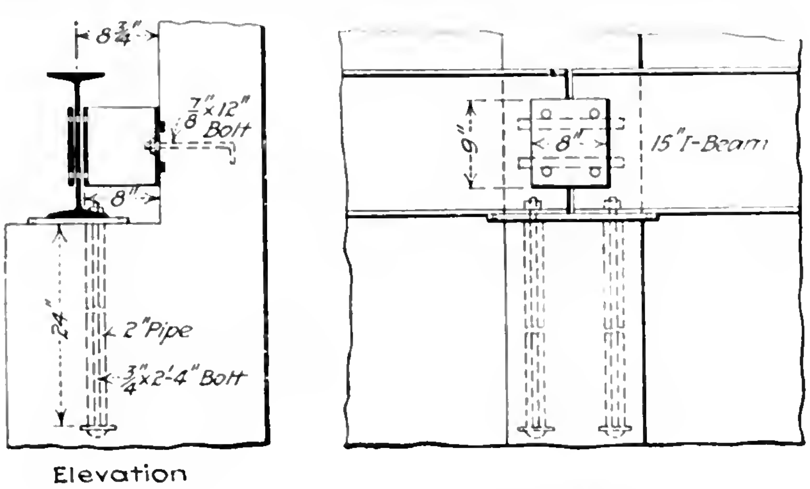
The Galigher Machinery Co. has a general machine shop business and also deals in various iron and steel products, with a steady output of filter presses. The flood of orders, overtaxing the company's old plant,

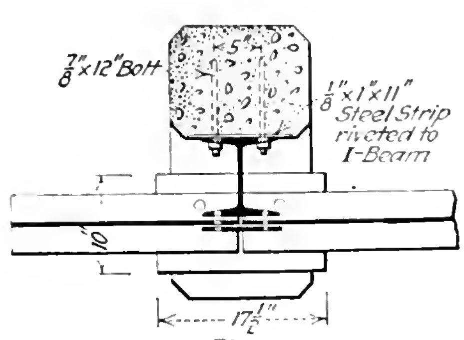


made it imperative to rush new buildings to completion during the severe winter of 1916-1917. The extremely favorable showing for the concrete frame was obtained simply by replacing the original open framework of steel beams and columns by one of concrete beams and columns, the roof and walls being filled in with other materials chosen with reference to their cost and appearance.

It was decided to build a wood roof on the concrete frame, utilizing for economy the large amount of form lumber which would have had to be sold at great sacrifice. A built-up sanded roofing with an asphalt base was used on the main building, but the rapid fluctuation in the prices of materials had altered the conditions before the warehouse was completed, and a tar-and-gravel roof was therefore adopted for that building.

One of the principal factors in keeping the cost on the concrete frame so much below that of steel was the uniformity of the design. Each bent is a duplicate of the preceding bent, and each beam has a corresponding beam in the next bay. The uniformity of the design reduced the cost of form detailing, and permitted the division of the building into three sections. The forms for Sec. 1 were re-used with practically no alteration on Sec. 2, and after that again on Sec. 3. The whole arrangements was so standardized that it was possible to carry the work out more or less like a manufacturing process.

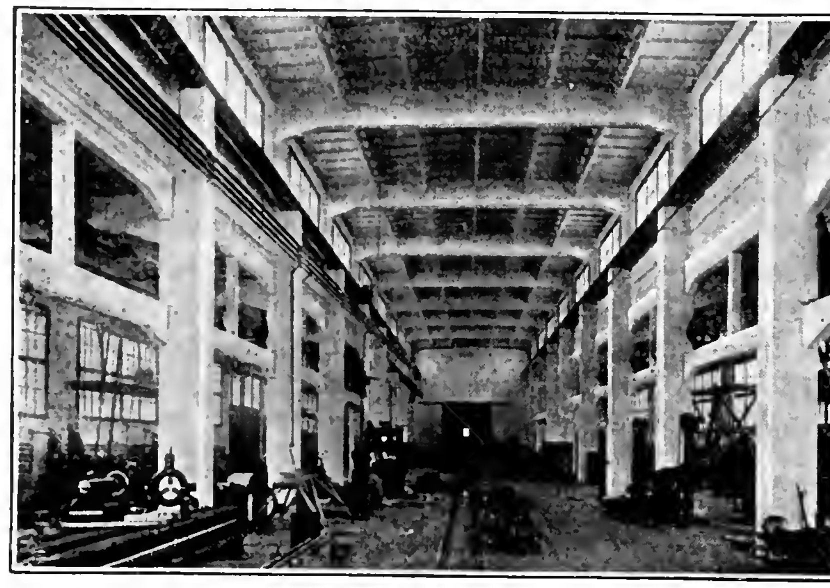




TYPICAL CONNECTION, STEEL CRANE BEAMS TO CONCRETE COLUMNS

A steam-driven stiffleg derrick with a 50-ft. boom, set on a truck, was placed to operate in the clear space down the center of the floor.

The forms came to the erecting floor from the saw mill in finished beam-and-column units, and were piled at the sides of the derrick under the boom, each piece placed according to a carefully prepared piling diagram. All reinforcing steel was fastened in place in the forms before erection. The derrick picked up the forms for the concrete framework and swung them into place. All that the carpenters on erection had to do was to drive the nails. As soon as a bent was set the derrick would swing the wooden purlins, rafters and sheathing into place, pick up the two steel crane beams, and then proceed to the next bent.



INTERIOR OF SHOP BUILDING

Lower beams and intermediate columns are for support of shafting and machinery

Every unit of form was detailed in the drafting room. Provision was made, as seen in the drawing reproduced, for setting little brackets for the support of wood purlins and throats were cut in the top of the form, to set the purlins in place during the form erection. The beam sides when stripped came off very easily, and left the purlins and all the roof in place. The sheathing and rafters were laid during form construction, so that they provided a good working platform for the pouring of the concrete, and covered in the roof area as part of the frost protection while the concrete was setting. Provision was made in designing the forms so that all beam bottoms would be left supported after the rest of the forms had been stripped and remodeled.

The frame beams were mixed 1:4, or approximately 1:1.4:2.6, and the columns 1:6. The grading of the aggregates was carried out as far as practicable by frequent visits to the pit, and by screening samples of sand from every load. As the cold weather had set in before the framework was poured, it was necessary to heat the mixing water and the aggregates. The hot water was obtained from the Utah Portland Cement Co. across the street, taking advantage of heat that was going to waste at the plant. The sand and gravel were heated by means of 2-in. perforated steam pipes laid on the ground under the sand and gravel piles. There was approximately 1 sq.ft. of heating surface in the pipes for each 6 sq.ft. of ground covered by the piles. That was sufficient to keep the materials hot through the coldest weather. The steam was supplied, at a pressure just barely above the atmosphere, by the boiler on the steam derrick, which was in no case engaged in erecting forms at the same time as when the concrete was being poured.

The temperature of the fresh concrete was probably about 120 deg. To protect the concrete still further against the cold, each section of the building was closed in with 8-oz. duck sheets, and salamanders were burned day and night. It was found that the concrete, even when not inclosed, would remain warm to the touch for about 24 hours after pouring. The heating of the concrete was governed by the idea that no dependence can be placed on any setting at a temperature lower than

40 deg. The heat was kept well above this minimum until the cement was well set. As a check on the proper setting of the concrete, test blocks were made in the form of 6-in cubes, and three or four of them were poured with every day's run and placed beside the most exposed beams to set under the same conditions as the framework. They were tested by crushing by Professor Beckstrand of the University of Utah, and his report was always consulted before the supports were removed.

The table herewith gives the results of tests on four of the cubes for the framework of the first section in a

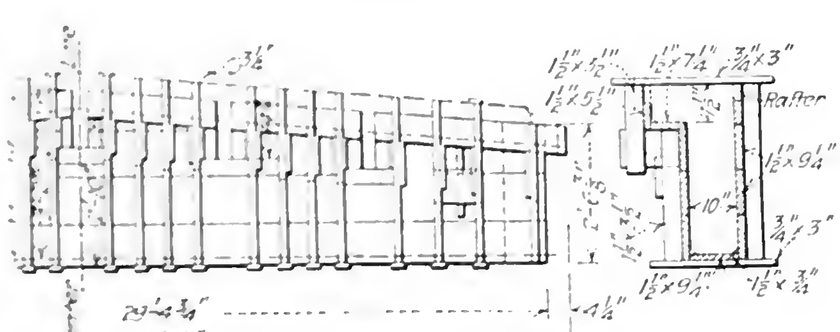
ULTIMATE STRENGTH OF CONCRETE SET AT LOW TEMPERATURE

Mixture	Ultimate Strength 6 × 6-In. Cube	Ultimate Strength lb. per Square Inch
1:4	93,050	2580
1:4	102,400	2870
1:6	52,300	1475
1:6	57,100	1600

portion which was not inclosed, where the concrete was poured at a temperature of 120 deg. and allowed to set for 41 days exposed to a temperature of 10 deg. above zero.

The whole interior of the building was whitewashed with hydrated lime, carrying a small proportion of salt, glucose and other ingredients. The woodwork, brickwork and plaster walls were all sprayed, but the concrete was for the most part brushed, in order to fill any little surface voids more thoroughly. The insurance rate on the buildings was quite noticeably reduced by the whitewashing, the saving being as great as 15% in the case of the warehouse. It is claimed that the presence of salt in the whitewash is an important factor in its fire-resisting properties.

Building work was carried on according to a very complete time schedule which showed the number of carpenters, laborers, and other workmen required at



DETAILS OF 30-FOOT BEAM FORMS FOR MONITOR

certain dates, the time of starting and finishing all subcontracts, and the time limit allowed for the delivery of all material. The time schedule was found of peculiar value in ordering brick, which had to come by the carload, and which could not be stored in very large quantities near the track. The plans for the main building were started in October, 1916, and it was completed ready for use on Jan. 31, 1917.

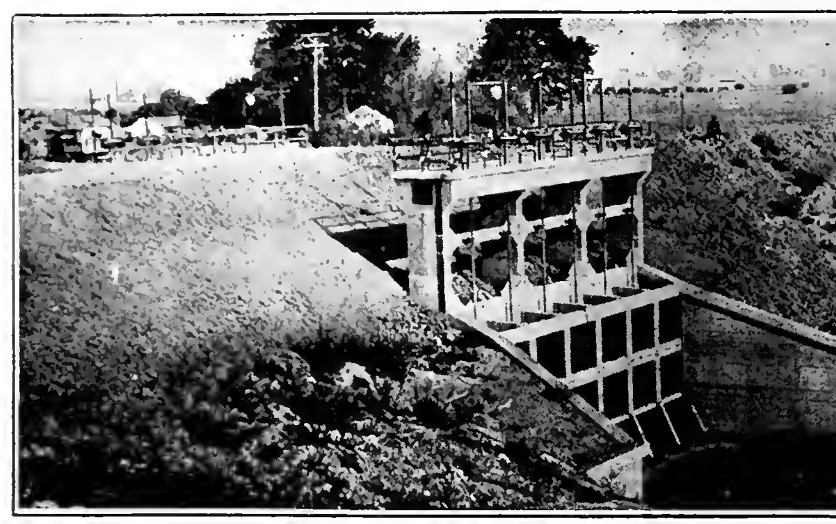
All work on the Galigher buildings was done under the supervision of Villadsen Brothers, Inc., engineers and contractors, Salt Lake City, and Leonard Cahoon, general superintendent of the Galigher Machinery Co.'s shops, all reporting to J. E. Galigher, vice president and manager of the Galigher Machinery Company.

Canal System Used Alternately To Irrigate and Drain

Low-Lift Pumps Required for Part of Area, But Much of It Is Served by Gravity Auxiliary Canals

A COMBINED reclamation and irrigation system, using the same canals for irrigating crops in the dry season and for draining off surplus waters in the flood season, has been developed in California. It is known as "District 108," and includes about 60,000 acres in the lower Colusa basin along the west side of the Sacramento River.

The canal system was first laid out on the reclamation district plan for draining the lands and keeping the water table down to a level safe for crop production. Then, in 1917, the state legislature revised the reclamation act to include provision for irrigation. After careful studies of the area affected, it was found that with the low gradients on which the canals were laid out some comparatively inexpensive changes in the canal system and the addition of headworks would make it possible to fill the canals by admitting water from the river. This necessitated, in some sections, pumping to get the water from the canals on to the land. The lift required was nowhere high, however, and by using a system of auxiliary canals a large portion of the area was served by gravity. The completed canal system will be such that no farming land will be more than two miles from a branch of the main canal system.



WILKINS SLOUGH INTAKE IS PROVIDED WITH TRASH ROCKS, FISH SCREENS AND REGULATING GATES

The general slope of the area is westerly, away from the river, falling 10 to 12 ft. in the first mile and 4 to 5 ft. in the second, after which it is quite level. The normal low water level in the river is about El. 28, practically the same as the ground level upon which 19 miles of the back levee is constructed. The lowest land in the district is about El. 22 and about 28,000 acres lie below El. 28. Thus almost half the total area could be, theoretically, supplied by gravity. The cost of checking is very low because of the regular, level surface.

It is proposed, should there be any temporary shortage of irrigation water, to siphon water in through the pumping plant, at the lower end of the district, installed for pumping out drainage. Another feature of the drainage system that is included in the irrigation plant is the culverts in the Howell Point cross levee near the center of the district. These culverts, provided

with gates at either end, are to be used when desired to maintain a higher water level in the upper half of the district than in the lower half.

The Wilkins Slough intake will control the entry of water from the Sacramento River into the canal system. It consists of six reinforced-concrete culverts 5 ft. square inside and set with the floor level at El. 20. Thus the tops of these culverts are 1 or 2 ft. below the lowest low water. The barrels are about 141 ft. long and terminate in retaining walls.

The intake structure is set back in Wilkins Slough about 150 ft. from the river bank, to avoid injury from river traffic or caving banks, and also because this afforded an easy way to maintain the levee during construction. When the intake was completed the channel to the intake was opened up by a large clamshell dredge during the high-water stage of the river, the levee over the intake culverts being reconstructed by the dredge at the same operation, using material dredged from the inlet channel.

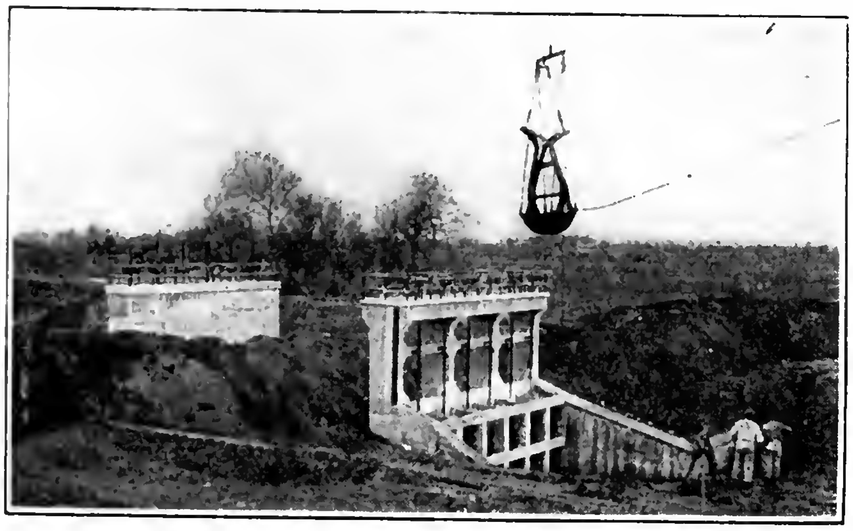
The headwalls on the riverward side support the operating mechanism for heavy, steel regulating gates. In front of these gates, sloping buttresses from the retaining wall also support steel trash racks and fish screens. Grooves were constructed in the concrete walls to permit of an emergency closure by stop logs in case the gates jam. As an additional precaution, reinforced-concrete wells were constructed near the center of the culverts, extending upward to the top of the levee at the landward edge of the crown. A second set of timber regulating gates was provided in these walls, permitting an entirely independent closure of the culverts. Three separate sets of reinforced-concrete collars or cutoff walls are provided. One of these, under each set of gates, incloses a heavy timber sheet pile cut-off wall driven 20 ft. farther into the substrata.

Test borings indicated clay, with a shallow stratum of hardpan to a depth of 10 ft. below the foundations of the structure, and no foundation difficulties developed. The total cost of the completed structure, including overhead charges for engineering, administration, etc., was approximately $100,000.

The intake is connected with the drainage canals by a system of main irrigation canals extending across the head of the district. The system classified as irrigation canals, and used chiefly for irrigation purposes, comprises four main canal divisions with a total length of approximately 11 miles, and a total volume to be excavated of about 751,000 cu.yd. The cost of the canal excavation, as estimated when the work was about 50% complete, was $195,000, or an average of about 26c. per cubic yard.

The canals between the intake and the upper end of the main drainage lateral of the eastern portion of the district were designed with a bottom width of 40 ft., side slopes of 1 on 1½, and a nominal capacity of 500 sec.-ft. The maximum depth of material to be excavated was not over 15 ft. The heaviest cutting was done with a dragline excavator mounted on two lines of car trucks and carrying a 4½-cu.yd. bucket on a 110-ft. boom. Other portions of the canal were dug with a smaller dragline, and with a dipper dredge mounted on car wheels and spanning the ditch.

The larger portion of the work, however, will be completed with floating clamshell dredges with 1¾-cu.yd. buckets, 75-ft. booms, and 28 x 80-ft. hulls. These machines can float in about 4 ft. of water, and can readily lift material to a height of 15 ft. or more above the water surface. Controlling works will be installed at the head of the main drainage laterals just below the junction with the main drainage canal, in order that



LEVEE OVER INTAKE CULVERTS WAS REBUILT WITH MATERIAL DREDGED FROM INTAKE CHANNEL

water may be held up across the district in the irrigation canals, or can be diverted down the drainage canals, as required.

The irrigation and drainage system and the intake were designed by Fred H. Tibbetts, civil engineer, San Francisco, engineer for Reclamation District No. 108. Fred C. Herrmann, consulting engineer, reviewed the plans for the intake. The Ajax Dredging Co., F. F. Cooper, president, of San Francisco, was the general contractor for the entire work.

Cantonment Fire Due to Faulty Masonry in Fireplace

Chimney Built of Scrap Material and Added After Frame Building Was Completed Found Full of Holes After Building Was Destroyed

FIRE in one of the officers' quarters at the United States Army General Hospital No. 3, at Colonia, N. J., last October entirely destroyed the building and caused the deaths of two of the medical officers sleeping in the building at the time, and the injury of several others who were trying to escape. Investigations of the fire were made by various officers immediately after the fire.

As a result of the investigations, it is apparently the opinion of the experts that the fire was caused through the faulty construction of a fireplace which was put into the building after it had been completed and while it was occupied.

The building was one of the typical cantonment-type timber-frame structures, one-story high and E-shaped in plan, having a headhouse and three pavilions extending therefrom. The center pavilion contained a lounge or rest room for the officers, and the remainder of the building was used for sleeping quarters. About six weeks before the fire some of the officers took it upon themselves to have built in one side of the lounge a large fireplace. For the construction of this fireplace

and chimney one of the soldiers in camp who said he was an expert bricklayer was called in.

Engineer officers examining the ruins of the building, which incidentally consisted only of a few charred timbers and the remains of the fireplace, state that the fireplace itself was of very poor construction. It seemed to have been built of scrap material, one officer stating that he had noticed five distinct classes of material and three grades of cement. These materials were 12 x 12 x 8-in. hollow-tile blocks, face brick, common brick, firebrick and concrete. The mortar used was evidently portland cement for the main body of the work with possibly lime added, fireclay for part of the fire lining, and plaster of paris for the last few layers of firebrick lining. Evidently, the mechanic had ransacked the camp for scrap material which he had put together as best he could. Officers examining the chimney after the fire found that it was full of openings which distinctly showed light through and which would readily have communicated fire to the surrounding timber.

A board of examiners, consisting of medical officers, did not seem to think that the fire could have originated in the chimney, but assumed that the start was probably due to either defective wiring or incendiary origin. While the engineer officers' report does not definitely so state, it is very evident that it is their opinion that the chimney was the source of the fire, and there seems to be also an unvoiced criticism of the medical officers for taking upon themselves the construction of a chimney and fireplace without proper engineering advice.

Latin and Greek as Preparation for Engineering

Dr. Mortimer E. Cooley, President of American Society of Mechanical Engineers, Advocates Teaching of Dead Languages

IN AN article published in *The Evening Sun*, New York City, Dr. Mortimer E. Cooley, dean of the colleges of engineering and architecture, University of Michigan, and president of the American Society of Mechanical Engineers, deplores the fact that in the future education of our youth Latin and Greek and other so-called dead languages are to play so small a part. He advocates the teaching of these languages as a means for training engineers for responsible citizenship. Extracts from his arguments favoring this educational procedure follow:

Even as a preparation for engineering I have for years considered that there was no better training than Latin and Greek. Most of the big engineers of today went to college when Latin and Greek were prime in the curricula. They were classical students—many of them. There was comparatively little of engineering science in those days and therefore plenty of time for something else than mere technical training.

Why, then, give our youth a smattering of this and that so-called practical thing as a preparation for college? How much better it is to give them something not only preparing them for college but starting them off in life so as to be of maximum use to themselves and their fellow men. Most young men have only four years in college; they have forty years afterward in which to learn and practice the bread-and-butter part of their life. The one great need today from our educational institutions is training for responsible citizenship.

Starting back in the grade schools, I would eliminate all fads and stress those things which make for an understanding and appreciation of natural things surrounding us.

Toward the end of the grades and before the high-school period I would start in with Latin, giving to it the importance that it formerly had, but teach it not as a dead but a live language; and along with it take up history and the natural sciences, all in preparation for later study of these subjects.

In the high school I would still keep away from fads and hammer away on the fundamentals, stressing all those things which fit one to live one's life better and getting out of it enjoyment for oneself and those with whom one has to live.

The college should follow along the same lines, stressing in the early years the things which make for general training, leaving the special things for a later period. Comparatively little specialization should, however, be done in the college. The work leading to the bachelor's degree should in the main be for general education. Following the college should come specialization in the field of one's lifework.

Advice to Young Engineers

This plan would add a year, perhaps two, but the delay would not really be any handicap. It certainly would not be so in engineering. One large employer of engineers complained that college engineers nowadays were unsatisfactory; that while they knew special engineering things extremely well, they did not know anything else; that what employers needed were young men of parts, those who could take part in activities not of a strictly technical character; that more than all else the world today needed engineers of imagination and vision to see beyond the walls built up around them in college.

For the young American going into engineering I would advise a thorough preparation in fundamentals, eschewing all fads, even manual training and the practical things thought so essential to his success, and including: Not less than two years of Latin, preferably three or four years; considerable history; some political economy; a good knowledge of English and of literature; a speaking knowledge of at least one foreign language, and if only one it should be Spanish; some philosophy and as much as possible of art, music and other things apparently having nothing to do with engineering.

This would bring to the world a type of engineer now rarely met—one, who besides being able to do the things required of him as an engineer, would be able to do other things vastly more important, it may be, and which only one with an engineering training could do. In a word, it would give to the world generals of engineering—masters of organized effort.

Studies of Compound Water Meters

Observations on compound water meters, with a view to their possible adoption by New York City as an aid in lessening under-registration, were made recently by the Department of Water Supply. Some notes on the subject were presented at the February meeting of the New York Section of the American Water-Works Association, by Fred B. Nelson, an engineer in the department. The tests indicated considerable saving. Particular attention was given to the regulating valve control between the small and the large meter. It was suggested that on 4-in. meters, for example, the bypass meter be increased in size so as to operate up to about 5 cu.ft. per minute, when the large meter should come into use and the bypass meter either be cut out, or, at least, the pressure difference on it be so cut down as to divert more abruptly to the large meter a flow sufficient for more accurate registration.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

A Definite Comparison—Engineer's Salary Versus Laborer's Wage

Sir—I have followed with keen interest the discussion in your journal with reference to the compensation received by engineers, as I will graduate from high school this June and contemplate taking up the study of engineering.

Last summer I visited my brother in Dayton, who is a graduate of one of the foremost engineering colleges in America and at the time was employed by the Bureau of Aircraft as a structural designer and was receiving a salary of $150 per month. He suggested that I get a job at McCook Field for the summer, as the Government was badly in need of men. This I did, and as I am unskilled I was hired as a laborer. On Aug. 1, my brother received his usual half-monthly pay, $75, while I received for the same period $80.40. Of course, I had put in considerable overtime, but so had he—including Saturday afternoons, Sundays and three evenings a week till 9.30, the only difference being that it showed up in my pay and not his.

As the result of this and similar conditions described by your readers, I am rather dubious about investing four years and $6,000 in a profession while such a premium exists on ignorance, for I feel as if it will be at least three years after I graduate before I will earn $160 per month, the equivalent of my earning capacity as a 17-year-old laborer.

New York City. LUCIEN ALTER.

More on Shear in Concrete

Sir—Not with the idea of continuing the discussion, but as a suggestion on some matters that the profession would do well to ponder, especially if revision in standards is contemplated, the writer would like to comment once more on the article and letters on the strength of concrete in shear which appeared in *Engineering News-Record*, of Feb. 27, 1919, p. 430, and Apr. 17, 1919, p. 783.

If the maintenance-of-way department of a railroad knew that a certain rail had an incipient transverse fissure, it would remove that rail from the track. There can be no doubt that these fissures and the rail failures that they cause are progressive. Other failures also are progressive. I have seen in broken axles undoubted proof that the failure was progressive. This is shown in the rusted portion of the fresh break, demonstrating that failure had begun some time before. This start of the axle failure is really the ultimate point of its usefulness. Repetition of the same load, or maybe less, is what breaks the axle. In a static test the axle that has started to fail may stand several times the load that it is commonly carrying.

This is a thing of which investigators and writers often lose sight. A concrete column that has begun to crack under a certain load may crack somewhere else under the same load repeated. A beam that has cracked, due to excessive shear of diagonal tension under a certain load, may crack somewhere else the next time the same load is applied, and keep on cracking until failure results. This is, then, the real, ultimate strength or ultimate point of usefulness of that beam in shear so far as the concrete is concerned, and not some higher load the beam may stand under very careful application of a static test.

I confess that I did not observe that test 4-AD-1 had flanges and stirrups but no concrete web, as Mr. Slater points out in his letter in the issue of Apr. 17. Why is not this test 4-AD-1 pertinent in determining how much of the shear passes through the web? It shows that even at a great disadvantage these two separated flanges enable the beam to carry half as much shear as one with a web to join them and make them act together. This test proves my contention exactly. Here is a beam without a concrete web which stood a shear about half as great as one with a web measuring nearly 90 sq.in. in area. It is my contention that in a reinforced-concrete beam with a web where the full shearing value is attributed to the concrete web, the unit shear in that web can be made to appear any desired intensity up to infinity by merely reducing the thickness of the web.

Pittsburgh, Penn. EDWARD GODFREY.

Private Employment Agencies Upheld

Sir—In your issue of Feb. 13, 1919, p. 328, C. E. Drayer, secretary of the American Association of Engineers, discussed the establishment of centralized employment offices by the engineering societies, as a means of eliminating the "leeching private agencies . . . sucking from the unfortunate engineer who is out of employment from 50 to 60% of his first month's salary." The following facts are submitted for consideration in this connection:

Under the fourteenth amendment of the constitution of the United States individuals have the right to engage in useful business. The United States Supreme Court in 1917 decided that a private employment agency was a useful business. This decision contained the following phrases: "Not inherently immoral, or dangerous to public welfare"; "such service is useful, commendable and in great demand"; "business is as legitimate as that of a banker, broker, or merchant, and may be said to be a necessary adjunct to modern business"; "business is not only innocent and innocuous but highly beneficial," and that "such agencies have been established for so long a time that they are now one of the necessary means whereby persons seeking employment are able to secure the same."

Private agencies have existed in competition with many forms of free service for many years. Men have not been compelled to patronize these offices, and are not now. The free methods of employment outnumber the paid agencies one hundred to one. The leading engineering societies have operated free employment departments for many years, presumably for the purpose of rendering service to their members as a whole and not as self-constituted redeemers of less than one per cent. of their members, who through choice patronize paid employment agents, against whom the worst that can be said is that they charge commis-

sions, though these commissions are covered in a signed contract in advance, and are contingent entirely upon the acceptance by the applicant of a satisfactory position.

What is to be shall be. If some new scheme of free employment service is to prove all-satisfying, then paid agencies will be no more. Until then, why not presume that the Supreme Court's appraisal of private agencies is correct and cease to insult the intelligence of those who prefer this method of finding employment?

A. G. FROST,

President, National Association of Technical, Educational and Commercial Employment Agencies.

Chicago, Ill.

Distributed Passenger Terminals

Sir—A rather erroneous idea of the terminal and traffic of the Aurora, Elgin & Chicago Ry. is given in the editorial on "Distributed Versus Centralized Passenger Terminals," in *Engineering News-Record* of Apr. 17, 1919, page 752. The trains of this electric railway connect with the Garfield Park branch of the Metropolitan Elevated Ry. at Laramie Ave. and run over this line for 6½ miles to a downtown terminal on Wells St., the west boundary of the loop district. Some of the elevated trains also use this terminal, but most of them go around the elevated loop. The Aurora, Elgin & Chicago Ry. trains do not handle local traffic on the elevated line and do not stop at the stations on this line, with the one exception of Marshfield Ave., a junction point, where inbound passengers can get off and outbound passengers may board the trains. The Aurora, Elgin & Chicago Ry. has its own ticket office and entrance at the Wells St. terminal, separate from the facilities of the elevated railway. Baggage is not handled on the regular trains.

The Chicago, Lake Shore & South Bend Electric Ry. runs certain of its trains over the terminal lines of the Illinois Central R.R. to the downtown terminal at Randolph St. These trains are handled by steam locomotives between Randolph St. and Kensington, 15 miles. Plans have been proposed at various times for bringing other south-shore electric lines into the La Salle terminal station by means of an elevated structure over the right-of-way of the steam lines. It has been proposed also to bring trains of the Chicago, North Shore & Milwaukee Electric Ry. into the city over the Northwestern Elevated Ry. As this electric line has its terminal at Evanston, 12 miles from Chicago, it is felt that it is handicapped by so long a transfer on the elevated trains, as passengers to Milwaukee and intermediate points find it more convenient to take trains of the steam railways at their city terminals.

Chicago, Ill. RAILWAY.

Utilitarian or Scenic Highway Locations

Sir—The writer was very much pleased to see your editorials in *Engineering News-Record* of Apr. 10, 1919, p. 698, in regard to the desirability of making our improved roads scenic rather than straight-line highways. Not only is it usually the case that the contour road involves very much less cost per mile, but, except in very irregular country, it will usually be found that the cost between terminals is also much less, although the distance will be somewhat greater.

The driver of a heavy truck, and for that matter the speed maniac, is chiefly concerned with getting between points in the shortest possible time. But growing sanity in regard to the use of motor trucks, and a better realization of the fact that the use of the 10 or 12 motor trucks required to handle the contents of an ordinary freight car results in a net cost to the community (where the haul is of any length) much greater than the cost of the same transportation on the railroad, whether steam or electric, is rapidly restricting the motor truck to its proper field of short hauls in the city, while the furious speeders are after all a small proportion of the users of the highway.

The average man is concerned to no small extent with the beauties of the country, and that road which winds somewhat so that the points of interest develop one by one as the ride proceeds, particularly appeals to him. This fact, in connection with the lower cost, would seem sufficient argument against the straight-line trunk.

Incidentally, there is another point of considerable importance against the latter road, when, as is so often the case, it involves considerable cutting. In a country where there is snow, these cuts serve as accumulators of snow, and, to a very considerable extent blocking of traffic through the winter weather results. This tendency to leave through cuts is often followed, even in cases where one side is little more than a shell. Such a proceeding leads to drift troubles in winter and often serves to spoil what might otherwise be a beautiful view.

The writer has particularly in mind a fine highway from Avon, Conn., to Hartford, over Talcott Mountain, where what should be a marvelous view of the beautiful Farmington River valley is blocked off by such cuts to a very considerable extent. In this case, the addition of a small yardage to make a side-hill excavation would have cleared most of these obstacles away. Unfortunately, this road is anything but an exception. Moreover, I am confident, although in this case I do not know from personal observation, that these cuts are sources of serious trouble in every snowstorm of any moment.

CHARLES RUFUS HARTE.

New Haven, Conn.

Thoughts From a Reader and Contributor to Technical Journals

Sir—We sometimes ask ourselves, What is the value of technical articles? The average engineer subscribes to technical journals in the hope that he will receive from them educational benefits in his line. Contractors and machinery makers take them to keep posted on business activities.

Lately the professional journals are taking an active part in trying to better the working conditions of the profession. It is a great and laudable work that strives to obtain for civil engineers the same wages as the aristocratic bricklayers and plasterers have earned for years. Looks as if we had hitched our wagon to the star.

We were too proud to fight, but we finally got busy and did a good job of scrapping in the Argonne. Marquis of Queensberry rules were laid aside. We have been too proud to unionize, but we are hitting

in that direction. "Civil Engineers' Local No. 23 Meets First Wednesday in the Month."

But to get away from sordid money thoughts back to the rarefied atmosphere of technical authorship. Technical journals would do well to solicit longer articles, those in which the author builds up his thought, and thus allows his readers to absorb a little real knowledge. "Be brief" is a good motto for a telegram, but articles which are merely a synopsis impress very few. All articles are not of universal interest. There may possibly be a few persons who read a technical journal from cover to cover, but the majority pick out one or two articles that come within their purview and interest. Consequently, articles that are worth reading should not leave out half the information—an author saturated in his subject expects us to do liaison work between disjointed paragraphs. Instead of being brief, be complete.

Renton, Wash. FRANK W. HARRIS.

Engineering and the Popular Magazines

Sir—I have just returned from the service and have examined with considerable interest the numbers of *Engineering News-Record* issued during my absence, particularly those articles pertaining to education, reimbursement, and the status of the profession. Perhaps a word from a young member of the profession would not be amiss.

It is true, perhaps, that the engineering profession has been underpaid, and correspondents have called attention to the fact that routine work may be performed by men not having the broader training of the engineer. Yet today we are constantly reminded that men of technical training capable of performing administrative work are in demand. Montesquieu, the French essayist, divided mankind into three classes—briefly, the captains, the lieutenants and the privates. An engineer is a member either of the first or second class. That being the case, shall we not avail ourselves of this opportunity for which a technical training is so valuable? In this connection we may note that a principal failing of engineers is general lack of knowledge of business methods and conditions. Why not estimate our abilities, and if found deficient, promptly remedy the evil?

Respecting the status of the profession and engineering education: The April number of *Harper's Magazine* contains an article entitled "The Chemists of the Future," similar to one I have long hoped some able engineer would write for publication in a popular magazine. If the status of the profession is to be raised, why discuss it only in engineering periodicals? Ellwood Hendrick, author of this article, says: "There is, nevertheless, a journeyman side to chemistry, and I think we should prepare for it. . . . Such a career provides a fair living, and it is not more monotonous than keeping accounts. . . . If we have been trained as laboratory helpers, without the theory and vision of chemists, then that is what we shall remain. . . . Of course, men will call themselves what they please, we cannot legislate titles. But it seems to me of vital importance that only those students of today should become chemists who are properly equipped to meet the g eat responsibilities which are there to encounter. It is the coming profession."

The general public has as little exact knowledge of the chemist's scope as it has of the engineer's. Assuming this, Mr. Hendrick writes lucidly, tactfully, so that the layman readily grasps the point when he speaks of catalysis, colloids, osmosis, etc. Here is a nine-page article in a publication suitable for telling the intelligent public the generalities of the profession's work. Cannot a competent engineer follow this worthy example? Cannot the purpose of raising the status of the engineer be gained more efficiently and to a wider extent by articles in the current magazines rather than in engineering periodicals? It should be remembered that as a class those who employ engineers do not read our literature. One very ready method would be a series of articles in our local newspapers describing the work of the various departments of the city engineering department and the necessary qualifications of the employees.

One other point of note in the above-mentioned article is related to engineering: "Municipal wastes must be conserved. . . . There are places along the East River where the water is not changed by the tide, and its condition is already septic. . . . Conditions must be changed and it is the chemist alone who can change them."

Shall the chemist outrun the engineer?

Washington, D. C. CHARLES W. BARBER.

Should Spend $1,000,000 on Topographic Maps

An annual expenditure of $1,000,000 for the topographic mapping of the United States is justified, in the opinion of Franklin K. Lane, secretary of the interior, in a letter to M. O. Leighton, chairman of the National Service Committee of the Engineering Council. Mr. Leighton had written to the secretary calling attention to the essential relation of the topographic mapping of the country to good engineering and the economic development of our resources. In replying, Secretary Lane said that the Geological Survey now has available a trained personnel sufficient to permit a large expansion of the Government's activities in topographic surveys; a summer school was established by the Department of the Interior for training young engineers in military mapping and to furnish the Engineer Corps with officers for this specialized service. Most of the men so trained are now available to supplement the regular topographic force of the Geological Survey. Mr. Lane's letter continues as follows: "For this reason, an annual expenditure of $1,000,000 on the topographic map of the United States is now justified both by the public needs and the ability of this department to perform this work economically and effectively. In such a program it is hoped that the states might increase their coöperative contributions to $500,000, especially as the coöperation for the two years past was necessarily interrupted by the military mapping being largely confined to a few border states. I am told that in several states the officials are now urging the completion of the coöperative mapping of their states within the next few years. . . . My present purpose is te submit a supplemental estimate to the 66th Congress, as you suggest, increasing the appropriation for topographic work to $500,000. The support of this larger program by the Engineering Council, representing as it does the great national societies, will be appreciated."

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Telescopic Pipe Carries Steam Supply to Traveling Derrick

TO AVOID the difficulties attendant upon the use of steam hose for a track derrick whose travel was several hundred feet, the "shotgun feed" was applied by E. B. Van de Greyn, chief engineer of the Beaumont Shipbuilding and Dry Dock Co. The device consists of three long pieces of pipe of three different sizes. The smallest one was connected to the traveler. The next one received the smaller one and had a stuffing-box on the end. In the same way this medium-size pipe passed through a stuffing-box on the end of a larger pipe and telescoped into it. The largest pipe was stationary, being attached to the steam main from the power house. This arrangement was found entirely satisfactory, very little steam was lost, and, while the pipe was lined up carefully at first, it was found later that such care was not necessary. At the bottom of the derrick or tower a water trap was provided to dry the steam before it reached the engines. This would, of course, have been necessary with any such long line, without regard to the telescopic feature. J. W. Link is president and general manager of the Beaumont Shipbuilding and Dry Dock Company.

Other Articles in This Issue of Interest to Contractors:

Compressed-Air Shortage Relieved by Waste-Prevention Campaign

SHORTAGE of compressed air became critical at the Fore River yard of the Bethlehem Shipbuilding Corporation, Ltd., a year and a half ago, just after production was sharply speeded up by the war demands. The period started with 150 to 160 riveting gangs, and in a few months this force had increased to 300 gangs. Even with the smaller number, however, the air was short, and often at 10 a.m. the pressure was down to 50 lb. A remarkably successful waste-prevention campaign was then inaugurated, and it solved the difficulty. The air consumption per gang was cut down to less than half, and the pressure was kept up to normal throughout the day.

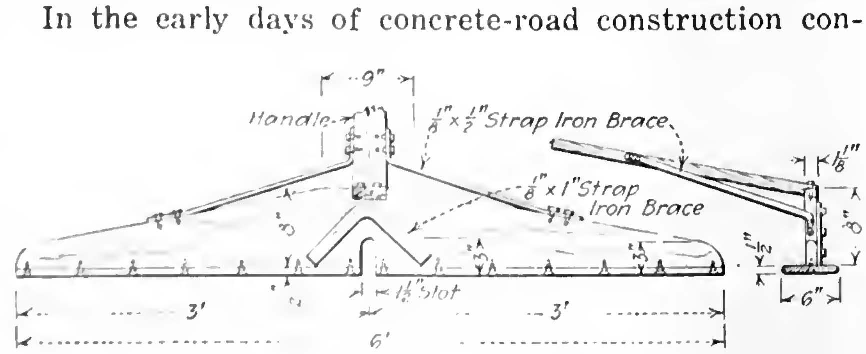
As soon as the shortage became critical, an investigation started by direction of the general manager, S. W. Wakeman, showed widespread evidences of leakage and waste. A 12-man patrol was sent out to stop leaks wherever found in the yard, and the shops were policed. The men of the patrols had orders to cut all leaky hose. Blowing snow off material by compressed air was also stopped. This positive work was aided by educational work through posters. In a short time the air consumption, which had run up to 60 cu.ft. per minute per riveting gang, was brought down to nearly 30, and then down to 25 or lower. On the biggest operating day, Aug. 1, 1918, there were 315 riveting gangs at work in the yard, which means several times that number of air tools in operation; yet the pressure was held up to 90 pounds. Addition of two 5000-cu.ft. electric compressors later increased the previous capacity of 12,600 cu.ft. per minute by displacement to a total of 23,600 cu.ft. Before the new machines were in, a 1000-ft. compressor was rented, and later two 1700-cu.ft. machines were borrowed from the equipment built for the new Squantum plant. Except for these two temporary additions, however, the old installation had to carry the load. A year ago the air consumption ran up to 11,000,000 cu.ft. in 24 hours, by piston displacement; the present consumption ranges from 8,000,000 to 9,000,000 cu.ft., in spite of a 50% increase in the number of gangs working. The following figures for three consecutive days, from a recent record sheet, are representative:

246 gangs, 26.61 cu.ft. per minute per gang, 9,000,000 cu.ft. displacement per 24 hours.
247 gangs, 24.23 cu.ft. per minute per gang
253 gangs, 22.32 cu.ft. per minute per gang
273 gangs, 23.70 cu.ft. per minute per gang

Split Float for Finishing Concrete at Expansion Joints

FINISHING the surface of concrete pavement at transverse expansion joints (where the expansion material projects above the surface), in order to give a uniform elevation on each side of the joint is accomplished by means of the split float illustrated. While the use of split templets on concrete-road work is not new, the float shown has some features which are of value.

In the early days of concrete-road construction con-



SPLIT FLOAT OF SIMPLE CONSTRUCTION EFFECTIVE AT TRANSVERSE JOINTS

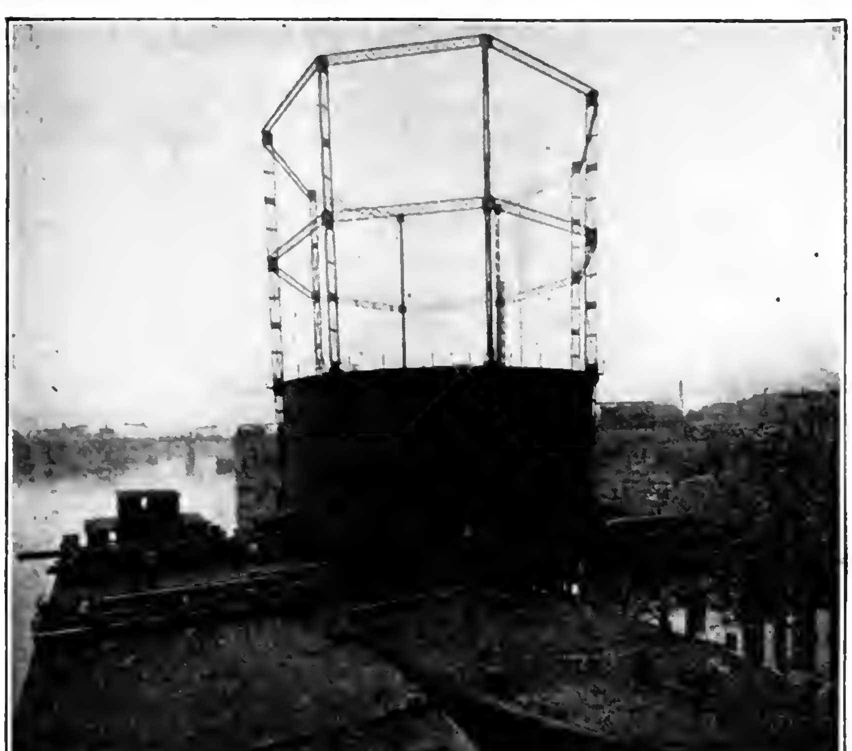
siderable trouble was experienced in making the adjoining slabs at the same elevation. The unevenness due to difference in elevation was disagreeable to traffic and caused excessive wear, often resulting in the destruction of the pavement. To overcome this, various methods, using split templets, etc., were devised; all of them required the finishing of the surface on the two sides of the joint independently. The device here described is so constructed that both surfaces may be floated at the same time, assuring uniformity.

The dimensions and construction of the float are clearly indicated by the illustration. In operation it is easy to tell at once where concrete should be removed or filled in adjacent to the joint, by the way the float rests on the surface. The slot is made to fit over the expansion joint as with the ordinary split straightedge, while the flat 6-in. board on the bottom floats the concrete to a perfect surface which is in the same plane on both sides of the joint.

This device, which was described in the *Concrete Highway Magazine*, was successfully used by the Connelly Construction Co. on the Bartlesville-Dewey road at Bartlesville, Okla.

Gas Container 70 Feet in Diameter Moved on Two Barges

THE gas container pictured herewith we recently moved a distance of 3 miles in Portland, Ore. It is 70 ft. in diameter and 75 ft. high, and weighs 300 tons. It was raised a distance of 15 ft. and loaded on rollers at Front and Everett Sts., then moved two blocks north



300-TON GAS CONTAINER BEING ROLLED ONTO BARGES FOR THREE-MILE VOYAGE

and two east, being lowered from the street to dock level, a distance of 28 ft. It was then rolled onto two barges lashed together, using hardwood rollers with block and tackle and a large gasoline engine. The barges were then towed three miles to the Northwest Steel Shipbuilding plant, where the tank was unloaded and raised 26 ft., moved across newly filled ground a distance of 2000 ft. (crossing a railroad track) and placed on its new foundation. The entire work required 71 days.

The tank was moved by Clay S. Morse, Inc., under the supervision of C. J. Disler, engineer of Le Doux & Le Doux, general contractors.

Pipe Line Lowered by Side Cuts Allowing Core to Squeeze Out

SINKING a 48-in. reinforced-concrete pipe line to grade by excavating along either side and allowing the triangular ridge or core to crush down under the weight of the pipe, was the method employed in lowering a part of the Signal Hill storm drain at Long Beach, Calif. About 300 ft. of pipe had floated above grade line in the 10-ft. trench, and backfilling was deposited before this condition was discovered, the maximum rise being about 14 inches.

In reopening the trench, excavation was carried down to 12 in. above the bottom of the pipe, and seepage water was then allowed to collect, the balance of the excavation being done under water. For this work the material was taken out only at the sides, the weight of the pipe, 900 lb. per linear foot, crushing down the ridge of soft, wet earth beneath it. The excavation was carried on in this way until the pipe had regained its original position. The advantage of this procedure was that the pipe was supported continuously and was lowered as a monolithic structure. Only one joint was damaged during the operation, but five had been cracked when the pipe rose.

Plans for the drain were prepared by R. V. Pearsall, of Long Beach, Calif., and James Kennedy, of Los Angeles, Calif., was the contractor.

Thaw Ice Cakes to Clear Foundation

ICE formation nearly 4 ft. thick piled up along the Mohawk River at the time when the General Electric Co. pumping station at Schenectady was built during the severe winter of 1917-18. The accompanying view shows how the contractor, Keith O. Guthrie, of Schenectady, got the impeding ice out of the way. The ice was first cut with steam jets, and pieces weighing several tons each were picked up with the nearby derrick and hoisted out of the way onto the adjoining bank.

40-INCH CAKES OF ICE CUT WITH STEAM PIPES

NEWS OF THE WEEK

New York, May 8, 1919

New York Public Service Commission Abolished

New State Law Establishes Two Independent Commissioners—Nixon Appointed, but Parsons Declines

With the signing of the Foley bill by Governor Smith of New York State May 3 the Public Service Commission (of the First District), which has been carrying on both regulation of utilities and construction of rapid-transit lines in New York City for 10 years, was abolished, and a single utility-regulation commission was established to take up its regulative work. Under another legislative bill, not yet signed, construction of rapid-transit lines is to be handled by a separate organization under a rapid-transit construction commissioner.

Immediately following his signing of the new public-service law, Governor Smith appointed Lewis Nixon, state superintendent of public works, as regulation commissioner for the city. Mr. Nixon, graduated from Annapolis in 1882, was a naval constructor for many years, and then established a shipyard at Elizabethport, N. J. Later he was chairman of the new East River Bridge Commission which built the Williamsburg bridge, and subsequently became Commissioner of Public Works and acting borough president of Richmond (Staten Island), New York City. He was appointed Superintendent of Public Works for the State of New York in January. His deputy, Edward F. Walsh, succeeds to this position.

Col. William Barclay Parsons, 11th Engineers, to whom Governor Smith some weeks ago offered the position of rapid-transit construction commissioner, to complete the proposed reorganization of the Public Service Commission, has declined to accept. Until a construction commissioner is named, Mr. Nixon will perform the duties of this office. Three members of the Public Service Commission of five were in service at the time when the commission's existence ended: Travis H. Whitney, acting chairman and formerly secretary of the commission; F. J. H. Kracke and Charles S. Hervey.

Extensive Changes of Personnel in Fleet Corporation

Important changes in the Emergency Fleet Corporation took effect May 1. Chief among them was the retirement of Charles Piez as director general and Howard Coonley, as vice-president in charge of administration. At the same time Admiral H. H. Rousseau, head of the shipyard plants division, Daniel H. Cox, head of the steel ship division, and four other division heads retired. Steel-ship construction will hereafter be in charge of Pierce J. McAuliffe, hitherto first assistant. Capt. R. N. Bakenhus becomes head of the shipyard plants division.

Employment Bureaus

Engineering Societies' Employment Bureau, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Pay and Classification of Engineering Positions

Engineering Council has appointed a committee to investigate the compensation of engineers and to formulate a standard classification of engineering positions, with corresponding rates of compensation. The general committee is organized in sections, each of which has charge of a particular field of engineering work. The chairman of the general committee is Arthur F. Tuttle, deputy chief engineer of the Board of Estimate and Apportionment of New York City. Mr. Tuttle is also chairman of the municipal engineers' section. The chairman of the section which is to deal with engineers in the Federal Government service is John C. Hoyt, of Washington, D. C., hydraulic engineer of the United States Geological Survey. The chairman of the railway engineers' section is Francis Lee Stuart, consulting engineer, New York City, late advisory engineer to the Federal Railroad Administration. Each of these sectional committees is proceeding with investigations and obtaining from as wide a field as possible records of such classifications of engineering positions as are now in force, with the rates of compensation.

Chamber of Commerce For Federal Highways

Annual Meeting at St. Louis Also Passes Resolutions for Water-power Development

The Chamber of Commerce of the United States, at the annual meeting held in St. Louis Apr. 30, passed resolutions urging the creation of a Federal Highway Commission, and Federal appropriations for highways; development of waterways and water-power, and a resolution against Government operation and ownership of businesses which can be successfully undertaken and conducted by private enterprise.

The resolution regarding a national highway system states:

"That highways are an integral part of our nation's system of transportation has been emphasized by the war, and an enormous development is at hand, so important as to require a comprehensive national policy, under which Federal appropriations for highways will be applied to national needs for interstate commerce, agriculture, postal delivery, common defense and general welfare.

"Congress should create a Federal highway commission, independent of present departments of the Government, composed of members from the different geographical sections of the country, to perform all executive functions of the Federal Government pertaining to highways, including those relating to existing appropriations in aid of state construction. Such a commission should act in coördination with any Federal agency that may have functions of articulating rail, trolley, water and highway transportation.

"Congress should make substantial appropriations for the construction and maintenance of a national highway system to serve the need for the maintenance of interstate travel and traffic.

"The commission should report to Congress a plan for continued aid for state construction of highways in the period beyond 1921, to which time the provisions of existing Federal-aid laws extend.

"Expenditures of funds should be permitted only for highways which are of a permanent type, having thorough drainage, substantial foundations, sufficient width and a capacity for traffic which will be reasonably adequate for future needs."

Another resolution favored the speedy completion of river improvements and water-way projects already authorized by Federal laws, and another the "true conservation of the water-power resources of the United States."

The resolution regarding Government

operation and ownership is as follows:

"The very essence of civilization is that there be placed upon the individual only that degree of restraint which shall prevent his encroachment upon the rights of others, thus realizing to the utmost individual initiative in every proper direction. Our form of government most effectively expresses and maintains this principle. Within our basic law exists ample provision for such changes as may, from time to time, be necessary to safeguard our people.

"It is therefore essential that our Government should scrupulously refrain from entering any of the fields of transportation, communication, industry, and commerce, or any phase of business when it can be successfully undertaken and conducted by private enterprise. Any tendency of Government to enter such fields should be carefully weighed in the light of its possible effect upon the genius of our Constitution."

Extensive Ship Cancellations to Readjust Program

In addition to 2,000,000 tons of steel ships the contracts for which have been cancelled since last November by the Shipping Board, 2,000,000 tons more are now being cancelled, according to a statement by Edward N. Hurley, chairman of the board. No details are given as to the sizes of ships and the yards affected. The statement refers to the necessity of balancing the fleet and also to the war prices of the contracts. Chairman Hurley says, "We feel that we should now be building only at peace prices," and states that the cancellation of all existing contracts is under contemplation, where keels have not actually been laid. This statement, issued from the Shipping Board office Apr. 25, is amplified and somewhat changed by a statement issued May 5. According to the latter, the type of vessel that will be most largely needed for post-war ocean carriage is a combined freight and passenger vessel of at least 12,000 to 15,000 tons dead weight carrying capacity, and the cancellations are to be made with a view to preparing for placing orders for this type of ship.

Plant-Disposal Section Created To Sell Shipyards

Preparing to put on the market the Emergency Fleet Corporation's interests in shipyards and ship-fabricating plants, the Director General has established a plant disposal section of the corporation, in charge of B. E. Grant, hitherto engineer of the shipyard plants division. Property totaling several hundred million dollars in value is involved, and it is desired to put these great interests into private hands as going concerns. It is stated that the corporation already has an offer from one of the Southern concrete yards to take over the yard, with a view to building a concrete dry dock.

11th Engineers Parade in New York

Unit That Held Germans Before Amiens Marches Down Fifth Avenue Soon After Arrival

The 11th Engineers of the United States Army, the unit that held the Germans before Amiens a year ago last March, paraded down Fifth Avenue, New York City, Apr. 30, led by its commander, Col. William Barclay Parsons, a few days after the regiment's arrival at the port of debarkation at Hoboken, N. J. Thirteen hundred of these men, who had served overseas for 22 months, marched between cheering crowds along Fifth Avenue from 96th St. to 34th Street.

Col. William Barclay Parsons marched with his staff at the head of his command. He was accompanied by Lieut. Col. William T. Chevalier. Maj. Charles D. Drew led the first battalion and Maj. B. A. Value the second. In the official reviewing stand, opposite 82nd St., were Governor Smith, Mayor Hylan, Deputy Police Commissioner Rodman Wanamaker, Brig. Gen. F. V. Abbott, and Maj. Gen. D. C. Shanks, in charge of the port of debarkation at Hoboken.

At 34th St. the regiment swung off the avenue and proceeded to the Pennsylvania Hotel, where a dinner tendered by the Military Engineering Society was served. J. Waldo Smith, chief engineer of the Board of Water Supply, City of New York, and chairman of the Committee of Welcome of the Military Engineering Society, introduced Colonel Parsons, who spoke of the pride of the engineering profession in the deeds of his men. Colonel Parsons declared that two things in the regiment's war career had almost escaped the notice of the public.

"A year ago last March," he said, "when the Germans began their great offensive, flinging masses of men between the British and French line, which bent and fell back, but—thank God!—never broke, and when General Pershing was told that two regiments of engineers were needed at the very front, there was never any question about the first regiment chosen—it was the 11th. They thought for some time before selecting the second regiment.

"The other thing is the rise of the enlisted men. Sixty-eight became commissioned officers during the war."

Free Service Bureau of Contractors' Association

In the interest of obtaining competent general contractors' employees, the Associated General Contractors of America have established a free service clearing house for members. G. W. Buchholz, acting secretary, 111 W. Washington St., Chicago, has issued a call as follows:

"Whenever you are obliged to dispense with the services of a general foreman, superintendent, engineer, estimator, bookkeeper, or any other employee whom you consider worthy, send his name and address to this office, with a short description of his abilities and past record, salary that you have been paying him, whether he is married or not, and if he is willing to go to any part of the country. If you contemplate increasing your force in any way, notify this office, stating the type of employee you desire, approximately what his duties will be, and the amount of salary you expect to pay."

National Conference on Training for Commercial Engineering

A national conference on "Business Training for Engineers and Engineering Training for Business Men" will be held in Washington, D. C., June 23-24. This conference is called by Commissioner of Education Claxton on behalf of a conference committee on commercial engineering recently created by the Department of Education. Representatives of all general interests, all educational institutions, commercial organizations, and engineering societies will be invited to participate.

Active Discussion Expected at A. S. T. M. Meeting

Unusually active discussion of test methods and results will mark the 1919 meeting of the American Society for Testing Materials, according to present indications. While committee reports will be less extensive than in normal years, and it is likely that only one or two new specifications will be presented, the program of papers will be of exceptional character. A topical discussion of "Magnetic Analysis of Steel" is to be made a prominent feature. The meeting will be held at the Hotel Traymore, Atlantic City, N. J., June 24-27.

In the field of iron and steel, a subject of special importance at present will be covered by a paper on "Deep Etching of Rails and Forgings," by K. E. Hofammann and F. M. Waring. Other important papers are: "Modern High-Speed Steel," by J. A. Mathews; "Some Fatigue Tests of Nickel Steel and Chrome-Nickel Steel," by H. F. Moore and A. G. Gehrig, and "The Influence of Very Low Percentages of Copper in Retarding the Corrosion of Steel," by D. M. Buck. The discussion of magnetic analysis will be opened by five papers, including among other things the application of the method to ball-bearing races, rifle-barrel steel and railroad rails. In nonferrous metals, season-cracking of wrought manganese bronze will be further discussed by P. D. Merica and R. W. Woodward.

Half a dozen papers on cement and concrete of an unusual degree of interest are to be presented. They include "Theoretical Studies of the Surface-Area Method of Proportioning as Applied to Concrete," by R. B. Young; "Proportioning of Pit-Run Gravel for Concrete," by R. W. Crum; "Modulus of Elasticity of Concrete," by Stanton Walker; "Effect of Fine-

ness of Cement," by D. A. Abrams, and "Cements Producing Quick-Hardening Concrete," by P. H. Bates. Instruments will be dealt with in papers on "The Strainagraph and Its Application to Concrete Ships," by F. R. McMillan; "A Fatigue-Testing Machine," by F. N. Farmer, and "A Machine for Measuring Hardness of Thin Metal Sheets," by S. L. Goodale. In the field of preservative coatings a new view of the subject will be presented under the title of "Paint a Plastic Material and Not a Viscous Liquid; The Measurement of Its Mobility and Yield Value," by E. C. Bingham and Henry Green. A number of more specialized papers are on the program.

The evening session of June 24 will be a memorial session for Dr. Edgar Marburg, late secretary of the society. President G. H. Clamer, Provost Edgar F. Smith, John M. Goodell, Robert W. Leslie, Arthur N. Talbot and Robert W. Hunt will speak of Dr. Marburg's activities and his work for the society.

To Retire as Secretary of Municipal League

Clinton Rogers Woodruff, for the past 25 years secretary of the National Municipal League, has announced in a letter to Lawson Purdy, president of the league, that he will not be a candidate for reëlection. Mr. Woodruff expects to devote his entire time to the practice of law. In part, Mr. Woodruff's letter to Mr. Purdy follows:

"On May 28 next I shall have completed 25 years of service as secretary of the National Municipal League. Elected at the first meeting held in New York City, I have served continuously ever since. During this period the movement for higher municipal standards and democratic city government has developed to a point where a larger share of my time and attention is required than my other interests will permit me to give. I am therefore reluctantly forced to the conclusion that I must retire, so I hereby give notice that I shall not be a candidate for reëlection to my present position."

Kansas City Viaduct Contract Let to Low Bidder

Settlement of the controversy over the contract for building the Twenty-third St. Trafficway, Kansas City, has been reached by letting the contract to the low bidder, the A. S. Hecker Co., of Cleveland, after the latter agreed to guarantee that the cost should not exceed its estimate. As noted in these columns four weeks ago (p. 743), the city council refused to award the contract to the Hecker company, and asserted that the cost-plus form of contract did not protect the city. In its final form the contract provides a fixed maximum price of $716,000 for the work; the city shares equally with the contractor in any reduction of cost below its estimate of $666,000.

Program of National Traffic Association Meeting

The annual meeting of the National Highway Traffic Association will be held at the Automobile Club of America, 247 W. 54th St., New York City, May 14. Among the speakers and their subjects are the following:

Afternoon session, 2:30 p.m., "Development of Rural Motor Express Throughout the United States," by F. W. Fenn, secretary of the motor truck committee, National Automobile Chamber of Commerce; "Transportation Surveys for Rural Motor Express Routes," by J. H. Collins, member of the highway transport committee, Council of National Defense; "Wanted, Rural Motor Express in the State of New York," by James E. Boyle, extension professor of rural economy, Cornell University; "Signposting for Through Routes in Municipalities, and Detours During Highway Construction," by Elmer Thompson, secretary of the Automobile Club of America.

Evening session, 8 p.m., presidential address, "Highway Transport Engineering" (illustrated), by Arthur H. Blanchard; "The Townsend Highway Bill and the Work of the Federal Highway Council," by H. G. Shirley, secretary of the Federal Highway Council; "Highway Requirements for Twentieth-Century Transportation," by W. G. Thompson, state highway engineer of New Jersey; "The Control of Traffic on Feeder Highways," by Edward J. Mehren, editor of *Engineering News-Record*, George H. Pride, president of the Heavy Haulage Co., and George M. Graham, manager, Pierce-Arrow Motor Car Co. The first motion picture created to show the high cost of bad roads and the advantage of motor transport, entitled "The Open Road to a Greater America," will be shown by the educational department of the Universal Film Mfg. Company.

Motor Truck Impact Tests Made By Bureau of Public Roads

Tests of importance to road builders, automobile builders, state authorities in control of speed laws, etc., were made May 5 by engineers connected with the Bureau of Public Roads of the Department of Agriculture on roads just outside of Washington, D. C. For the first time, a direct measurement of the impact of trucks on roads was made. The engineers mentioned have invented a system to measure this impact by the compression of a copper cylinder set in a chamber in the road, which is similar to the system used to measure the explosion in a rifled gun.

The device, which is the invention of Prevost Hubbard and A. T. Goldbeck, was tested on the roads of the agricultural experimental farm on the Potomac River in Virginia, in the presence of the designers, and of T. H. MacDonald, the new engineer in charge of Federal-aid roads, as well as John M. Goodell, F. H. Jackson and A. T. Smith, all connected with the Bureau of Public Roads, and the Washington representative of *Engineering News-Record.*

Details of the results have not yet been tabulated. The engineers expect to be able to announce results which will be of importance to road builders, automobile tire builders, and others.

Some Highway Engineers Coming Home

The War Department announces, in accordance with a cablegram received from General Pershing, that a few units of the 23rd Engineers have been assigned to early convoy for return to the United States from France. The units so far scheduled to come home are the fourth battalion, the wagon-train headquarters and wagon companies Nos. 1, 2, 3, 4 and 5. No information is obtainable, according to the Washington correspondent of *Engineering News-Record*, as to when the remainder of the 23rd Engineers is to return, but it is believed in Washington that the conferences which Secretary Baker had with General Pershing while in France have influenced the decision to return some of the highway engineers at this time, and it is hoped that the remainder of the regiment will be back before the road-building season is over. It is stated in Washington that other engineering units are now being scheduled for early return. Announcements as to the return of other engineering units may be expected in cablegrams from General Pershing from day to day from now on.

Proposed Legislation in Illinois to Develop 40,000 Kilowatts

The water-way scheme which has passed the senate of Illinois and which will provide a transportation waterway from Chicago to down-state and Mississippi River points, contemplates the removal of a dam in the Desplaines River at Joliet, and the construction of a modern 40,000-kw. power plant four miles farther south at a site known as Brandon's Road. At the same time, there is in the legislature a bill which will enable the Sanitary District of Chicago to bid on the power from this site, either developed or undeveloped. Should the bill pass in its present form it would enable the Sanitary District to bid not only on the new power at Brandon's Road, but also on the power from the old site, which has been the cause of so much court action in which the Economy Light & Power Co. was an interested party.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, $1200-$1440 per year, May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District, $1501 to $2100 per year. Apply to

State Civil Service Commission, Albany, N. Y. File applications before May 24.

For United States civil service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File application before June 10.

Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year, technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 12-13, Chicago.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 29 W. 39th St., New York; May 16, New York.

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

Engineering Societies

The Southwest Water-Works Association will hold its annual convention in Kansas City, Mo., June 23-26. A feature of the convention will be "round table talks," at which water-works engineers and superintendents will be given an opportunity to speak briefly on various problems with which they have recently been confronted.

The American Association of Engineers will discuss the following subjects at the annual meeting May 12-13 in Chicago: "Relation of Other Societies to the A. A. E., Local, State and National Societies, Engineering Council, Engineering Institute of Canada"; "Relation of Engineers to Each Other in Employment"; "Relation of Engineering Organizations to Engineering Education"; "Recognition of Engineers through Proper Compensation and Through Self-Improvement and Service"; "How Far Will A. A. E. Go Into Politics?" To "Employment Department, New Fields and Opportunities" will be devoted a whole session. Col. Walter Dill Scott will speak on "Fitting the Engineer to His Job."

The Tidewater Virginia Technical Engineers is the name adopted for the new society organized at Norfolk, Apr. 23, at a meeting of local engineers. The following officers were elected: President, Capt. Whit. P. Tunstall; vice-presidents, W. B. Bates and John F. Benson; secretary, R. W. Bonney; assistant secretary, R. Johnson Neely, and treasurer, G. Hubbard Massey. The new organization has about 100 members. The intention is announced of becoming a chapter of the American Association of Engineers.

The Canadian Military and Civil Engineers' Association has been formed by officers of engineering units of the Canadian Expeditionary Forces, according to a statement made by Maj. F. J. O'Leary, late brigade major, First Canadian Divisional Engineers, who recently arrived from France. The object of the association is announced to be to protect the interests of its members regarding pensions, war-service gratuities and civil reëstablishment, as well as rendering financial assistance where required. The officers, elected in France, include the following: Gen. Sir A. C. MacDonnell, Col. A. McPhail, Lieut. Col. J. M. Rolston, and Lieut. Col. E. Peppler.

The Detroit Engineering Society held a joint meeting May 1 with the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers, at which A. A. Oswald, research engineer, Western Electric Co., New York, spoke on "Wireless Telephony and Telegraphy in War." A regular meeting of the society was held May 2, which was addressed by John L. Harper, chief engineer, Niagara Falls Power Co., who spoke on "The Past and Prospective Power Development at Niagara Falls and Hydraulic Problems Connected Therewith."

The Utah Society of Engineers held a meeting Apr. 23 devoted to a discussion of the engineering phases of the production of sugar. The following papers were presented: "Mechanical Operation of Factory," by W. Y. Cannon, assistant consulting engineer, Utah-Idaho Sugar Co.; "Process and Chemical Control," by B. R. Smoot, assistant general superintendent, Utah-Idaho Sugar Co.; "Design of Factory" by A. P. Cooper, consulting engineer; "Byproducts" by Mark Austin, general agriculturist, Utah-Idaho Sugar Co.

The Engineers' Club, of Columbus, Ohio, will open its new club rooms May 15. A reception will be held to mark the event. The new officers to be installed May 15 are: President, **J. J. Morgan**; vice-presidents, J. E. Payne and J. R. Withrow; secretary, **Arthur** Richards, and treasurer, T. H. Brannan. The retiring president and secretary are, respectively, E. G. **Brad**bury and Clyde T. Morris.

The Omaha Chapter of the American Association of Engineers recently elected the following officers: President, W. R. McKeen, president of the McKeen Motor Car Co.; vice-presidents, J R. Houghton and J. A. Bruce; secretary, E. Trimble, construction equipment contract department, Union Pacific Co.; and treasurer, W. J. F. Sackriede.

The Municipal Section of the St. Loius Chapter of the American Association of Engineers has been organized with the following officers: E. Paffrath, chairman, and George Grimm, Jr., secretary. One vice-chairman will be elected from each of the five city departments.

The Engineers' Club of Philadelphia held a joint meeting May 6 with the Philadelphia Association of Members of the American Society of Civil Engineers, at which George W. Fuller, consulting engineer, New York City, spoke on the "Coming Duties and Opportunities of Engineers." The annual meeting of the club will be held May 20. The subject of the annual presidential address, by the retiring president, J. Franklin Stevens, will be "The Engineers' Club; Retrospect and Prospect." Following the presidential address Jamison Handy, vice-president of the Bray Studios, Inc., will deliver a paper, illustrated with motion pictures, on "The Motion Picture's Un-

known Part in Winning the War," treating of the secret use of motion pictures during the war for instruction and other uses. The weekly luncheon of the club, May 6, was addressed by Capt. C. J. Clarke, U. S. A., who spoke on "The Relationship of the Wounded Soldier to Business," and the meeting on May 13 will be addressed by Maj. J. A. Vogleson, U. S. A., who will speak on "Camp Sanitation."

The Dayton, Ohio, Chapter of the American Association of Engineers recently elected the following officers: President, E. J. Correll; vice-president, G Calvert; secretary, H. Gellin; financial secretary, L. Born, and treasurer, L. E. Ettinger.

The Twin City Chapter of the American Association of Engineers elected the following officers at the recent annual meeting: President, Frederick K. Bennett; vice-presidents, W. B. Irwin and A. V. Duncanson; secretary, R. C. Smith; treasurer, E. M. Bolmgren.

The Rochester, N. Y., Engineering Society held a meeting May 7 which was addressed by Maj. John F. Coneybear, Ordnance Department, U. S. A., who spoke on "Machine Guns." A meeting will be held May 9 at which Charles C. Zoller will be the speaker.

Personal Notes

WALTER A. FISCHER, formerly designing and constructing engineer on water-works and hydro-electric plants in California and New Mexico, and more recently hydraulic engineer, Construction Division, U. S. A., has been appointed advisory engineer for water upply, Construction Division of the Army, succeeding Lieut. Col. Dabney H. Maury.

CAPT. LOUIS D. KOOP, 211th Engineers, U. S. A., who recently received his discharge from the service, has been appointed chief engineer, Mark C. Tredennick Co., builders, New York City. Captain Koop also served with the 102d Engineers and was constructing quartermaster at Camp Wadsworth, South Carolina.

HENRY C. MEYER, JR., WILLIAM E. S. STRONG, and BASSETT JONES have become associated under the firm name of MEYER, STRONG & JONES, INC., consulting engineers, with offices at 101 Park Ave., New York City, and will specialize in power plants, and mechanical and electrical equipment of buildings and industrial establishments.

RODMAN M. BROWN, chief engineer, city building department of Omaha, has resigned to become general manager, Stiles Construction Co., now engaged in the erection of the Western Motor Car Co.'s new building. It is announced that the Stiles company will open a permanent office in Omaha.

W. R. ARMSTRONG, engineer maintenance of way, Union Pacific System and St. Joseph & Grand Island Ry., has been appointed assistant chief engineer, with jurisdiction as well in the Oregon Short Line, Los Angeles & Salt Lake R.R. His headquarters are in Salt Lake City. Mr. Armstrong was born in 1869 and was graduated from Kansas State University in 1890. His first railroad experience was with the Kansas City, Pittsburgh & Gulf R.R. (now the Kansas City Southern Ry.) in location work, and he afterward became division engineer. After nearly 14 years' experience in engineering and operating departments on various railroads, Mr. Armstrong went to the Oregon Short Line in 1905. He was employed on special engineering work during his first year with that company, and later had charge of construction of the Yellowstone Park branch and of the line from Huntington to Homestead, Ore. He later became superintendent of the mountain division and was appointed chief engineer and general manager in 1913. In 1916 he was appointed engineer maintenance of way, Union Pacific System.

KARL R. KENNISON has been transferred from the middle Atlantic district, United States Shipping Board, Emergency Fleet Corporation, at Baltimore, to the Southern district, where he has been appointed assistant district plant engineer, with headquarters in New Orleans.

MAJ. H. J. BURT, Construction Division, U. S. A., who for the past 18 months has been expediting officer, engineering branch of the Construction Division, has received his discharge from the service and has resumed his association with HOLABIRD & ROCHE, Chicago, as manager.

MAJ. ALLAN M. JACKSON, Canadian Engineers, who has just returned from two years' service overseas, has been appointed chief engineer and superintendent of construction for the Brant County, Ontario, highway system.

FRED R. WHITE, head of the road department, Iowa State Highway Commission, since 1915, has been appointed chief engineer of the State Highway Commission, succeeding T. H. MacDonald, whose appointment as engineer of the Federal-aid road act was noted in *Engineering News-Record* of Apr. 3, 1919, p. 689. He was born in 1884 and was graduated from Iowa State College in the civil-engineering course in 1907. His first engineering work was with the Florida East Coast R.R., on the construction of the Long Key viaduct. He entered the service of the Iowa State Highway Commission in 1908, two years later becoming associated with the Morgan Engineering Co. In 1911 he returned to Iowa and engaged in bridge-construction work for Cerro Gordo County, afterward entering the service of the State Highway Commission as field engineer.

CHARLES F. WILSON, for several years deputy city engineer, Yakima, Wash., has been appointed city engineer, succeeding N. A. Gilman, whose resignation was noted in *Engineering News-Record* of Apr. 10, 1919, p. 747. C. DE VERE FAIRCHILD has been appointed deputy city engineer.

WILLIAM H. ADAMS and ROBERT J. CUMMINS have dissolved the partnership of ADAMS & CUMMINS, consulting engineers, Detroit and Houston, Tex. The Northern business of the firm, with headquarters in Detroit, will be continued by Mr. Adams, and the Southern business, with headquarters in Houston, by Mr. Cummins.

CLEMENT A. HARDY, who for some years has been in the sales department of the Whiting Foundry Equipment Co., Harvey, Ill., has engaged in private practice as a consulting engineer, specializing in industrial-plant layouts, with offices in Chicago.

R. B. ROBINSON, engineer maintenance of way, Oregon Short Line, with headquarters at Pocatello, Idaho, has been appointed engineer maintenance of way, Union Pacific System and the St. Joseph & Grand Island Ry., succeeding W. R. Armstrong, appointed assistant chief engineer, as noted elsewhere.

CAPT. HARRY P. LETTON, Engineers, U. S. A., who was recently discharged from the service after 14 months with the Expeditionary Forces, largely in the water-supply service, has become associated in partnership with GRANT & FULTON, engineers, Lincoln, Neb., under the firm name of GRANT, FULTON & LETTON.

E. V. WILLARD, acting state drainage engineer of Minnesota, has been appointed commissioner of drainage and waters under the new drainage laws abolishing the state drainage commission and creating the position of commissioner.

EDMUND P. BURKE, who during the war was cost engineer, Engineering Division, United States Housing Corporation, has opened offices in the Kresge Building, Detroit, to engage in general engineering practice.

WILLIAM J. NORTON, of NORTON, BIRD & WHITMAN, has completed his work as general superintendent of the Aberdeen Proving Grond contract of the Maryland Dredging & Contracting Co., and has opened offices in New York City, in addition to those in Chicago, Baltimore and Boston. He will resume his consulting work on utility rate regulation problems. In association with

the Withington-Roberts-Wrights Co., Cleveland, industrial architects and engineers, he will engage in general industrial engineering.

L. W. HELMREICH, assistant engineer, Missouri Public Utilities Commission, has been appointed engineer of the recently organized Arkansas Corporation Commission, which will have under its jurisdiction the general supervision of public utilities operating within the state.

SYDNEY W. TAYLOR, JR., civil engineer, San Francisco, who during the war served as secretary of the Capital Issues Committees for the 12th Federal District, has resumed his practice, having opened an office in San Francisco.

HARRY C. COONS, assistant engineer, Eastern Washtenaw Good Roads District, Michigan, has resigned to become district engineer, Michigan State Highway Department, with headquarters at Farmington.

LIEUT. COL. DEWITT P. OLSON, Engineers, U. S. A., who since his return from France has been engaged as military instructor, Iowa State Agricultural College, has been appointed state highway engineer of Idaho, succeeding H. C. Allen, resigned.

CAPT. C. T. BISSELL, Construction Division, U. S. A., has received his discharge from the service and has returned to his former position as engineer, National Board of Fire Underwriters, with office in New York City.

J. J. COAN and EDWARD M. FULLER have become associated under the firm name of COAN & FULLER, engineers and contractors, Salt Lake City, Utah. Mr. Fuller recently resigned as construction engineer of the Utah Fuel Company.

VICTOR MAYPER, who recently has been engaged in Government work in Cuba and Panama, has returned and has opened offices for the practice of engineering at 15 E. 40th St., New York City.

MAJ. MYRON S. FALK, formerly chief, Raw Materials Branch, Explosives, Chemicals and Loading Division, has been promoted to the grade of lieutenant colonel, assigned to the Nitrate Division, Ordnance Department.

H. A. SEWELL, HANS STRASLSUND and C. W. STRAIGHT have organized the Interstate Engineering & Construction Co. with headquarters at Newport, Wash., and will engage in engineering construction.

FRANCIS E. DANIELS, Sanitary Corps, U. S. A., who acted as camp sanitary engineer, Camp Lee, Virginia, has received his discharge from the service and returned to the engineering division of the Pennsylvania State Department of Health, with office at Harrisburg.

HARLAND BARTHOLOMEW, consulting engineer, St. Louis, has been formally retained as consulting engineer for the City Planning Commission of Omaha.

CAPT. MAURICE R. SCHARFF, Engineers, U. S. A., who recently received his discharge from the service, has returned to his former work as principal assistant engineer, Morris Knowles, Inc., engineers, Pittsburgh.

DAVID A. MCCLOSKEY, formerly assistant engineer to the State Engineer, District No. 6, Pennsylvania Department of Highways, has been appointed engineer of Blair County.

R. T. SMITH, formerly of Temple, Tex., has been appointed city engineer and superintendent of water-works at Waxahatchie, Tex.

J. LEE PLUMMER, JR., and LEWIS R. OWEN have become associated under the firm name of OWEN & PLUMMER, civil engineers, Johnstown, Penn.

D. L. MCLEAN, district engineer at Shoal Lake for the Greater Winnipeg Water District, has been appointed office engineer, Manitoba Drainage Commission.

C. B. MCCULLOUGH, professor of civil engineering, Oregon Agricultural College, Corvallis, has been appointed state highway bridge engineer.

E. G. ATKINSON has been appointed assistant city engineer of Schenectady, N. Y.

ARTHUR FRANK, previously connected with the engineering department of the Excelsior Machine Co., St. Louis, has joined the engineering staff of the P. E. Gray Construction Co., Tulsa, Okla.

R. H. PENNORTZ, assistant engineer, Kansas Highway Commission, has resigned to become Oklahoma representative for the Barrett Co., New York City.

VINCENT G. SHINKLE has become a member of the firm, F. W. FREEBORN ENGINEERING CO., Tulsa, Okla., specialists in valuation of oil and gas properties.

J. E. JELLICK, senior resident engineer, Los Angeles County, California, Road Department, has been appointed division engineer, Wyoming State Highway Commission.

R. W. SPOFFORD, who was placed on the retired list of the Navy after the armistice, has returned to the J. G. White Management Corporation, New York City, and has been appointed general manager of the Manila Electric Railway & Light Co., Manila, P. I., for which the White corporation acts as operating manager.

HENRY S. EVANS, formerly of the firm of Evans & Evans, engineers, Altoona, Penn., has been appointed general manager of the Engineering Service Co., Inc., Johnstown, Penn.

R. O. RENSHAW, Huntington, W. Va., has been appointed county engineer of Ritchie County.

JOHN C. BAGLEY, state fire prevention engineer of Indiana, has resigned to become sales manager of the Obenchain-Boyer Co., Logansport, Ind.

E. J. UMSTEAD, formerly chief draftsman, mechanical division, Bureau of Water Supply, Pittsburgh, has been promoted to division engineer.

E. DRINKWATER, consulting engineer, Montreal, Can., has removed his Montreal South office to Rooms 212-13, 180 St. James St., Montreal.

EDWARD J. SMITH, hydraulic engineer, New York City, has established offices in El Paso, Tex., located in Rooms 812-13, Mills Building.

OBITUARY

HERMANN SCHUSSLER, for nearly 50 years engineer for the Spring Valley Water Co., of San Francisco, died in that city Apr. 27, at the age of 76. He entered the company's service in 1866 and remained in its employ as chief engineer until 1909. During this period he designed and constructed the company's entire system, including a large, concrete, subterranean filter-gallery system in Alameda County, Crystal Springs, San Andreas and Pilarcitos dams (San Mateo County), the conduit system conveying the water to San Francisco, and the distributing system in San Francisco. In 1909 he resigned as chief engineer to devote more time to his private practice. In his private practice as civil and hydraulic engineer he was identified with a number of works in California, Oregon, Nevada and Hawaii, and in a consulting capacity made numerous investigations, report and plans on development work in California. Mr. Schussler was consulting engineer for the California-Oregon Power Co. at the time when the Copco dam was built.

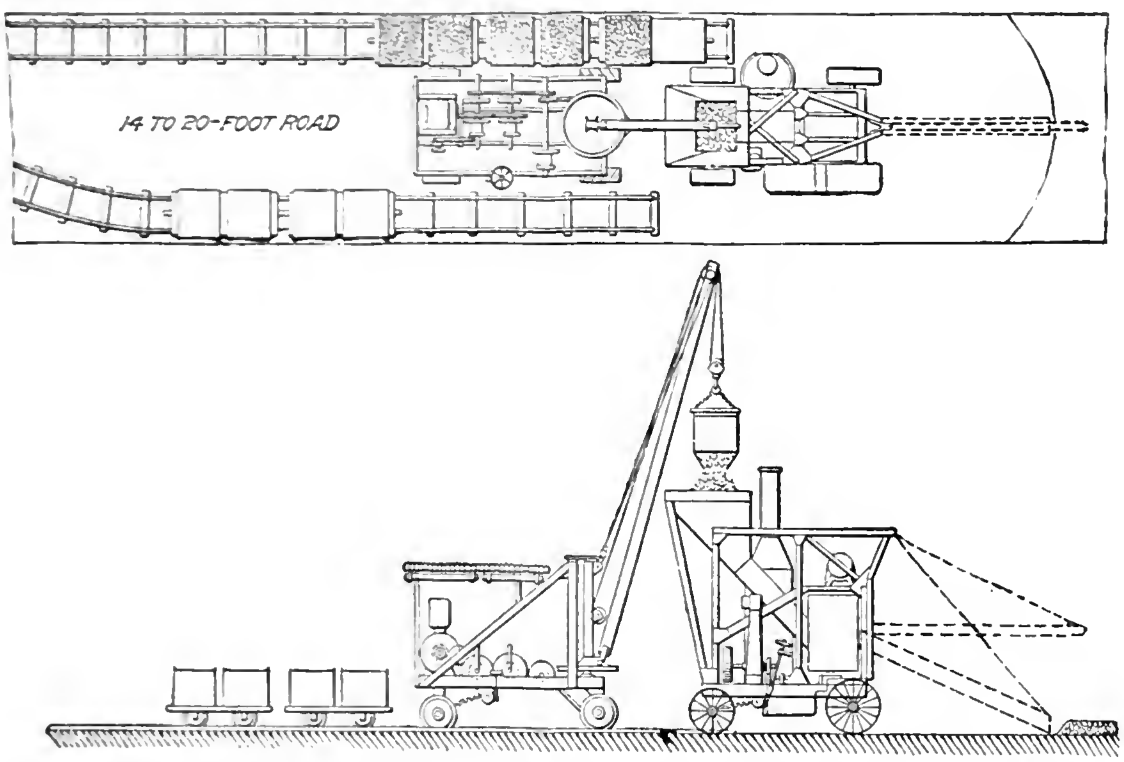
MAJ. JOHN WILLIAM MARK, 302nd Engineers, U. S. A., who since his return from France had been attached to the Engineer Officers' Training School at Camp A. A. Humphreys, Virginia, died in New York City May 2.

Self-Propelled Crane for Charging Concrete Mixer

A self-propelled crane for transferring "batch" hoppers from industrial railway cars to the charging hoppers of concrete mixers is being manufactured by the John F. Byers Machine Co., of Ravenna, Ohio. A similar device is used with steam power and a longer boom with clam attachment, for unloading and transferring aggregates from cars to the bins at the siding.

The layout for using the crane in connection with a concrete mixer is shown in the accompanying illustration. The crane carriage is of such width that it can operate upon a 14-ft. roadbed with a line of industrial track on each side. The crane is equipped with two friction drums, a forward and reverse propelling mechanism, a boom swinger and a bull wheel. The power is supplied by a 10-hp. gasoline engine. The capacity of the crane is two tons at a 10-ft. radius. While this machine may be used with the ordinary hoist-hopper mixer, the drawing shows a combination which, it is asserted, saves 25% on first cost of mixer and about 10 sec. on each batch, by dumping directly into the mixer drum.

Wide wheels are used so that the apparatus can move easily over the subgrade. It is said that this device will overcome many of the difficulties which have attended feeding concrete mixers from industrial railways by a derrick attached to the mixer.



PLANT LAYOUT USING SELF-PROPELLED CRANE FOR CHARGING MIXER

Purify Water in Large Swimming Pool by Ozonization

Purification of the water in what is said to be the largest swimming pool in the world, in New Krug Park, Omaha, Neb., will be accomplished by what is known as ozonization by the Ozone Co. of America, according to reports of the contract. The pool has a water surface area of more than an acre and holds 1,000,000 gallons of water.

Trade Organizations Begin Work on National Association Building

During the present week, work was started upon a building which it is planned to make the national home for all trade associations now located, or which will locate in the future, in New York City. Among the advantages which are expected from this plan are: Closer coöperation between allied industries; greater convenience for business men desiring to see several associations; special advantages for coöperative meeting rooms, and added prestige due to having a high-grade building devoted to the interests of business men, in the heart of the hotel, railroad and subway terminal districts of New York.

The building will be near the corner of Fifth Ave. and 43d St., extending through the block to 44th St. It will be 20 stories high, having about 275,000 sq.ft. of floor space, and will be terraced above the 12th floor to conform to the New York zoning law for conservation of light. An arcade with display rooms will extend through from 43d St. to 44th St. It is the first large business building enterprise started in New York since the armistice was signed. The contract was let to Fred T. Ley & Company.

The name of the structure will be the National Association Building. It will be ready for occupancy the latter part of next January. Further information may be obtained by addressing Willard C. Brinton, consulting engineer, 17 W. 44th St., New York City.

Railroad Administration Purchases 2,000,000 Ties

Through L. S. Carroll, chairman of the purchasing department of the United States Railroad Administration, the Pacific Coast fir lumbermen have received an order for 2,000,000 railroad ties, aggregating 75,000,000 ft. b.m. Of these 500,000 ft. will be ordered from the Oregon mills, while the remainder will be purchased in Washington. The ties will be No. 1 common lumber, running about 40 ft. to the tie. The purchase price was $20 to $21 per 1000 ft. b.m. The specifications require heartwood. The ties are to be used on the New York Central, the Baltimore & Ohio, the Pennsylvania and other Eastern railroads.

Business Notes

The Chicago Bridge and Iron Co., Chicago, Ill., has moved its general sales office from the Chicago works to the 15th floor of the Old Colony Bldg., which quarters it occupied before the war.

The Philadelphia Vitrified Brick Co., Philadelphia, Penn., has been licensed to manufacture wire-cut lug paving brick by the Dunn Wire-Cut Lug Brick Co. of Conneaut, O., becoming the 75th licensee of that company. The Eastern works of the company are at Saxton, Penn.

The Dean Bros. Steam Pump Works of Indianapolis, Ind., has opened a sales office at 141 Broadway, New York City. H. Meacham has been appointed district sales manager.

The Reichert Mfg. Co., of Milwaukee, Wis., has changed its corporate name to the Metal Forms Corporation. The product will be the same as that manufactured heretofore, the new trade name being "Metaforms."

The Nichols-Moore Co., with offices at 11705 Detroit Ave., Cleveland, Ohio, has been organized to carry on a general advertising business. The organizers are Druses H. Nichols, formerly managing director of the Allied Publicity Bureau, and John C. Moore, formerly assistant director of the same organization.

Trade Publications

The Republic Creosoting Co., of Indianapolis, Ind., has issued a new catalog which gives scientific and practical information pertaining to creosote wood-block flooring, and its advantages in shop practice.

"How Business With Foreign Countries Is Financed" is the title of a pamphlet issued by the Guaranty Trust Co. of New York. It is published for the benefit of exporters and importers and others having business or financial relations with foreign countries. It contains 28 reproductions of specimen forms of drafts,

letters of credit, bills of lading, invoices and other documents generally used in connection with the financing of exports and imports, together with explanatory notes. It will be sent on request.

"Coaling Ships Mechanically" is the title of a handsomely illustrated 8½ x 11-in. booklet just issued by the Michener Storage Co., 17 Battery Place, New York City. The illustrations depict inside and outside apparatus for coaling large ocean liners.

The Taylor Instrument Co. of Rochester, N. Y., has just issued a general industrial catalog of Tycos instruments, containing 422 pages. The catalog contains useful information in regard to temperature-indicating, recording and control apparatus.

The Portable Machinery Co., of Passaic, N. J., has issued a folder on the subject, "Over 1000 Scoop Conveyors." The folder is illustrated and describes the loaders.

The American Lava Company, of Chattanooga, Tenn., has issued a 16-page pamphlet on the subject, "Lava for Mechanical and Electrical Purposes." The booklet describes the composition of the company's product, which is machined from mineral steatite.

"Truscon Standard Buildings" is the title of a booklet issued by the Truscon Steel Co., Detroit, Mich. Descriptions and illustrations of the various sizes of standard buildings made by the company are given.

Common Labor Becoming Scarcer

Only Lively Construction Can Prevent Serious Shortage — Labor Just Sufficient for Moderate Amount of Work Now Under Way

By Alden W. Welch

Common labor is not plentiful. Nationally, the situation is that there is just about enough common labor to supply the present moderate demand. If construction were normal there would be a serious scarcity. To those who look beyond the moment, the situation is worthy of serious consideration.

There are many indications that construction work will soon get under way in an encouraging volume. Prices of materials are high, but bids on construction projects do not appear to be excessive. In numerous instances they are less than the engineer's estimate.

PRESENT COST OF COMMON LABOR

	Rate per Eight Hour Day	Class of Common Labor
Atlanta	$2.44	City pays
Atlanta	2.40-2.68	Contractors pay
Baltimore	3.20-3.60	All
Baltimore	3.68	Shipyard
Boston	3.60	Concrete
Boston	3.60-4.00	Common
Dallas	2.40	Building
Dallas	2.50-2.80	City pays
Denver	3.50	City pays
Detroit	4.00	All
Kansas City	4.60	Common
Los Angeles	3.50-4.00	Common
Los Angeles	3.50-4.50	Wheelbarrow
Los Angeles	3.50-4.00	Sewer
Los Angeles	4.50	Hod Carriers
Los Angeles	4.00	Paving
New Orleans	2.40	Common
New York	4.00	Concrete
Pittsburgh	3.60	Common
St. Louis	2.00-2.16	Concrete
St. Louis	2.16-2.40	Brick
St. Louis	2.80	Sewer
St. Paul	3.60	Common
San Francisco	3.50-4.00	Nonunion

On Apr. 30, proposals were received in Albany, N. Y., on 19 highway projects. In every instance there were bids under the estimate. In most cases, all the bids were lower than the estimate.

Conceive of prices of construction materials falling to a more attractive level. A boom would probably result. Much labor would be needed. A shortage of common labor would ensue, and wages would advance.

The price of common labor varies throughout the country—as shown by the tabulation—and, in view of the cost of living, is nowhere excessive. The labor problem is not one of cost but of availability. A trip to the Federal Custom House in New York will discover a long line of aliens procuring passports to return to their native lands. One financial paper estimates that soon a million will have left New York, bearing with them $1,000,000,000 in money plus $1,500,000,000 in annual productive effort.

This heavy exodus is not being compensated for by immigration, which is practically at a standstill. During the war there came to this country not more than 1,000,000 workers—only 25% of the normal influx. This shortage, added to the million now leaving, creates a total shortage of 4,000,000. The longer construction work is put off, the more serious will become the labor situation.

North to South to West

Boston faces the likelihood of a carpenters' strike this month, as the union agreement lapsed May 1, when the carpenters were to ask $8 for eight hours' work, against the present $6.40. Concrete workers receive 45c. per hour; concrete laborers, 45, 47 and 50c. Stonecutters and quarrymen are on strike.

T. M. Barr, Federal director for Maryland of the United States Employment Service, states that the common-labor market in Baltimore is satisfactory—a steady stream of applicants, with employment for all. Wages average 40 to 45c. per hour.

In Atlanta, Ga., labor is not overabundant, though sufficient for present needs. The city pays $2.75 for a nine-hour day; contractors, $3 to $3.35 for 10 hours.

Dallas, Tex., reports just enough labor to supply present demand. The general opinion is, in view of the $17,000,000 worth of road bonds voted in Texas, that when work gets under way common labor will be very scarce.

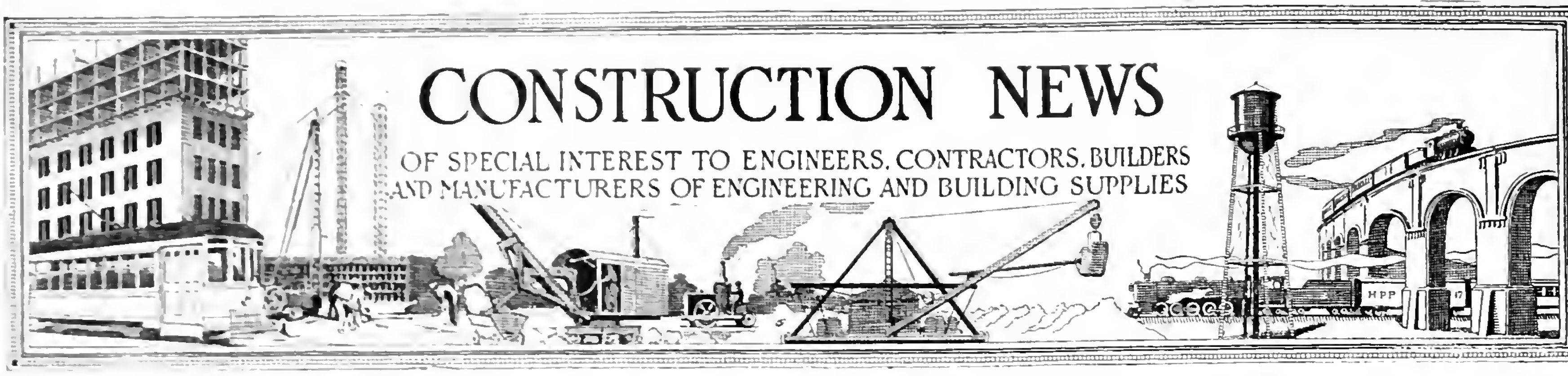
In the building trades in Kansas City, Mo., labor conditions are fairly normal. The War Labor Board has under consideration the demand of the structural iron workers. Plasterers and carriers are striking for 68¾c. per hour; but work is not delayed, because their places are being filled by building laborers at 57½c. Labor in paving work is plentiful, and this class of work is booming.

In Detroit, Mich., the supply of common labor just meets the demand. Contractors pay $5 for a 10-hour day.

Denver, Colo., reports excellent conditions in the labor market. There is a heavy demand for farm labor, not only in Colorado, but in Idaho and South Dakota as well, with offered wages of $50 to $60 a month, with board and lodging. Considerable building is under way in Denver, and in the building trades there is practically no idle labor. Bricklayers receive $7 for an eight-hour day, and expect to demand $8 this spring. Carpenters and painters are paid $6.40. Contractors complain of a shortage of common labor, especially for grading, teaming and mining. The city pays $3.50 for common labor. Telluride, near Denver, calls for 100 machine men, mine men and muckers. The railways are doing little new construction, but track men are in demand. Track work is usually lively at this season, owing to the winter damage in the mountain districts. The strike of the Leadville miners has been settled. The men resisted a decrease from $4.50 to $3.50, compromising on $4.

Since the adjustments reached by the employers and unions in San Francisco, Seattle and San Pedro, unemployment on the coast has greatly decreased. The total in California is 12,000 unemployed, of whom 7300 are laborers; in Washington, 7000; in Oregon, 4000. About half these men are unskilled laborers. Work in the country districts has improved; but the large corporations, including the public utilities, are undertaking no important projects.

In Los Angeles labor is usually plentiful, but not since the armistice has it been scarcer. The Employment Division of the United States Department of Labor reports a decrease in the number of unemployed since Mar. 15, when 9000 was the estimate. The absorption of the surplus of that class of labor used in construction, including building, has been especially rapid in the past few weeks. Agricultural activities have also claimed many men. There have been urgent calls, recently, for common labor on several highway contracts in southern California. Mexicans constitute about 15% of the supply. Before the war they received $1.25 to $2.50; the present rate is $3.50, and some are demanding $4, the prevailing rate for American labor. Plainly, the market is tightening.



PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
May 13	Hollandale, Miss.	Apr. 17
May 13	Albert Lea, Minn.	May 8
May 14	Gilboa, N. Y.	Apr. 17
	Adv. Apr. 10 to 24.	
May 15	Fairmont, Minn.	May 8
May 27	Niles, Mich.	May 1
May 29	Tamaqua, Pa.	Apr. 24
	Adv. Apr. 24.	
June 2	Mankato, Minn.	May 1
	Adv. May 1.	

SEWERS

May 12	Pontiac, Mich.	Apr. 24
	Adv. Apr. 24.	
May 13	Newark, N. J.	Apr. 24
May 13	Frederick, Okla.	May 8
May 14	Humphrey, Neb.	May 1
May 14	Cleveland, O.	May 1
May 15	Litchfield, Minn.	May 8
May 15	Milwaukee, Wis.	May 8
May 16	Beloit, Wis.	May 8
May 17	Barberton, O.	May 8
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 19	Fresno, Cal.	May 8
May 20	Erie, Pa.	Apr. 24
	Adv. Apr. 24.	
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 22	Milwaukee, Wis.	May 8
May 27	Niles, Mich.	May 1

BRIDGES

May 12	St. Croix, Que.	May 1
May 12	Bright, Ont.	May 1
May 13	North Temiskaming, Que.	May 1
May 14	Rome, N. Y.	May 8
May 15	Valdosta, Ga	Apr. 24
May 15	Marion, Ia.	May 1
May 16	Thomasville, Ga.	Apr. 24
May 16	Watseka, Ill.	May 8
May 19	Cottonwood, Ariz.	Apr. 24
May 19	Jerome, Ariz.	May 1
May 19	Bowling Green, O.	May 1
May 19	Marysville, Wash.	May 8
May 19	La Fayette, Ga.	May 8
May 20	Macon, Ga.	May 1
May 27	Harrisburg, Ark.	May 8
	Adv. May 8.	
June 5	Stratford, Conn.	May 8
June 6	Monroe, Ga	May 8
June 9	Montgomery Ala.	May 8
	Adv. May 8.	

STREETS AND ROADS

May 9	Patchogue, N. Y.	Apr. 24
	Adv. Apr. 24.	
May 9	Trenton, N. J.	May 1
May 9	Ebensburg, Pa.	May 8
May 10	Pittsfield, Mass.	May 1
	Adv. May 1	
May 12	Elk River, Minn.	Apr 17
May 12	David City, Neb	Apr 24
May 12	Wahoo, Neb	Apr 24
May 12	St. Paul, Neb	Apr 24
May 12	New Jersey	Apr 24
May 12	Salem, N. J.	Apr 24
May 12	Great Falls, S. C.	May 1
May 12	Oneonta, N. Y.	May 1
May 12	Charleston, Wash	May 1
May 12	Bremerton, Wash	May 1
May 12	Hutchinson, Kan.	May 1
May 12	Seattle, Wash.	May 1
May 12	Duluth, Minn.	May 8
May 12	Gallitzen, Pa.	May 8
May 12	Paris, Ont	May 8
May 12	Chicago, Ill.	May 8
May 13	North Bend, Ore.	May 8
May 13	Massachusetts	May 8
May 13	Boston, Mass	May 8
May 13	Jersey City, N. J.	May 8
May 13	Buffalo, Minn.	May 8
May 13	Madisonville, Ky.	May 8
May 13	Toledo, O.	May 1
May 13	Beatrice, Neb.	Apr. 24
May 14	Arkansas	Apr. 17
	Adv. Apr. 17 and 24.	
May 14	Austin, Minn.	Apr. 24
May 14	Nebraska City, Neb.	Apr. 24
May 14	Humphrey, Neb.	Apr. 24
May 14	St. Catharines, Ont.	May 8
May 14	Helena, Mont.	May 1
May 14	Illinois	May 1
May 14	New Jersey	May 1
May 15	Sioux Falls, S. D.	May 1
May 15	Columbus, Tex.	May 1
May 15	Duluth, Minn.	May 1
May 15	Rushville, Neb.	Apr. 24
May 15	Hastings, Minn.	Apr. 24
May 15	Plymouth, Wis.	Apr. 10
May 15	Rome, Ga.	May 8
May 15	Bridgeville, Pa.	Apr. 24
May 15	New York	May 1
May 15	Lebanon, Pa.	May 1
	Adv. May 1.	
May 15	Terra Haute, Ind.	May 1
May 15	Cumberland, Md.	May 1
	Adv. May 1.	
May 16	Toronto, Ont.	Apr. 24
May 16	La Moure, N. D.	May 1
May 16	Newport, Pa.	May 8
May 16	Rhode Island	May 8
	Adv. May 8.	
May 17	Lincoln, Neb.	May 8
	Adv. May 8.	
May 17	Memico, Ont.	May 8
May 19	Merced, Cal.	Apr. 10
May 19	Tulsa, Okla.	Apr. 17
	Adv. Apr. 17 and 24.	
May 19	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 19	Minneapolis, Minn.	May 1
May 19	Plainfield, N. J.	May 8
May 19	California	May 8
May 19	Washington	May 8
May 19	Grafton, W. Va.	May 8
May 19	Brampton, Ont.	May 8
May 20	Windom, Minn.	Apr. 24
May 20	Brockton, Mass.	May 8
	Adv. May 8.	
May 20	Nutley, N. J.	May 8
May 20	Columbus, O.	May 8
May 20	Albemarle, N. C.	May 8
May 21	Akron, O.	Apr. 24
	Adv. Apr. 24.	
May 21	Preston, Minn.	May 8
May 21	Illinois	May 8
May 21	Ebensburg, Pa.	May 8
May 22	Benson, Minn.	May 1
May 22	Clay Center, Neb.	May 8
	Adv. May 8.	
May 22	Pittsburgh, Pa.	May 8
May 23	Lawrence, Kan.	May 1
May 26	Pennsylvania	May 8
	Adv. May 8.	
May 27	Preston, Minn.	May 1
May 27	Henderson, Minn.	May 8
May 27	Mahnomey, Minn.	May 8
May 27	Harrisburg, Ark.	May 8
	Adv. May 8.	
May 27	St. Louis, Mo.	May 8
May 28	Killmar, Minn.	May 3
May 28	Nashville, Tenn.	May 1
	Adv. May 1.	
May 29	Michigan	May 8
May 30	Dallas, Tex.	Apr. 17
	Adv. Apr. 17 and 24.	
June 1	Michigan	May 8
June 2	St. Severe, Que.	Apr. 24
June 2	Elkins, W. Va.	May 8
	Adv. May 8.	
June 3	Griffin, Ga.	May 8
June 3	New York, N. Y.	May 8
	Adv. May 8.	
June 10	Clarksville, Pa.	Apr. 3

EXCAVATION AND DREDGING

May 14	Sheboygan, Wis.	May 1
May 14	Poplar Bluff, Mo.	Apr. 3
May 15	Mobile, Ala	Apr. 10
	Adv. Apr. 10 to 24.	
May 15	Sheboygan, Wis.	May 1
May 16	Grant City, Mo.	May 1
	Adv. May 1.	
June 2	Beaufort, N. C.	Apr. 24
	Adv. Apr. 24.	

INDUSTRIAL WORKS

May 10	Sheboygan, Wis.	Apr. 24
May 13	North Wittshire, P. E. I.	May 8
May 15	Toronto, Ont.	Apr. 24
May 15	Bemidji, Minn.	Apr. 17
June 15	Montreal, Que.	May 8
May 21	Guelph, Ont.	May 8
May 24	Brooklyn, N. Y.	May 8

BUILDINGS

May 10	Joplin, Mo.	May 8
May 10	Fergus Falls, Minn.	May 8
May 12	Trail, B. C.	May 8
May 12	Chambersburg, Pa.	May 8
May 12	Ironton, O.	May 1
	Adv. May 1.	
May 12	Flint, Mich.	Apr. 17
May 12	Hawley, Minn.	Apr. 24
May 13	Faribault, Minn.	May 8
May 15	Port Washington, Wis.	Apr. 24
May 15	Verona, N. J.	Apr. 10
May 15	Kearney, Minn.	Apr. 17
May 15	Winnebago, Minn.	Apr. 24
May 15	Sault Ste. Marie, Ont.	May 1
May 15	Farrell, Pa.	May 1
May 15	Montreal, Que.	May 8
May 15	Waterbury, Conn.	May 8
May 15	Franklin, O.	May 8
May 16	Round Lake, Minn.	May 8
May 16	Grand Rapids, Mich.	May 1
	Adv. May 1.	
May 17	Guelph, Ont.	May 8
May 17	Birmingham, Ala.	May 8
May 19	Charleston, S. C.	May 1
May 20	Cathay, N. D.	May 1
	Adv. May 1.	
May 21	Cohoes, N. Y.	May 1
May 21	Los Angeles, Cal.	May 8
May 22	Springfield, Mass.	May 8
May 26	Gallipolis, O.	May 1
June 1	Montreal, Que.	May 8
June 1	St. Cloud, Minn.	May 8
June 1	Rochester, Minn.	May 8
June 15	Anoka, Minn.	May 8

FEDERAL GOVERNMENT WORK

May 12	Dredging — New York, N. Y.	Apr. 10
	Adv. Apr. 10 to 24.	
May 12	Torpedo Storage Building —Spec. 3767 — Newport, R. I.	Apr. 24
May 12	Storehouse — Spec. 3842 — Charleston, S. C.	Apr. 24
May 12	Conduit System—Spec. 3846 —Pensacola, Fla.	Apr. 24
May 12	Buildings — Spec. 3855 — Paris Island, S. C.	May 1
May 15	Rip Rap—Baltimore, Md.	Apr. 17
	Adv. Apr. 10 to 24.	
May 15	Dredging — New Bedford, Mass.	Apr. 17
	Adv. Apr. 10 to 24.	
May 15	Grading — Washington, D. C.	May 8
May 15	Road Work — Kalispell, Mont.	May 8
May 15	Road Work—Hailey, Idaho.	May 8
May 19	Dry Dock—Spec. 3858—Charleston, S. C.	Apr. 24
May 19	Elevators and shaft—Spec. 3851—Philadelphia, Pa.	May 1
May 19	Crane—Spec. 3869—Pensacola, Fla.	May 1
May 19	Cranes—Spec. 3670—South Charleston Va.	May 8
May 20	Dredging — New London, Conn.	May 1
	Adv. May 1.	
May 20	Conduit, Wiring and Lighting Fixtures—Elgin, Ill.	May 1
	Adv. May 1.	
May 21	Dredging—Duluth, Minn.	Apr. 24
	Adv. Apr. 24.	
May 21	Derricks—Florence, Ala.	Apr. 24
	Adv. Apr. 24.	

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

Engineering News-Record

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren, *Editor*

Charles Whiting Baker, *Consulting Editor*

Volume 82 — NEW YORK, THURSDAY, MAY 15, 1919 — Number 20

Danger in Thawing Concrete

THAWING out a frozen surface of concrete with the warm concrete which is to form the next layer in the mass seems to have been practiced successfully in two recent dams, but the engineer's testimony on another page is noted there as a record, not as a recommendation for general practice. For a superficial, recent surface freezing such a scheme may work, but the probabilities of stratification due to delayed setting or reduced strength would point to the greatest care in using this method where weak horizontal planes might threaten future danger.

Hauls for Export Freight

PORTS are essentially national institutions. No matter how extensively they are financed by the city or state where they are located, or how largely they benefit that city or state, their fundamental purpose is to link up domestic and foreign trade centers. Too often this has been forgotten and the port has been developed as an isolated unit, in the hope that time would force both land and water trade routes to utilize its mechanical or possibly geographic advantages. A superior line of attack is that indicated in the analysis of the Mississippi Valley possibilities by J. R. Bibbins, on another page, where trade is studied as a unit from the American consumer to the foreign producer or vice versa, and the whole rate structure—on land and on sea—analyzed, not with a view of promoting any one port, but with the idea of so distributing the foreign trade movement as to produce the most economic through carriage of freight, regardless of local advantages. As was pointed out in these columns some months ago, this requires national thinking and doing in transportation matters, and surely the time came long ago when this was necessary. Persistence in the old policy has been wasteful.

Selling the Spruce Equipment

LIKE a tragedy of the great war, the sudden demise of spruce-production activities in the Northwest at first seems the untimely ending of a promising enterprise. In the Vancouver cut-up plant, so recently teeming with workers, there is now the dead silence of a great warehouse. The sharp contrast is to the engineer-visitor a persistent suggestion that something must have gone wrong. But this is only the illusion that may arise when military activity enters the field of engineering. An abandoned project from the engineering point of view does indeed suggest an untimely ending, but military endeavor runs in a different channel—one in which sudden interruption often indicates attainment of purpose. It was so with the Spruce Production Division. Its work was well planned and consummated with skill. Now that its military purpose has been served, a most commendable policy is directing the closing up of affairs in such way as to interfere as little as possible with trade conditions in the Northwest. To dump $10,000,000 worth of equipment and materials on the market at cut prices would have demoralized local conditions for years to come. Yet disappointed bidders turned upon the spruce corporation with bitter criticism when offers below market values were rejected. Rumor spread that at Vancouver Barracks there was a "junk pile" where brokers were profiteering at the purchaser's expense. Nothing could have been farther from the truth. The orderly array of equipment and the systematic records of the stock are truly surprising, when the difficulties under which it was handled are considered. The Secretary of War and the Chief of Staff on a recent inspection visit commented on the care that the equipment had received and the splendid condition in which they found it. First and last the soldierly precision that has characterized the spruce-production work warrants a "well done."

Responsibility for Tank Failure

NO NEW technical teachings are found in the circumstances of the Boston molasses-tank failure recorded in this issue. The case was simply one of a structure designed and built too weak for its service; it was not more than half as strong as it needed to be. Engineers know thoroughly well how to build tanks so that they will be safe, and they have nothing to learn, therefore, from the manner of failure of this scamped piece of construction. But they may well learn, or try to learn, in another respect. It is evident that they do not know how to make sure that their technical skill and knowledge will be applied to the use of the community. They have failed in not creating conditions such that only safe engineering structures can be built in Boston —or, for that matter, in any other city. The blame for this rests on the engineering profession, for in the long run the safety of structures that may endanger life and property is the concern of the engineering profession as a whole. Where does the responsibility lie and how is it to be made a means of protecting the public? Courts of law will be called upon to consider the case, and they will doubtless attend to the responsibility of the men who built the tank; of those who, while supposedly guarding public safety, allowed it to be built, and of those who put the tank to use and continued to use it in spite of the fact that they might and should have known its dangerous condition. But, beyond this, there is the further question of engineering responsibility. Was an engineer concerned in the construction of the tank? Did this engineer jeopardize the reputation of the pro-

fession by grossly faulty work, or perhaps by yielding technical authority to an incompetent superior? Or, did state and city permit a dangerous structure to be erected without the assurance that an engineer's skill and science had been applied to it? Finally, does the name engineer in Boston mean either competence or responsible authority? Questions such as these go to the very heart of some of the conditions now agitating the profession, and give substance to discussions of professional regulation, of the obligation of competence, and of the need for group action by engineers.

The Professional Conscience

SURELY the malpractice of whatever engineers were connected with the fatal molasses tank is a matter of personal concern to the technical community, just as definitely as a lawyer's malpractice is of concern to the legal community wherein he labors. There is such a thing as a professional conscience, and it is rooted in the simple but compelling truth that the reputation and the livelihood of every member of the profession depend on the good conduct of every other member. Lawyers have organized bar associations to be custodians of the legal conscience. But who is the custodian of the engineering conscience? When we study this question carefully, and find an answer, we shall have set a signpost that, in the confusion of movements for local, state, national and ultra-centralized organizations, points unmistakably to the ultimate unit of structure in the professional community—the local group.

Output Versus Wages as the Contractor's Problem

CONTRACTORS need to spend more time in developing output and less time in deploring high wages. When two or three are gathered together, the wage topic soon takes precedence. Wages are high and they will continue high. Output has not climbed with wages; it has slipped back. The problem is clear. What contractors have to do is not merely to *talk* about the worker's wage demands but to get busy increasing his output. The modern method of procedure is to enlist the worker's interest and coöperation—just what the big industrial organizations, like the White Company, the Standard Oil Company and others, are now trying to do. Action along constructive lines is to be expected of strong men; grumbling is not.

Methods of increasing output are available. One hesitates nowadays to mention scientific management; its fanatic disciples have made the name a jest among contractors. Nevertheless, the reasonable professors of this "science" have developed ways of increasing the output of workmen. Some of these ways are being employed partially. The workman has been the chief obstacle to their general adoption, for two principal reasons: The practices were imposed from above and aroused the workman's resentment against dictation, and the workman saw in these practices only an attempt to increase production without an adequate increase in remuneration. The workman's conclusion may not have been justified. The important fact is that such was his conclusion. Again, the task of the contractor is to meet the condition and not to deplore its existence.

The coöperation of labor in devising better methods has seldom been formally enlisted. Instead, the plan has been formulated by the employer and imposed by declaration, and labor was expected to espouse the reform with zeal. It did not. It will not do so, and it cannot be expected to de so without the conviction which the employer has of the need and the benefit of the plan and the further conviction that labor will become a direct beneficiary. Labor's attitude is largely justified. Without similar understanding and assurance the contractor would not accept a declaration by the owner of, say, a new method of estimating monthly payments.

Labor will help to increase production if it is made to understand the necessity and is assured a share in the gain. This is not the statement of a visionary; too many contractors are demonstrating its possibility for it to be successfully denied. As an example, the statement by J. B. Lippincott in *Engineering News-Record*, of Mar. 27, 1919, p. 605, may be noted. With the necessity for increasing output put squarely before the unions, Mr. Lippincott reports that they "took a keen interest in assisting in improving unit costs." Similar testimony is given by word of mouth from other construction managers. Contractors cannot logically complain of labor inefficiency until they have tested the worker's response to this sort of treatment. The spirit of coöperation will be found latent in a greater number of union labor leaders than contractors are accustomed to credit with fair thinking.

In any event, let us be done with mere wailing over high wages. He who is acting along lines that have brought success to others may have some right to complain—but we are inclined to think that he is not the man who is complaining.

Higher Standards For Road Construction Will Mean Higher Prices

CHANGES in concrete-road construction practice which will alter contracting methods in some important particulars are forecast by the action, noted on page 955, of the conference of highway engineers of the leading road-building states of the Mississippi Valley. The recommendations of this conference, while they do not commit anyone to definite action, are the mature conclusions of the highway officials who participated, and in general it may be expected that they will dictate practice in the present season's construction and to a greater extent in the construction of coming seasons. Evidence in support of this belief is found in the new specifications of the Division of Highways of Illinois, which were reviewed in *Engineering News-Record* of Apr. 10, 1919, p. 735. In some particulars the requirements of the Illinois specifications are even more exacting than those recommended by the conference.

As was stated editorially by *Engineering News-Record* of Mar. 27, 1919, p. 599, opinion is becoming settled that the wet mixtures which have been used are no longer permissible for road construction. Concrete mixed so dry that it must be compacted by tamping, and a rigid control of consistency by slump tests in the field, will in a year or two be common requirements in specifications for concrete roads. A general tightening up of the control of subgrade construction, cold-weather work, and finishing and curing, will accompany the demands for richer and stiffer concrete mixtures. As a whole, construction standards will be raised.

Revision of contracting methods must naturally follow these revisions in construction practice. In accomplishing this revision the public-roads officials has a part to play as well as has the contractor. No obstacle stands in the contractor's way to meeting the new requirements except agreement on prices. *Construction will cost more.* Not merely are materials and equipment more expensive and wages much higher, but richer mixtures of tamped concrete cost more to place and finish. Public-roads officials must revise their standards of prices as they have revised their standards of quality and perfection of workmanship.

Even then there remains this question: Are the roads built on the new standards worth the added price? The engineers responsible for the new standards will say, Yes. Some experienced contractors, men ranking as engineers, have said, No. In theory the engineers have the better of the argument and should be supported. For the final answer, however, do we not need to wait the test of service?

Scientific and Technical Employees of Government Form Union

THE scientific and technical employees of the Government departments and agencies in Washington have taken steps to form a branch of the Federal Employees' Union No. 2, which is a part of the American Federation of Labor. This union has now about 21,000 members, and has been very active in connection with Congressional bills affecting employment in Government service in the District of Columbia. The formal vote to join this union was taken at a meeting May 8, at which 185 scientists and engineers favored the plan and 132 favored a permanent organization without affiliation with the American Federation. The leading speaker for the union plan was Dr. Edward B. Rosa, chief physicist of the Bureau of Standards, and actively interested in the American engineering standards movement, as recorded in the two preceding issues of *Engineering News-Record.*

The news that some of the men long prominent in Government scientific and technical work have organized a labor union and have become associated with the American Federation of Labor will startle those who have not followed the recent developments in collective bargaining and do not appreciate the particularly hard lot of the Government specialist. He has been driven by the hopeless condition in which the high cost of living leaves him to take decisive measures to present his plea for fair treatment to Congress. A characteristic incident is the assumption by Thomas H. MacDonald of the duties of the nation's roadbuilder, salary $6000, and the practically simultaneous resignation of H. K. Bishop from the Bureau of Public Roads to become chief engineer of the Indiana Highway Department, salary $7000. Congress asks Mr. MacDonald to make a financial sacrifice in order to accept the most responsible highway post in the country; the experienced business men on the Indiana Highway Commission offer Mr. Bishop the proper compensation for the work. In that difference of viewpoint lies the fundamental explanation of the decay that is beginning to take place in Government scientific and technical work. It is a matter of personnel, of the impossibility of doing good work continuously without reasonable compensation. The unionizing of the Government scientist and engineer is proceeding rapidly only because these classes like the work, appreciate the honorable position of Government service, and wish to stay in it if there is any way to bring to the attention of Congress in a convincing way their present unfortunate condition. If Congress does not heed the warning, the Government departments will suffer seriously.

This decision to have a union of the scientific and technical staff in the District of Columbia has another disturbing aspect. Salaries are paid to these men under two plans. Congress sometimes allots a lump some for a group of investigations, and the bureau chief and his superior, the cabinet officer at the head of the department, then fix the number and salaries of the men engaged in this work. This allows considerable flexibility in arranging the work and selecting men for it, and is the system under which all the activities of the Bureau of Mines are conducted. The second system is the designation by Congress of the grades of men to be employed, the compensation in each grade, and the number of men in each; this is known as the statutory-salary system, and all the work of the Patent Office is conducted under it. In most bureaus there are both statutory and lump-fund salaries, and, so far as scientific and technical work is concerned, the lump-fund system is much better. Congress desires the statutory system, however, on the ground that it enables that body to control the activities of the bureaus more effectively than under the lump-fund system. The difficulties it presents to a bureau chief can be understood by picturing the predicament of a chief engineer of a railroad who was told at the beginning of each year just how many grades of assistants from office boys to chief assistants his staff should contain, how much each man was to be paid and how many men in each grade he could have.

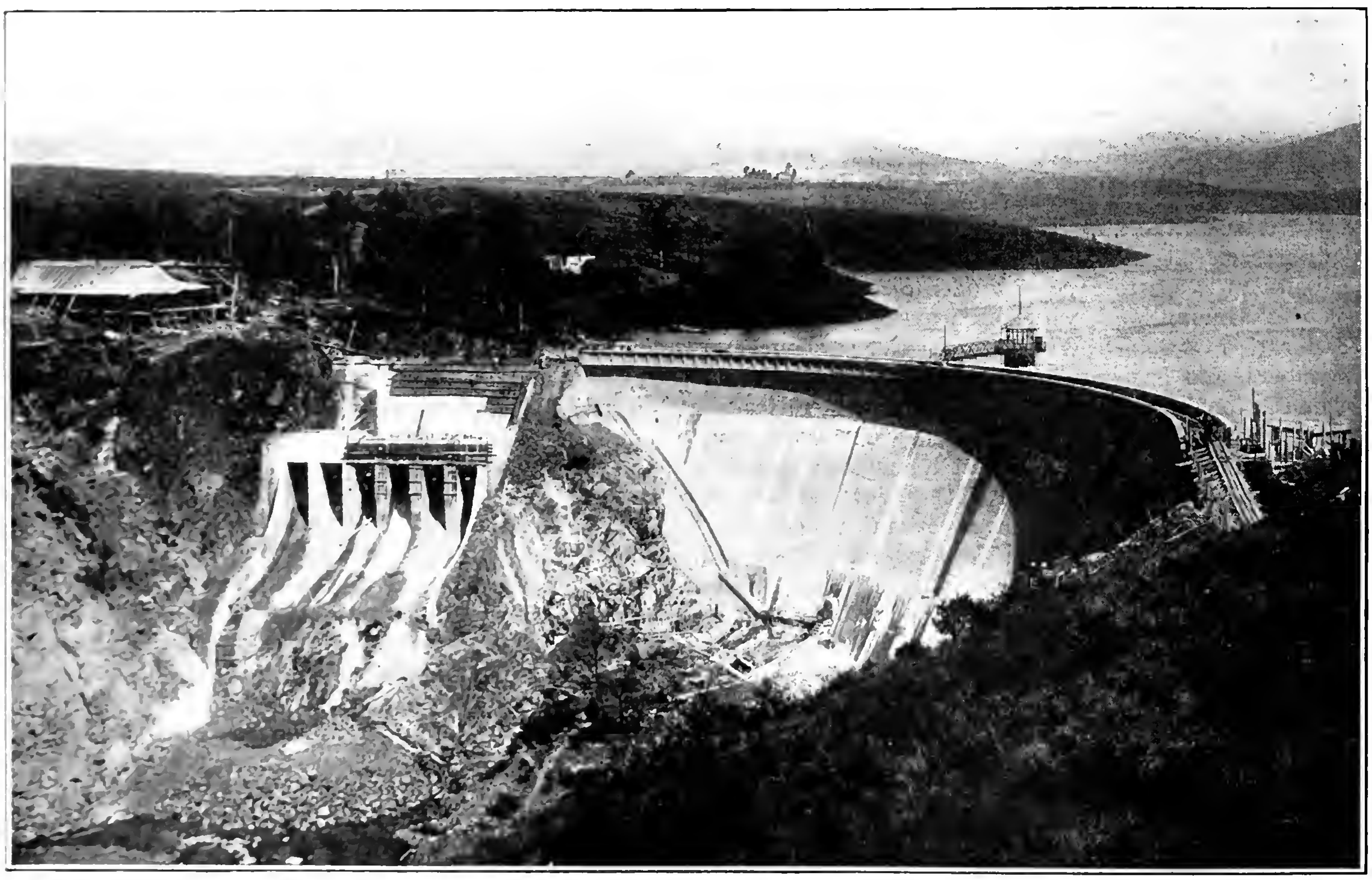
Through the efforts of the Federal Employees' Union No. 2, a joint Congressional committee has been appointed to study a readjustment of the salaries of practically all Government employees in the District of Columbia, in order that work requiring similar qualifications and involving like responsibilities may be uniformly compensated. The bureau chiefs responsible for carrying out the work efficiently and satisfactorily fear that the outcome will be the placing of all Government work on a statutory basis. If this is done, the difficulties of a bureau chief will be greatly multiplied, and the salaries of these chiefs should be substantially increased in most cases. It will then be practicable to increase the salaries of other bureau employees to the amounts that similar responsibilities command in private life. As a matter of fact, the most underpaid men in Government service are the bureau chiefs, and the next in the scale of inadequate compensation are the employees at the bottom of the scale of salaries. How some of the latter have managed to live during the war is a mystery to all but themselves. With them it was a question of mere existence, with bureau chiefs it was a question of duty to their families conflicting with duty to the country, and in the grades between the top and bottom the question was one in which both considerations entered in many cases. The public—at least the public which understands the conditions—will certainly sympathize with the attempt of the scientific and technical employees to secure adequate compensation, even though it may not hold that unionization is necessary to make Congress act justly.

Sweetwater Dam Enlarged for the Third Time

Latest Reconstruction Adds to Height, Provides Siphon Spillways and Enlarges Weir Spillways to Take Care of Maximum Flood—Second Time Dam Has Been Given More Spillway Capacity

By H. N. Savage
Consulting Engineer, Sweetwater Water Co., San Diego, Calif.

TWICE overtopped, each time with an unprecedented flood flow, and three times enlarged to provide either larger storage or larger spillway capacity, the Sweetwater dam, near San Diego, Calif., is a notable example of the revision of an engineering structure to meet new conditions not considered when it was built. The latest flood, in January, 1916, was about three times as great as any previously recorded, and required the reconstruction just being completed. While repairing the 1916 flood damage, there was a general remodeling of the structure which provides for passing a flow of 45,000 sec.ft. This included the construction of new siphon spillways and the enlargement of the previously built weir spillway.



DOWNSTREAM VIEW OF DAM WITH SIPHON SPILLWAY ON LEFT

The dam, seven miles from San Diego Bay and ten miles east of San Diego, Calif., was projected by the San Diego Land & Town Co. and put under construction in 1886. The purpose of the reservoir to be created was to impound the seasonal, and not infrequently torrential, run-off from the drainage basin of the Sweetwater River to insure an adequate and continuous supply of water for irrigation and domestic purposes for use in connection with a large area of land located adjacent to the bay and City of San Diego in the southeast, and which the company was developing for sale for suburban homes and for growing citrous fruits. Construction was commenced in accordance with designs developed by F. E. Brown, who had then only recently designed and constructed the famous Bear Valley dam.

The supervision of the engineering and construction work on the Sweetwater dam was subsequently, and before any material construction progress had been made, turned over to the late James D. Schuyler, who redesigned and supervised the construction of the dam, which was completed in 1888.

The structure, which was of uncoursed rubble masonry, was 90 ft. high above lowest foundation; 333 ft. long, exclusive of spillway bays; 46 ft. thick at base and 12 ft. thick at top; of the arch type, with a radius of 213.3 ft. It created a reservoir with a maximum storage depth of 70 ft., having a maximum length of about four miles and a width of one mile; impounding capacity, 6,000,000,000 gal. of water, equal to about 18,000 acre-feet.

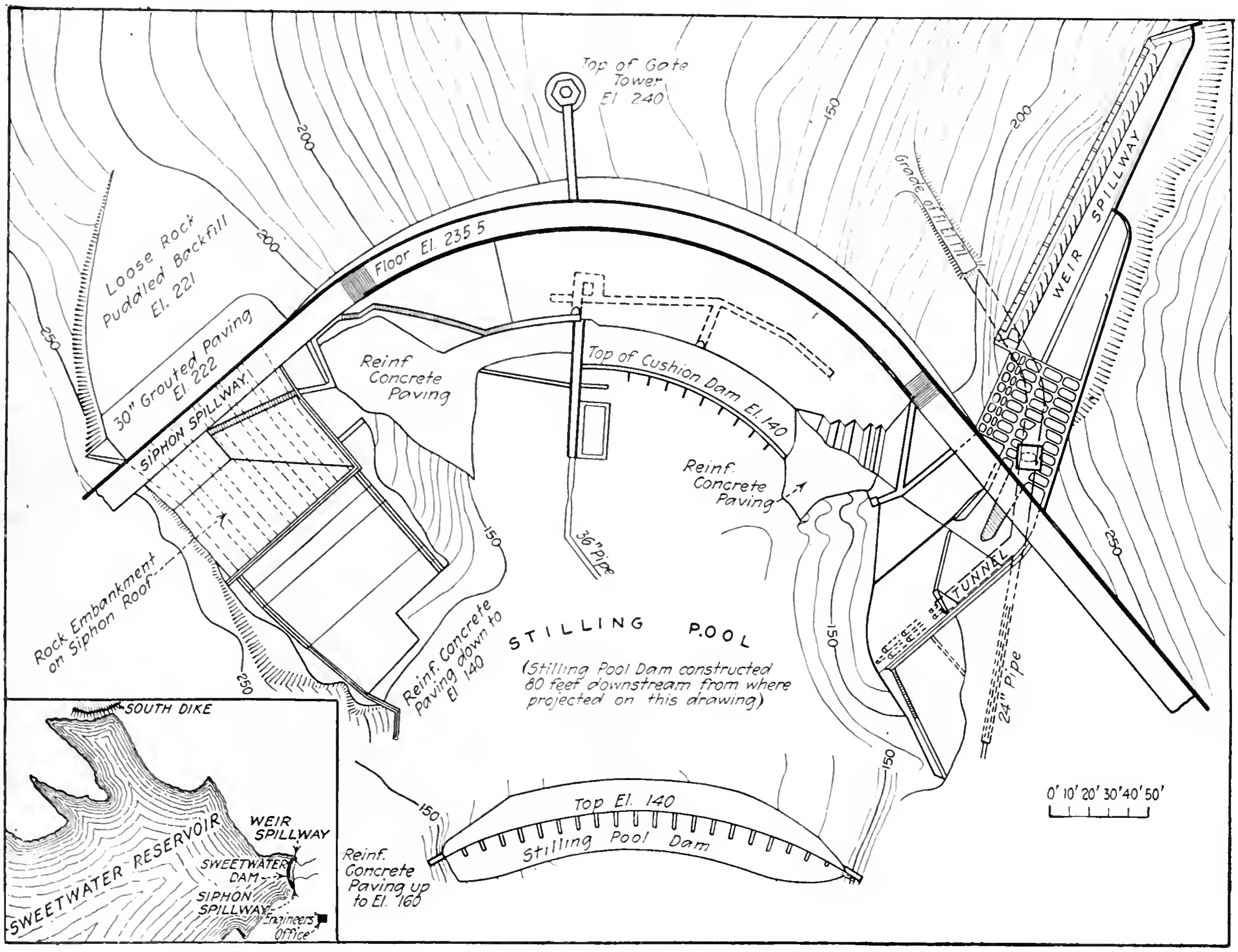
The Sweetwater River has its source in the Cuyamaca Mountains of the Coast Range. The maximum elevation drained is 6515 ft. The river flows southwesterly and discharges into San Diego Bay. The drainage basin has a length of 40 miles and an unusually uni-

form width averaging about 4½ miles. The total area of the basin above the dam is 186 square miles.

The mean annual rainfall at San Diego, as observed for the past 66 years, has been slightly less than 10 in., and has varied from a minimum of about 5 in. to a maximum of 16.03 in., except for the years 1883-84, when it was 27.59 in. The mean monthly rainfall for the 66-year period has been for July, 0.06; August, 0.10; September, 0.08; October, 0.36; November, 0.96; December, 1.79; January, 1.84; February, 1.98; March, 1.48; April, 0.62; May, 0.32; June, 0.06.

The months having greatest precipitation have been December, 1873, 5.46 in.; March, 1893, 5.50 in.; December, 1879, 6.30 in.; January, 1895, 7.33 in.; January, 1916, 7.56 in.; February, 1884, 9.05 in. Excessive rainfall (2.50 in. in 24 hours) has occurred but three times during the period. The rainfall for the 24 hours of Jan. 19, 1895, was 2.15 in., and for the 24 hours of Jan. 26-27, 1916, was 2.41 in. The rainfall on the Sweetwater drainage basin normally increases with the elevation, closely approximating 0.6 in. for each 100 ft. increase in elevation. Southwesterly winds approaching hurricane velocity usually accompany maximum rainstorms. Winds with maximum velocities have occurred as follows: March, 1912, 43 miles per hour; February, 1914, 45 miles per hour; January, 1916, 54 miles per hour.

Neither observations nor gagings had been recorded of the discharge of the Sweetwater River previous to 1886. When the dam was constructed in 1886-8 a discharge capacity of 1800 cu.ft. per sec. was given the spillways. Some additional capacity was provided by the blowoff pipes; this, together with the storage afforded by the reservoir, was then deemed by the engineer sufficient to handle any flood which might occur. In March, 1893, the rainfall was 5.50 in., and the flood into the reservoir reached the extreme volume of 5500 cu.ft. per second. The spillway capacity was thereupon substantially increased. In the month of January, 1895, the rainfall was 7.33 in., causing a flood which developed a peak discharge of 18,148 cu.ft. per second, which continued for over one hour. The Sweetwater dam was overtopped to a maximum depth of 22 in., notwithstanding all the spillways and blowoffs had been opened well in advance. The water poured over the top of the dam for 40 hours before the spillways and the blowoffs sufficiently reduced the volume to bring the storage down to the level of the parapet, the mean flow for the 24 hours, including the peak, having been 7200 cu.ft. per second.



PLAN AND LOCATION DIAGRAM OF SWEETWATER DAM NEAR SAN DIEGO, CALIF.

Upon the writer, then acting as chief engineer, devolved the responsibility of making the repairs which had been necessitated by the flood of 1895, and extensions to the Sweetwater reservoir structures to handle safely and pass a flood of equal volume or of somewhat greater volume, if one such should occur. The late James D. Schuyler, at the writer's request, collaborated in formulating the designs for the repair and extension

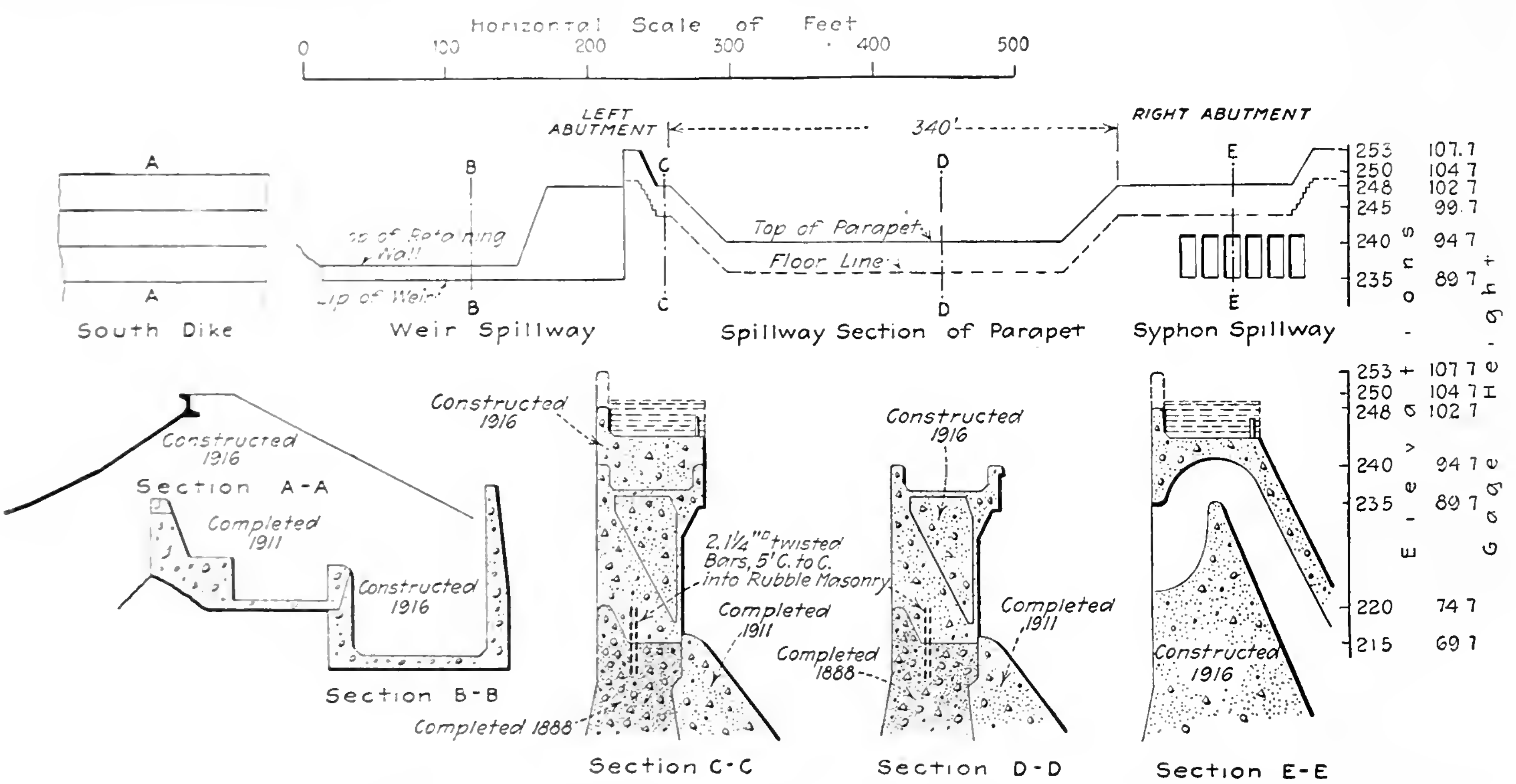
work. The discharge capacity of the spillways was materially increased by adding four bays to the original seven and by doubling the effective depth of all the bays. A flood-discharge tunnel, which had previously, in 1889, been driven from about the midway elevation of the reservoir around the left abutment of the dam, was put under control to discharge through four blowoff pipes—two 36 in. and two 30 in. in diameter—each fitted with tandem operating and emergency gates.

Provision was also made for the central 200 ft. of the dam to be safely overtopped in emergencies, by increasing the height of the parapet wall at either end of the dam to prevent its being flanked by passing floods, and by constructing a 15-ft.-high masonry structure across the cañon 50 ft. downstream to form a water-cushion basin to prevent the Sweetwater dam, if overtopped, from being undermined.

Opportunity was also accepted to increase the reservoir storage 25% by adding 5 ft. to the effective height of the dam, thereby bringing the normal reservoir height up to gage 75 ft., or El. 220 ft., based on sea level.

The Sweetwater Water Co. early in 1910 decided to increase further the storage capacity of the reservoir by 70%. The writer was prevented from responding to the water company's call by reason of other exacting duties, and the late James D. Schuyler was selected for the responsible task of preparing the plans for the extension. This work was described by Mr. Schuyler in *Engineering News* of Mar. 30, 1911, p. 369. He raised the effective height of the dam 15 ft., thus bringing the normal reservoir surface up to gage 90 ft., or El. 235 ft., based on sea level. Previous to the extension of the dam in 1910-11 the stability of the structure had been dependent on its arch plan. The resultant of pressures, with a reservoir full and the dam overtopped, fell well outside of the toe and some distance downstream therefrom. The dam, as extended, was thickened at the base by 30 ft. and transformed into one of the usual gravity type in that the resultant of pressures with a full reservoir fell inside the middle third. It had a factor of 2 against overturning. An additional factor of safety of very considerable but indeterminate amount was retained by the arch plan of the structure. As completed in 1911, the height of the dam above the lowest foundation was 108 ft. to the fixed lip of the spillway at El. 233 ft. above sea level. The spillway was provided with stop planks at El. 235 ft., corresponding to reservoir gage 90 ft., at which elevation the reservoir had a storage capacity of 35,051 acre-feet on an area of 1055 acres.

The spillway was located along the reservoir at the left end of the dam, with which it was monolithic, and consisted of a concrete-lined channel controlled by a weir lip 234 ft. long with its crest corresponding to reservoir gage 90 ft. One hundred and seventy-two feet of the crest was fitted with stop planks resting on cast-iron frames, and could be lowered to gage 88. Its rated capacity was 5500 cu.ft. per second.



PROFILE SHOWING DIFFERENT RECONSTRUCTIONS OF SWEETWATER DAM

The spillway, together with the blowoff pipes through the tunnel and the storage in the upper portion of the reservoir, was deemed by the engineer sufficient in capacity to control and pass a flood similar to that of 1895, which was the greatest previously recorded.

An earth embankment, known as the south dike, 650 ft. long, with its crest corresponding to reservoir gage 97.7, at El. 243, and having a height of 23 ft., had been constructed across a saddle in the rim of the reservoir basin one mile south of the dam.

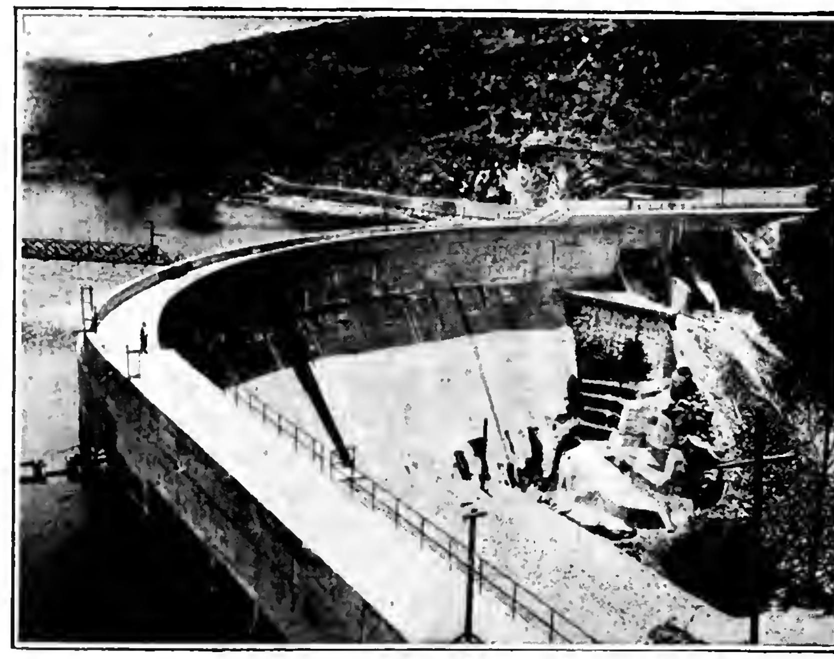
Beginning Jan. 14, 1916, there was an extraordinary storm period in the vicinity of the dam. The storm was in two sections, the first, occurring between Jan. 14 and Jan. 20, giving a precipitation of 5.11 in., and the second, between Jan. 25 and Jan. 28, giving a precipitation of 3.09 in. at the dam, with much greater precipitation on the higher slopes of the watershed to the east, which at a distance of only 10 miles back up into the drainage basin from the Sweetwater reservoir. The precipitation amounted to 10 in. in the 24 hours of Jan. 27, of which 7 in. fell in 14 consecutive hours, thus

largely accounting for the unprecedented flood discharge which followed.

The first section of the storm filled the reservoir to gage 92.9 ft. and to within 22 in. of the top of the parapet, and the second section came upon the top of the full reservoir. This storm raised the reservoir to gage 98.34 ft., corresponding to El. 243.64, overtopping the parapet of the dam 3.66 ft. and overtopping and destroying the south dike.

No apparent damage was done to the masonry section of the Sweetwater dam by the flow of 3.66 ft. in depth over its parapet. At the north end of the dam, as extended, there was a section 90 ft. long with a maximum height of 20 ft., composed of an earth-and-rock embankment with a concrete core wall and parapet. This embankment was washed out and a channel 90 ft. wide was eroded around the north end of the dam to a depth of about 45 ft. below the top of the parapet, or to El. 195. At the south end of the dam the rock against which the dam abutted was also cut away by the water to a width of 20 ft. and a depth of 40 ft. Views of the damage appeared in *Engineering Record* of Feb. 12, 1916, p. 225.

In both cases this erosion is explained by the nature of the rock upon which the dam is founded. This is a porphyritic rock intersected by innumerable cleavage planes by which the rock is divided into blocks held together by some cementing material easily softened by water and slowly disintegrated by air. The rock is a suitable and reliable material for foundations so long as it is protected from running water.



LOOKING ACROSS DAM TOWARD WEIR SPILLWAY

The flood of Jan. 27, 1916, produced an estimated maximum peak discharge of 45,500 cu.ft. per second for a period of over an hour, and an average discharge of over 20,000 cu.ft. per second for a 24-hour period including the peak. As a basis for developing plans for spillways it was deemed advisable to provide a total capacity sufficient to handle a discharge one and one-half times that produced by the flood of Jan. 27, 1916.

All computations to determine the spillway discharge required are based upon the reservoir being filled at the beginning of a flood to normal capacity, gage 90 ft., El. 235.

A flood of similar characteristics to that of Jan. 27, 1916, but having a peak discharge of 50,000 cu.ft. per second, as modified by the temporary impounding capacity on the normal reservoir above the crest of the weir spillway, at gage 90, El. 235, would be controlled and safely passed by the spillways as provided, and only require their operation up to a maximum discharge of 32,000 cu.ft. per second, and the maximum water in the reservoir would not exceed gage 98, El. 243.

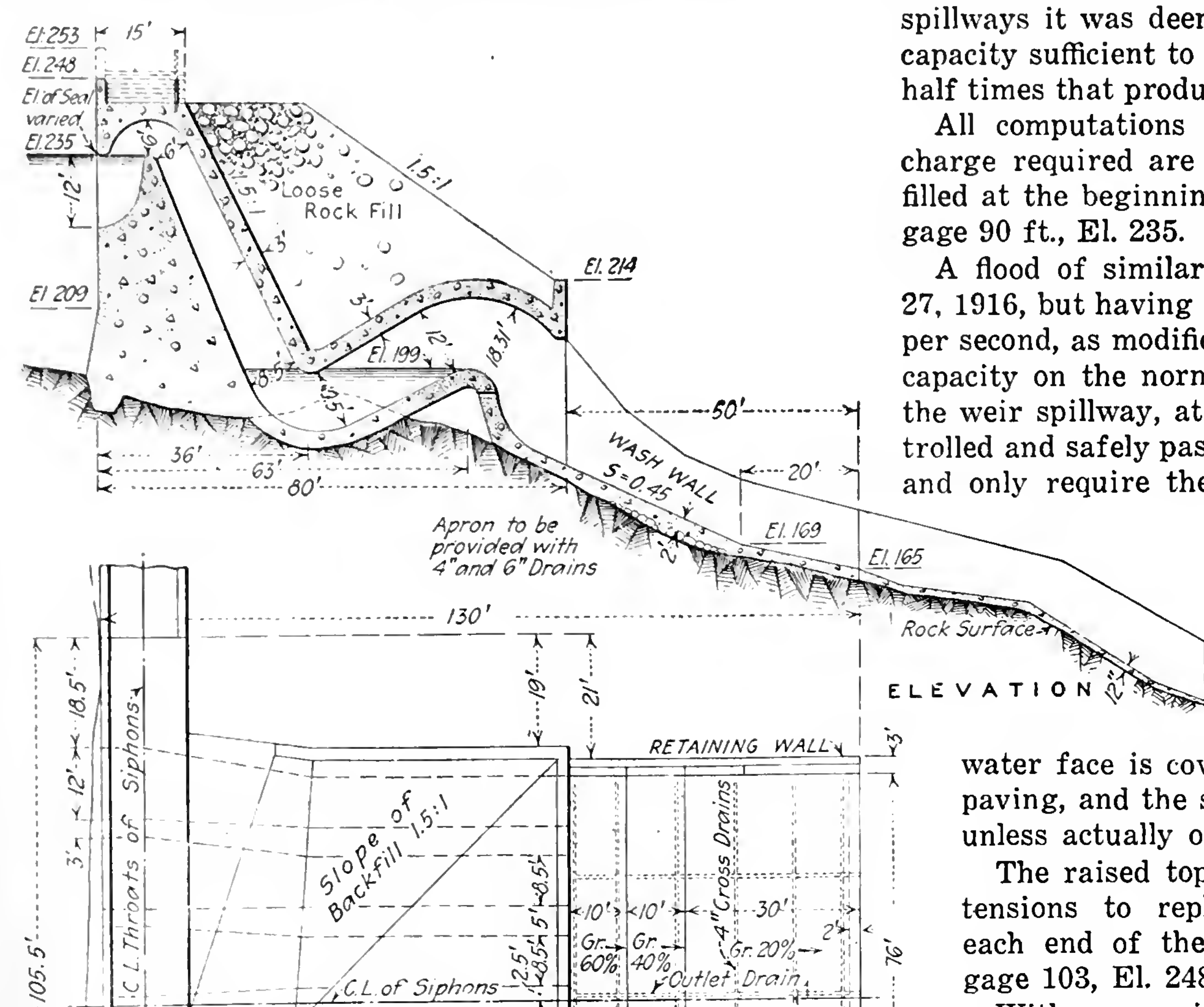
In the design for the south dike the top was fixed at gage 105, El. 250. The water face is covered with a reinforced-concrete paving, and the structure should not be damaged unless actually overtopped.

The raised top of the parapet wall of the extensions to replace the eroded abutments at each end of the Sweetwater dam was fixed at gage 103, El. 248.

With reservoir gage 103, the spillways will dischage 50,000 cu.ft. per second continuous flow, and before the south dike could be overtopped, gage 105, the spillways' discharge would increase by about 25 per cent.

The extreme ends of the parapet walls have also been raised to gage 108, El. 253, to prevent the Sweetwater dam from being flanked by any flood which can occur.

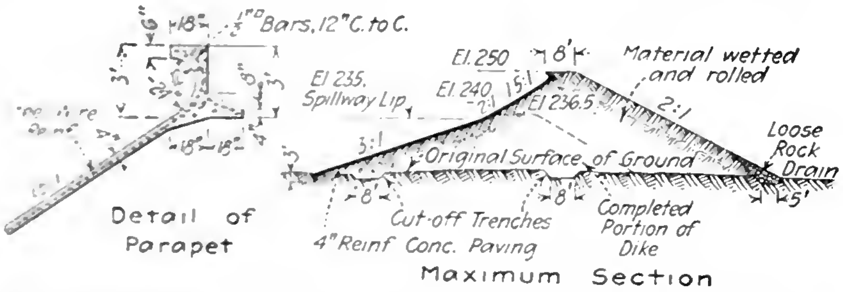
The new location of the south dike is somewhat within the reservoir basin from its former



DETAILS OF SIPHON SPILLWAY ON SWEETWATER DAM

location, due to the erosion by the escaping flood waters at the original site. The new alignment was dictated by the local topography. The south dike is 1260 ft. long and 37 ft. high from the bottom of the front-face concrete cutoff wall. The foundation and the materials available for construction both indicated that the structure should be an earth embankment. The material used was about half clayey adobe and half gravelly, ranging from fine to small boulders. The latter, when sized larger than 3 x 4 in. in the two largest dimensions, were rejected and placed on the lower portion of the downstream slope for drainage and paving. The embankment was placed in 6-in. layers, sprinkled with water and compacted to 4½-in. thickness by a 10-ton roller having corrugated faces on all of its wheels. The water face is sloped from the base up 3 horizontal to 1 vertical, changing successively to 2 : 1 and to 1½ : at the top portion.

The water face is protected from wave erosion by a concrete paving 4½ in. thick, reinforced with steel wire mesh No. 8 B.w.g., spaced 4 in. c. to. At the top the paving merges into a steel reinforced-concrete parapet curved to deflect waves back onto the surface of the reservoir and prevent them breaking over the top of the dike. A coat of crude oil containing 30% asphaltum was applied to the downstream slope and top



ENLARGEMENT OF SOUTH DIKE ON SWEETWATER DAM

of the dike, at the average rate of 5.6 gal. per square yard of surface, to prevent the growth of vegetation, the burrowing of animals, and erosion by rainstorms.

The topography and the geological formation of the reservoir basin restricted the location of all spillways to the immediate vicinity of the Sweetwater dam.

The necessity of replacing both abutments of the dam, which had been eroded away by the flood, made it advisable for economical reasons to combine the spillways with the gravity extension at either end of the dam. The topography of the gaps dictated materially the type of both end spillways.

In making studies and comparative estimates preliminary to deciding on the final designs, it was found advantageous to divide the total spillway capacity required about equally among the three structures which it was found most advantageous to provide and construct. The capacity of the original weir spillway at the left end of the dam was very materially increased by means of a connected channel, with a relatively wide and deep cross-section, located parallel with and back of the original channel. Three ports left in the gravity extension from the left end of the dam serve as dischargeways for the left spillway.

Provision for overtopping the central 236 ft. of the dam in emergencies was made by raising the top of the gravity extension at both ends of the dam by eight feet.

A siphon-type spillway, made up of six independent rectangular tubes each 12 x 6 ft. at the throat, was decided on for the right end of the dam. An efficiency factor of 70% was used in computing its discharge capacity. The type was selected for several reasons; prominent among them were the automatic action approaching maximum capacity whenever water rises above the normal flow line, such as a flood discharge into a reservoir already filled.

In this instance the siphon-type structure provided a necessary support for the perpendicular abutment rock below the dam, and on account of the height of the lip permitted the placing and maintenance of a rock embankment to protect the vertical face of the rock abutment above and adjacent to the end of the dam. The roof of the siphon-spillway feature also furnished a foundation for a rock embankment to protect the vertical face of the rock abutment below the dam to prevent its ravelling. The rock embankments at the north end of the dam were made of rock excavated from the additional left weir spillway channel, which was trammed across the top of the dam. The rock wasted on top of the siphon-spillway roof, weighing about 6000 tons, is also a very desirable additional factor in resisting the tendency of the water discharging through the siphon tubes to set up vibration in the structure.

During maximum flood discharge there will be a potential horsepower of about 175,000 in the water discharging through the siphon, of which about one-half may be destroyed in entering, passing through and discharging from the structure.

In order to protect the rock abutments and foundations in the vicinity of the base of the dam from further erosion, which might be disastrous, a stilling pool dam has been constructed across the cañon 300 ft. below the base of the Sweetwater dam. It is of the hollow buttressed type, 15 ft. high, 200 ft. long, with its upstream face sloping with an angle of 45° with the horizontal.

The relatively high-up abutment rock, down against which water from over the top emergency spillway will impinge, has been protected with concrete paving averaging 1 ft. thick, reinforced with wire mesh spaced 4 in. c. to c., hung on iron pins spaced about 5 ft. c. to c., holes for the pins having first been drilled into the face of the sloping rock cliffs.

The emergency repair work on both the Sweetwater dam and the south dike was rushed forward under Superintendent W. M. Gates, in charge of temporary construction, Don Moore in charge of team work. Repair of main pipe lines was carried on under miscellaneous foremen with forces obtained from the Western Pipe and Steel Co. R. H. Willcomb acted as resident engineer and made all the designs for the permanent work under the immediate and continuous supervision of the writer.

An emergency contract for the placing of 10,000 cu.yd. of earth material in the south dike was awarded to Henry G. Fenton, contractor, of San Diego, and an advertisement was gotten out and bids were received for building the three principal schedules of the repair and extension work on the Sweetwater dam, the stilling pool dam and the south dike. The contract for the south dike work was awarded to the C. L. Hyde Construction Co., and the contract for the other schedules was awarded to Henry G. Fenton, W. A. Stebbins and W. M. Gates.

C. F. Fulton, B. B. Boyd, E. I. Fisher and E. P. Watson, Jr., acted as instrumentmen and inspectors at different times on the work.

What the American Army Engineers Did in the War

The following tribute to the fighting and working engineers of the United States Army is a part of an official report on the war made by Benedict Crowell, assistant secretary of war and director of munitions. The entire report will tell in detail the extent of America's participation in the mechanics of the war. These extracts are printed here to give wider circulation to this official recognition of the American engineers' work in the 17 months of war.—EDITOR.

IN DESCRIBING the activities of the engineers, we are carried to the front itself, into the zone beaten by enemy fire, where machine-gun bullet, bursting shell, and deadly gases have brought sudden death and painful wounds to many members of the technical services. A large proportion of the engineers are combatant troops, constituting in the American Expeditionary Forces about 8% of the total combatant troops engaged. These troops, trained and equipped to march and fight as infantry, demonstrated their fighting qualities during the war on numerous occasions, both when used as infantry to increase the rifle strength of that arm and when fighting as engineers to obtain possession of terrain as a preliminary to the exercise of their technical art in its organization.

From the day the first sector was taken over by American troops in November, 1917, until the Meuse River was passed and the enemy, in flight, sought an armistice to save his armies from destruction, the combatant engineers—the "sappeurs" of French soldier lore and song—fought and bled in a manner never to be forgotten. Railroad engineers, nominally considered noncombatant, fought with a will at Cambrai, dropping their tools to take arms and fight stubbornly shoulder to shoulder with their British brothers with whom they were learning to work under the peculiar conditions of the front. From Cantigny to Chateau Thierry, engineer troops fought as well as worked, and often not only advanced with the infantry under or through the barrage but actually led the first wave, to demolish or remove the obstacles placed in its path. Through the days, when from March 21, 1918, until July 18, 1918, the German army made its rapid plunges toward Paris until checked and thrown back at the Marne near Chateau Thierry, the sapper troops fought and worked with the infantry of their divisions, enduring the same dangers, privations and hardships, and winning equal honors and commendation.

They Fought as Well as Worked

In the drive at St. Mihiel and through the Argonne, the combatant engineers played a conspicuous part. Advancing with the tanks, they made possible the passage of many difficult points for these lumbering monsters, against which was directed a particularly destructive fire. Using elongated torpedoes of high explosive, they prepared passages for the infantry through the broad, barbed-wire entanglements, echeloned in depth by numerous separate lines, each to be breached and passed before the objective could be gained. In this work the engineers fought as well as worked, reducing the machine-gun nests that hindered their operation, cleaning up the strong points that delayed the advance of the tanks they were assisting, and throwing extemporized foot-bridges across the streams which barred the further advance of the infantry.

Actually fighting, taking prisoners, reducing machine-gun positions and combat groups, the combatant engineers did their part in the winning of the reconquered ground, as well as the lion's share of its organization for the defense and the maintenance of the communications behind it. In this last respect alone, the engineers, as combatant troops, opened across No Man's land the first communications practicable for the light artillery, which pressed forward immediately behind the infantry troops to their support and protection.

Filling in trenches, removing wire entanglements, building trestles across wide mine craters, searching for and rendering inoperative treacherous mines and traps of extreme ingenuity and destructiveness, the sapper found a wide field of operations for the exercise of his functions.

Shattered and obliterated by four years of shelling and mining, trenching, and countermining, the "roads" across No Man's Land existed only on the map, and as they retreated the Germans demolished and obstructed the highways behind the old front from which they had been driven, with the thoroughness and attention to detail for which they are noted.

Road Building Under Enemy Fire

As our infantry advanced, upon their heels, literally speaking, came our engineers, to attack the problem of providing for the artillery and the supply trains a means of following. From the standpoint of the road builder in civil life, their methods were crude in the extreme, but for the military purpose and the pressing immediate needs, their road-building achievement was adequate. The engineers sometimes reopened abandoned quarries, and sometimes started them where none had existed before, to obtain a supply of road material, which was supplemented and in some cases replaced by the use of débris from ruined villages and shattered farmhouses. From demolished structures many useful materials were extracted and adapted to the military purpose by the engineers. Where bridge and trestle timbers were lacking, deserted buildings—in one case the tower of a ruined church— filled the need. Where shell hole or crater yawned a remnant of a stable wall might be pulled down by ropes and man-power, and broken up to fill the void.

Through the dense woods, the soft forest floor offered no support even to the light artillery, and miles of corduroy and brush path were built to permit the guns to advance to the reinforcement of the attack. In many places the tactical situation admitted of insufficient time to build even the crudest paths, and then the engineers fell to and assisted the artillery and the supply wagons to get through and over the bad spots, replacing guns on the road where they had run into the ditch, righting and reloading combat wagons when they had turned over in shell holes or deep ruts.

While thus engaged the sapper troops were subjected to the fire of the enemy artillery seeking to prevent the advance of the supporting guns, and, further, they were working within the zone of combat enemy aviators, the rattle of whose deadly machine guns, as they plunged at low altitude toward a busy working party, was as much to be dreaded as the high-explosive bombs which they dropped.

Behind the combatant engineer troops, extending through the service of supply to the base ports and across the ocean to the United States, was an organization of technical noncombatant supply and administration. The work of these production, construction, and supply departments in France was organized under the administration of three divisions of the office of the Chief Engineer. These were the division of military engineering and engineering supplies, the division of construction and forestry, and the division of light railways and roads.

The division of military engineering and engineering supplies was charged with the procurement, standardization, and distribution of all classes of supplies used by engineer troops and with the current investigations into new developments of the art of military engineering. The division of construction and forestry was charged with all construction work in the service of supply, and also with the procuring of forest products for the American Expeditionary Forces. At the signing of the armistice its organization totaled 150,823 men, of whom about 127,000 were constantly engaged in production work. The light-railway and road regiments of engineers attached to the armies at the front, while their duties did not carry them so far or so much into the zone of enemy fire, may be considered as combatant units, since they operated with and in support of combatant troops in the field. To the light-railway regiments were assigned the construction, operation, and maintenance of the light railroads of 60-cm. gage, a great quantity of which was used during the war.

Engineering Profession Responded Nobly

To furnish the necessary organization of technical troops and specialists the original engineer arm of the United States Army was increased to 131.5 times its pre-war strength, and the proportion of engineer troops relative to the total forces was increased from 1.6% to 10.8%. To accomplish this, a heavy demand was made upon the technical professions and upon the industries of this country. In filling this demand most necessary assistance was given by the engineer societies and the engineering journals, whose patriotic work demands the highest praise.

In situations requiring special knowledge, almost always there could be found some specialist capable of adapting himself and his work to the military needs. Engineer officers for the combatant regiments were younger members of the technical professions, who were sent to the training camps provided for the purpose and there given the essentials of strictly military knowledge. This training was later supplemented by courses in engineer and line schools located in France. The training officers of the regiments were supplied from the Corps of Engineers, these men having both the military and technical knowledge fitting them for the command. The diversity of education and experience necessary in all branches of the engineer service may be understood by a consideration of the duties of the different units sent to France during the war—specialist units, in addition to the strictly combatant divisional regiments, who also numbered among their commissioned and enlisted personnel many technical specialists, men of high attainment.

We had, for instance, seven railway-construction regiments, two railway-construction battalions, one regiment and five battalions for railway maintenance-of-way, two battalions for maintenance of railway equipment, four regiments and one battalion to operate our main military railways in France, three regiments to operate the light railways in France and their repair shops, two regiments for operating the regular railway shops, two regiments and six battalions for constructing buildings and other general construction work, two regiments for storing and transporting engineer supplies, a forestry regiment, a light-railway construction regiment, a regiment for building roads, a water-supply regiment, a mining regiment, a quarrying regiment, a technical regiment for handling surveying, sound ranging, and location of enemy positions by means of special apparatus, three survey and printing battalions, two railway-transportation battalions, an electrical and mechanical regiment, several companies to operate cranes, a camouflage service, five inland-waterway companies, five ponton trains, a ponton park, a railway-transportation and stores battalion, and also a searchlight regiment.

Upward Pressure Test Pipes Constructed in Concrete Dam

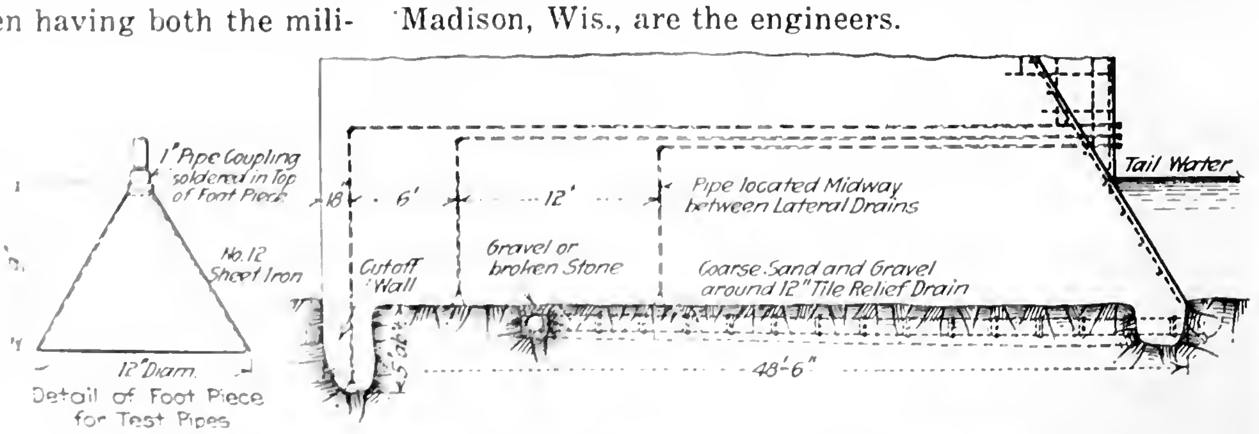
UPWARD-pressure test pipes were constructed in the base of the new Brule River dam in Wisconsin. This dam is constructed of concrete, and is about 70 ft. high, 6 ft. wide on top, and 48½ ft. wide at the base, and will sustain an average working head of 60 ft.

Provision is made for underdrainage by the use of a 12-in. vitrified tile drain, placed longitudinally with the dam, as indicated by the drawing and connecting with 12-in. lateral drains at right angles spaced every 20 inches.

To determine the effect of upward pressure, if any exists under the dam, 1-in. iron pipes were placed as shown on the drawing. Construction was simple, the only special detail being the inverted cone collector resting on the rock bed. Great care was taken to see that no concrete got under the cone.

It is believed that after construction is completed and the water is raised to full head these pipes will afford observations on upward pressure which may be of value.

The dam was built for the Peninsular Power Co., of Wisconsin. Daniel W. Mead and Charles V. Seastone, Madison, Wis., are the engineers.



PIPES CONSTRUCTED IN DAM TO TEST UPWARD PRESSURE

Concrete Highway Construction Standards Raised

Mississippi Valley State Road Officials Recommend Tamped Concrete and Heavier Sections—Action Affects Wide Territory

BETTER built subgrade, heavier slab sections, graded aggregates, slump consistency tests, tamped concrete, and more intensive finishing are recommended for concrete roads by the Mississippi Valley Association of State Highway Departments. The exponents of this advanced doctrine are, moreover, putting its precepts into practice. A notable example is the Division of Highways of Illinois, whose new specifications were reviewed in *Engineering News-Record* of Apr. 10, 1919, p. 735, and May 8, 1919, p. 905. Other state highway officials announce that their practice will be similarly modified as conditions make action practicable.

The decision to revise standards of construction was reached at a two days' conference of the association members held in Chicago in February. With the highway departments of eight states represented, the standards of practice of the American Concrete Institute (See "Proceedings," Vol. XIV, p. 517) were considered, section by section, changed and extended as the delegates decided, and the original document as altered was adopted as recommended practice. The changes extended to minor details, but only those of broad significance to the contractor call for particular mention. They include pavement design, but relate for the most part to materials and methods of construction. Quoted matter contained in this article shows the alterations as adopted.

Heavier Slabs and Better Concrete

Concrete roads less than 18 ft. wide are inadvisable, but if single-track roads must be built a width of 9 ft. is recommended and no road widths between 10 ft. and 16 ft. are approved. The width of traveled grade is set at 24 ft. for all roads, and 8-ft. shoulders are advised for all widths of slab. A slab uniformly not less than 7 in. thick is specified for single-track roads, and for two-track roads up to 20 ft. wide the minimum thickness is 7 in. at the edges and 8 in. at the center. These thicknesses are roughly 1 in. greater than those set by the standards of the American Concrete Institute.

A 1 : 2 : 4 concrete is suitable when the slab is finished by machine; for hand-finishing the proportions are 1 : 2 : 3½. Consistency is to be governed by slump tests. "For this test 6 x 12-in. cylinders should be tamped full of the concrete as mixed and the cylinder immediately removed. For work that is to be finished by hand, the slump of the concrete upon removal of the cylinder should not exceed 6 in., and for work that is to be machine-finished, the slump should not exceed two inches."

Emphasis is put on the field testing of aggregates. Sieve grading, using Nos. 100, 48, 28, 14 and 4 screens, is specified. Volumetric tests for silt are approved for field determination, but unless this test shows less than 7% of silt materials are not to be accepted for construction until the quantity of silt is determined by the weight method. Fine aggregate must all pass a No. 4 screen, but natural sand or any mixture up to equal parts of sand and screenings is acceptable, provided the screenings are from durable stone and are without dust. For coarse aggregate, besides pebbles and broken stone, "slag of suitable quality and uniformity" is acceptable.

Stress is laid on subgrade construction. It is recommended that the subgrade be not trenched out, and that it be kept higher than the natural berms, so as to provide drainage directly to the side ditches. A 10-ton macadam-type roller is recommended, and very careful rolling is urged. "If the rolling at any time causes the subgrade to become wavy, the rolling should be stopped immediately over the wavy parts, and the soft material investigated. In clays, this is almost always due to moisture and, unless it is possible for it to dry out by the sun and wind without delaying the work, it should be removed and replaced with dry clay or other suitable material that can be rolled in a satisfactory manner. If any depressions develop they should be filled with acceptable material as the rolling progresses."

It is recommended that the rough grading be completed very close to the intended cross-section of the subgrade and to the full width of the shoulders. The finished subgrade immediately ahead of the concrete should be corrected to proper cross-section, using a templet.

Where the aggregates are stored on the subgrade the latter should be completed fully in sections not exceeding 600 ft. in length, immediately before the aggregates are deposited. The surface should be brought to true cross-section, using a templet or other acceptable method, and the roller should be kept in constant operation while the aggregate is being delivered. Wherever possible, hauling over the finished subgrade with teams or motor trucks should be avoided.

Concreting Practice Made More Definite

Two-bag batch mixers are recommended for concrete-road work. The mixer should be equipped with "a boom and bucket or some other mechanical device that will deliver concrete of a proper consistency; also with an automatic timing device and a device that will accurately measure the water for each batch." The attention of mixer manufacturers "is directed to the advantages of perfecting a mixer that will shorten the time necessary for proper mixing and permit the inspection of the batch before delivery."

Duplicate pumping machinery should be provided, with booster pumps on long pipe lines. Steel side forms should be used.

The concrete may be transported from the mixer to place on the subgrade in any manner which avoids the segregation of materials. Every effort should be made to arrange for closing concrete-road work in the autumn on or about such date "as the Weather Bureau reports for the locality for the past 10 years indicate the probability of temperatures materially below the freezing point." If circumstances necessitate continuing work for a short period after freezing weather is likely to occur, precautions should be observed which will insure positively that the concrete may not become frozen under the most extreme conditions of temperature for the period, "as indicated by weather reports for the past 10 years." Concrete should be absolutely protected from freezing by suitable means for at least seven days after placing.

When mixtures of relatively dry consistency are used, "mechanical strikers and tampers should be used." Machines should be so constructed and operated that they strike off and thoroughly tamp the concrete, and that they "may be readily operated over the same area repeatedly." If a mechanical finisher is not used after

the spreading, the concrete should be thoroughly hand-tamped by means of a tamper "of the nature of a strike-board operated by one or two men stationed at each end of the tamper on opposite sides of the roadway." Hand-tamping should be vigorous and sufficient to consolidate the concrete in such a manner as to leave the surface behind the final strikeboard "true to grade, crown and surface, and absolutely free from porous places."

Trained Inspectors Essential

Inspectors should be selected with great care. The remuneration of an inspector should be sufficient to secure a man of the following qualifications: "Practical experience, knowledge of specifications and construction, absolute integrity, quick decision, sound judgment, forceful personality, common sense and the ability to command the respect of the contractor." The inspector should have broad perspective and should be able to distinguish between essentials and nonessentials. It is recommended that inspectors of concrete construction receive a preliminary course of training in their duties, including a study of materials and the interpretation and significance of laboratory and field tests.

Put New Chords on Drawbridge Carrying Traffic

Engineer Plans Work to Avoid Closing of Busy Street — Bridge Swings Free of End Supports While Riveting Is Done

The reinforcement of an old swing bridge without the use of falsework and without putting the bridge out of service was a difficult piece of work accomplished successfully at Chicago. The particular methods employed were adopted in order to avoid serious interruption to travel on a heavy-traffic street.

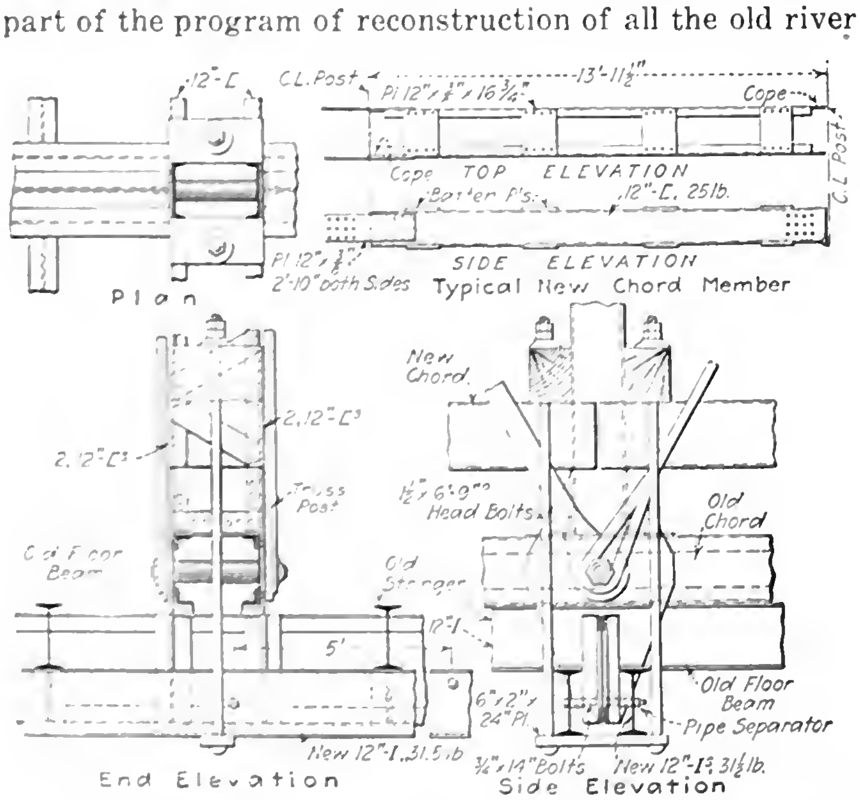
The repair work was of an unusual character, consisting in the application of new bottom chords and floor-beams to the Clark St. bridge over the Chicago River. The work was imperative on account of corrosion and general deterioration, coupled with the necessity of retaining the old structure until funds are available for its renewal. Its replacement will be part of the program of reconstruction of all the old river bridges at Chicago. The swing span, built in 1889, is 208½ ft. long, with three through trusses spaced 21 ft. on centers.

New bottom chords for the reinforcement of the trusses were located above the floor, for convenience of erection. They were composed of pairs of 12-in. channels placed with the flanges inward and connected by batten plates at top and bottom, the flanges being cut away at the ends to allow the webs to be riveted against the truss posts. Splice plates were placed outside of the chord joints on these posts.

While the riveting was being done the bridge swung free, being supported entirely at the center and being clear of end supports. Thus there was no upward reaction in the trusses, and although the bridge tipped as cars ran on and off there was no difficulty in fitting the new chord members.

Deterioration of the floor-beams and their connections made it necessary to provide additional supports for the stringers, which were in good condition. At each panel point two wood blocks were placed across the new chord and against the post, forming supports for the threaded ends of two hanger rods whose upset heads carried a bearing plate. Upon each pair of plates were placed the ends of two 12-in. I-beams, one on each side of the old plate-girder floor-beam, and these were drawn up against the stringers by means of nuts on the hangers. The I-beams were secured in place by through bolts spaced about 5 ft. apart and located alternately at the center line and top of the webs. These bolts passed through pipe separators fitted between the webs of the I-beams and old girders.

This method of reinforcement was planned by F. H. Avery, engineer of bridge construction and repairs, Department of Public Works, under the direction of John Ericson, city engineer, and Thomas G. Pihlfeldt, engineer of bridges. The work was done by city forces under Mr. Avery's supervision.



TYPICAL NEW CHORD MEMBER AND ARRANGEMENT OF NEW I-BEAMS SUPPORTING STRINGERS

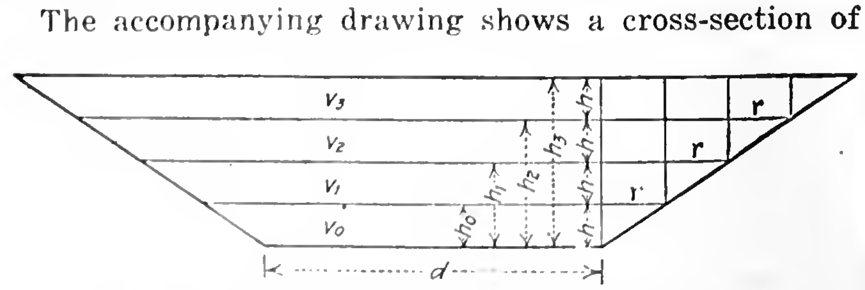
Laying Out a Reservoir Gage Table

By E. D. Cole
Chief Engineer, Empire Gas & Fuel Company, Bartlesville, Okla.

In computing a gage table for a circular reservoir with sloping side walls, it is customary to figure the volumes for each inch of height, measured from the gage plate on the bottom. The necessary computations in this case are somewhat long and tedious, owing to the reservoir being considered as the frustum of a cone with volumes increasing with the height above the gage plate by a constantly increasing increment.

The writer recently had occasion to figure such a gage table for a 350,000-bbl. oil-storage reservoir of this type, and devised the following formulas, showing the relation between succeeding volumes corresponding to equal values of height. By this method succeeding volumes are easily and quickly figured for as many values of h (height) as desired.

The accompanying drawing shows a cross-section of



SECTION THROUGH CIRCULAR RESERVOIR

an inverted frustum of a cone, corresponding to a cross-section of the reservoir, divided into horizontal sections, whose volumes are represented by:

V_0, V_1, V_2, V_3, corresponding to equal values of h, as h_0, h_1, h_4.

The volume of V_0 is obtained by computing the center section of height h_0 and diameter d and adding to it the volume represented by the area of the triangle $a\ c\ e$ of height h_0 and width r times the circumference at the center of gravity of the triangle. This volume is given by the formula:

$$V_0 = \tfrac{1}{4}\pi (d)^2 h + \pi (d + 2/3\, r)\left(\frac{r\,h}{2}\right) \qquad (1)$$

Volumes V_1, V_2 and V_3 are given by the formulas:

$$V_1 = \tfrac{1}{4}\pi (d + 2r)^2 h + \pi (d + 2r + 2/3\, r)\left(\frac{r\,h}{2}\right)$$

$$V_2 = \tfrac{1}{4}\pi (d + 4r)^2 h + \pi (d + 4r + 2/3\, r)\left(\frac{r\,h}{2}\right)$$

$$V_3 = \tfrac{1}{4}\pi (d + 6r)^2 h + \pi (d + 6r + 2/3\, r)\left(\frac{r\,h}{2}\right)$$

The relation between succeeding volumes is obtained by subtracting V_2 from V_3, V_1 from V_2 and V_0 from V_1.

$$V_3 - V_2 = \frac{\pi h}{4}\ (4\ dr + 20\ r^2)$$

$$V_2 - V_1 = \frac{\pi h}{4}\ (4\ dr + 12\ r^2)$$

$$V_1 - V_0 = \frac{\pi h}{4}\ (4\ dr + 4\ r^2)$$

Then:

$$(V_3 - V_2) - (V_2 - V_1) = 2\ \pi\ h\ r^2 = \text{Constant}$$

and:

$$(V_2 - V_1) - (V_1 - V_0) = 2\ \pi\ h\ r_2 = \text{Constant}$$

The next succeeding volume may then be obtained directly by adding to the last known volume the difference between it and the next preceding one plus the constant as follows:

Given V_2 and V_3, to find V_4:

$$V_4 = V_3 + (V_3 - V_2) + 2\ \pi\ h\,r^2.$$

Leaky Subway Station Made Tight

A campaign of grouting has proved successful in stopping serious inflow of water into the new Canal St. subway section and station, New York City, according to a statement of the Public Service Commission. The section extends east from the new Broadway subway to the Centre St. loop subway, passing under the old subway in Lafayette St. In building it, connection had to be made with the existing subway structures in Lafayette St. and Centre St., after tunneling under them. Pumping down the ground-water by wells was resorted to during the construction, in order to facilitate the excavation work. After completion of the station, leakage developed at many points, and ultimately the total inflow reached the amount of 150 gal. per minute. It was necessary to cut channels for the water and provide gutters and pipes at various points, in order to permit the station to be kept in use as a means of transfer between the three subways. The leakage came through breaks at the connection of waterproofing laps on the outside of the structure. To stop them, grout was pumped through holes drilled in the wall of the station. These grouting operations have been carried on for a number of months, and they have been so successful that now the total flow of water into the station is reported at less than 2 gal. per minute. It is expected that when the grouting is completed the leakage will be eliminated.

Improving Concrete By Rodding

Tests Show That Strength Is Increased Materially by Continuous Agitation of Wet Concrete With Rods

By F. E. Giesecke
Head of Division of Engineering, Bureau of Economic Geology and Technology, University of Texas, Austin, Texas

"RODDING" concrete—that is, working a pointed rod of about ⅝-in. diameter into and around the soft mixture, adds considerably to its strength, according to tests made in the laboratories of the University of Texas. The tests were made to determine if this method would have any beneficial effect in removing the excess water which the necessity of a workable mix generally imposes on concrete placed in the field.

Eight groups of specimens, designated A to H, were prepared. Each group consisted of six 6 x 12-in. cylinders of the same concrete composed by weight of

Colorado River gravel P 1¼—R ¾	29.7%
Colorado River gravel P ¾—R ¼	29.5%
Colorado River sand P ¼—R 12	12.0%
Colorado River sand P 12—R 50	11.3%
Colorado River sand P 50	3.1%
Blend cement of two brands of Texas cement	14.4%
	100.0%

This mix corresponds very closely to the ordinary 1 : 2 : 4 mix; the resulting concrete contains about six sacks of cement per cubic yard of concrete. The lag of the tests is given in the accompanying table.

The A specimens were prepared with water amounting to 6.7% of the total weight of the other materials, or 46.5% of the weight of cement, or about 71% of the volume of the cement. They were of a very stiff consistency, and were thoroughly tamped while being placed in the molds. All other specimens were prepared with water amounting to 10% of the weight of the other materials, or 69.4% of the weight of the cement, or about 104.5 per cent. of the volume of the cement.

The concrete for the specimens was so thin that it flowed readily and was difficult to handle with shovels. It contained more water than need ever be used in practice to secure easy handling and a thorough filling of the forms.

Of these seven groups, the concrete for the B specimens was deposited in the molds, and as it settled more was added, so that the molds were well filled when the specimens were completed. The C specimens were tamped lightly with a wooden tamper. The D speci-

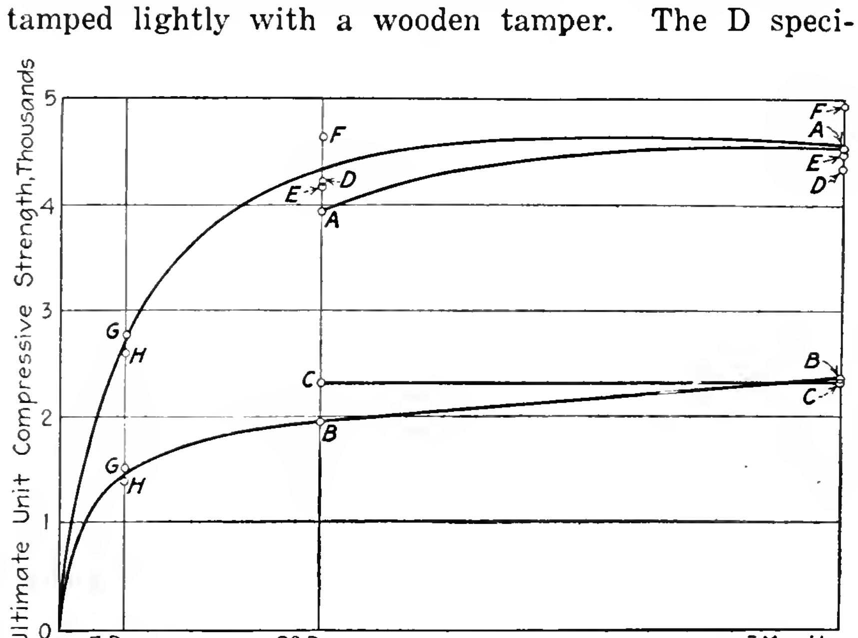


FIG. 1. TIME-STRENGTH CURVE OF RODDED CONCRETE CYLINDERS

mens were rodded every 15 to 30 minutes for four hours, when the concrete had set so firm that the rod would not penetrate more than 2½ in. The E specimens were rodded every 10 to 12 minutes for 2½ hours. The F specimens were rodded every 30 minutes for seven hours. Of the G and H specimens, one-half were rodded every 30 minutes for 7½ hours, and the other half were left untreated, like the B specimens; the G specimens were

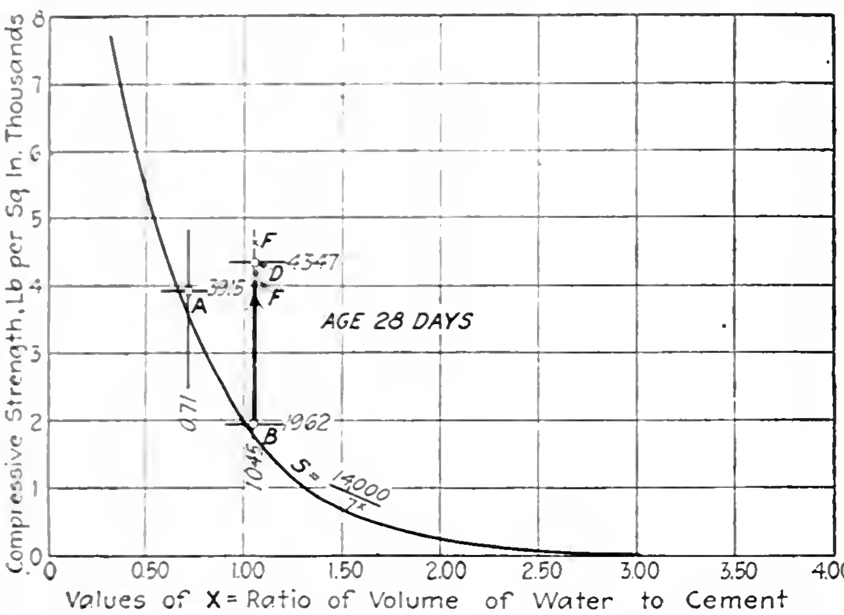


FIG. 2. WATER CONTENT OF SPECIMENS PLOTTED AGAINST STRENGTH

stored under usual laboratory conditions, and the H specimens were left in the molds and exposed to the weather and approximate working conditions.

These average values are shown graphically in Fig. 1. Comparing lines C-C and B-B shows that tamping the soft concrete increased the strength very little. Comparing lines DEF-DEF and B-B shows that rodding the soft concrete increased its strength about 100% at an age of 28 days and over, and about 80% at an age of seven days. Comparing lines DEF-DEF and A-A shows that the soft concrete prepared with a considerable excess water and rodded was stronger than the same concrete prepared with as little water as it was practicable to use.

A very thorough study of the effect of excess water on the strength of concrete by Prof. D. A. Abrams of Lewis Institute led to the value $14{,}000 \div 7^x$ as the ultimate unit strength of concrete at an age of 28 days, x representing the ratio of the volume of water to that of the cement, the latter being based on a weight of 94 lb. per cubic foot. (See *Engineering News-Record* of May 2, 1918, p. 873.) Fig. 2 shows the value $14{,}000 \div 7^x$ and the average 28-day strengths of the A, B, D, E, and F groups of specimens. An inspection of this figure shows that the strengths of the A and B groups, which were not rodded, agree very well with the value $14{,}000 \div 7^x$ and that the rodded groups, D, E, and F, are very much stronger.

TABLE SHOWING EFFECT OF RODDING CONCRETE

	Water Content in Per Cent. of Total Weight	Treatment	Compressive Strength Lb. 1 Sq. In. 28 Days	3 Months
A	6.7	Tamped	3,915	4,559
B	10	Slowly filled	1,962	2,386
C	10	Tamped lightly	2,313	2,343
D	10	Rodded every 15 to 30 min. for four hours	4,211	4,363
E	10	Rodded every 10 to 12 min. for 2½ hours	4,188	4,512
F	10	Rodded every 30 min. for seven hours	4,644	4,961
G (a)	10	Rodded every 30 min. for 7½ hours, stored in laboratory	2,770	
G (b)	10	Slowly filled, stored in laboratory	1,522	
H (a)	10	Rodded every 30 min. for 7½ hours; exposed to weather; slowly filled	2,611	
H (b)	10	Slowly filled; exposed to weather	1,409	

It seems very probable, from a study of Fig. 2, that the particular increase in strength, about 100%, due to rodding, found in these experiments, was caused by the particular percentage of excess of water used in preparing the specimens, and that the beneficial effect of rodding varies with the percentage of excess water used.

The increase in strength produced by the rodding is no doubt due to the removal of the excess water and the entrapped air and to the compacting of the aggregate. Specimens D, E and F, for example, had an average weight of 147.9 lb. per cubit foot and specimens B a weight of only 142.1 lb. To a certain extent, the excess water may act as a lubricant to permit a better compacting of the aggregate.

Strength Requirements for Manila Rope

SPECIFICATIONS for purchase and acceptance of manila rope recently drawn up for Government use by the Bureau of Standards give figures for required breaking strength according to the table reproduced below. Tests are to be made on pieces not less than 5 ft. long between end connections or splices; at least one coil of each size of rope in a given lot is to be tested, and if the lot includes a large number of a given size from 3 to 5% of the coils shall be tested. If the ends of the test specimens are fitted with eye-splices for test the inside diameter of the eye must be at least 7 in., and the splices must be strong enough to insure a break in the body of the specimen. An unusual clause of the specifications reads:

If not more than 30% of the coils tested fail, the lot, except the coils which have failed, shall be accepted. If more than 30% fail the manufacturer may request and shall be granted a retest of one or more lots of an equal number of specimens taken from the same coil or other coils of the lot. If not more than 30% of the entire number of tests fail, the lot, except those coils which have failed, shall be accepted. Any coil which has failed to

WEIGHT AND STRENGTH OF MANILA ROPE

New Government Specifications, Drawn by Bureau of Standards
Figures apply to three-strand rope, medium-laid. Four-strand rope may run up to 7% heavier and may show 95% of the tabulated strength.

Approximate Diameter in Inches		Circumference in Inches	Approx. Gross Weight of a 1200-Ft., Coil in Pounds	Maximum Net Weight per Foot Rope in Pounds	Minimum Breaking Strength in Pounds
6 thd.	1/4	3/4	24	0.0196	700
9 thd.	5/16	1	35	0.0286	1,200
12 thd.	3/8	1 1/8	50	0.0408	1,450
15 thd.	7/16	1 1/4	66	0.0539	1,750
18 thd.	15/32	1 3/8	78	0.0637	2,100
21 thd.	1/2	1 1/2	90	0.0735	2,450
	9/16	1 3/4	126	0.1029	3,150
	5/8	2	160	0.1307	4,000
	3/4	2 1/4	198	0.1617	4,900
	13/16	2 1/2	234	0.1911	5,900
	7/8	2 3/4	270	0.2205	7,000
	1	3	324	0.2645	8,200
	1 1/16	3 1/4	378	0.3087	9,500
	1 1/8	3 1/2	432	0.3528	11,000
	1 1/4	3 3/4	504	0.4115	12,500
	1 5/16	4	576	0.4703	14,200
	1 3/8	4 1/4	648	0.5290	16,000
	1 1/2	4 1/2	720	0.5879	17,500
	1 9/16	4 3/4	810	0.6615	19,500
	1 5/8	5	900	0.7348	21,500
	1 3/4	5 1/2	1,080	0.8818	25,500
	2	6	1,296	1.059	30,000
	2 1/16	6 1/2	1,500	1.225	34,000
	2 1/4	7	1,764	1.441	38,500
	2 1/2	7 1/2	2,016	1.646	4[illegible],500
	2 5/8	8	2,304	1.881	49,000
	2 7/8	8 1/2	2,580	2.107	55,000
	3	9	2,916	2.381	61,000
	3 1/8	9 1/2	3,240	2.645	67,000
	3 1/4	10	3,600	2.940	73,000

meet tensile requirements on the first test shall be accepted if two subsequent tests prove satisfactory.

The size and weight of the rope are to be determined while the rope is stressed by a load in pounds equal to 200 times the square of the diameter of the rope in inches. The weight per foot is also determined on the basis of the length of the rope when stretched under this load. A tolerance on circumferential measurement of size is allowed, ranging from $\frac{1}{8}$ in. for rope from $\frac{3}{4}$ to $1\frac{3}{4}$ in. in circumference, to $\frac{5}{8}$ in. for rope $9\frac{1}{2}$ in. and over in circumference. The weight tested is used, in case the rope overruns the tabulated weight, for reducing the billed weight in the same proportion as the overrun of the weight per foot.

It is specified that rope shall contain not less than 8% nor more than 12% of lubricant content. No non-manila fiber must be present in the rope, as indicated by the brown coloration of manila and red coloration of other fibers after treatment with acidified bleaching-powder solution followed by exposure (when dry) to strong ammonia fumes.

Concrete Mat and Columns Reduce Cost of Building

Heavy Foundation Work Avoided by Concrete Mat Over the Site—Columns Have Cast-Iron Core with Rods and Spirals

TO AVOID excavation in quicksand, and other expensive work in soft soil, a reinforced-concrete mat covering the entire area of the site was used for the foundation of the 10-story Blatt apartment building, which was erected in Chicago in 1917. Concrete columns of the Emperger type, with cast-iron pipe cores, were used in the same building. Street columns and reinforced-concrete floors were provided in the original design, but concrete construction was adopted on account of the high cost and uncertain supply of steel. The cost of the concrete columns and floors is said by the designer to have been only about 55% of that estimated for the steel work thus eliminated.

Situated near the lake shore, the site, about 106 x 160 ft., has the sidewalk elevation 14 ft. above lake level and only 6 ft. above ground water. The ground consisted of 20 ft. of fine sand over 30 ft. of soft clay.

Footings on wood piles were called for in the original design. Under the Chicago building code, however, the piles would have to be cut off 12 in. below lake level. This would have required 15 ft. of excavation, 9 ft. being in water-bearing sand or quicksand, necessitating the inclosure of the site with steel sheeting. The cost of such foundation work would have been prohibitive. Concrete piles also would have been expensive, as they would have had to be at least 40 ft. long.

A flat-slab raft or mat foundation which would give a load of not more than about 2000 lb. per square foot was then proposed. This was adopted, and the work was completed within six weeks. The slab is 24 and 20 in. thick, made of 1:2:4 concrete. Reinforcing bars are arranged as shown in the drawing. Special $\frac{3}{4}$-in. bottom bars in the spaces between the columns are provided for taking up the negative moment, and 1-in. bottom bars under the columns are provided for the same purpose. Both sets of rods are 10 ft. long.

To limit the shear to about 75 lb. per square inch, column footings or pedestals of 1:1:2 concrete were built on the slab. Each footing is 30 in. high, $5\frac{1}{2}$ ft. square at the base and $3\frac{1}{2}$ ft. at the top. It is reinforced with a 25-in. spiral of $\frac{1}{4}$-in. wire with 1-in. pitch, in order to allow the high compression load which the columns concentrate on the cast-iron base-plates.

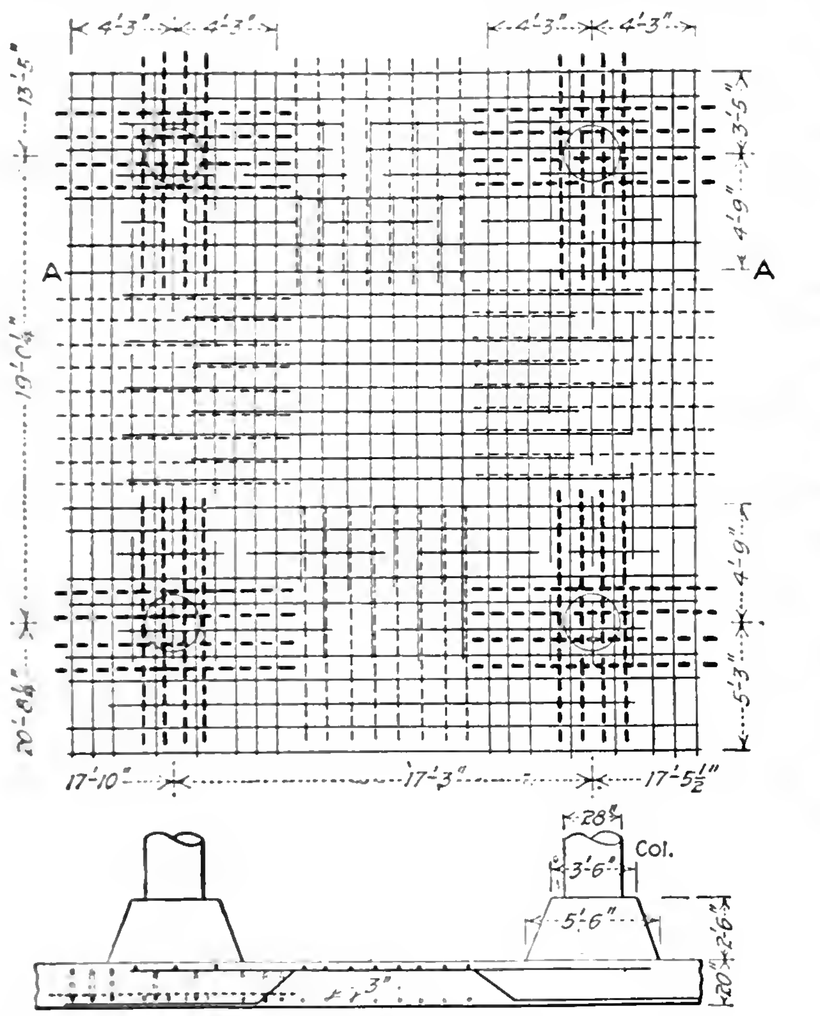
FOUNDATION SLAB AT BASEMENT IS READY FOR SUPERSTRUCTURE

Columns of the Emperger type, having cast-iron pipe cores, form one of the special features of the structure. The cores were plain cylindrical castings, poured vertically. They were mainly of 5- and $9\frac{1}{4}$-in. outside diameter, the thickness varying from $\frac{1}{2}$ to 1 in. for the former and $\frac{7}{8}$ to $1\frac{1}{2}$ in. for the latter. Butt joints were made about 2 ft. above each floor line, spliced with outside sleeves, as shown. Three 12-in. dowel rods were embedded in the concrete filling, in order to line up the columns and prevent lateral shifting. Cores for the basement and the first floor were cast in one piece, as the basement is only a 6-ft. pipe chamber, so that the height of these tall cores did not exceed 15 feet.

Dowel bars in the columns extend from the bottom of the concrete slab to about 30 in. above the first floor, as shown

in one of the drawings. There are 12 of these bars to each column. In the wall columns eight bars are on the outer side, with their horizontal bottom ends bent toward the inside of the building. The other four bars are on the inner side of the column, with their ends bent toward the outside of the building. All the rods lie within the spiral hooping of the column base and column.

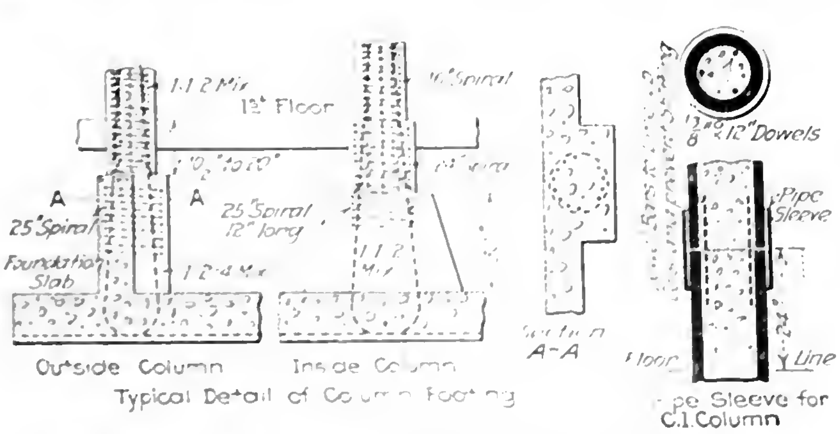
Above the first floor the columns were made of the same sizes as those originally provided for steel con-



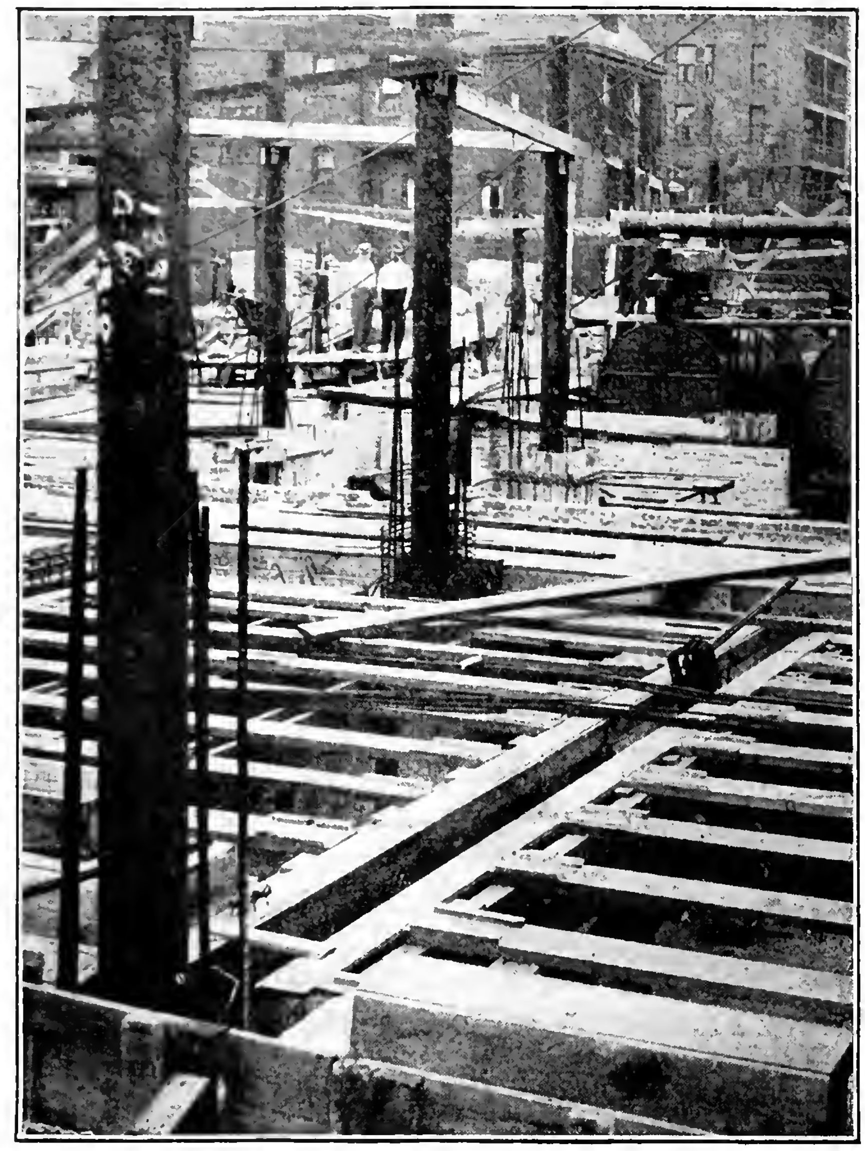
CONCRETE MAT IS FOUNDATION FOR 10-STORY BUILDING ON SOFT GROUND

struction with concrete fireproofing. The short stub columns in the basement were made larger than the original design and were provided with pyramidal concrete bases, as already described, in order to distribute the load and thus reduce the punching shear on the concrete mat which forms the foundation of the building.

Concrete of 1:1:2 mix was used for the interior filling and exterior casing of the core, the latter being 1½ in. thick outside of the steel spiral which surrounds the vertical reinforcing rods. To meet the safe-load requirement of the Chicago building department, the



CONCRETE COLUMNS HAVE CAST-IRON CORES—BENT BARS ANCHOR THEM TO THE FOUNDATION SLAB



CAST-IRON CORES READY FOR COLUMN FORMS—FLOOR FORMS IN PLACE

vertical reinforcement and spiral were each made 1% of the cross-sectional area of the iron core. Stress on concrete over full core area, inside spiral, was taken as 1120 lb. per square inch. Stress on cast iron was taken as 11,200 lb. less the 1120 lb., or 10,080 lb. per square inch.

R. W. Wilson & Co. were the architects. The adopted foundation and columns were designed and built by L. J. Mensch, contracting engineer. These plans were checked by the Westcott Engineering Co.. consulting engineers for the architects.

Decrease in Lumber Production in 1918

Recent tables compiled by the United States Forest Service show that the State of Washington, with a record of more than 3,250,000,000 ft. of lumber cut in 1918, Oregon with 2,000,000,000 cut and Louisiana with a cut of more than 1,500,000,000 ft. are still the great lumber-producing states of the country, with Mississippi, California and Nevada (the two in one division), Wisconsin, Arkansas, Texas and Idaho each cutting more than 500,000,000 ft. each. A total lumber production of 32,760,000,000 ft. is the estimated cut for 1918 on the basis of partial returns received by the Forest Service from 731 sawmills, each of which cut 5,000,000 or more feet in 1917 or 1918.

In 1917 the total production of lumber in this country amounted to 36,000,000,000 feet. The decrease in 1918 is not confined to any one region but is general. It is largest in the Southern and Eastern states and least in the Western states. Maine shows the greatest percentage of decrease.

Short-Circuiting Floods in the Big Sioux River

Two Thousand Second-Feet of Floodwater Dropped 110 Feet in Distance of 300 Feet Through Canal at Bend in River—Hydraulic Jump Takes Energy Out of Fall

By Francis C. Shenehon
Consulting Hydraulic Engineer, Minneapolis, Minn.

FLOODS in the Big Sioux River near Sioux Falls, S. D., are to be guarded against in the future by the Sioux Falls spillway, designed to pass 2000 cu.ft. of floodwater per second through a descent of 110 ft. in a distance of 300 ft. The spillway not only conducts the water but serves to absorb the destructiveness of its great energy. This absorbed energy is better comprehended by thinking of it as 25,000 theoretical horsepower.

The Big Sioux River, approaching Sioux Falls from the north, passes south tangent to the city, then makes a loop of 26 miles of meandering course, and returns through the city. The descent of the river over a bed of red jasper or quartzite rock creates a water power about which the city has centered and grown. The developed fall is 62 ft. The river departs northward again flowing in a deep gorge, and having a water surface level about 115 ft. below the surface level of its first tangential approach. From the upper river to the lower river across the neck of the loop is about 2½ miles, and this is the short cut for the diversion of floodwaters.

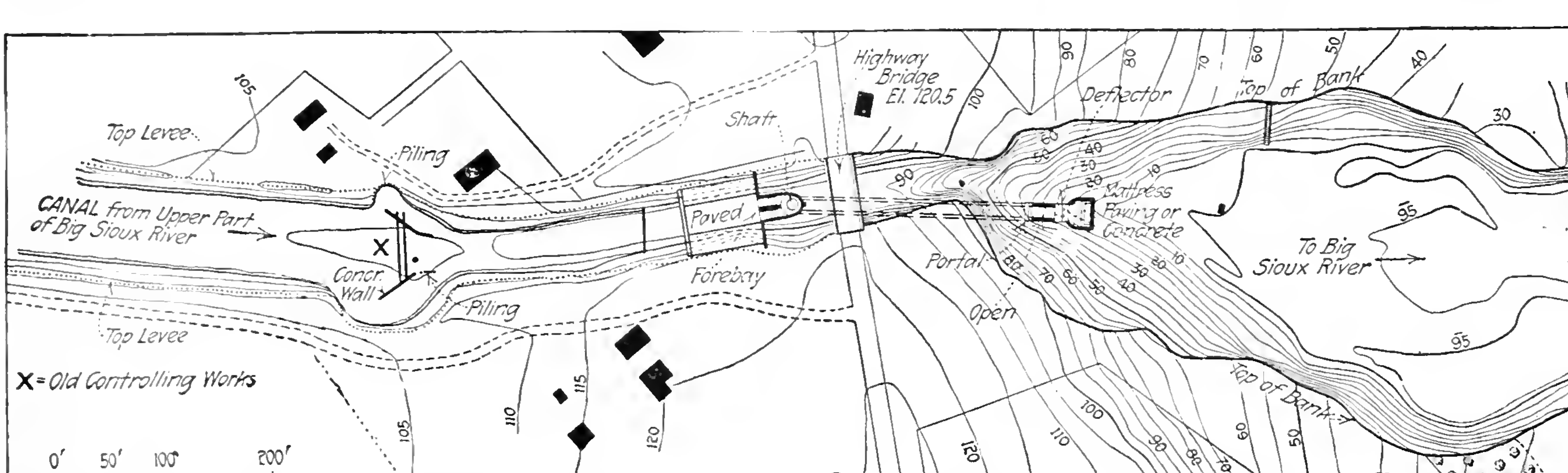
The river as it comes from the north has a drainage basin above Sioux Falls of 4450 square miles, the headwaters lying in the Heights of the Prairies in the northeastern part of the state. It has the characteristic devious, winding course of a stream flowing in banks little depressed below meadow lands. Its travel in reaching Sioux Falls appears as much as 300 miles with slopes not much exceeding 1 ft. to the mile. Between 1% and 2% of its drainage basin consists of lakes which have a slight tendency to detain the floodwaters and stabilize the flow. The normal annual rainfall is about 23 inches.

The southward flow of the river, with the ice disappearing downstream first and clearing the way for the later floodwaters from up-state, is not favorable for excessive flood volumes in the spring breakup. The corridor shape of the drainage basin, and its flat slopes, tend to the slow development of floods, and the lesser probability of synchronizing flood peaks. No records were available of flood flows. From high-water marks, channel dimensions and slope considerations, the writer's estimate of the bank-full flood flow was 6000 cu.ft. per second; or 1.35 cu.ft. per second per square mile of drainage basin. The spillway was designed to carry one-third of this normal flood flow, with some overload capacity.

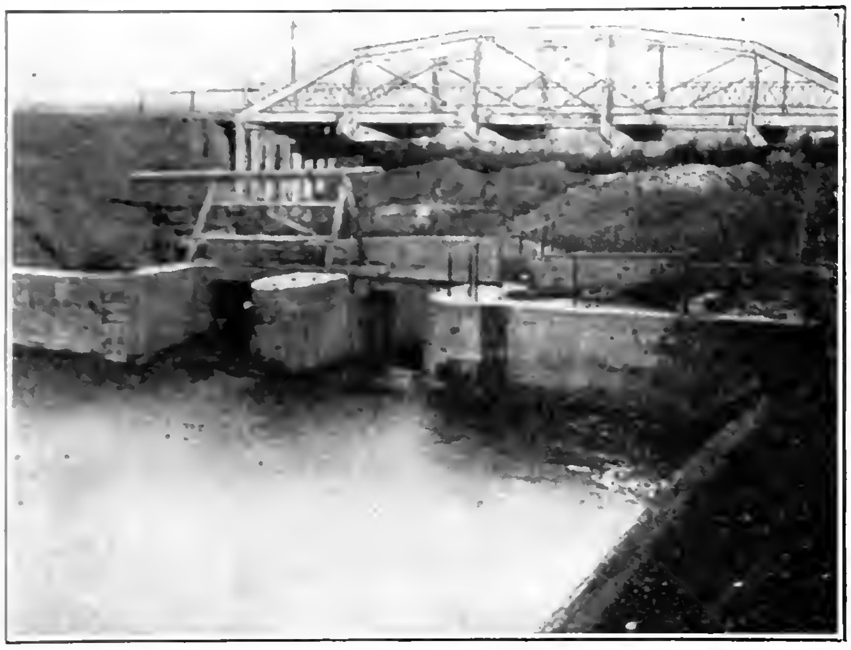
The upper river valley is flat, about two miles wide, and rimmed on either side with low boulder-clay ridges. The valley subsoil is fine sand easily eroded, and the top soil is a black clay loam enriched by centuries of overflow. The lands bear abundant crops and are valuable. The river channel is but slightly depressed in the valley floor, and in the past it has shifted to some extent.

WRECK OF OLD SPILLWAY, FLOOD OF MARCH, 1916

It was an obvious expedient to ditch this land for drainage purposes, and to give these ditches an outlet through the south rim of hills into the river of the gorge. These ditches were made large enough to divert water from the upper river across the neck to the lower river, and thus relieve the congestion of flood-time in



PLAN OF SPILLWAY TO TAKE FLOOD WATER ACROSS LOOP OF BIG SIOUX RIVER, NEAR SIOUX FALLS, S. D.



FOREBAY AND SLUICEWAYS AT HEAD OF SHAFT OF NEW SPILLWAY

the loop. One ditch taps the river 12 miles up the valley, and a second almost abreast the north edge of the city.

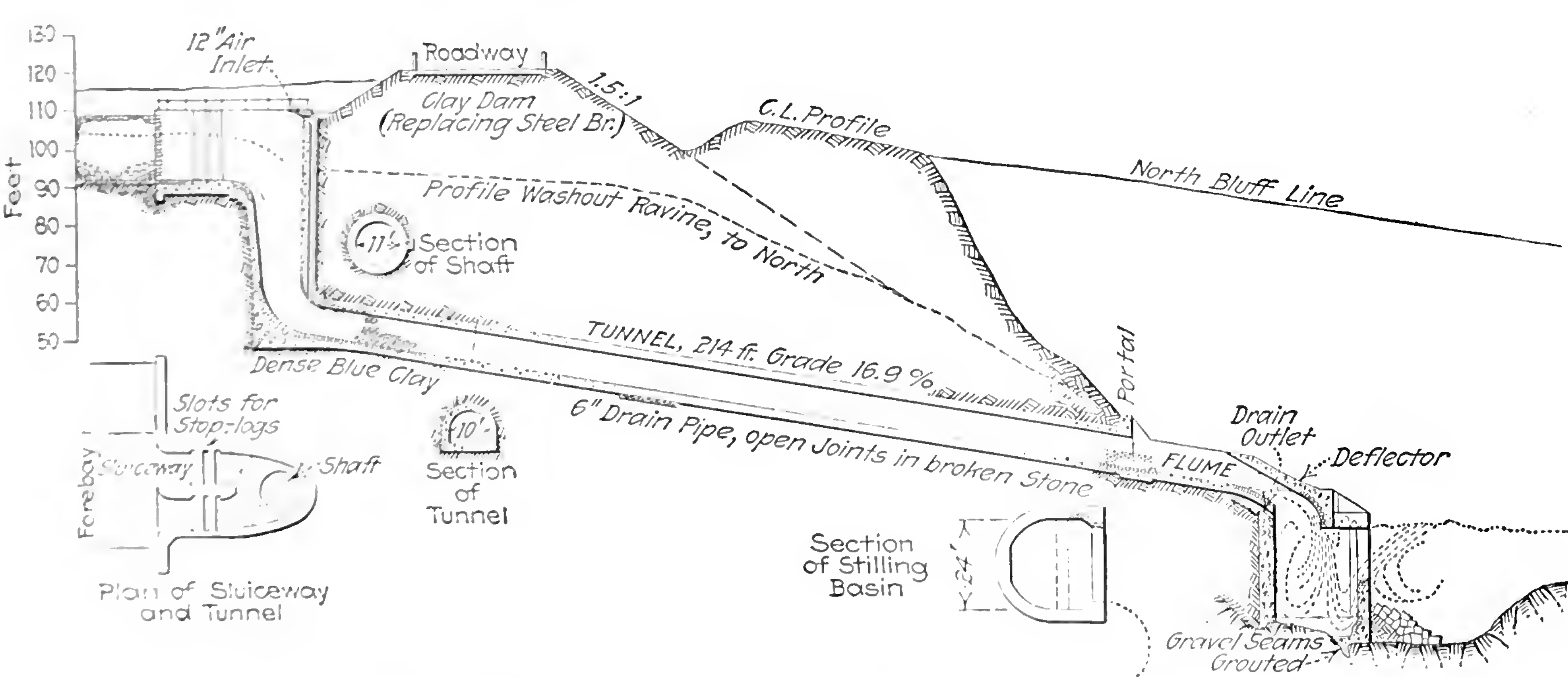
To bring these waters from the valley floor to the lower level, some ten years ago a cut was made through the valley rim and down the sloping river bank, and a reinforced-concrete trough lining was constructed. The destructive energy carried in the surcharged trough was perhaps not fully appreciated; and in the flood of March, 1916, the torrent cut out the protective works at the outlet end, and, by undercutting, tumbled the trough into a mass of broken concrete at the bottom of a gorge excavated 800 ft. back into the sloping hillside. One of the views shows the trough in process of destruction.

The writer was called by the board of county commissioners of Minnehaha County, in August, 1917, to design and construct a spillway of ample capacity.

As stated, the normal desirable capacity of the spillway (2000 cu.ft. per second) was taken as one-third the normal flood flow of the river, and somewhat in excess of the normal bank-full capacities of the ditches tributary to it. When an extreme flood overflows the ditches and brings water overland, increased depth in the spillway sluices will give an overload capacity of 2500 cu.ft. per second.

The geological formations and the topography determined the type of the spillway structure. The walls of the gorge cut at the time of the wrecking of the old trough spillway revealed an underlying stratum nearly 100 ft. thick of tough, rubber-like bluish-gray clay, which in the glacial epoch had been compacted by the enormous pressure coming from an ice sheet a mile or more in thickness. Above the blue clay was a cover of yellow clay of little tenacity. The blue clay at an unknown depth was underlain by the red quartzite rock. It was decided to penetrate the blue clay by shaft and tunnel and thus take the shortest route to the gorge, where a confined stilling basin at the outlet could be founded on rock and have a rock bottom.

The spillway as perfected was made up of simple elements. Controlling works were placed at the upper end, with sluiceways limiting the inflow to 2000 cu.ft. per second with water at El. 104. The sluiceways are provided with stop-logs to shut off the flow when desirable. Above the sluiceways the ditch is enlarged into a forebay and paved. A stilling basin is at the lower end, where the flood waters are made to plunge into a well, 25 ft. deep, U-shaped and equivalent in horizontal area to a circle 24 ft. in diameter. A conduit leads from the sluiceways to the stilling basin. It was designed to destroy energy, so the conduit first drops vertically in a circular shaft tapering to a diameter of 10 ft. at bottom. Then an elbow turns the water through an angle of 80° into a tunnel 10 ft. wide and 8 ft. high, with circular arch overhead. The tunnel is 214 ft. long and descends on a 16.9% grade. Then comes an open flume of the same width, with sidewalls 8 ft. high, bridged between the tunnel portal and the basin, so that the earth may settle from under its floor without endangering its stability.



SECTION THROUGH SPILLWAY CANAL AND TUNNEL SHOWING DETAILS OF STILLING BASIN

The flume leads to a curved deflector beam, where the flood stream is turned vertically down into the center of the well or stilling basin. As the water is turned downward on the deflector it spreads out laterally and strikes the water in the basin in a thin sheet perhaps 2 ft. thick and 20 ft. wide. Perhaps the well should be called a seething basin instead of a stilling basin, be-

FLOODWATER COMING FROM TUNNEL INTO STILLING BASIN CUTS ITS OWN CHANNEL

cause the water is not stilled when it issues from the basin in a stream 20 ft. wide and 15 ft. deep, but is alive with energy. The final absorption of the residual energy takes place in the open gorge downstream from the basin, where the rock bottom is at a depth of 30 ft., and the stream is free to cut out for itself a channel 100 ft. wide if it needs it. Sixty feet downstream from the basin the floodwater flows tamely away.

The original intention was to confine the secondary turbulence and expansion within concrete walls extending 80 ft. downstream. Since, however, this secondary turbulence could excavate in the gorge its own deep basin without cost and without danger to the stilling basin on its rock foundation, it appeared sound to regard the concrete extension as redundant, and to save its cost. This hydraulic excavation of the outer basin was successfully accomplished in an eight-day flood in March of this year. The flow was restricted by stoplogs to 1200 cu.ft. per second and the gorge walls were brought down in little landslides which did not endanger the structure. The lateral eddies were not allowed to advance unduly upstream. When the outside basin dimensions have been worked out by the floodwater itself, a fillet of heavy rock fragments will be made outside the basin and downstream from the sill, and a heavy cover of rock will be placed at the sides of the basin where the slow swing of the eddies tends to encroach upstream.

One geological feature is still to be explained. The rubber-like blue-gray clay rests on a stratum of fine quartz sand, which at the basin was 20 ft. in depth. This sand yields a small spring flow. It is not quicksand and does not flow, but where exposed to current wash it undermines the blue clay and causes the landslides mentioned above. When a condition of equilibrium is reached, the blue clay has formed a talus bank which confines and protects the sand from further wash. The clay itself does not scour readily.

The principle involved in the absorption of energy in the stilling basin is that of the hydraulic jump, or standing wave, in which a stream of high velocity and small section undergoes a transition to a stream of low velocity and large section. It has been much discussed of recent years in connection with the detaining reservoirs of the Ohio flood-relief projects.

The object of projecting the swift stream vertically downward into a deep well is to make the structure shorter and more compact. This feature was suggested by Adolph F. Meyer, associate professor of hydraulic engineering in the University of Minnesota, who at my request made experiments in the hydraulic laboratory to test the action of vertical jets in a confined pool. Desirable depths and basin dimensions were recommended by Mr. Meyer, but he is not chargeable with the final dimensions adopted or with the omission of the extended basin to contain the secondary turbulence and expansion.

By the Unwin equation a stream 2 ft. deep, with a velocity of 50 ft. per second will have, as its "alternate" after the hydraulic jump, a stream 16.7 ft. deep with a mean velocity of 6 ft. per second. A stream 2 ft. deep flowing at 60 ft. per second will have, after the transition, a depth of 20.2 ft. The velocity of the stream plunging into the well will be between these limits. The well is 25 ft. deep and the depth over the outlet sill is 15 feet.

All structures are of reinforced concrete of massive design. Perhaps the forces to be cared for may be more readily grasped when it is stated that at overload capacity 4700 tons of water per minute are speeding at 35 miles an hour vertically through the shaft, turned nearly to horizontal in the elbow, turned to vertical on the deflector; then flow out of the basin horizontally again. The reaction in the elbow and on the deflector is over 100 tons.

The two sluiceways, each 8 ft. wide and 12 ft. deep at normal flood flow, admit substantially 2000 cu.ft. per second. The duplicate sluices prevent vortex in the

shaft. When the flood is 2 ft. higher, some lands in the vicinity of the spillway are flooded, and some water passes overland back to the upper river further downstream. The sluices under this condition will admit 2500 cu.ft. of water per second. In extreme floods, coming at wide intervals, this depth is expected. When coming in March or April the temporary flooding of some lands will create no large damage. Such a flood means water coming overland from up the valley, the river and the ditches overflowing.

How the Shaft Was Built

The shaft was excavated through the tough blue clay 40 ft. deep and 15 ft. in mean diameter, without shoring. No forms were used, the facing wall of jasper and the clay surface forming the mold into which the concrete was poured. After the tube of reinforced concrete had set over a period of 10 summer days, the excavation was carried down to the base of the elbow, undermining the 120-ton tube. This tended to settle it, like a cork in a bottle, imperviously into the clay.

The tunnel heading was driven from both ends, the dense clay being blasted out with dynamite, and being carved into shape, 12 ft. high and 14 ft. wide, without timbering. One exception to this was over a length of 20 ft. where a pocket was encountered, which precipitated about 200 cu.yd. of wet sand and gravel into the heading. The jasper-faced floor and side walls to a height of 4 ft. needed no forms. The arch was carried on portable forms. All the rock facing was set integral with the concrete.

The basin presented the only really difficult problem. Suitable rock foundation lay at a depth of 25 ft. below water and through 20 ft. of sand. The site was hemmed in by clay bluffs, 100 ft. high, with slopes too steep for stability. Landslides were not uncommon. The basin construction is a story in itself. Pneumatic caisson was clearly indicated, but it was shoved through inside a circular ring of steel sheetpiling. The basin with the deflector and half the flume weighs nearly 700 tons. Its walls are locked to the rock, and it is anchored by the steel of the flume to the earth-bound tunnel against the heavy earth pressure and the water impact.

The spillway was built under the direction of the Board of Commissioners of Minnehaha County, South Dakota. The Sioux Falls Construction Co. executed the work. L. M. Norelius was resident engineer during the most difficult period.

Origin of English Weights and Measures

According to a letter formulated by the World Trade Club advocating universal adoption of the metric system, the present coinage of the British Isles, as well as the weights and measures of both the British Isles and of America, is German. The British pound, both sterling and avoirdupois, originated with the old German Osterling Hanseatic League, which for hundreds of years controlled the trade of England. What is still more remarkable is that America and Britannia continue to use these old German tools after Germany herself has forgotten them. The latter country adopted in 1871 the simplest decimal system of quantity expression known—the application of the decimal to weights and measures, the invention of that truly great Briton, James Watt, in 1783.

Frozen Concrete Thawed by Putting Warm Concrete on Surface

It Is Also Found That Chemical Changes in Setting Concrete Produced Enough Heat To Prevent Freezing

WARM concrete placed on the frozen surface of a previous layer was reported as thawing out the latter, in the construction of the Dead River dam, in northern Michigan, as described in an article in *Engineering News-Record* of Aug. 8, 1918, p. 260. Similar behavior is now recorded in the construction of the East Canyon Creek dam, near Ogden, Utah, described in a paper by A. E. Parker in the "Proceedings" of the American Society of Civil Engineers, March, 1919. In addition, the engineers on the Utah dam concluded that the chemical action by the setting concrete developed enough heat in itself to prevent damage from freezing. The particulars of the concreting work are recited by Mr. Parker as follows:

Most of the sand was in a large pile on the side hill above the two bins and, becoming wet from the autumn storms, it froze to a depth of 2 or 3 ft. The broken rock was coated with frozen earth, snow and ice. Although the bins were roofed, the materials often froze. The only thing done to overcome these conditions was to mix the concrete with hot water. The concrete as it came from the mixer was just above the freezing point, and to maintain it at this temperature it was necessary to keep the water hot and to throw out the larger, solidly frozen lumps. It was planned to use rock plums in the concrete, but cold weather prevented this, as it was too difficult to remove the snow, ice and dirt from the rock.

Rise in Temperature Prevented Damage

Experience soon showed that the rise of temperature due to chemical changes in setting prevented damage from frost when the concrete in the forms was covered at night. Canvas was spread over the forms, steam jets prevented surface freezing, and the temperature of the mass below the surface soon increased sufficiently to remove any frost occurring there, if not too great in quantity. As the steam caused heavy deposits of frozen moisture on the forms, which in melting made a very sloppy condition, salamanders burning coke were substituted for the steam jets, bringing about an improvement of conditions.

When concrete was placed on very cold days the surface of the fresh concrete often froze immediately to the depth of an inch or two. It was found that placing fresh concrete thickly over such a surface quickly thawed it out without harm, but when the freezing was too severe the frozen part was picked, broken up and thrown out. Steam jets were used freely to thaw out and remove the ice from the forms, concrete surfaces and rock walls immediately before concrete was placed against them.

The removal of the 1½-in. pipes in the contraction joints afforded a favorable means of testing the rise in temperature in the concrete when setting. Thermometers lowered into the holes showed in every case a considerable rise, a typical test showing a temperature of 70° F. at a depth of 15 ft. when the air was at 14° Fahrenheit.

A Map-Indexing System Adapted to Small Cities

Number Book, with Simple Classification Scheme Combined with Four-Color Card Index, Used at Riverside, California

By Frank J. Calkins
Riverside, California

NUMEROUS schemes for systematizing the filing of maps and other engineering data in large cities are on record, but very little information is to be found concerning indexing systems suitable for smaller cities, say of 10,000 to 50,000 population. The system developed by the writer for the City of Riverside, Calif., may be useful to others who have met the same difficulty. It is believed that the system will serve until a city has grown to such size that the city engineer's office is divided into several departments.

The objection to systems used by many small cities is that they leave too much to the memory of officials in charge. In developing a better system it was the purpose to eliminate this element. As finally revised, the plan includes a card index and a number record book. These two parts of the system are expected to afford so effective a means of cross-reference that there will never be delay or difficulty in locating the desired map.

The number record book was selected with a view to the strongest and most durable binding. Its page size is 9½ x 13½ inches, with ordinary record-book ruling.

Three numbers were placed on each page, the plan being to reserve one-third of the page for each entry and thus avoid the use of any subnumbers. The description of an article entered under each number is very brief; just enough to trace it in the card index. Thus the space allotted for each number is enough so that as old work is taken out of the files and replaced by new plans or maps the first record under any number can be canceled and the blank space below it used for later entries.

In the front of the book several pages were specially ruled for use as a chronological index of the numbers. In these pages the entries consist of date of entry and number, only. Their purpose is to facilitate finding the entry for a plan about which there may be some confusion in the index, or whose classification has been forgotten. If the approximate date of filing is known the chronological record makes it possible to turn immediately to the entries made about that time.

Another set of pages, with special ruling, in the front of the book is reserved for vacated numbers. That is, when articles are permanently removed from the files and the entries in the book are canceled, the numbers are listed in the vacated-number record, thereby indicating that these numbers are available for new entries. As these numbers are again used for new entries they are crossed off this list.

The index cards are 5 x 8 in. in size and are ruled and printed alike in four different colors—yellow, salmon, blue and white. Other colors, of course, could be added as further classifications were necessary. Yellow cards are used for all street work and alley work, and improvements such as bridges, culverts, profiles, cross-sections, surveys and lighting systems. Salmon cards are for sanitary-sewer records, including sewer farms, manholes, etc. Blue cards are for drainage work, including drainage sewers, ditches, manhole plans, etc. White cards are used for miscellaneous records, including plans, profiles, notes pertaining to parks, schools, public buildings, water systems, etc. The cards are always kept in the index case in the order of yellow, salmon, blue and white.

The column on the index card marked "Kind or Book" is used for describing the kind of paper upon which the map is drawn, or, when field notes are indexed, this column gives the field-book number, and in the "Map No." column following, the page number of the field book is given.

A key card kept in front of the index bears the following explanation of the system: (1) Maps are first indexed in the number-record book; next in the chronological record, and finally in the card index; (2) the heading typed on the index cards should begin over the letter "N" in the word 'Description"; (3) cards are placed in the file in the following order: yellow, salmon, blue and white; (4) all articles are to be cross-indexed as completely as possible; (5) the sign on the index cards shows that the article indexed covers more work than is shown on that particular card; (6) when a map or a plan is taken from the files permanently the number must be entered in the vacated-number list in the record book and note made in the record book and on the card index stating the date and the cause of removal; (7) when vacated numbers are used again such numbers must be crossed off the vacated-number list. As for the plans and maps themselves, they are kept in paper tubes riveted together with eye-rivets, in sections of 50 tubes each; each section just fitting into a space in a wooden rack built in a fire-resisting vault. The tubes are 2 in. in diameter and 36 in. long, and the rack can hold 900 tubes. The tubes are not fastened to the rack and can be removed whenever desired. This size has been found large enough for all practical purposes. The wall space occupied by the rack is approximately 5½ ft. square, while the floor space

MAGNOLIA AVE.

NATURE	COMPLETE DESCRIPTION	DATE	KIND OR BOOK	MAP NO.
Map	Terracina Drive to Jurupa Ave. Improvement map (macadam)	4/3/17	Tracing	437
Notes	Fill across arroyo. Preliminary	3/12/17	132-12	
Map	Fill across arroyo. Preliminary	10/4/17	Detail	542
Profile	Jackson St. to Van Buren St. For grading	9/30/18	Pro. cloth	566
Map	Lighting System across arroyo	1918	Tracing	573
Plan	Culvert at Washington St. Concrete, 38" by 48" by 96'	4/6/18	Detail	581
Contour map	for fill across arroyo (scale 100')Drawn by G.R.W.	1917	Detail	395

STREET INDEX CARD USED WITH RECORD BOOK

required is about 4 x 5½ ft. The tube numbers are marked upon the wooden strips which border each space in the frame. Units are marked on horizontal strips and tens and hundreds on vertical strips.

Center Gutter Construction Used on Bituminous Street

Sidewalks With Unequal Exposure Utilized as Curbs on Narrow Streets—Plan Helped to Save Trees and Was Economical

By W. D. Johnston
City Engineer, Waterloo, Iowa

BITUMINOUS-surfaced pavement depressed at the center to form a gutter has been used with success in Cedar River Park Plat, Waterloo, Iowa. By utilizing the sidewalks as curbs, and building them with unequal exposures on opposite sides of the street to compensate for differences in elevation, many shade trees, rustic fences, etc., were saved, and a satisfactory and economical improvement was obtained. While streets with center gutters have been constructed elsewhere, it is not known that similar methods and materials were used.

Cedar River Park Plat, on a sandy ridge adjoining the river, was laid out, for the most part, following the rectangular system. The lots were 40 ft. front by

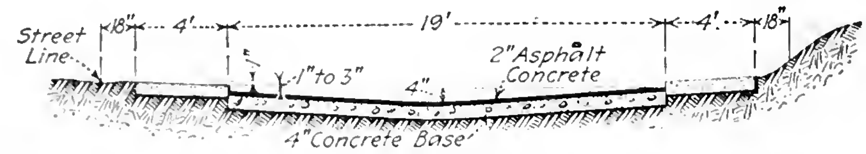
COMPLETED STREET SHOWING WALKS AND TREES

80 ft. in depth, and the streets were 30 ft. wide, with no alleys in the plat. The first stage of its development had been the building of a number of rather small, temporary cottages for summer occupation only; but as time went on additions were made to a considerable number of these and they were reconstructed into permanent homes. This led to a demand for permanent improvements such as sewers, sidewalks and pavements, for the small lots with the increasing number of outside toilets soon proved a nuisance, and the sloping, sandy streets washed away badly with each rain.

In the selection of a type of cross-section for the walks and pavement, the deciding factors were as follows: Rather low property values; sandy soil; fairly steep grades on most of the streets, and the presence of many shade trees, rustic fences, shrubbery, etc., on or near the street lines. After considerable study, the plan and cross-section shown were adopted.

Walks 4 ft. wide were constructed 1½ ft. outside the property line in an effort to leave the trees, shrubs and rustic fences undisturbed. The curves at intersections were built with 4-ft. radii on the inner side and an 8-ft. radius on the outer side. After the walks and sewers had been constructed bids were taken on several types of paving, and the contract was let in February, 1917, on 2-in. asphaltic-concrete surfacing with 4-in. concrete base, at $1.54 per square yard.

In carrying out the construction, a few places were encountered where the transverse slope was excessive and, to avoid throwing the center gutter too far toward



SIDEWALKS ABUT AGAINST CONCRETE BASE AND CONFINE BITUMINOUS SURFACING

the low side, an exposure of ½ to ¾ in. on the low walk, as against 3 to 3½ in. on the high walk, was resorted to, giving the desired result. A view of the completed street is shown.

The cost of the improvement to corner lots where both streets were paved was $190, while for interior lots it was $90, being a portion of the cost of side-street paving and a pro rata part of the total intersection cost. By the elimination of the side curbs a saving of approximately $38 to the corner lots and $26 to interior lots was effected.

Electrical Equipment for Movable Bridges

THE electrical equipment for various types of movable bridges—swing bridges, lift bridges and bascule bridges—is about the same, according to H. H. Vernon, of the power and engineering department of the General Electric Co., in the *General Electric Review.* Both alternating and direct current are used successfully. Standard practice for alternating curent, as illustrated in equipment for a double-leaf bascule bridge, adopts for the main operating power slip-ring motors with normal torque twice that required to overcome the friction of the bridge. Starting torque should be at least twice normal torque. This is necessary in order to provide sufficient torque to overcome static friction under adverse conditions, and to open and close the bridge when a high wind is blowing. The motors drive through a pinion which is either mounted on the motor shaft or on another shaft connected thereto by means of a coupling. Spring-set shoe-type solenoid brakes capable of holding 75 to 100% of the motor torque are mounted on the collector-ring end of the motor The spring-set brakes are used in order that they may be effective at any position of the motor when opening or closing the bridge. The brakes must be arranged so that they can be released by hand, because it is sometimes necessary to operate the bridge on failure of power. Emergency brakes of the spring-set type to hold from 100 to 125% of the normal torque of the motor are mounted on an extension of the motor shaft. Standard solenoid brakes can be obtained to hold 2800-lb. torque at 1-ft. radius.

Either drum controllers or panels containing magnetic switches are used. The lock motor is almost always of 5 hp., of the totally inclosed squirrel-cage type, arranged with metalline bearings and a spring-set shoe type solenoid brake so that it can be tilted at an angle of 90° in a direction at right angles to the shaft. A geared-type limit switch is used for each leaf of the bridge to shut off power from the motors when the leaves have reached their upper and lower limits, and, in addition, to show by means of lamps the open, nearly open, nearly closed and closed positions of the bridge. In order that the power

may not be applied to the lock motor until after the bridge has closed, a track-type limit switch is used that opens as soon as the bridge leaf opens.

In direct-current equipment, the main operating motors are of the series-wound totally inclosed crane or mill type, for which the normal torque should be about twice that required to overcome the friction of the bridge. The motors are arranged with either grease-cut or oil-waste lubrication, so that they will operate successfully when tilted to an angle of 90°. The solenoid brakes are of the same type as that used for alternating-current equipment.

Demobilizing Equipment of Spruce Production Division

System for Inspecting and Recording Keeps Order Among 4800 Classifications—Receipts up to 45 Carloads Per Day Soon Fill 50-Acre Tract of Yards and Warehouses

A WELL organized force of 50,000 men can operate a large amount of logging and sawmill equipment in these days of highly developed machinery. When the armistice was signed, the Spruce Production Division of the Army had great quantities of equipment in the Northwest to demobilize and an endeavor was made to collect it as quickly as possible during the rainy season, and then to dispose of it without disrupting local market conditions. This required also the classifying, inspecting, recording and labeling of each item as it was received, the provision of such weather protection and repairs as were necessary, and when the material was stored, marked and appraised, to find a buyer at a price which would not be unfair to the trade. That, in brief, was the final task set for the organization whose war-time achievements were reviewed in *Engineering News-Record* of Dec. 5, 1918, p. 1023.

STORAGE BAY IN ONE OF THE VANCOUVER WAREHOUSES

The point selected for the collection of the equipment was the cut-up plant at Vancouver Barracks, near Portland, Ore. To this center, shipments were made from about 160 subcenters of assembly at mills or camps in the woods. Each consignment contained a miscellaneous assortment, and, when coming in at the rate of 45 carloads per day, as occurred in January, a good deal of time and attention was required before each item could be delivered to the particular location assigned in the 50-acre tract of yards and warehouses.

There was no time to build new warehouses—in fact, shipments began to come in a full month before work stopped in the big cut-up mill for which the Vancouver tract was laid out. Therefore, as fast as the equipment arrived that required cover, storage space had to be found in the barracks, lumber sheds or kilns. By the time the mill could be shut down and its equipment dismantled, every foot of floor space under the many acres of roofs had been laid off in bays and sections and assigned for storage of classified materials.

For example, in one part of a shed something over 300 ft. square, long tiers of bins were built into which pipe fittings of several hundred varieties and sizes could be conveniently segregated. Across the aisle, racks were built up in which to lay pipe of various sizes that came in with every shipment. Other parts of the same shed were used for railway, blacksmith and grading tools, stoves, pumps, tanks and some 300 other classifications. The interior of one of these storage sheds is illustrated.

There were 4800 classifications on the list, all told. However, for convenience in handling records everything was included under one of 20 general headings, as shown in the table:

GENERAL CLASSIFICATIONS OF LOGGING AND SAWMILL EQUIPMENT

Letter	Number	Description
R.R.	1	Locomotive and repair parts and equipment
R.E.	2	Railroad cars, repair parts and equipment
L.	3	Logging engines, repair parts and equipment
L.E.	4	Cable, blocks and rope
B.	5	Boats and parts
G.	6	Grading tools and machinery
P.	7	Pile-driver and equipment
S.M.	8	Sawmill machinery supplies, etc.
E.	9	Electric equipment and supplies
P.L.	10	Plumbing supplies.
P.F.	11	Pipe and fittings
M.T.	12	Miscellaneous tools and machinery
M.S.	13	Miscellaneous supplies
O.S.	14	Office supplies
C.K.	15	Camp and kitchen ware
E.I.	16	Engineering instruments
F.P.	17	Fire-protection equipment
C.	18	Cranes
L.B.	19	Lumber
R.F.	20	Rails and fittings

Clerks at each shipping point numbered consecutively the consignments for Vancouver, and filled in a shipping tag for each. On these tags were entered quantities, sizes and the general classification numbers of all items included in the consignment. These shipping tags were checked on arrival at Vancouver, and a more complete record was made for the catalog files. The first or general record was made in duplicate on 4 x 8-in. cards, as shown in the accompanying illustration. A yellow copy was sent to Portland headquarters, while a salmon-colored copy was kept at Vancouver barracks. The entries on these cards give the classification number and indicate the storage location by warehouse and section numbers. The inventory number shows by letter the general classification of the article and the number of the item, as entered in that classification. The shipping number includes a letter to designate the camp from which the item came, and the number of the shipment from that camp.

INVENTORY NO.	REQ. NO.	COST PRICE	APPRAISED PRICE	TOTAL NO.	ITEM AND DESCRIPTION — CLASS NO. 3	WAREHOUSE LOCATION — GENERAL	WAREHOUSE LOCATION — STATION	PAGE NO. 4 SECTION 3 — REMARKS
L 212	1253 R	$8417.00	$6850.00	1	12¼ x 12 Tacoma Yarder-extended fire box with loading drum and shipping skids. Engine No. 1451	Spur	S-5	90% 1500'-1 3/8" Cable 2500'- 5/8" Cable 2000'- 3/8" Cable on drums For specifications See supplement page 48 class AA

COMPLETE CATALOG LOOSE-LEAF FILE SHEET USED AT VANCOUVER BARRACKS

The catalog files, on the other hand, contain a more detailed description, as shown, and where possible refer to specifications or other manufacturer's records. These catalog files, of which five copies are made, carry the same inventory number as the card index, thus providing a ready cross-index.

A policy was established of putting the current market price on new goods, and rating used equipment on a percentage of this price. To arrive at a fair appraisal value of used equipment such as cranes, locomotives and logging engines, a thorough examination was made, usually by three inspectors working together. One of these represented the catalog board, another the sales department, while the third was a civilian engineer employed as an independent. These three men looked over the equipment together and discussed and agreed upon a fair price for each engine before moving on to the next. Only the clothing and grocery stocks, being considered more or less perishable, were turned over to brokers. On all other classes the purchaser may deal direct with the Spruce Division officers, no matter how small the purchase.

Logging Engine

" Tacoma Yarder" ; 1451
12¼ X 12--- 3 Drums
Extension fire box
Puget Sound Iron Works

Recd.

CLASS 3
WHSE.
SECTION

[illegible]	[illegible]	NO. ARTICLES	[illegible]	[illegible]	PRICE	VALUE
L-212	Y 1096	1	1253-R	19	8417.00	90%

GENERAL-RECORD CARD FOR ALL EQUIPMENT RECEIVED

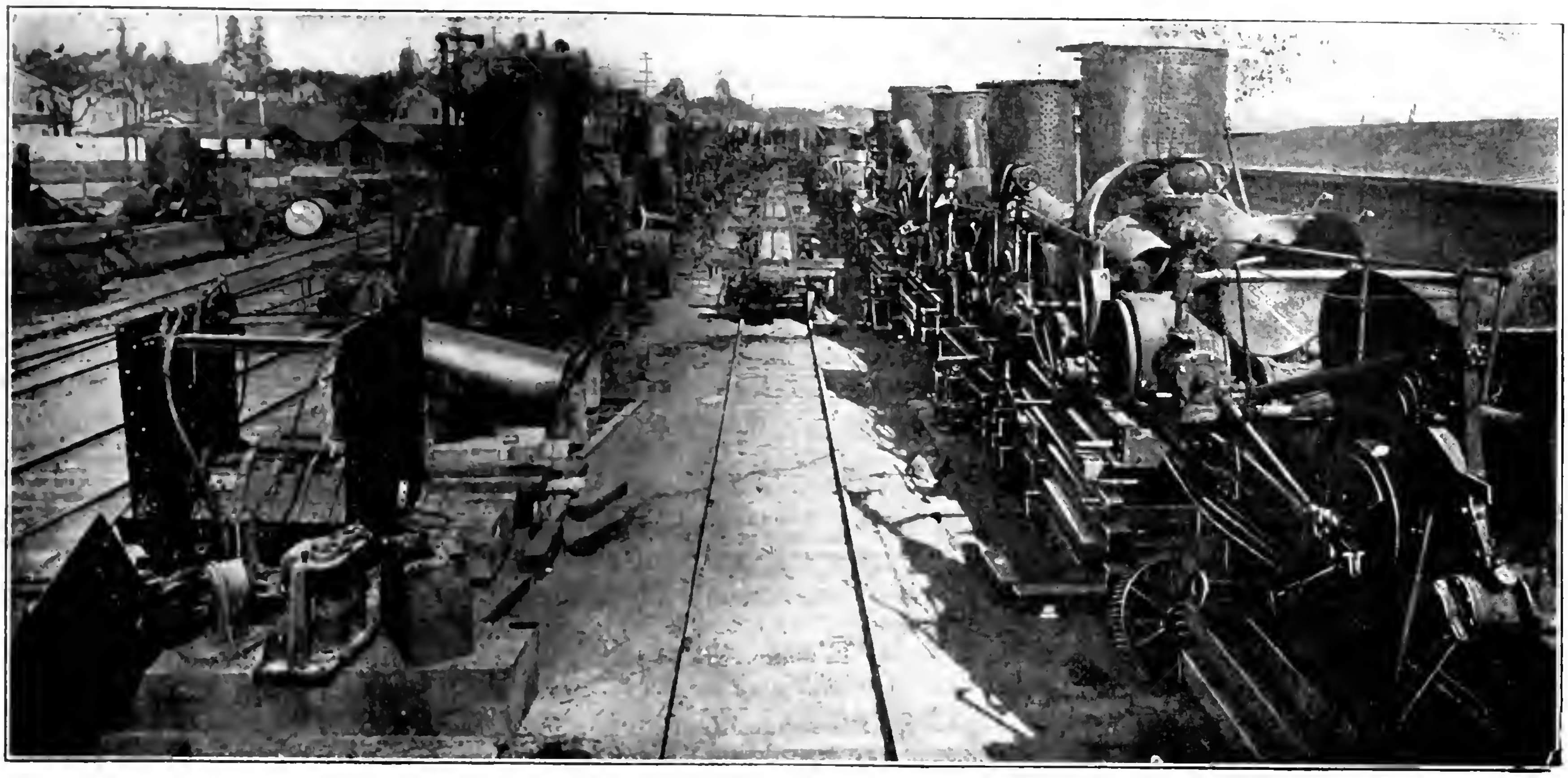
The classification and inventory work was assigned to a catalog board of Spruce Division officers appointed immediately after the armistice was signed. A sales board was also organized and charged with the advertisement and disposal of the property. As soon as the more important items could be classified a list was published, giving a month's notice that bids would be opened Feb. 15. Some 1500 bids were received, but in most of these the bidders had ignored the announcement that bids far below market values would not be considered. Therefore comparatively few bids could be accepted.

Equipment began to come in rapidly by Nov. 25, and the steady stream continued until about Feb. 1. A total of 1324 carloads was received. Without actually seeing the Vancouver storage yards it is difficult to visualize the great quantity and variety of equipment collected there. For example, there were 274 donkey engines, most of which were of large size (11 x 13- and 12 x 14-in. cylinders), 26 locomotives, equipment for three complete lumber mills, 260 pairs of car trucks, a million-dollar stock of groceries, 11,700 tons of rails and 600 motors with electrical equipment complete. Absolutely nothing was left in the woods. Even scrap was brought in to avoid the possible criticisms that might be aroused should it be found there in later years.

Much of the equipment was loaded in the rain, and all of it was more or less hastily taken down, so that, as it arrived at Vancouver, each consignment received such attention as it required. Wet tents were dried out in the kilns; broken parts on machines were replaced; gears and moving parts were greased, and bright parts were coated with white lead. To prevent rusting of the machine as a whole, most of the larger pieces, such as cranes, donkey engines and car trucks, received a light coat of black paint.

At first, logging engines were stored on their sleds, just as they came in. These sleds are made of large timbers about 60 ft. long, and had to be placed parallel to the spur tracks between which they were stored. This required so much space that it was decided to dismount the engines and pile the sleds. The engines were then set on cribs of railroad ties built up to flat-car height, as shown, so they could be easily loaded or unloaded over skids.

The steel cable required more attention at Vancouver, perhaps, than any other one item on the lists. Up to Apr. 15 a total of 629,678 ft. of it had been received in sizes of ⅜ to 1½ in. All of this except the unused reels was rewound so it could be measured, oiled, inspected and appraised. To facilitate this work, two frames, on which reels could be conveniently turned by hand, were set up in the cable warehouse, about 50 ft. apart. A long, narrow trough, from frame to frame, was filled with crude oil, and a snatch block at either end oiled the cable as it passed from reel to reel.



LOGGING ENGINES DISMOUNTED ON TIMBER CRIBS

After being rewound, the cable length was marked on each reel, and the appraised value was entered on the records. Cable was unwound from engine drums in the yard by use of a locomotive crane. To save rewinding this cable again in the warehouse, it was drawn over a measured length of track by means of a snatch block attached to the rail. Thus it passed under the inspector's eye and through a small oil tank on the crane tender, so that when delivered to the warehouse the cable had been oiled, measured and appraised and its length had been marked on the reel.

On the 13 railroads built last year by the Spruce Division nine were considered to have no future as commercial logging projects; therefore, their equipment and rails were brought to Vancouver. The Lewis and Clark line was taken over by the lumbering company with which an agreement on this point had been made before construction. The other three lines are being offered for sale complete as commercial logging properties. These include the 36-mile line on the Olympic peninsula in Washington (Railroad No. 1), 40 miles of track on the Yaquina lines (Railroads Nos. 10, 11 & 12) along the Oregon Coast and the North Nemah line (Railroad No. 5) 7¾ miles long near Willapa Bay, Washington.

A total of 143,000,000 ft. of airplane stock was shipped out by the Spruce Division, the rate of production having been increased from something over 2,000,000 ft. per month in October, 1917, to about 22,000,000 ft. in October, 1918. The 29,000,000 ft. of commercial lumber stored at Vancouver has been sold. All told, about $10,000,000 worth of equipment was centralized at Vancouver Barracks; about $2,000,000 worth of this has already been disposed of.

Shortly before the signing of the armistice the production activities of the Spruce Production Division were taken over by the United States Spruce Production Corporation, and the personnel of the latter has been reduced steadily since that time. Those who remain in important positions are those who were identified with and are proud of its war-time activities. Some are still in the service and some are retained in a civil capacity. The War Department desires that the corporation liquidate its own affairs, and this is being done under the direction of Lieut. Col. C. P. Stearns as successor to General Disque. The fixed policy of the corporation is "to go out of business with as little disruption as possible in the industries and business of the Northwest, with the hope that when the corporation and its activities have passed into history it may be said of it that it helped rather than hindered the community in which it operated."

Motor Sweepers and Trucks Show Economy

HAULAGE of street material by motor trucks, and operation of motor-driven street sweepers and sprinklers have proved economical in Denver, Colo., according to a statement made by F. J. Altvater, highway commissioner, in the April number of *Municipal Facts*, published by the city. At the present charge for teams, the trucks hauling slag and gravel will pay for themselves in one year.

Motor trucks for hauling slag and gravel for street work show a material saving in cost, owing to the high prices and slow work with teams. In 1918, the daily cost for a team was $6 per day, which this year has been increased to $7. A team will average three 1½-cu.yd. loads per day, making a cost of $1.33 per yard or $1.55 at the 1919 rate. Last year three motor trucks hauled from 5540 to 5930 cu.yd. each at an average cost of $0.766 per yard. This cost included repair, oil, gasoline, chauffeur, interest at 6% and depreciation. The depreciation charge was computed at 33.3% for the first year and 25, 20, 15 and 6.3% for succeeding years. Five motor-driven street-sweepers and a motor-driven flushing machine also effected a considerable saving over horse-drawn apparatus; but the sweepers were rather light for the service and their repair cost was very high. Two 2-ton trucks were purchased later to do the heavier sweeping, and as they are separate from the sweepers they can be attached to wagons and other apparatus and thus are kept in use for about 16 hours daily. The two new machines have displaced 10 teams.

Construction Firm Finds Personnel Work Profitable

Group Insurance, Shareholding, Accident Prevention and Medical Care Repaid By Increased Efficiency

(Editorial Interview)

ACCIDENT prevention is an important part, but it is only a part, of the "personnel" service which contractors owe their employees. If reduction of accidents in construction operations pays (and it certainly does pay) so do group insurance, medical supervision and social and personal service of many sorts. Combine these activities with some arrangement by which directing employees become shareholders in the firm's business, and an organization is knit together with which a contractor can face unstable construction conditions with reasonable assurance. "These assertions are not theory," stated L. D. Woedke, manager of the protection and safety department of Fred T. Ley & Co., contractors; "they are facts demonstrated by our own experience."

About every kind of construction has been performed by the company, its work has been widely distributed and its force on different jobs has averaged from ten to ten thousand. If personnel work is impracticable in contracting it would seem that it should fail under these conditions. But the company has proved to its own satisfaction and to that of its clients and its employees that it can take so good care of its men that "they follow the company's operations everywhere and repay, in efficiency, loyalty, reduction in labor turnover, economy and speed, every dollar spent in their interests."

Accident prevention as it is practised by the firm has already been described in *Engineering News-Record* of Mar. 14, 1918, p. 523, and all that need be said in addition is that the results become more favorable with increased experience. Medical service goes beyond caring for injuries. On large jobs complete field hospitals are installed and equipped with medical and surgical supplies, and a regular staff of doctors and nurses and attendants is placed in charge. All kinds of illness are treated in these hospitals, not merely injuries received on the job.

As an illustration of this policy, when influenza threatened to overcrowd the regular hospital accommodations on one job last autumn, an additional field hospital with 40 beds was built and placed in service, with doctors and nurses, in 12 hours. When work on this hospital was begun mechanics and laborers were packing their kits for a general exodus. The sight of the new hospital at once relieved the crisis. Grips were unpacked, the panic subsided and not a man left the job.

The establishment of hospitals is not practicable on small operations, but no job is too small to be without a first-aid cabinet. If the work is near a settlement where physicians are available, arangements are made whereby they will be on call if needed.

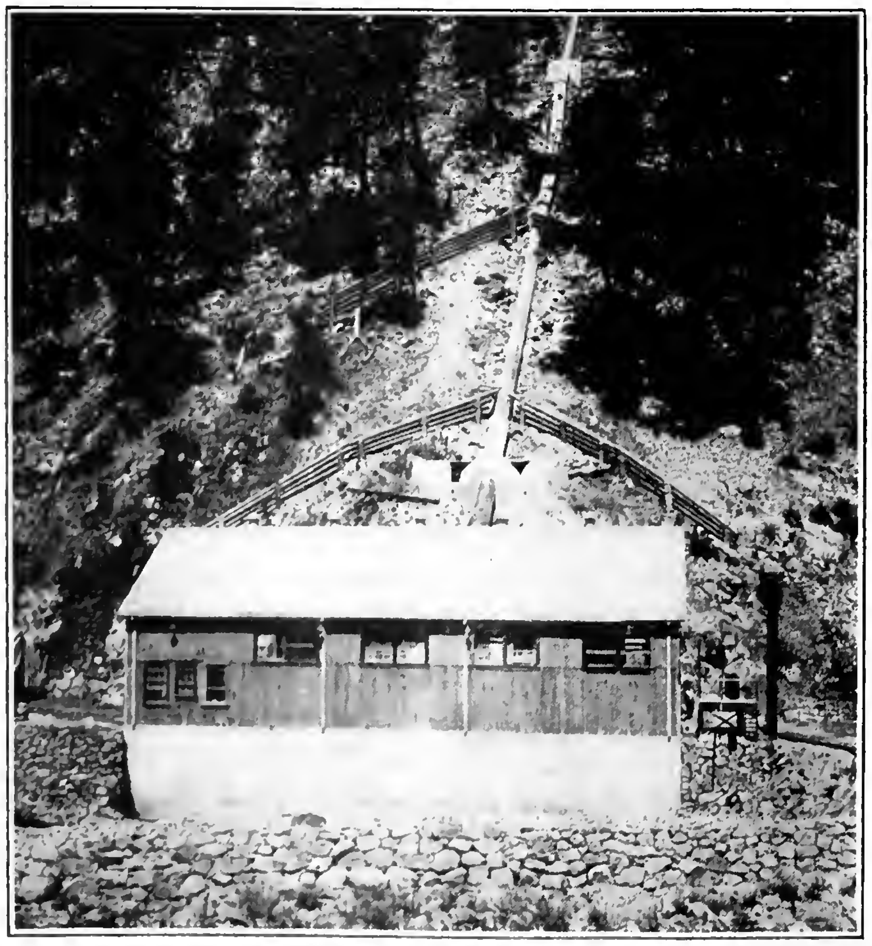
Good wishes and prudent advice are not the limit of service toward making employees financially independent. The firm gives its permanent or regular employees life insurance in amounts of $1000, $1500 and $2000, depending on length of service. In addition, these permanent employees, department heads, superintendents, engineers, etc., have, during the last few years, received preferred stock in amounts determined by length of service, position held and record for good service. A record in detail of every employee enables the firm to shift men to better positions and to place employees who have finished or are about to finish their work on various operations. All these measures combine to make the employee feel that he is an integral part of the business, and he repays the company by loyalty and better work.

The employees themselves have organized for mutual service. The Leyers Club at the home office has branches on all large jobs. Through the activities of this club athletics, dances, field days, lectures, etc., are fostered, the sick are visited, and assistance is given to anyone in trouble. Weekly news bulletins edited by the club are issued to all jobs, offices and departments. The club is now considering a sick-benefit and relief plan.

Annually the company gathers at the home office in Springfield, Mass., all its superintendents, foremen, timekeepers, engineers, department heads, office managers and executives, for a discussion of all phases and details of the business. At this time all complaints, difficulties or troubles of the respective departments or field offices are discussed, with Mr. Ley sitting as chairman. Full stenographic reports are made of these meetings. From the various discussions changes in policies, rules, instructions and agreements have resulted, with improvements in organization and in methods of doing work. All in all, the interest the company has shown in its men has been a substantial factor in the company's rapid and substantial development. C. S. H.

Timber Walls to Divert Rolling Rock From Power House

IN THE cañon of the Tuolumne River, where water will enter an 18-mile tunnel on the Hetch Hetchy project, the slopes are quite steep, with a cliff here and there. Early in the construction work a small wooden tool house near the site of the temporary power house



POWER HOUSE WITH PROTECTION OF TIMBER WALLS

was practically demolished by a rock which was loosened by the road excavation above and rolled down the hill. This accident was taken as a warning of possible damage that might result if a boulder rolled down onto the roof of the temporary power house. Timber wing walls were therefore built along the penstock for the purpose of stopping or diverting rocks that might roll toward the power house.

The power is supplied by a 42-in. steel pipe, 530 ft. long, running from the end of the ditch line on the hillside above. Each of the wing walls consists of two parts flanking the penstock at an angle above the power house. The supports are 14 to 20-in. round posts set 8 ft. in the ground. On the uphill side of the posts a facing of rough logs has been built up and lashed to them with pieces of old cable. Thus far the power house has sustained no damage from rolling rock.

This work is being carried out by the City of San Francisco under the direction of M. M. O'Shaughnessy, city engineer.

Economics of Transportation in the Mississippi Valley

Southern Ports Can Well Be Developed to Take Care of Some of Our Foreign Trade if Interior Transportation Is Revised and Improved—Existing Rates Limit Interior Zones for Foreign Shipment

By J. R. Bibbins
Engineer, Associated with Bion J. Arnold, Chicago

TRANSPORTATION economics in the United States today has to be considered in relation not only to domestic trade but to foreign trade. Future development must take into account easy and cheap transport of goods to and from the great interior of this country to the centers of production and consumption the world over. No longer should it be proper, in the planning for trade, to be bound by the great East-West railroad lines, built up in the past by readily seen causes, but the strategic and economic position of the Mississippi Valley should be studied with a view to its logical connection to world routes. A start on such a study has been made. Its elements indicate some radical revisions in the transportation routes and methods of the United States.

A physical examination of the Mississippi drainage basin leads one to wonder why the lines of economic gravitation cannot be developed along the same lines as hydraulic flow, and then to inquire what forces and tendencies so altered this natural gravitation in the early history of the United States as to result today in the elevation, over the passes of the Appalachian range to north Atlantic tidewater, of by far the greatest proportion of the production of this valley, with all the increased expense incident to such elevation. No student can overlook for one moment the fact that the urge of commerce originated in Europe and has continued in effect throughout the century-old commercial independence of America. However, it must be patent that the study of the "vector diagram" of commerce with reference to Europe and South America, respectively, will reveal the fact that the relative value of abscissa and ordinate are changing, with the result that the force of commerce is gradually shifting toward Panama. New Orleans and Galveston have grown as southern gateways of the United States largely by virtue of the fact that other nations needed our cotton. New Orleans has profited by a triangular trade to Europe, to South America, and back to New Orleans in British bottoms. But still the great transcontinental gateways of Chicago, St. Louis, Pittsburgh, etc., have witnessed the overflowing production from the vast Western plain headed for north Atlantic ports directly in contravention of the natural outlet for this territory through the southern water gates.

The answer must lie in the brains of the inhabitants of the Mississippi Valley, who represent the majority of the voting population of the United States. Their vast waterways lie idle. While dozens of freight trunks radiate from the crowded East-West tunnels of Chicago and St. Louis, not one radial trunk reaches into the Northwest from the second port of the United States. The country seemingly has been educated to think east and west, and the prevailing rate system is conceived on its east and west economic base line. What will be the result when the people of the Mississippi Valley fully conceive of a different economic base line—Chicago to the Gulf?

The Mississippi Valley Association, recently convened in Chicago, showed itself to be alive to the necessities of this situation. At this convention standing committees reported upon numerous matters of fundamental importance. One of these committees, a subcommittee on the economic development of waterways, terminals and electric and highway feeders in relation to transportation, presented a report prepared by Bion J. Arnold, consulting engineer, Chicago. Colonel Arnold's report was based on instructions to investigate the now existing facilities for foreign trade; that is, the existing physical plan of the railroads, terminals and steamship lines and their capacity and adequacy for the contemplated freight movement of the valley. It also dealt with the economic policy under which these transportation facilities are used and should be used.

As a preliminary to the study, Colonel Arnold prepared a statement of principles and policies which is as follows:

1. Methods of securing actual commodity movement along natural economic lines of transit.
2. What are these natural economic lines of transit?
3. Natural and artificial barriers, preventing logical movement.
4. Necessity of curtailing man-handling of freight.
5. Economic median lines of rail transit for overseas movements.
6. Function of low-grade lines in controlling mass movement; their ultimate dependence on shipping.
7. Midcontinental gateways and their effect on commodity movement.
8. Shall the cost-of-service-plus-profit basis be allowed to control the transit movement in the valley?
9. Should overseas traffic movement be adjusted to a least-ton mileage basis—that is, shortest route, taking the relative cost of water and rail into consideration?
10. Function of storage in absorbing heavy seasonal movement and securing much desired two-way loading for steamship lines—i.e., a "balanced port."

11. Effect of policy of national waterway development upon transcontinental movement.

12. Lessons to be drawn from past waterway experience.

13. Proper economic field for railroads and waterways with respect to different classes of freight.

14. Comparative possibilities of Mississippi River and rail routes between specific points.

15. Should waterways develop as through freight carriers—i.e., largely as a full-cargo trunk line, rather than as packet lines?

16. Special terminal facilities required for: (a) Freight originating at main terminal; (b) transshipped freight.

17. Desirability of the "sailing day plan" as a terminal policy for both rail and barge lines.

18. Type of floating equipment and economic units best suited for handling different classes of cargo.

19. Can the electric railways function individually or collectively to any extent as freight carriers to and from points of rail interchange or transshipment to water lines?

20. Is there any necessity of extensive motor-highway development as a means of accelerating interior production and thus tending to guide this movement through properly designed channels or terminals?

21. Immediate steps to be taken to secure a sound development program.

General Consideration of Principles

Having put these general questions, Colonel Arnold continued with the following general consideration of the policy to be pursued and the conclusions which are to be drawn therefrom:

The Mississippi Valley should be considered as a great *drainage basin* favoring natural rather than artificial outlets. Up to the present time, the laws of economic gravitation within this drainage basin have been artificially upset to a large degree. The question now is to reëstablish economic equilibrium, which involves four essential elements: (1) Rails; (2) waterways; (3) terminals, and (4) shipping.

It is contended that commerce needs *both* rail and inland water transportation, especially where a vast bulk of commodity movement runs in seasons. Railroads are expensive transportation systems when they have to be built largely for short-seasonal use. Therefore, on general principles, the capacity of the natural waterways should be drawn upon to their fullest extent where possible to relieve railroad operation of this expensive peak-load traffic.

Successful business adjusts the character of its facilities to the requirements and profits of each particular branch; that is, classifies its operation. So should the waterways be used intelligently as a coördinate agency to railroad transportation, rather than as a competitive agency.

But a clear definition and understanding of advantages and limitations is very desirable. To attempt to handle bulk cargo in little bottoms with no terminal facilities is manifestly wrong policy. The great waterways are trunk lines primarily, and transportation should be provided and sold *wholesale* rather than retail. Further, something more than a paved levee or even a simple wharf is required for economic handling, especially with rising wages. Frequent *man-handling* will destroy both the profits and the practical success of waterways movement. For this reason, the "*original-package*" idea is being actively worked out, by means of which transshipment from rail to barge and vice versa may take place, without breaking bulk, through mechanical handling in original packages.

Over 30% of Chicago's freight passes *through* the city, carload freight being rehandled in original cars, less-than-carload freight being handled in parcels. For carload freight, man-handling has been reduced to a minimum by the terminal yards at clearing. The railroads are still wrestling with the problem of reducing the cost of man-handling less-than-carload freight.

In the Mississippi Valley's largest port, nearly 30% of the incoming freight passes over the wharves *direct* and this would probably be increased to 50% if all *freight held in transit* were included; i.e., seasonal freight held over season in storage warehouses for later transshipment. Chicago's freight has to pass on promptly, as every hour's delay means increased congestion. Overseas freight, on the other hand, must have waiting time, hence the vital importance of warehousing, storage and methods of prompt handling to clear the wharves for incoming and outgoing boats. It would be idle to build railroads without vast city terminals. It is equally idle to develop waterways without equivalent terminals; for terminals are only reservoirs in which to permit freight to "slow up" in its general movement to destination. The faster the main-line movement, the more terminal capacity is required to avoid congestion.

Conclusions as to Policy

In order that the Mississippi Valley Association may have a tangible basis upon which to organize, promote and finance the advanced policies, physical improvements and desired changes in established methods of transportation, it should undertake a transportation survey to be conducted with as little delay as possible for the purpose of argument and defense of the following program:

1. Encourage the construction of more direct trunk-line transportation from the Northwest to Gulf ports, particularly via the Alexandria-Shreveport gateway.

2. Ascertain the maximum possibilities of classification and freight handling by means of which slow and fast freight may be routed on lines best adapted thereto, with rates gaged accordingly.

3. Endeavor to secure a freer interchange between steam and electric lines than at present, in order that the latter may become more useful in the general transportation scheme than at present.

4. Consider fully the economics of motor-truck transportation in all its aspects, prior to commitments for vast expenditures in expensive motor highways, so that both motor equipment and highway expenditures may be kept within their proper economic limits.

5. Study carefully every possible means of encouraging a balanced two-way vessel movement through Gulf ports which will be perhaps the most important factor in attracting additional shipping facilites.

6. Support the Government program for inland waterway development assisted by state contributions where necessary to prevent excessive lockage time and delays on canalized routes.

7. Ascertain the reasonable *base cost of service* per ton-mile of transportation within the valley:
   - (a) By rail;
   - (b) By water;
   - (c) By rail and water;
   - (d) Cost of transshipment:
     - (1) By handling or trucking,
     - (2) By mechanical means

   for typical commodities and points of origin.

8. Ascertain similar base cost of service per ton-mile of both waterway and overseas haul, disregarding existing arbitraries and differentials.

9. Determine how far the cost-of-service-plus-profit basis may be allowed to control the transit movement within the valley, without too great disturbance of the existing economic structure upon which the commerce of the country is based.

10. Determine what readjustment of shipping schedules and capacity, as between various ports, is reasonably called for in order to meet this cost-of-service basis of interior transit.

11. Ascertain the desirable economic section which should be built for the Illinois waterway, the rock cuts and for locks in this and in other waterways, in order to minimize the delays in breaking up fleets of barges in transit.

12. Consider with care the economic size of barge units.

13. Consider the maximum application of the "original-package" idea for rail-river transportation, in order that a fair trial may be had.

14. Encourage the construction of barge terminals for originating or transshipped freight, and especially the pro-

vision of mechanical methods of freight handling to the maximum extent.

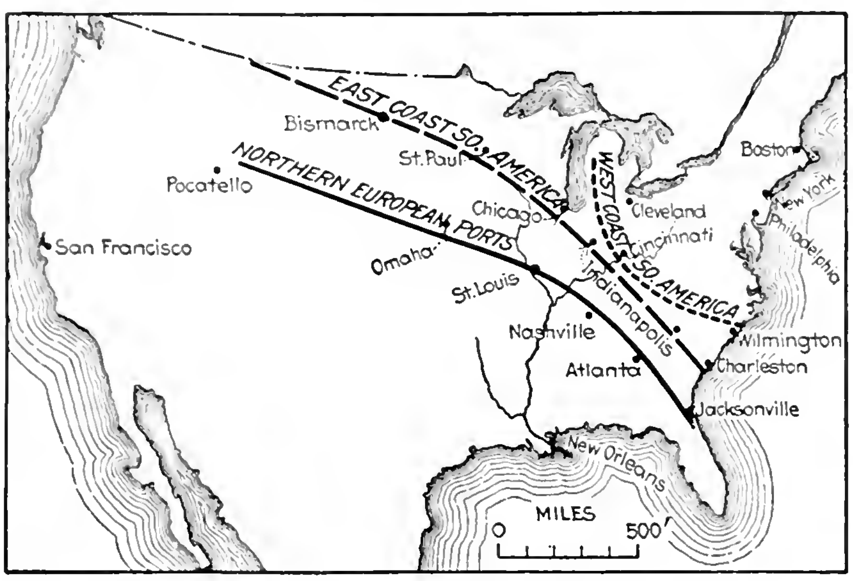
15. Impress upon municipalities the vital necessity of doing their full share in providing the required terminal facilities.

Delays in transit will be the greatest enemy of inland water transportation.

Economic Median Lines Explained

A definite conception of what is involved in the great economic questions analyzed in the foregoing statement is illustrated in the accompanying diagram, which is presented through the courtesy of the Public Belt R. R. of New Orleans, being a part of a technical study of the transportation development of that city.

This diagram shows which territory is properly tributary to the Gulf and North Atlantic ports of the United States (specifically in the diagram New Orleans and New York), disregarding all other considerations except those of rail and overseas transportation. The territory north and east of each of the lines, for instance, should



ECONOMIC MEDIAN LINES SHOW ZONES FROM WHICH OVERSEAS FREIGHT SHOULD BE SHIPPED

Goods to and from territory north and east of lines should pass through New York; zones south and west are tributary to New Orleans; based on average prevailing tariffs, assuming one mile rail haul equals four miles water haul.

ship goods to the foreign districts attached to those lines, through the north Atlantic ports. The territory south and west of each of the lines should ship and receive goods through the Gulf ports. These lines, which for the purpose are called economic media lines, are worked out on the only basis now available; that is, cost-of-service-plus-profit average rail haul in the United States and average water haul overseas with such controlling rate points as Gibraltar, Pernambuco and Panama. In other words, these lines reflect what the rail and water carriers actually charged to the shippers for transportation.

Considering Panama as the water-gate to the Pacific and the west coast of South America, it will be seen that almost the entire Mississippi Valley is logically tributary to Gulf ports. For the east coast of South America and South Africa, the Chicago gateway marks in general the dividing line between Gulf and Atlantic ports. If we consider northern European ports, it appears that almost half of the Mississippi Valley should in fact be tributary to the Gulf ports.

Is this allocation carried out in practice, even under present rates? The answer will be found partly in the great preponderance of east-west transportation lines, incidentally in the comparative absence of the trunk lines from the mouth of the Mississippi into the great Northwest.

It may be contended that these lines are not properly conceived, as they must be drawn for specific cases. Theoretically, this is quite true, and yet the diagram illustrates forcefully the general situation. It is fundamentally based upon the assumption of one-mile rail-haul equals four miles of water-haul. Considering the fact that transcontinental rates are constructed upon a New York-Chicago base line with its extensive detours or mountain climbs, it is plain that if such a diagram were reconstructed on the basis of a water-grade base line of Chicago to the Gulf, all three median lines would move eastwardly, and the result would be still more conclusively in favor of the development of Mississippi Valley transit through the Gulf ports.

In view of these conditions, should not the United States of America, with the largest systems of transportation on the face of the globe, awaken to the necessity of a deeper consideration of this vital subject of internal transportation and lift this question out of the domain of legal and political controversy, and place it squarely upon the basis of scientific analysis and uncontrovertible fact—so that uncoördinated state legislation and ill considered action by both labor and Congress may not culminate in retarding rather than developing this great agency of transportation, which has been chiefly instrumental in the development of our commerce as it is today?

Water-Softening Sludge Repumped Eliminates After-Reactions

THE re-use of sludge in the lime softening of water at Grand Rapids, Mich., to intensify the removal of colloids, to save alum and accelerate the "curing" of water so as to stabilize the effluent, thereby eliminating after-reaction difficulties, has been tried in a large-scale experiment. The results were told recently by W. A. Sperry, chemist in charge, in a paper read before the Illinois Section of the American Water-Works Association. The experiment was suggested by what is being done with the use of air and sludge in the treatment of sewage.

Preliminary laboratory experiments indicated that the time of contact was not a factor beyond the period required for thorough intermixing; that the volume was of exceeding importance; that the sludge was most effective when applied just after the addition of alum or when the normal lime reactions were most nearly completed; that it seemed most effective in removing the products of the reaction rather than to hasten it; and that it worked better under winter conditions than under summer conditions. The amount of air applied was such as to keep the sludge well up in suspension, with the result that it formed into large, ragged, feathery flocs that seemed to fall from suspension like sand.

For the working-scale experiment a motor-driven, 6-in. centrifugal pump was connected with a 100-ft. section of pipe with 1-in. holes bored 1 ft. apart on alternate sides of the horizontal diameter. This pipe was located at a point in the settling basin where the sludge accumulated deepest.

The several runs confirmed the laboratory tests as to the greater effectiveness in the winter and the importance of a sufficient volume. Alkalinity was reduced

to 33 ppm., 10 parts lower than the average for five years. A negligible drop in alkalinity and normal carbonate was noted in the going through the filters. Ordinarily, the loss, causing incrustation, was 13 parts in alkalinity and 11 in normal carbonate.

The unfavorable considerations were: (1) Difficulty in getting a sufficient amount of sludge, due to the fact that it would not flow, and (2) the production of a finely divided suspended matter difficult and expensive to remove by alum. To eliminate the first difficulty Mr. Sperry suggests the use of a Dorr thickener to bring the sludge to the suction, or some type of traveling or flexible suction to follow up the sludge. The second difficulty was contrary to the laboratory experiment and hard to explain, unless due to mechanical agitation in the pump. No agitation was used other than that afforded by the normal baffling. As an explanation of the results, which Mr. Sperry considers of enough value to warrant further study, he stated that they are largely mechanical in that the sludge contains no residual chemical activity but apparently acts to "scour out" the colloidal matter, the many crystals of calcium carbonate acting as foci for the more rapid formation of such crystals than normally takes place.

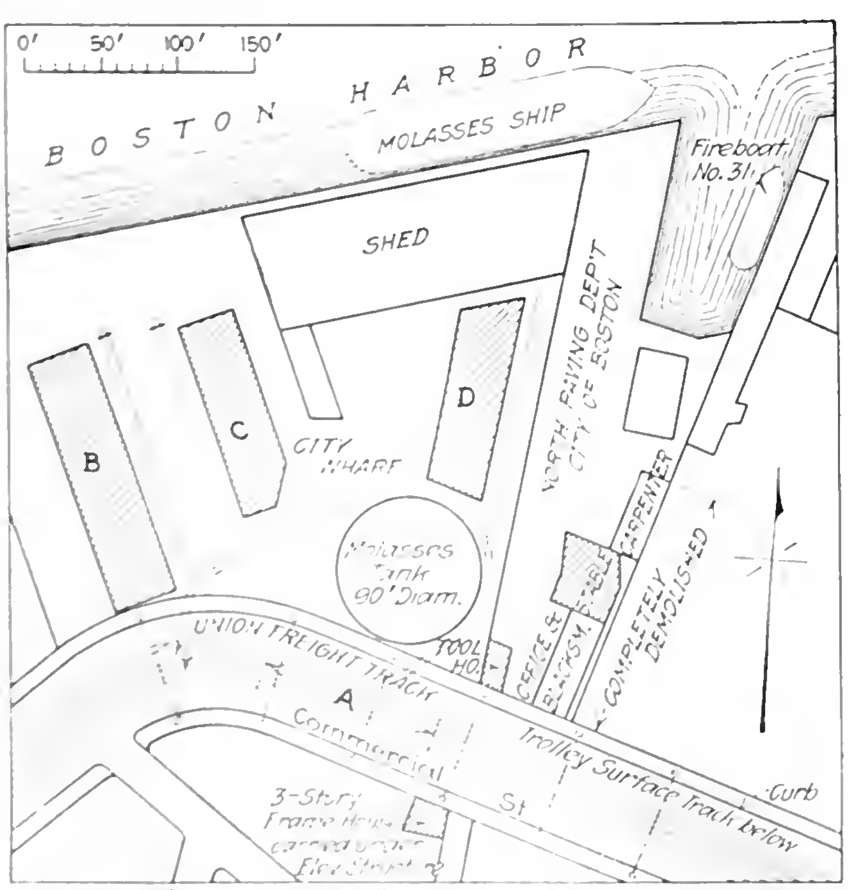
Details of the Failure of a 90-Foot Molasses Tank

Steel Shell Used in Wrecked Boston Structure Highly Overstressed—Designed and Built by Construction Company

BY BURTIS S. BROWN
Consulting Engineer, Boston, Mass.

THE peculiar accident of serious magnitude which occurred in Boston during the noon hour, Jan. 15, as described in a news note in *Engineering News-Record* of Feb. 13, 1919, p. 353, was the result of the collapse of a 90-ft. riveted steel tank used for storing molasses by the Purity Distilling Co., a subsidiary of the United States Industrial Alcohol Co. A flood of 2,300,000 gal. of molasses spread over Commercial St. and the adjoining lots, and filled the cellars of nearby houses. The steel plates of the tank wrapped themselves around the columns of the elevated-railway structure, shearing one of them completely near its base.

This tank, 90 ft. in diameter and about 50 ft. high, was built in 1915-16. The treasurer of the distilling company accepted a noncompetitive bid from the Hammond Iron Works, a construction company which had built smaller tanks in Cambridge for the same company.



Portion "A" of Elevated Structure ... to be removed and New Members built
B-C-D - Trolley Freight Sheds

FIG. 1. LAYOUT OF DEVASTATED REGION NEAR MOLASSES TANK

It "was thought" that a factor of safety of 3 was used. Details were left to the construction company, and the tank was formally accepted by the purchasers on Feb. 1, 1916, and put into use for storing molasses.

The court finding, announced after investigation, that this tank design was wholly insufficient in structural strength, is borne out by stress computations submitted herewith, showing a highly overstressed condition of the steel shell and rivets. Among other causes which have been suggested are: (1) An explosion; (2) a collision by a trolley freight car—it is reported that

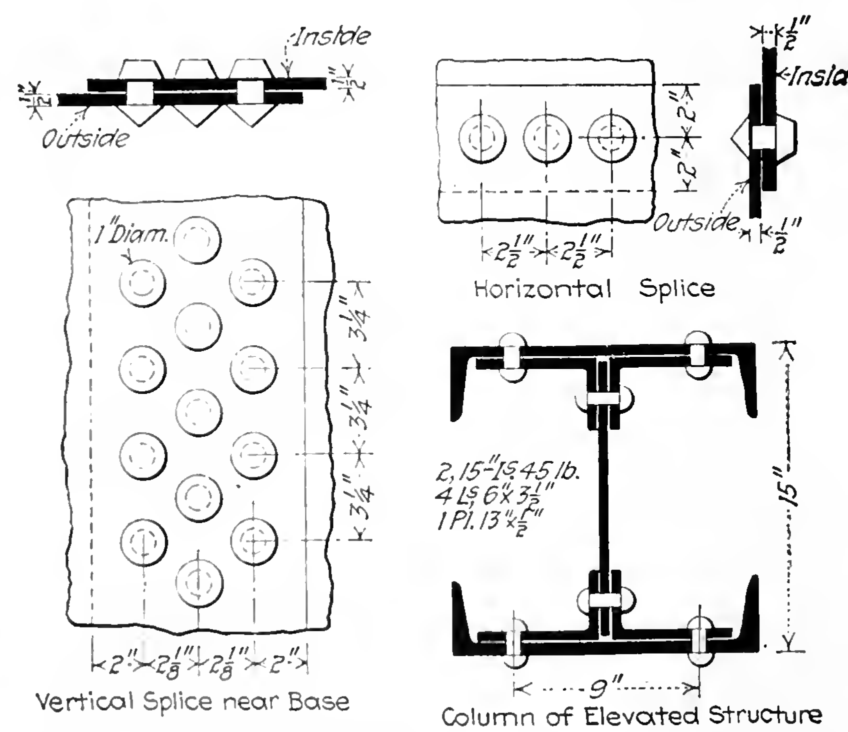


FIG. 2. RIVETED JOINTS OF TANK AND SECTION OF ELEVATED COLUMNS

twice before such cars had split a switch and run into the tank; (3) vibrations from elevated trains. The day of the accident was cloudy, the wind was blowing from the west about 13 miles per hour, and the temperature was 44° Fahrenheit.

Location—The accompanying plan (Fig. 1) shows the surrounding buildings before the collapse; the tank, located on Commercial St., adjoined the North End playground and recreation pier and other buildings belonging to the City of Boston, including the headquarters of Fire Boat No. 31, and the office, stable and storage yard of the North End division of the paving department. To the west are the trolley freight yard and sheds on land owned by the Boston Elevated Railway Company.

The tank was about 300 ft. from the harbor line, and molasses was brought by steamers and pumped into it for storage. Thence it was drawn into trolley tank cars and transported to the Cambridge plant of the distilling company and used to make alcohol for the

FIG. 3. ELEVATED-RAILWAY COLUMN SHEARED OFF NEAR BASE AND BENT UP UNDER GIRDERS

manufacture of munitions. The Boston Navy Yard is located just across the harbor.

Results of the Accident—Twelve persons lost their lives either by drowning in molasses, smothering, or by wreckage. Forty more were injured. Many horses belonging to the paving department were drowned, and others had to be shot. The elevated structure of the Boston Elevated Railway Co. was put out of use for several weeks. Occupied houses were demolished. Motor trucks passing along Commercial St. were marooned and in some cases the truck bodies were floated away several hundred feet, and in general the vicinity looked as if a small cyclone had struck the place.

Calculations—The weight of molasses is taken as 11.75 lb. per gallon, or 90 lb. per cubic foot, which is 44% heavier than water. From data obtained just after the collapse, the depth of molasses in the tank was 48 ft. 10 in. The steel plates in this tank near the bottom, as measured by calipers, varied from $\frac{1}{2}$ in. to $\frac{5}{8}$ in. in thickness. Ordinary lap joints were used. The rivets were of 1-in. diameter, with flat-topped heads on the inside and conical heads on the outside. The tension in the side of the tank at the bottom

FIG. 4. VIEW OF WRECKAGE, SHOWING ROOF AND BASE OF COLLAPSED TANK

would therefore be $90 \times 48.83 \times 90/2 = 198{,}000$ lb. in 1-ft. height. Hence the unit stress on a solid $\frac{1}{2}$-in. plate, $12 \times \frac{1}{2} = 6$ sq.in., is 36,000 lb. per square inch, or on $\frac{5}{8}$-in. plate, $12 \times \frac{5}{8} = 7.5$ sq.in., is 26,400 lb. per square inch. If the riveted-joint efficiency is assumed to be 66%, the unit stress on the net section would be 50,000 and 40,000 lb. per square inch, respectively. These values approach the ultimate strength of steel plates.

The spacing of the rivets in the vertical joints near the base is shown in Fig. 2. There are 11 rivets in 1-ft. height, so that each rivet carries $198{,}000 \text{ lb.} \div 11 = 18{,}000$ lb. Comparing this value with the allowable stresses for 1-in. rivets bearing on $\frac{1}{2}$-in. plates permitted by the Boston building law (10,000 lb. per square inch shear and 18,000 lb. per square inch bearing) it is found that the rivets are overstressed about 2.2 times in shear and 1.92 times in bearing.

An examination of the wreckage shows that part of the vertical joints failed by shearing off the rivets, while at other points the plates were torn apart between rivets. Many of the rivets dropped out of the holes after shearing off, indicating that possibly the rivets were driven cold.

Effect on the Elevated Structure—On collapsing, a side of the tank was carried against one of the columns

FIG. 5. STEEL SHELL AND ELEVATED RAILWAY WRECKED

supporting the elevated structure. This column was completely sheared off as shown in Fig. 3, and forced back under the structure. These columns are built up, as shown in section, Fig. 2, and are spaced between 50 and 60 ft. apart longitudinally at this point, where the structure is on a curve. Fig. 5 shows how the track was pushed out of alignment and the superstructure dropped several feet. It has been necessary to remove completely two entire bents, as noted on the plan, where the collapsing side of the tank was carried against the outer face of the curve.

The tank was built on a concrete mat, supported by concrete piles. After the débris was cleared away, the concrete appeared to be in excellent condition. Not a crack or defect of any kind could be noted anywhere.

Approval of Plans—The plans for this structure

FIG. 6. STEEL PLATES WRAPPED AROUND COLUMN

were filed Sept. 30, 1915, with the Boston building department, as required by law, and after the examination by the plan division a permit was issued. The plan examiner who was supposed to check the plans admitted in the municipal court investigation that the problem was beyond him. He approved the plans as filed for construction because they bore the stamp of C. H. Gannett, a civil engineer, who filed the plans for the distillery company. The latter did not check over the steel design, but simply laid out the foundations. The building department now requires that all calculations of the designer shall be filed with the plans and that the sheet be signed.

From the foregoing investigation it would appear that this tank was erected near a busy city street, where hundreds of lives were endangered, with practically no factor of safety and without competent check of the design by the building department of the city.

Macadam Stone Treated With Deliquescent Salts

Roads at Detroit Naval Training Station Surfaced With This Material Have Noiseless and Dustless Surface

By Harlan H. Edwards
Highway Engineer, Chicago, Illinois

During the past few years a new type of macadam road surfacing has been developed in and near Detroit, Mich., and its use is spreading to other parts of the country as road engineers and municipal officials become acquainted with its merits. It is a combination of crushed stone and deliquescent salts, the latter being used for their water-collecting and retaining feature. This type of road-surfacing material was used during the past summer at the River Rouge Naval Training Camp, Detroit, Mich., and because of its low cost, ease of construction and maintenance, noiselessness and dustlessness, it was placed on most of the roads. Since this work was done, it is reported that contracts have been let to put trial stretches in the road systems of Wayne and Ottawa Counties.

Character of the Material

The stone used is a dolomite or limestone which, before impregnation, is crushed and graded into a well-proportioned mixture, varying in size from ½ in. down. When treated and placed on the road it has the appearance of wet, coarse, limestone screenings, and packs down under the roller to a smooth, compact mass. The chemicals used—a mixture of calcium, magnesium, and other chlorides obtained as a byproduct from salt wells—supply a property, the lack of which has made the purely water-bound macadam road a failure for motor traffic. Heretofore the water bond has failed because it could not be kept uniform. This resulted in a road that was either too wet or too dry. If too wet, the road softened and cut; if too dry, it crushed, ground, and disintegrated. The wind completed the job by blowing off the fine cementing material, leaving the large, sharp stones exposed. The result was the raveling and rutting of the surface.

In this mixture, on the other hand, the deliquescent salts act as a stabilizer, maintaining approximately an even degree of dampness throughout the entire mass. They do not easily wash off, waste or evaporate, but gather moisture from the air, dew, rains, and from the soil below the roadbed. This keeps the surface constantly damp—making practically a dustless roadway having enough elasticity to prevent crushing of the surface even under heavy loads. There is just enough moisture, so that automobile tires serve as a *constructive* instead of a *destructive* medium. The tires have a tendency to pack and "iron out" the road, rather than to suck up the fine particles. It has been found necessary to maintain a thickness of 4 or 5 in. of surfacing in order to hold enough moisture to insure this condition.

Method of Construction

In the construction of the roads at the Detroit Naval Training Camp it was necessary first to provide a firm foundation upon which to place the surfacing material, for the soil was originally a marshy river deposit, subject to inundation each spring. It had been drained recently to permit construction work to begin on the camp, and at the start was of such a consistency that at times it took four horses to pull an empty wagon through it. This necessitated delivering the first building materials at the camp by water.

A base of from 6 to 12 in. of brickbats, slag and cinders was placed and rolled on all the roads originally laid out, and over this foundation most of the heavy hauling for the camp was done. This consisted of heavy motor-truck loads of crushed stone, cement, lumber, cast-iron pipe, etc. The surfacing mixture was then hauled from town, a distance of about six miles, in large trucks carrying from six to eight tons per load. It was spread upon the subgrade to such depth that, when struck off to the proper crown and rolled, a thickness of at least 4 in. would result. This required from 5 to 5½ in. of the loose material. Before this was placed, however, an earth shoulder was thrown up and tamped to the proper line and grade on each side of the road.

Traffic need not be shut off the roadway during the placing of the surfacing, except between the time when the final crown has been given by the templet and the time when the roller is applied. In fact, it is well if wagons do travel over the road, for they help consolidate the loose spots which may not be reached by the heavy wide wheels of the roller. If a roller cannot be obtained, this packing can be left entirely to the traffic, with the only added expense of a man with a rake to smooth out the wheel and hoof marks.

At this camp a 10-ton roller was used. The surface formed was hard, yet, if a depression occurred, that part of the road bed could be loosened easily with a stiff rake or pick, and new material could be added to bring it up to a level surface, and packed down again with a tamp or by traffic. About six to ten times over with the roller was usually sufficient for the original compaction.

In order to provide adequate subdrainage in part of

this soil, a 4- or 6-in. farm tile was laid about 1 ft. off the edge of the road, and to a depth of from 2 to 4 ft. The trench was backfilled partly with cinders, and the remainder with loose stone, brickbats, earth, etc., to permit the surface water to escape rapidly to the tile.

The organization was usually small, consisting of one man and a helper to set line and grade stakes from the engineer's offset stakes, two men to build up and pack the earth shoulders, three men to spread the surfacing material, two men to strike it off to the proper crown with a wooden templet and one foreman—a total of 10. With this organization some 400 to 600 lin.ft. of 12-ft. pavement, crowned 1½ in., can be laid in a day. One cubic yard of the material covered approximately 7 sq.yd. of finished road, costing in all about $1.25 per square yard. This was under war conditions and prices, and the long haul by truck raised the price considerably. Under normal conditions, with a good organization and the source of materials nearer at hand, this price should be reduced nearly one-half.

This impregnated stone road-surfacing has many advantages for medium traffic roads and residence streets, and for walks and drives in cemeteries, large estates, etc., where a permanent, noiseless, and medium-priced road is desired. It matters little how many times it is torn up and relaid, as it will always knit again. One man with a horse and wagon or a small truck and a stock pile of the material should be able to keep from 12 to 16 miles of 20 ft. roadway in perfect condition. It is claimed that a satisfactory road can be obtained from dolomite, gravel, slag or cinders treated with these deliquescent salts, the degree of excellence being in the order given.

Standard Precast Concrete Frames Make Up Flume Trestles

Sections Cast Along Line Put Together To Carry Conduit Over Gullies Up To 180 Feet Long and 36 Feet Deep

TRESTLES UP TO 36 FEET IN HEIGHT BUILT UP OF PRECAST CONCRETE FRAMES

X ONCRETE trestles, made up of standardized trap-E ezoidal frames set one on top of the other in bents and tied together with longitudinal stringers grouted into place, have been built to carry the conduit of the San Dieguito Mutual Water Co. from the Lake Hodges reservoir in southern California. The five-mile conduit consists in the main of a concrete-lined canal, but over depressions up to 36 ft. in depth the line was carried in iron flume or siphon pipe on the trestles.

In all, 27 trestles were required, of which 23 carried open flume and four were used to carry the 42-in. reinforced-concrete siphons at the low point where there would have been danger to the pipe from floods. In the construction of all these trestles the precast method was adopted, partly because of the difficulty anticipated in handling and pouring concrete in small monolithic structures which would each be a separate job, and partly because of a serious labor shortage that existed when the work was planned. It was believed that the precast sections could be erected with a smaller crew than monolithic construction would require.

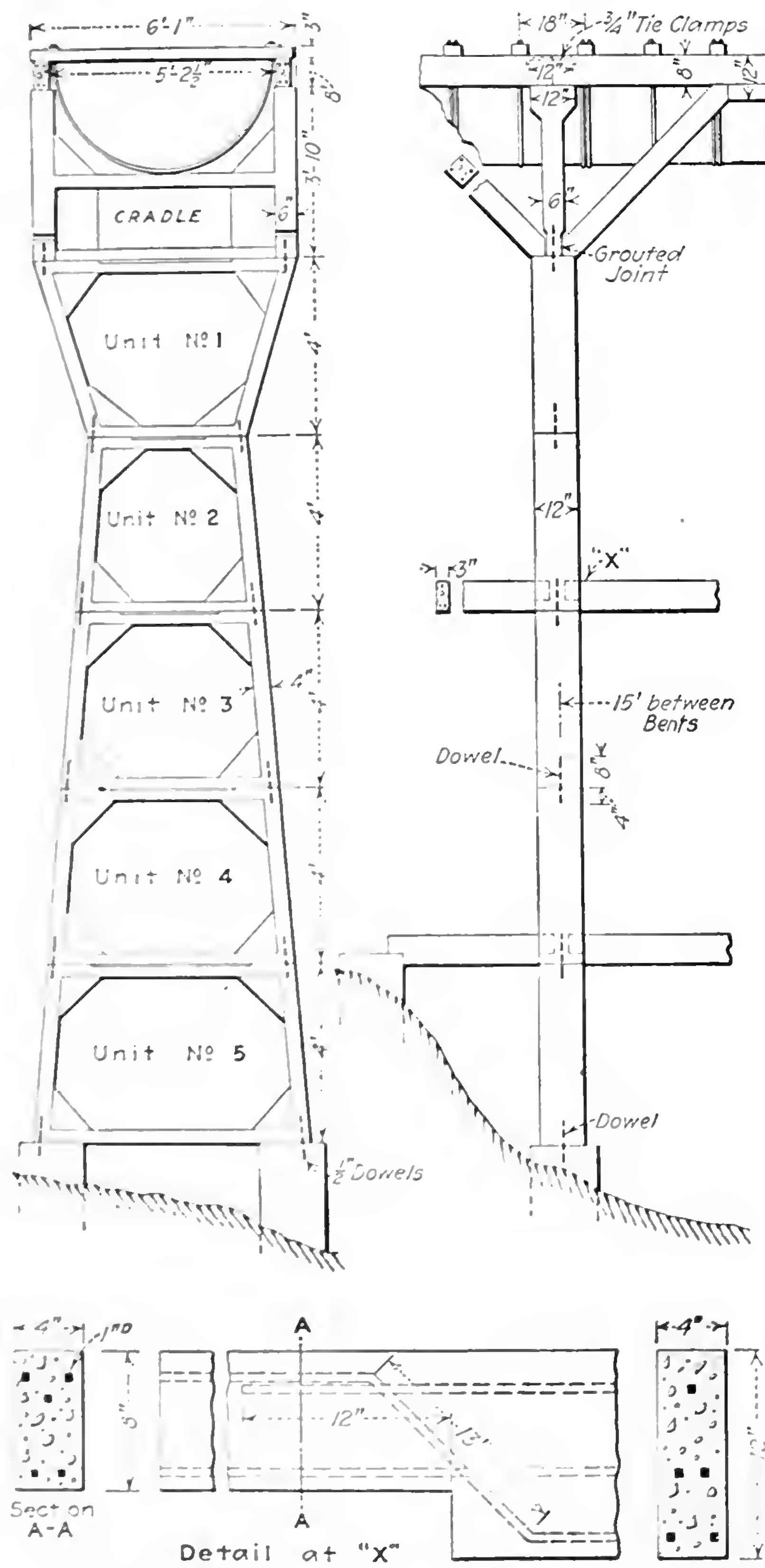
Although the trestles varied from 15 to 180 ft. in length and from a few feet to 36 ft. in height, the precast sections were standardized so that the upper units on all trestles were the same. All bent sections were 4 ft. in height, gradually increasing in width from the top downward. The only variation in design of the trestles was to replace the cross-ties used as supports for the open flumes with slabs on those trestles which were to carry the 42-in. siphons.

The units forming the trestles were cast in nearby yards in forms laid flat. The forms were built up of 2-in. lumber surfaced on one side. By thoroughly scraping and oiling them between pourings, some were used 20 times. The method of procedure was to build first the forms required for the highest trestle on the line. There was then on hand a set of forms suitable for building any other trestle, and the bottom sections not needed after the larger trestles had been built were available for repairing other forms. Casting yards were located at points central to several trestle sites. Care was taken in placing the concrete around the steel, and it is believed that more accurate location of steel was obtained than would have been possible if monolithic construction had been used. After the concrete had been poured into the forms the top surface was finished by hand with a trowel.

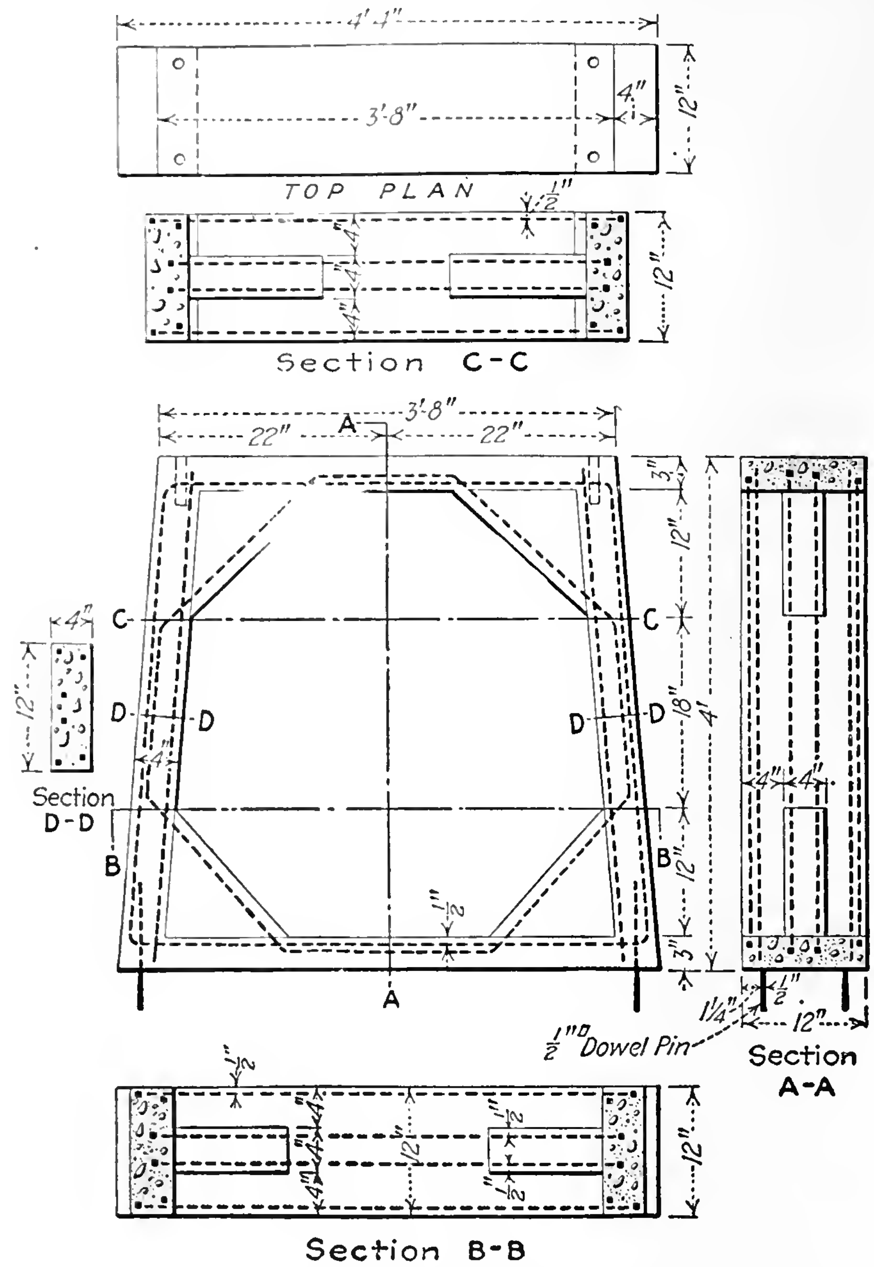
Cableways were used for the erection of the trestles

in all cases. The largest pieces to be handled were the girders for the siphon trestle which weighed about 1000 lb. each. In the higher trestles—the maximum being about 36 ft. from foundation to flume top—the sections placed at the footings weighed about 900 lb. Concrete piers were provided as foundation for each bent, and as each section was superimposed on its predecessor the dowel pins of ½-in. steel projecting 4 in. into the lower section were carefully grouted in place.

A feature of design is the dap used in the middle of the top of each section so that the sections bear one upon another only above the struts. This was done to avoid the possibility of any roughness on the surface at the center of the section causing a tendency to "rock." Even in the highest trestle the bents were erected independently and without guys. After the placing of the cradle on top of each bent the pair of girders connecting adjoining bents were placed, and the tie clamps were grouted into place to fasten together abutting girders.



DETAILS OF PRECAST PIECE TRESTLE CARRYING FRAME OF FLUME



DETAILS OF THE PRECAST SECTION LOCATED NEXT TO THE TOP OF THE TRESTLE

Dap along the top chord of section is not shown in this drawing

Originally, it was planned to grout only the angle braces running from bent to girder, but during construction it was found desirable to use grout between sections at various points, particularly in placing the cradles.

On the higher trestles, horizontal braces running the full length of the structure longitudinally were placed 8 ft. apart vertically. These braces consisted of 15-ft. beams spanning from bent to bent and resting upon the horizontal members of the sections. These were held in place by their own weight, any lateral thrust being taken by the shoulders provided on each beam end. Concrete abutments were provided where the ends of these longitudinal beams reached the ground line.

The trestles were designed by Thomas H. King, office engineer for the San Dieguito Mutual Water Co., and were erected under the direction of E. W. Case, chief engineer. Bent Brothers of Los Angeles were the contractors.

Correction

Through a typographical error, the letter L was omitted from the numerator of the expression for D in Equation (4), *Engineering News-Record* of May 8, 1919, p. 921, in the article "Computation of the Time Required to Fill a Graving Dock," by Eugene E. Halmos. The expression should read $\frac{2lmL}{K\Sigma a\sqrt{2g}} = D$.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

New Edition of Structural Handbook

STRUCTURAL ENGINEERS' HANDBOOK: Data for the Design and Construction of Steel Bridges and Buildings—By Milo S. Ketchum, C. E., M. Am. Soc. C. E., Dean of the College of Engineering and Professor of Civil Engineering, University of Colorado; Consulting Engineer. Second Edition. New York: McGraw-Hill Book Co., Inc. Flexible Cover, 6 x 9 in.; pp. 896; illustrated. $5.

In the second edition of this widely used structural engineers' handbook, the first edition of which was reviewed in *Engineering Record* of Nov. 28, 1914, p. 598, and *Engineering News* of Mar. 18, 1915, p. 530, no attempt has been made by the author to carry out the complete and thorough revision which had been planned, chiefly owing to performance of war duties as the assistant director in charge of construction, United States Government Explosives Plant at Nitro, W. Va. Errors have been corrected and 16 pages added in Chapter I illustrating standard details for steel windows and doors, giving data on cement and gypsum tile roofs, and presenting methods and formulas for computing stresses in mill-building columns and in rigid frames.

Chapter III, treating of steel highway bridges, has been largely rewritten and enlarged by the addition of 16 pages of new matter. The added data include the bridge standards of the Wisconsin and Iowa highway commissions, results of various tests on floor-slabs, a complete discussion of the distribution of concentrated loads to stringers in bridge floors, a treatment of wearing surfaces, useful tables and diagrams to assist in the design of floors for various motor-truck concentrations, and reproductions of standard details of the later highway-bridge designs issued by various highway commissions.

In typography and general appearance the new edition is an improvement over the old.

Revision of "Irrigation Engineering"

REVIEWED BY F. H. NEWELL

Professor of Civil Engineering, University of Illinois, Urbana

IRRIGATION ENGINEERING—By Arthur Powell Davis, D.Sc., M. Am. Soc. C. E., Director and Chief Engineer U. S. Reclamation Service, Author of "Irrigation Works Constructed by the United States," etc.; and Herbert M. Wilson, C. E., M. Am. Soc. C. E.; Former Chief Engineer and Irrigation Engineer, U. S. Geological Survey; Author of "Topographic Surveying," etc. Seventh Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 640; illustrated. $4.50.

New data and general conclusions based on recent practice are offered to students and to engineers engaged in irrigation investigation, construction and management, in the Davis or seventh edition of Wilson's "Irrigation." The original work, long regarded as the *vade mecum* on water control and its application to dry lands, revised from time to time by the original author, has been rearranged and brought up to date to such an extent as to justify considering this as practically a new book; the added facts and deductions are adequate to form in themselves a valuable treatise.

The older data, acquired by Mr. Wilson during his visits to India, Egypt and other irrigated lands, serve, while forming the essential background, to emphasize the rapid developments which have taken place on this continent in response to the demands imposed by American conditions, where, as pointed out, the high cost of labor as contrasted with that abroad requires entirely different methods of building and operation.

The more striking of the new facts, as might be supposed, are those which have come from the long experience of Mr. Davis who, as chief engineer of the United States Reclamation Service, has had intimate connection with a larger number and a greater variety of irrigation projects, under American conditions, than any other person. He has given especial consideration in his revision to the larger structural features, such as canal headgates, linings, spillways, drops, flumes and pipes—all well illustrated—and has also introduced a wealth of information on reservior construction, including the design and building of large dams.

Waterproofing Engineering

WATERPROOFING ENGINEERING: For Engineers, Architects, Builders, Roofers and Waterproofers—By Joseph Ross, B.S., C. E., Waterproofing Engineer. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 442. $5.

Waterproofing is too often considered one of the minor details of engineering, something which can be left for odd moments of design and which requires little thought or effort in construction. It happens, however, that when there is need at all for waterproofing there is very great need, and instances are far too common when repairs required by faulty waterproofing greatly exceed any preliminary expense which should have been put into original waterproofing design. For these special cases, then, a book on waterproofing engineering practice will be useful, although there must be much that is elementary in any exhaustive treatment of the subject. This would seem to be the main criticism of Mr. Ross' book. It treats fully the subject of waterproofing, but in an effort to make a complete exposition he has entered into so many of the elements of the subject as to make it somewhat difficult to follow the treatment throughout the whole volume. If the book is used purely for reference, picking out as required the details of construction which apply to any case in hand, it is valuable. Considering it as a students' manual or as a book to be read by the engineer, much will have to be passed over.

Rigid Concrete Frame Analysis

ANALYSIS AND TESTS OF RIGIDLY CONNECTED REINFORCED-CONCRETE FRAMES—By Mikishi Abe, Formerly Student in the Graduate School of the University of Illinois. Urbana, Ill.: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 106; illustrated.

Reinforced-concrete frames are peculiarly adaptable to analysis as a rigid system. Such a method of analysis has been common in continental European practice for some years, and has had a fairly wide application in this country recently. The exact determination of the stresses and the consequent close designing make the method attractive, although its application has been

somewhat complicated. In this bulletin the author goes very thoroughly into the theory of design and checks this theory by a rather limited set of tests on large-size rigidly connected concrete frames. All concrete designers who are interested in the development of their art would do well to study this exposition of the tests.

Mathematics for Engineers

MATHEMATICS FOR ENGINEERS, PART I: Including Elementary and Higher Algebra, Mensuration and Graphs, and Plane Trigonometry—By W. N. Rose, B.Sc. Eng. (London), Lecturer in Engineering Mathematics at the University of London Goldsmiths' College. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 510; illustrated. $5.

This first volume of two planned as a systematic and complete treatment of the subject includes proof of rules, etc., with practical illustrations well chosen from engineering practice. Methods of calculation, algebraic processes, mensuration of simple areas and solids, including conic sections, graphs and charts, earthwork problems, slide rule and planimeter work, are all well handled. This is one of "The Directly-Useful Technical Series" (D. U. Series) of which Wilfrid J. Lineham is editor.

Relation of Land Slides and Glacial Deposits to Reservoir Sites

RELATION OF LANDSLIDES AND GLACIAL DEPOSITS TO RESERVOIR SITES IN THE SAN JUAN MOUNTAINS, COLORADO—By Wallace W. Atwood. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 38; illustrated.

Geology as an allied science has little interest to a number of engineers, but to those concerned with the construction of dams it is, perhaps, the principal minor study which they must pursue. The United States Geological Survey Bulletin noted here should be of great aid to all dam builders. While it describes the formations of a limited area of this country, it is an area which contains a great number of dams and one in which subsurface conditions have been particularly difficult. The analysis of the geological formation and the consequent infiltration of the water through strata beneath the dam has application to other locations.

Two New Books on Shipbuilding

THE ELEMENTS OF WOOD-SHIP CONSTRUCTION—By W. H Curtis, Naval Architect and Marine Engineer. New York: McGraw-Hill Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 223; illustrated. $2.50.

THE SHIPBUILDING INDUSTRY—By Roy Willmarth Kelly, Director, Harvard Bureau of Vocational Guidance, Author of "Hiring the Worker," and Frederick J. Allen, Assistant Director, Harvard Bureau of Vocational Guidance, Author of "The Shoe Industry." With an Introduction by Charles M. Schwab. Boston and New York: Houghton Mifflin Co. Cloth; 6 x 9 in.; pp. 303; illustrated. $3.

Two new publications dealing with shipbuilding prove to be of radically different character. Curtis' "Elements of Wood-Ship Construction" is an excellent technical monograph, logically arranged, concise, clear and judiciously illustrated. On the other hand, the reader is entitled to a warning against "The Shipbuilding Industry," which is not a technical book at all, but may from its title be thought to be in part scientific or scholarly. It is a piece of "popular," or, more accurately, Sunday-magazine, writing, consisting of a confused mass of heterogeneous statements in which there is much gross misinformation. The reason for the preparation and publication of the book, say the authors, is that many more men must become shipyard artisans, and the book may "help them to decide for themselves whether or not they are qualified to undertake any of the work which it describes." That is, it is intended as a recruiting device, though it does not seem likely to show very high efficiency in this service.

Our critical shortage of shipworkers also led to the writing of Curtis' book, which is based on an instruction text prepared by the author for the Emergency Fleet Corporation. But in this instance a product of lasting value resulted. The steps in building a wooden ship are described sequentially, and the mechanical interrelation of the successive steps as well as the character of workmanship required are made apparent to the student in remarkably clear manner. Design, or the why of shaping the parts of a ship as the drawings show them, is not touched directly, but the reader can hardly fail to acquire much inferential knowledge concerning it. An unusual number of illustrations, which show excellent judgment on the author's part in deciding on scope, scale and detail of explanatory drawings, support the text.

Designing Concrete Mixtures

DESIGN OF CONCRETE MIXTURES—By Duff A. Abrams, Professor in Charge of Laboratory, Lewis Institute. Chicago, Ill.: The Institute. Paper; 6 x 9 in.; pp. 20; illustrated.

Extensive extracts from this bulletin were given in *Engineering News-Record* of Apr. 17, 1919, p. 758, but every concrete engineer, or contractor working in concrete, should get a copy of the full report, for study. Professor Abrams has been conducting a monumental series of tests on the properties of concrete, and has announced some very definite views, backed up with laboratory facts. Some of these views are going to be subjected to searching inquiry in the next few months, and the controversies which will arise will undoubtedly be among the most alive of any that have stirred the concrete industry. It behooves every one interested to be well informed, therefore, on the basic tests reported here.

Packing Engineering Material for Export

An instruction book for packing engineering material for exportation to foreign countries has been issued by the Engineer Corps, U. S. A. This book should be interesting to all those who have problems in packing similar material for export. Seven subjects are treated in the book. The first four are from standard specifications of the War Department and are as follows: Crating, boxing, wire-bound boxes, and baling. Two subjects are taken from the specifications of the General Engineering Depot. The first one discusses "The Problem," the second, "Packing Specifications." The last division covers "Marking of Packages." The book is 5 x 7¾ inches in size, contains 63 pages, and is illustrated.

Helping Disabled Soldiers to a Vocation

Among the "Opportunity Monographs" in the Rehabilitation Series designed to aid disabled soldiers, sailors and marines in choosing a vocation are No. 6, "Safety and Fire-Protection Engineering"; No. 9, "Oxy-acetylene Welding," and No. 13, "Concrete Construction and Cement Manufacture: Engineer or Architect, Inspector, Contractor, Superintendent, Foreman, Machine Operators, Modelers, Pattern Makers." (Federal Board for Vocational Education, Washington, D. C.)

Book List for Disabled Soldiers

As one of the many aids toward putting disabled soldiers in the way of earning their living to the best advantage of themselves and of the country, the American Library Association, through its library war service, which has its headquarters in the Library of Congress, Washington, D. C., has issued a "Reconstruction Hospital List; Books on Subjects Taught in Reconstruction Hospitals." No less than 150 subjects are covered, ranging alphabetically from advertising and agricultural engineering to wiring and wood finishing. Other subjects that may be mentioned are chemistry, farm machinery, forestry, irrigation farming, landscape gardening, railroad engineering, sanitation, and steam engineering. Various occupations are also included, as well as a wide range of science, art and literature.

Dining Rooms for Industrial Plants

More and more industrial plants are building dining rooms of one sort or another for the accommodation of their workers. Very little literature on the subject is available for those engineers who are called upon to lay out such accommodations. Therefore, a recent pamphlet issued by the William Disston Co., of Tacony, Penn., describing the new cafeteria which has been built at its manufacturing plant outside of Philadelphia, should be valuable. This plant was designed under the direction of A. S. Blum, chief engineer of the company, and the pamphlet, which can be obtained from the Disston company, was prepared by Mr. Blum.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

AMERICAN CONCRETE PIPE ASSOCIATION CONVENTION: Official Proceedings, Feb. 14-15, 1919. Chicago, Ill.: The Association. Paper; 6 x 9 in.; pp. 93; illustrated.

CALIFORNIA STATE ENGINEERING DEPARTMENT, Sixth Biennial Report, Dec. 1, 1916 to Nov. 20, 1918. Sacramento, Calif.: California State Printing Office. Paper; 6 x 9 in.; pp. 93; illustrated.
Reports on various phases of the California water problem—irrigation development, water conservation, flood control and land reclamation, river navigation and the mining débris problem; San Francisco's harbor-front improvements; snow studies.

CHICAGO BOARD OF LOCAL IMPROVEMENTS: Quadrennial Report to the Mayor and City Council, for 1915-18. Chicago, Ill.: The Board. Paper; 6 x 9 in.; pp. 100; illustrated.
Outlines the history of this board from its inception in 1897, and reviews the work of its paving, sewer, civil and other divisions. The board has charge of the initiation and execution of public improvements paid for in whole or in part by special assessments. Certain acts of the board are subject to approval by the City Council and others by the courts.

COMMUNITY LEADERSHIP: The New Profession—By Lucius E. Wilson, Vice-President of the American City Bureau. New York: The Bureau. Cloth; 5 x 7 in.; pp. 137. $1.50.

EXPERTS IN CITY GOVERNMENT—By Edward A. Fitzpatrick, Ph.D., Director, Society for the Promotion of Training for Public Service; Editor, "The Public Servant." National Municipal League Series. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 363; illustrated. $2.25.

FLORIDA STATE ROAD DEPARTMENT: Second Biennial Report, Oct. 1, 1916, to Sept. 30, 1918. Tallahassee, Fla. The Department. Paper; 6 x 9 in.; pp. 47; illustrated.

THE GOVERNMENT OF THE UNITED STATES, NATIONAL, STATE AND LOCAL—By William Bennett Munro, Ph.D., LL.B., Professor of Municipal Government in Harvard University. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 648. $2.75.

HOW AMERICAN MANUFACTURERS VIEW EMPLOYMENT RELATIONS—By Stephen C. Mason, President of the National Association of Manufacturers. New York City: The Association, 30 Church St. Paper; 6 x 9 in.; pp. 11.

HOW FRANCE IS GOVERNED—By Raymond Poincaré of the French Academy and President of the Republic; Translated by Bernard Miall. New York: Robert M. McBride & Co. Cloth; 5 x 8 in.; pp. 336. $2.

INDUSTRIAL GOODWILL—By John R. Commons, University of Wisconsin. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 213. $2.

INFLUENCE OF THE GREAT WAR UPON SHIPPING—By J. Russell Smith, Professor of Geography and Industry, University of Pennsylvania; Carnegie Endowment for International Peace; Preliminary Economic Studies of the War, Edited by David Kinley, Professor of Political Economy, University of Illinois; Member of Committee of Research of the Endowment. Washington, D. C.: Carnegie Endowment for International Peace. Paper; 7 x 10 in.; pp. 357.

LABOR TURNOVER, LOYALTY AND OUTPUT: A Consideration of the Trend of the Times as Shown by the Results of War Activities in the Machine Shops and Elsewhere—By Fred H. Colvin, Associate Editor *American Machinist;* M. Am. Soc. M. E., and Franklin Institute. New York: McGraw-Hill Book Co., Inc. Cloth; 5 x 8 in.; pp. 152; illustrated. $1.50.

MAINE STATE HIGHWAY COMMISSION: Fifth Annual Report, Jan. to Dec., 1917. Augusta, Me. The Commission. Paper; 6 x 9 in.; pp. 61.

MANUAL OF GURLEY HYDRAULIC ENGINEERING INSTRUMENTS. Troy, N. Y.: W. & L. E. Gurley. Cloth; 6 x 9 in.; pp. 139; illustrated. 50c.
Although primarily a trade catalog, this volume has a broader scope. Besides describing the current meters and water-stage recorders made by the publishers, the book contains a considerable amount of general information on hydraulic measurements, including some tables.

NEW YORK STATE COMMISSIONER OF HIGHWAYS: Report Transmitted to the Legislature Feb. 15, 1918. Albany, N. Y.: The Commissioner. Cloth; 6 x 9 in.; pp. 592.

OFFICE ADMINISTRATION—By J. William Schultze, B.C.S., C.P.A., with William Demuth & Co.; Formerly Controller, Robert H. Ingersoll & Bros., Etc.; Author of "The American Office," "Production Records," Etc. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 295; illustrated. $3.
A book written to meet the requirements of the business executive and business student by discussion of the principles and methods which underlie efficient and economical office management, including office layout.

OREGON STATE ENGINEER, SEVENTH BIENNIAL REPORT TO THE GOVERNOR: For the Period Beginning Dec. 1, 1916, ending Nov. 30, 1918—By Percy A. Cupper, State Engineer, Salem, Ore.: The Author. Paper; 6 x 9 in.; pp. 30; illustrated.

PHYSICAL PROPERTIES OF DENSE CONCRETE AS DETERMINED BY THE RELATIVE QUANTITY OF CEMENT—By F. E. Giesecke and S. P. Finch. Bureau of Economic Geology and Technology, J. A. Udden, Director Division of Engineering, F. E. Giesecke, Head of the Division. University of Texas Bulletin. Austin, Texas: The University. Paper; 6 x 9 in.; pp. 85; illustrated.

THE REDEMPTION OF THE DISABLED: A Study of Programs of Rehabilitation for the Disabled of War and of Industry—By Garrard Harris, Research Division, Federal Board for Vocational Education; With an Introductory Chapter by Frank Billings, Colonel, Medical Corps, U. S. A.; and a Foreword by Charles A. Prosser, Director of the Federal Board for Vocational Education. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 318; illustrated. $2.

REST PERIODS FOR INDUSTRIAL WORKERS: Research Report No. 13, January, 1919. Boston, Mass.: National Industrial Conference Board. Paper; 6 x 9 in.; pp. 55.

SAND AND GRAVEL IN 1917—By R. W. Stone. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 15.

STANDARD SPECIFICATIONS FOR WROUGHT-IRON PLATES: Spanish Text as Adopted by the American Society for Testing Materials. Washington, D. C.: Bureau of Foreign and Domestic Commerce. Paper; 6 x 9 in.; pp. 13. 5c. from Superintendent of Documents.

TIDE TABLES FOR THE EASTERN COASTS OF CANADA, 1919: Including the River and Gulf of St. Lawrence, the Bay of Fundy, Northumberland and Cabot Straits; and Information on Currents. The Tidal and Current Survey in the Department of the Naval Service of the Dominion of Canada, W. Bell Dawson, M.A., D.Sc., M. Inst. C. E., F.R.S.C., Superintendent. Ottawa, Can.: The Department. Paper; 7 x 10 in.; pp. 64.

TRAUTWINE'S CIVIL ENGINEER'S POCKET-BOOK—By John C. Trautwine, Civil Engineer; Revised by John C. Trautwine, Jr., and John C. Trautwine, 3d., Civil Engineers. 20th Edition. Philadelphia, Penn.: Trautwine Co. London: Chapman & Hall, Ltd. Montreal: Renouf Publishing Co. Flexible Cover; 4 x 7 in.; pp. 1528; illustrated. $6.

VITAL STATISTICS: An Introduction to the Science of Demography—By George Chandler Whipple, Professor of Sanitary Engineering in Harvard University, Member of the Public Health Council, Massachusetts State Department of Health. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible Cover; 5 x 7 in.; pp. 517; illustrated. $4.

WASHINGTON STATE, FIRST BIENNIAL REPORT OF THE STATE HYDRAULIC ENGINEER TO THE GOVERNOR: June 15, 1917, to Nov. 30, 1918—By Marvin Chase, State Hydraulic Engineer. Olympia, Wash.: The Author. Paper; 6 x 9 in.; pp. 50.

WASHINGTON STATE WATER CODE AND ITS ADMINISTRATION—By Marvin Chase, State Hydraulic Engineer. Olympia, Wash.: The Author. Paper; 6 x 9 in.; pp. 53; illustrated.

WHY OUR SHIPS WILL NOW STAY ON THE OCEAN—By Edward N. Hurley, Chairman, U. S. Shipping Board, Philadelphia, Penn.: U. S. Shiping Board, Emergency Fleet Corporation. Paper; 6 x 9 in.; pp. 14.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

Questionnaire by Oregon Society

The following questionnaire is being sent to members of the Oregon Society of Engineers, in order to draw out their opinions and develop suggestions:

1. Are you satisfied to have the Oregon Society continue in its past course?
2. What do you consider the proper activities to make the society a vital moving force among engineers?
3. Do you favor the society looking more actively to the business interests of engineers?
4. Shall we establish an effective employment department?
5. Do you favor the establishment of a scale of minimum salaries and fees?
6. Do you favor taking an active and aggressive part in legislation affecting engineers?
7. Do you favor affiliation in any way with existing trade unions?
8. Are you familiar with the aims of the American Association of Engineers?
9. Do you favor affiliation with the American Association?
10. Do you favor coöperation with local chapters of the national societies and other local engineering bodies?
11. What form of such local coöperation do you suggest?
12. Shall we establish a downtown office headquarters?
13. Shall we acquire clubroom facilities?
14. Would you advocate the increase of our present annual dues if clubroom and library facilities were provided?
15. Would you support a luncheon conducted in connection with clubrooms?
16. Would you support weekly or biweekly engineers' luncheons such as we have had in the past?
17. Do you favor increased attention by the society to social activities among engineers?
18. Would you attend an engineers' dance?
19. Make us a helpful suggestion. Answer in as much detail as you like. Paper is cheap and ideas are wanted.
20. What can the society do to better serve out-of-town members?

Engineers' Club Plans Larger Activities

The Engineers' Club of the Youngstown district, Youngstown, Ohio, is making a drive for greatly increased membership. At its April meeting, with an attendance of 347, it was announced that 625 applications had been received. The club covers the territory within a radius of 25 miles, including several other cities, and it is estimated that there are 1500 men eligible for membership. It is planned to have the club active in coöperation with civic bodies and such commercial organizations as boards of trade and chambers of commerce in regard to problems of an engineering character. The membership is of five classes, admitting those in all branches of engineering, architecture, chemistry and applied science, and also those interested in the advancement of engineering. It has been voted to lease a floor of the Park Theater Bldg. for headquarters. The president is F. W. Funk; the vice-president is W. H. Ramage, and the secretary is E. R. Rose, Republic Iron & Steel Co., Youngstown, Ohio.

Publicity by Engineering Societies Promises Good Results

Passage of the Iowa engineers' registration law was helped materially by the hard work of the Iowa Engineering Society and of engineers who took time for nearly a month to make members of the legislature realize the public benefit of the measure. It is considered evident that engineers can exert considerable influence in public affairs if their efforts are properly coördinated, and that state engineering societies may be powerful agencies in securing proper appreciation of the engineering profession by the public. Educational publicity work of this kind will do much to make clear to the legislator and the average citizen the scope and importance of the engineer's work.

Societies Submit Names for Board of Engineer Examiners

At a dinner to representatives of various technical societies given by Calvin W. Rice, secretary of the American Society of Mechanical Engineers, at the University Club, Denver, Colo., the license law recently passed in Colorado was discussed, and the question of the appointment of members for the board of engineer examiners was raised. It was resolved that each society represented at the dinner should choose three of its members for candidates, and that these names should be submitted to the Governor.

As a result the following list of names has been forwarded to the Governor: For the Colorado Association of Members of the American Society of Civil Engineers, Prof. Milo S. Ketchum, C. W. Comstock, and J. C. Ulrich; for the American Institute of Mining and Metallurgical Engineers, Richard A. Parker, R. J. Grant and John T. Milliken; for the American Institute of Electrical Engineers, Prof. H. S. Evans, Franklin D. Wood and C. W. Comstock; for the American Society of Mechanical Engineers, J. B. McKennan, W. J. Reilly and Prof. J. A. Hunter; for the Colorado Scientific Society, D. W. Brunton, George O. Argall and H. S. Sands; for the Teknik Club, M. S. MacCarthy and L. L. Davis; for the Colorado Society of Engineers, R. M. Hosea, F. W. Whiteside and V. A. Kauffman.

Sanitary Engineers Condemn Shallow Wells

At a recent meeting of the Indiana Sanitary and Water-Supply Association shallow wells and privy vaults were condemned by resolution, as were dual water-supplies (one of which may be contaminated) and physical connections to industrial-plant supplies. Of the 500,000 wells in the state more than 2% have been tested in the past 12 years and 61% of these found to be bad. The privy vault and the back-yard well are both of vital concern to the sanitary engineers in Indiana, for water is easy to obtain and equally easy to contaminate.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Draftsman's and Shoemaker's Salaries

Sir—With reference to the letter from C. H. McGarry, in your issue of Apr. 24, 1919, p. 835, quoting from the April bulletin of the Civil Service Commission of Ohio announcing the examinations for positions of architectural draftsman and of shoemaker, I wish to make the following statement:

In so far as Mr. McGarry's letter might be interpreted by some readers as being a criticism of the Ohio Civil Service Commission, a brief description of the method in which the salaries for the positions in question are fixed is pertinent. The state department (in this case the Ohio Board of Administration) submits its request for salaries of its employees to the Budget Commissioner, who passes upon the request and forwards it, with his recommendations, to the Governor. The Governor transmits his recommendations, based upon the reports of the Budget Commissioner, to the legislature. The legislature, after making any changes it may deem advisable, makes a direct appropriation for salaries. The Civil Service Commission is not consulted in regard to the salaries, but is required to fix the grades and qualifications for the positions.

A careful consideration of the salaries paid, in connection with the nature of the two positions in question, would disclose the following points: The entrance salary of the architectural draftsman is $1500 per annum with no maximum limit designated. That of the shoemaker is $1200 with maximum limit of $1400 per annum.

The position of architectural draftsman affords excellent experience, which can be used by the incumbent as a means for future advancement. The position of shoemaker is "Grade 1" in the skilled labor service, and is practically without further possibilities to the shoemaker incumbent.

In connection with tnese examinations, it might be interesting to know that there were five applicants for architectural draftsman, and one applicant for shoemaker. G. F. SCHLESINGER.

Assistant Chief Examiner, The State Civil Service Commission of Ohio.
Columbus, Ohio.

Interpretation of Overhaul Specification

Sir—A letter from R. G. Williams in *Engineering News-Record* of Apr. 24, 1919, p. 835, asks for interpretations of a certain specification for overhaul.

This specification states that "payment for overhaul . . . . shall be the product of . . . . tons of material . . . . by its distance in miles (and fractions thereof) less one mile, of its *center of mass* from the points of locations. . . . (The italics are mine.)

Thus, in the first overhaul mile, i.e., the space covered between, say, mile post 1 and mile post 2 from the pit: If there be 100 tons of material, assumed to be uniformly distributed, the location of its center of mass will be at mile post 1½, and the overhaul paid should be 100 tons multiplied by ½ mile or 50 ton-miles, which, at 25c., unit price, amounts to $12.50, as claimed by the engineer. F. T. HOWES,

Resident Engineer, Northern Pacific Railroad.
Emigrant, Mont.

Sir—In your issue of Apr. 24, 1919, p. 835, R. G. Williams asks what is the correct interpretation of an overhaul specification.

In analyzing the specification I believe the following points should be taken into consideration:

1. The first sentence plainly says that the free haul shall be one mile from the pit or loading point. There is no uncertainty in this statement.

2. The second sentence says that for each mile or fraction thereof in excess of the one-mile free haul the contractor shall be paid for overhaul at the rate bid per ton-mile, which is 25c. This clearly means that the contractor shall receive 25c. per ton-mile for every ton of material hauled beyond the first mile, whether the material is hauled one foot past the first mile post or whether the material is hauled to any other point within the one- to two-mile zone.

3. The third sentence says that payment for overhaul shall be the product of the tons of material hauled times its distance in miles and fractions thereof less one mile, of its center of mass from the points of locations. The grammatical construction of this sentence is faulty and admits of two interpretations. The first part of the sentence which says payment of overhaul shall be "the product of tons of material hauled times its distance in miles and fractions thereof less one mile" is clear and must be construed as outlined in paragraph 2 above. The second part of the sentence goes on to say "of its center of mass from the points of location," and indicates that the engineer probably had some idea of paying for an average haul. However, he does not say so in good English.

The contractor in this case should have asked the engineer for his interpretation of this sentence before submitting his bid. This evidently was not done. On the other hand, the engineer has failed to write a clear specification.

A reasonable interpretation of the specification would be for the engineer to pay the contractor on the same basis, using the ton-mile unit of 25c., as other contractors are being paid on similar work in that state or that section of the state. NEWMAN B. GREGORY.
Walnut Ridge, Ark. General Contractor.

Joints in Concrete-Road Work

Sir—The lively interest in and discussion on transverse expansion joints in the construction of concrete highways will lead to a logical and proper solution. There is a significant tendency to abandon all joints, and, in some localities and under certain conditions this seems to be a sane departure from the theoretical idea of their importance. However, it will be best to act with caution, owing to the fact that concrete laid at or near freezing temperatures will, under summer heat, show expansion and may buckle or crush. Again, there is danger of expansion from moisture during rainy seasons, especially if the coarse aggregate used is absorbent or if the binder of cement and sand is not rich and dense enough to avoid penetration of moisture.

The blind joint is, in my judgment, the best type. This style of joint is most easily produced by placing a 4-in. weatherboarding, thin edge up, across between the forms and resting it on the subgrade. This will cut the slab from the bottom to about the center for standard work. As the work shrinks in curing, the cleavage will be over this board. The future behavior of the work will determine whether any treatment of the crack is advisable. We place this joint at the end of each day's work, or about every 400 feet.

If bituminous expansion strips are used for joints, the maximum thickness should not exceed $\frac{1}{4}$ in., and my present judgment and experience tend to condemn them entirely. They do not properly support and protect the edges of the concrete. In all cases where joints are inserted, either blind wood or bituminous, they ought not to cross the slab at right angles, but should cross as the segment of a circle.

This "rainbow" type is easily produced by using a strip of joint material of such length as will, when sprung into place between the forms, give the desired radius or curve. If the roadway be 18 ft. wide and we use a strip of joint material 18 ft. 4 in. in length, we shall produce a bow of 18 in. at the center of the roadway.

In case the specifications are old and the engineer in charge is ultra-conservative, thus forcing the elastic joint on the contractor and into the work, it is best to use a light metal templet not over $\frac{3}{16}$ in. thick sprung into position for placing the joint material. The strips of material may then be placed against the outer or convex surface of the templet and be held in place by driving light, wooden stakes into the subgrade, so as to hold the strips against the metal. Lifting out the templet is made easy by drilling two small holes near the top, say 4 in. from each end, and using small lifting hooks. In case wooden strips are used as mentioned above and left in, there is a total elimination of all labor after placing.

The "rainbow" type has many features of preference and should supersede the straight line in future work, whenever it is required to place joints of any description. Its appearance is more pleasing to the eye, and the wheel contact with the joint is better for both the driver and the vehicle. As in crossing car tracks at variance from a right angle, the thrust is only on one wheel at a time, as one passes over before the other reaches the curved line. The chug of both wheels at once gradually ravels the road at the crossing of the joint, and this is minimized by crossing the "rainbow" instead of a straight line. C. O. FRYE.

Tulsa, Okla.

Concrete Road with Bituminous Carpet Wrongly Classified

Sir—In the Apr. 3 issue of *Engineering News-Record*, p. 670, data were given on the cost of maintenance of different types of highways in the City of Philadelphia. In this table 1:3:6 concrete was listed under "foundation" when placed under vitrified brick and Bicomac. When thin bituminous carpet was placed on the concrete base, the concrete was listed under "type of surfacing."

A 1:3:6 mix of concrete is not the proper mixture for concrete surface. Under modern specifications the weakest mix being used for concrete surfacing is 1:2:4. In the majority of cases the mixture is even stronger. Where concrete base was placed with bituminous carpet, the concrete should have been carried under "type of foundation," as in the case of brick, and the surfacing should have been noted as "bituminous carpet."

I am calling this to your attention in the hope that you may correct in the minds of the readers of *Engineering News-Record* any wrong impression that they may have obtained in regard to the cost of maintenance on concrete highways. The average cost of maintenance on a properly constructed concrete highway is as low as on any other type of pavement, and the cost of maintaining a large mileage for this class of pavement surface for several years shows that it does not average over $\frac{1}{2}$c. per square yard per year. A 1:3:6 foundation with a bituminous carpet coat is not a concrete surface, and should not be classed as such. B. H. WAIT,

District Engineer, Portland Cement Association.

New York City.

Union of British Women Engineers

Sir—In regard to the item on this subject in *Engineering News-Record* of May 1, 1919, p. 863, it might have been well to point out that in England the term "engineer" is used as synonymous with our term "machinist," and that the Amalgamated Society of Engineers is a machinists' labor organization. However, it appears that the women also want to become members of technical societies, but it is not clear that membership in a trade union will help them in this respect.

Chicago. ENGINEER.

Control of Fires in Cinder Fills

Sir—For those who are experiencing difficulty in the control of fires in cinder fills, as described in your issue of Apr. 10, 1919, p. 711, the method which has been used with success at the Rensselaer Polytechnic Institute may be of some interest and help.

For a number of years the cinders have been dumped into a natural ravine close to the boiler house, and the fill probably reaches a depth at present of about thirty feet.

Considerable difficulty had been experienced from time to time with fires. Attempts were made to quench these by applying a large volume of water from a hose, but the attempts met with indifferent success. On one of these occasions there was danger that the fire might spread to soft coal stored near by, and the necessity for some more certain means of fighting it led to the adoption of the following plan:

A gridiron was constructed of several $\frac{3}{4}$-in. pipes, with tees spaced about 8 ft. apart. Into these tees were screwed other pipes about 6 ft. high, and upon the top end of each of these was screwed an automatic sprinkler head from which the disc had been removed. The whole arrangement was placed on top of the cinder fill over the place where the fire seemed to be, and connected by a rubber hose to the water supply. The water thus applied was distributed uniformly over the location of the fire and was very effective in its action. Usually not more than four sprinkler heads were required to quench the fire completely in a few days' time.

LE ROY W. CLARK,
Assistant Professor of Mechanics, Rensselaer Polytechnic Institute.

Troy, N. Y.

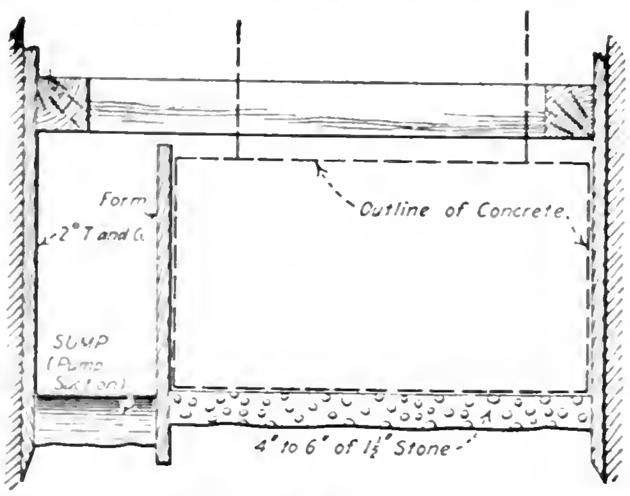
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Sump and Drain Keep Footing Pit Dry

By A. P. Roscoe
Ozone Park, N. Y.

USING the arrangement depicted by the accompanying drawing, concrete was placed without trouble from water in constructing elevated-railway column footings in New York City. The pits varied from



SUMP KEEPS FOUNDATION PITS DRY FOR CONCRETING

7 x 7 x 10 ft. to 9½ x 9½ x 12 ft., and ground-water level ranged from 2 ft. to 9 ft. above the pit bottoms. Tongue-and-groove sheeting was driven by hand and by steam hammer, and the water was kept down by steam pumps and gasoline-driven diaphragm pumps. As the drawing indicates, the sheeting was driven to the neat lines of the concrete on three sides, but on the fourth side it was driven 2 ft. outside the neat line. This gave a 2-ft. space for a sump which was excavated 6 in. deeper than the pit itself. A side form for the footing on the sump side was then set up, and the pit bottom was covered with 4 in. to 6 in. of 1½-in. broken stone. Water seeping into the pit drained through the broken stone into the sump and left practically dry the bottom on which the footing concrete was deposited. An open-joint tile drain embedded in the stone was laid across the pit bottom to the sump in the first few pits, but was afterward omitted as unnecessary.

Simple Device Decreases Loading Costs

By Max Miller
Engineer, M. Shapiro & Son, New York City

AN INEXPENSIVE device successfully used on concrete work resulted in a saving of a considerable percentage of loading and carting costs. As indicated by the illustration, it consists of a simple box made of old lumber and measuring about 5 x 7 ft. in plan by 1 ft. 6 in. deep. It holds about 2 cu. yd. of material and loads a motor truck by one operation in a few minutes. The box is arranged to rest on the side of the open railroad car in which the material is received, is slightly overbalanced outward, and is dumped by the release of a rope at the end of a lever at its back, which is fastened to the opposite side of the car.

On the job where this was used it took as long to fill the truck by the ordinary hand shoveling as was required for the truck to make a complete round trip. The device, therefore, practically doubled the number of trips per day for each truck. Furthermore, the loading laborers were continually busy filling the box and did not lose time waiting for the truck to come alongside of the car.

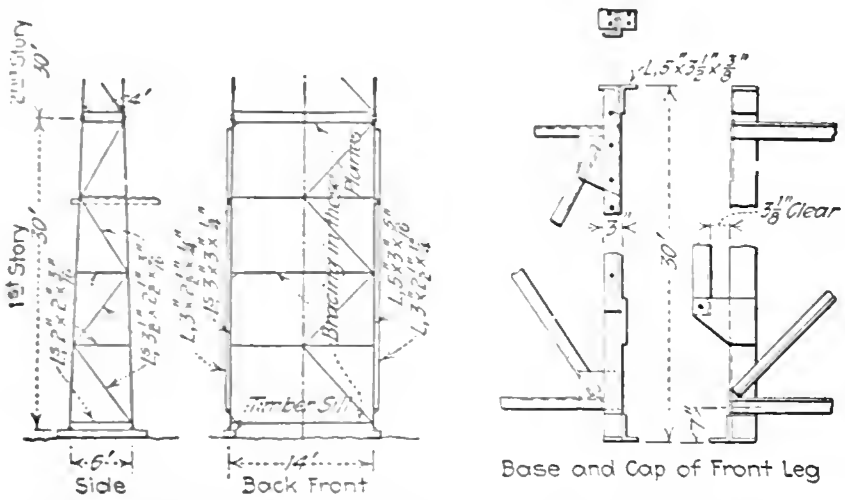
Other Articles in This Issue of Interest to Contractors:

BOX ON SIDE OF RAILROAD CAR DUMPED BY RELEASE OF LEVER

The device was used by M. Shapiro & Son, for whom the writer is engineer in charge of construction on the masonry, foundations and concrete work for the new Strand Theatre at Far Rockaway, N. Y.

Steel Scaffold Towers Reduce Handling at Fore River Shipyard

A DISTINCT simplification in ship-erection scaffolding is found at the Fore River shipyard of the Bethlehem Shipbuilding Corporation, Ltd., at Quincy, Mass. The supports are steel towers 6 x 14 ft. at the base, built in heights of 30 ft. and so detailed that a second story can be set on top of the first without trouble, and attached by a few bolts to keep it from shifting. Placing ledger planks to support the scaffold runways involves no more trouble than with wooden scaffolding. As shown in the detail sketches, an angle is attached to each of the tower leg angles by outstanding gusset plates in



STEEL SCAFFOLD UNITS AT FORE RIVER SHIPYARD

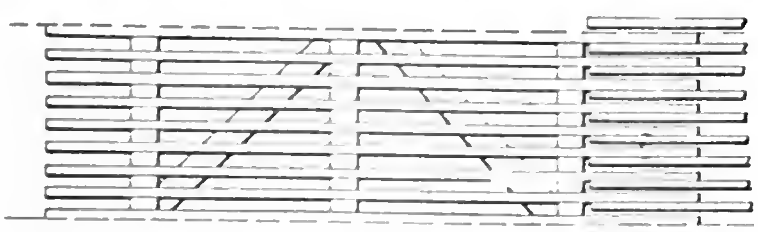
such position as to leave a clear space 3 in. wide between the two angles. The ledger boards are passed through this space, and are held by steel pins passed through holes in the two angles above and below the board.

Timber sills are attached to the foot of the tower, and thus the tower becomes a self-contained unit, which the shipbuilding cranes can easily pick up and place anywhere along the ship. As soon as it is set on the ground it is stable without bracing, and the ledgers and runways can be put in position. Because of the absence of timber bracing, the working space around the bottom of the ship is much clearer of obstructions than with the ordinary scaffolding made of independent bents.

The idea of self-contained scaffold units is credited to S. W. Wakeman, former general manager of the yard and now general manager of the eastern district of the Bethlehem Shipbuilding Corporation, Ltd., which embraces a number of yards and manufacturing plants. The towers were built by the New England Structural Co., of Everett, Mass. They have been in service about two years, and in that period little expense for repairs has been incurred. Compared with timber scaffolding they are regarded as virtually free from deterioration.

Timber Grid Floor Forms With Sheet Iron Covering

FLOOR-FORMS consisting of wood grids over which sheet iron was tacked were an important factor in the unusually rapid concreting operations in constructing the Boston Army supply base described in *Engineering News-Record* of Sept. 19, 1918, p. 522. The grids, as shown by the sketch, consist of 2 x 3-in. sticks set parallel on edge 3 in. apart and cleated together to form mats 3½ x 12 ft. in size. As shown, the ends of abutting mats can be telescoped to provide longitudinal adjustment. A succession of these mats was laid over the floor area, being supported on 4 x 6-in. stringers spaced 5 ft. apart and carried on 3 x 4-in. posts set about 5 ft. apart. Over the tops of the mats thus assembled was tacked No. 22-gage sheet iron which could be lapped in any direction to cover a given space without cutting. The grids, when sturdily built, could be used at least 10 times, and the sheet metal, which was rolled after each usage, was good for re-use from 12 to 15 times. Maj. Charles R. Gow was constructing quartermaster and the W. F. Kearns Co., Boston, Mass., was the general contractor for the base.


GRID AND SHEET-IRON COVERING CAPABLE OF REPEATED RE-USE

Check Bidding Prices Against List of Possible Cost Items

THERE are so many items of cost in road construction that memory alone is a feeble guarantee that all have been included when the contractor submits his sealed bids. To prevent errors or omission the Prendergast-Clark Construction Co., of St. Louis, Mo., general contractors, with extensive experience in road building has compiled a list of items to be considered in estimating the cost of 1 sq.yd. of pavement on concrete highway, as follows: (1) Surety bond; (2) liability insurance; (3) installing railway sidings; (4) freight on equipment; (5) equipment; (6) installing equipment, building bins and cement shed; (7) laying and taking up track (industrial-railway outfit); (8) cement, sand, gravel or stone on railway siding; (9) unloading cement, sand, gravel or stone; (10) hauling cement, sand, gravel or stone to roadway; (11) pumping water; (12) operating mixer; (13) charging mixer; (14) spreading concrete; (15) finishing concrete; (16) sprinkling concrete; (17) canvas covering for concrete and cement; (18) earth covering for concrete; (19) form setting for concrete; (20) subgrade for concrete; (21) rolling subgrade; (22) bundling cement sacks and return freight to mill; (23) lost and damaged sacks; (24) oil, gasoline and coal; (25) interest; (26) depreciation, and (27) overhead. In appraising these items, careful scrutiny of the specifications is made vital by the changes in requirements which are constantly being introduced. The requirements for dry concrete, for example, introduce tamping and tamping machines which must be appraised under items 5 and 14. Many other of the items can be subitemized to advantage, but the list furnishes a fairly complete skeleton on which to build up a schedule of costs that will be reasonably complete. No schedule to be devised will obviate the necessity of a final allowance for contingencies.

C. S. H.

Tractor Operators Trained for Road Work

In view of the probable shortage of tractor operators to handle the machines which will be required on the extensive road work planned in Nebraska for this year, Prof. L. W. Chase, head of the agricultural engineering department of the University of Nebraska, organized a special short course in tractor instruction, similar to the course for tractor operators on agricultural work. The time was short, but posters were hurriedly prepared and distributed Apr. 3 announcing that this special course would begin Apr. 14. The newspapers also gave publicity to the new course. Instead of 15 to 25 attendants as expected, there were over 80, so that three sections were necessary, and for five days the lecture periods had to be doubled. The course consisted of two lectures and six hours' laboratory work each day for 20 days. The innovation was suggested by George E. Johnson, state engineer.

NEWS OF THE WEEK

New York, May 15, 1919

Price Stabilization Board Resigns

Following the failure of the Railroad Administration, the steel producers and the Industrial Board of the Department of Commerce to agree on steel prices, the members of the latter board May 8 presented their resignations to Secretary Redfield, who accepted them. This marks the end of the attempt to stabilize prices on the part of a Government bureau by announcement of a fair price.

New Record of Ship Production

April figures for shipbuilding in the United States establish a new high mark for deliveries of completed ships: Ninety-three vessels, of 320,280 gross tons, which is 57,000 tons higher than the previous record figure, made in October, 1918. With this month's report the Shipping Board has abandoned the use of dead-weight carrying capacity tonnage, and has gone over to gross tonnage.

Rapid-Transit Construction Under a Single Commissioner

Direction of subway and elevated-railway building in New York City will hereafter be in the hands of a single commissioner, under a law signed by Governor Smith of New York State during the past week. This law completes the replacement of the five-member Public Service Commission for the First District (New York City) by two independent commissioners, one in charge of utility regulation and the other in charge of rapid-transit construction. As noted in these columns last week, Lewis Nixon, who was appointed regulative public service commissioner, is administering the duties of both offices pending the appointment of a construction commissioner.

Government Scientists Organize Union at Washington

Scientific and technical employees of the Government, at a meeting held in Washington, May 10, organized a union which is to become a branch of the present Federal Employees' Union. There was a long discussion on the formation of an independent organization, which would in no way be connected with the present union of Federal employees, but this was decided against, by a vote of 185 to 132.

Dr. Edward B. Rosa, chief physicist of the Bureau of Standards, said that the work of the joint Congressional reclassification commission had brought to the forefront the question of an organization of scientific and technical workers more acutely than ever before. He also spoke in opposition to the plan for an independent organization, declaring that it would be practically without influence, but that in a union allied with other Federal employees the scientific and technical employees would be heard and recognized, and the desired results would follow.

P. G. Agnew, secretary of the new organization, pointed out accomplishments of the Federal Employees' Union, accrediting it with increasing the wages of Government employees and securing the appointment of the reclassification commission.

Employment Bureaus

Engineering Societies' Employment Bureau, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Building War Department Concrete Steamers

Concrete river steamers for the use of the Army are to be built by the Newport Shipbuilding Corporation, Ltd., at its yard at Newbern, N. C. These ships, which were noted in *Engineering News-Record* of Jan 2, 1919, p. 65, are 130 ft. long and will be used as short-trip transports. Nine of them are contracted for.

More Harbor Bonds for Portland, Oregon

On June 3 the voters of Portland, Ore., will be asked to approve an additional bond issue of $1,000,000 to take care of any emergencies in the current improvement of the harbor and municipal port works. No definite use is indicated for the additional funds, but the port commission asks for the money to provide for contingencies.

Minnesota Drainage Control Reorganized by New Law

Complete reorganization of the state administration of land drainage in Minnesota is provided by a bill which has just become law through Governor Burnquist's approval. The original house bill was amended in the senate to provide an engineer commissioner, and in this form was passed and approved. The State Drainage Commission existing hitherto consisted of the Governor, the state auditor, and the secretary of state. The new law creates a Department of Drainage and Waters, to be headed by a commissioner ($4000 per year) appointed by the Governor for a term of four years. He is assisted by a deputy commissioner ($3000). The commissioner must be a practical drainage and hydraulic engineer.

In addition to the duties assigned to the old commission, the new department receives power to investigate the topographical features of the watersheds of the state; to ascertain the work necessary for securing proper drainage outlet for the lands in each basin and for preventing and controlling floods; to measure stream discharge; to determine drainage run-off coefficients; to establish rules and regulations governing the work of drainage engineers; to survey and establish the boundary lines of drainage basins or of organized drainage and conservancy districts; and to keep a record of all drainage improvements.

An important auxiliary feature of the law is a new schedule of maximum allowable compensation to be paid to engineers engaged in public drainage proceedings. The principal increases are: Engineers, from $10 to $12.50 per day; rodmen, from $3 to $4 per day; viewers, from $4 to $5 per day; chainmen, axemen, etc., from $2.50 to $4, the pay including necessary expenses in each case. It is further provided that referees must be qualified consulting civil engineers.

Government to Give 20,000 Motor Trucks to States

About 20,000 motor trucks, valued at more than $45,000,000 are to be distributed by the Secretary of Agriculture, through the Bureau of Public Roads, to the state highway departments. These trucks have been declared surplus by the War Department, and are being distributed to the states under the provisions of Section 7 of the Post-office appropriation bill. They must be used by the states on roads constructed in full or in part by Federal aid. All that the states are required to do to

obtain these trucks, which range in capacity from 2 to 5 tons, is to pay the loading and freight charges.

Of the total number of vehicles to be acquired, 11,000 are new and 9000 have been used, but all are reported to be in serviceable condition. They will be apportioned to the states only upon request of the state highway department and on the basis of the total number of requests received from the various states. The requirements of the Federal-aid law, under which these trucks must be apportioned, do not allow the Bureau of Public Roads to distribute trucks to counties or to individuals.

Army Camps Are Sold Cheap

Twelve Army camps, eight of them of the more or less temporary type used for National Guard concentration sites and four used for miscellaneous camps, have been sold for a total of $548,194.

Bids on these camps were noted in the "Business News" section of this journal, May 1, 1919. No statement has been given out as to the original costs of the camps, but they must have been forty or fifty times the selling price. Contracts awarded for the sale of the camps are shown in tabulated form on p. 292 of the Construction News Section of this issue.

The City of Montgomery, Ala., obtained Camp Sheridan; the State of North Carolina takes over Camp Polk. Other camps went to individuals and firms, except Camp Kendrick, New Jersey, which was withdrawn from auction, and is to be retained for the Navy. In the case of Camp Beauregard, Louisiana, the successful bidder must guarantee to the state without cost buildings and improvements sufficient for one regimental camping area for the use of the state troops. At Camp Hancock, near Augusta, Ga., the underground improvements must be left intact for the benefit of the community. At Camp Polk, North Carolina, the buildings were sold to the state for use in connection with the state penitentiary. To the City of Spartanburg, S. C., will be given the sewerage and water systems at Camp Wadsworth.

All of these camps had comparatively few buildings, the cost of construction going mostly into underground and ground work.

New Piers for Staten Island

Twelve new steamship piers for Staten Island are being designed in the Department of Wharves, Docks and Ferries of the City of New York. Two of the piers are ready for the contract advertisement and await only the appropriation of the Board of Estimate, having been authorized by the Sinking Fund Commission. The development is located on the eastern shore of the island, just inside the Narrows and between Clifton and Tompkinsville. Each pier will be 125 ft. wide and 1000 ft. long, with 300-ft. slips.

Program of Water-Works Association Meeting

Discussion of the present trend of prices and other economic subjects of current interest will engage an entire session of the annual meeting of the American Water-Works Association to be held in Buffalo, June 9-13, 1919, according to preliminary announcement of the program. In addition to papers on technical water-works subjects, a series of papers by United States Government officials and by manufacturers on the price situation will be read.

The first day of the meeting will be devoted largely to registration and to committee meetings. In the evening the Water-Works Manufacturers' Association will hold a reception at the Iroquois Hotel.

A. W. Kreinheder, commissioner of the Buffalo Board of Public Works, will deliver the address of welcome at the opening session on the second day of the meeting. He will be followed by John E. Teeple and John A. Kienle, who will speak on "The Relation of the Chemical Industry of Niagara Falls to the Water-Works." After this paper a round-table meeting will be held for the discussion of problems relating to operation and maintenance of water-works. Among the topics to be discussed will be "Damage to Fire Hydrants by Motor Vehicles, and Remedies Therefor." The afternoon session will include the report of the Private Fire Protection Service Committee, Nicholas S. Hill, Jr., chairman. In the evening the following papers will be presented: "Buffalo Water-Supply, With Special Reference to the Filtration Problem"; "Reduction of Water Consumption by Means of Survey and Constant Inspection," and "The Uniflow Pumping Engine," by D. A. Decrow.

The morning session June 11 will be given over to a discussion of economic and business subjects, and will be addressed by Government officials and manufacturers.

Other papers to be presented at the meeting are: "Purification of Water for the Army and Field Purification Plants," by William J. Orchard; "Air Lift and Water Purification," by John Oliphant; "The Effect of the War Period, 1914-1918, and Public Control Upon Water-Works of the United States," by Leonard Metcalf.

Minnesota Water-Works Meeting

Fire-supply connections as dangerous features of public water-supplies, sewage pollution, centrifugal pumps and aëration for water softening were the principal subjects presented at the semi-annual meeting of the Minnesota Section of the American Water-Works Association, held at the University of Minnesota, Minneapolis, May 3.

Papers relating to the first two subjects included "Water-Works for Fire Protection," by H. F. Blomquist, of St. Paul; "Features of Design in Small Water-Works," by F. H. Bass, of Minneapolis, and "Legal Responsibility for a Pure Water-Supply," by John Wilson, of Duluth. Resolutions were adopted opposing cross-connections between a polluted fire supply and a pure or purified public supply, and commending the state Board of Health for its work along these lines; also requesting the American Water-Works Association to appoint a committee to secure coöperation and standardization in the design of fire and domestic supplies, with a view to local or state control.

The remarkable results of a 30,000,000-gal. centrifugal pump at Minneapolis, with the economy of this large unit in regard to installation and operation, were the subject of a paper by F. W. Cappelen, city engineer. Water softening and removal of iron by aëration were discussed by J. A. Childs and L. I. Birdsall, who showed drawings of plants for removing iron from well supplies. Mr. Childs explained the need for this, as in small towns the people are apt to use a soft water readily available (but possibly polluted) in preference to a hard, iron-laden water supplied by the municipality.

Officers for 1919 were elected as follows: Chairman, H. F. Blomquist, of St. Paul; vice chairman, D. A. Reed, of Duluth. An invitation was extended to hold the fall meeting at Rochester, Minn.

Indiana State Highway Commission Selects Chief Engineer

Under the state highway law enacted by the last Indiana legislature the reorganized state highway commission has appointed H. K. Bishop, formerly district engineer of the Bureau of Public Roads, chief engineer. Mr. Bishop has had extensive experience in highway engineering, and in his position with the Bureau of Public Roads supervised all Federal-aid road work in Ohio, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina and New Jersey. He was graduated from Cornell University, Ithaca, N. Y., in 1893, and after considerable experience in municipal, New York State Barge Canal and other public work, became one of the first deputy engineers of the New York State Highway Commission when it was formed in 1909. He continued in this position until 1911. Following this he went to Honolulu, Hawaii, where he laid out the boulevard system and became commissioner of the Honolulu board of public works. Shortly after returning to the United States he became district engineer in the Bureau of Public Roads. The salary of his new position will be $7000 per year.

Milwaukee to Develop Harbor

Municipal docks and freight terminals on Jones Island, in Milwaukee harbor, are under consideration by the city. The harbor commission has just retained H. McL. Harding, consulting engineer, New York, to have charge of the project.

Campaign on Foot to Organize Auxiliary Engineer Corps

Letters have been sent to a number of the civilian members of the United States Engineer Department urging upon them the advocacy of an Auxiliary Engineer Corps, which will apparently be a part of the Corps of Engineers of the Army. The letter states that a bill for this purpose has recently been placed in the hands of Senator Ransdell of Louisiana, with a view to having it introduced at the coming session of Congress. This bill provides for a complete organization of the engineers doing public work in the United States, but placing the new department under the Chief of Engineers, U. S. A., and providing military status for all of the members thereof. The head of the department would be the Chief of Engineers, with the rank he now has of major general, and the division engineers would have the rank of brigadier general, and district engineers the rank of colonel, with provision for military rank for all subordinate assistants. It is the intention, according to the letter, that the corps be mobilized from the experienced men now in the United States Engineer Department. It is also stated that the duties of the corps will be the control of the river and harbor work of the United States as well as the construction, care and maintenance of all public works, particularly highways and bridges.

The last paragraph of the letter says: "Strong influence is working to turn public works over to the Quartermaster Corps, because they have already so many of our men in the service, and there is talk of a waterways commission and a construction-engineer branch in the quartermaster service, but it is not believed that either the people or Congress are ready for a change of engineers. The Auxiliary Engineer Corps will meet any public necessity, if there is one, for a waterways commission. There is a chance for any engineer who knows anything about river and harbor work to get in, as it calls for men having this special qualification."

Lieutenant Stuart Missing Since January 18

The American Red Cross is making every effort to locate Lieut. William H. Stuart, son of Duncan C. Stuart, of 12 Maple St., Oneonta, N. Y., who has been missing since Jan. 18, when he was last seen in New York City.

Any information that may be obtained is requested by the Red Cross.

Lieutenant Stuart is 27 years of age. He arrived from overseas service in January, and went to Washington Jan. 13, and received his discharge. He returned to New York and was last seen in that city Jan. 18 at 7:30 p.m. He is a graduate of Colgate University, class of 1914, and did two years' post-graduate work at the Brooklyn Polytechnic Institute. He is 5 ft. 8 in. tall, has dark brown hair and blue eyes and a ruddy complexion. He has a brown mole on the left side of his nose. If in uniform he has three gold service chevrons on his sleeve, indicating 18 months' service overseas. He was wearing, when last seen, spiral puttees, and not the customary leather ones for officers. Information relative to him may also be sent to D. C. Stuart, at the address given above, or Thomas Blizard, chief of police of Oneonta, N. Y.

British Columbia Technical Union Formed at Vancouver

An organization was recently formed in Vancouver, B. C., for "professional technical men and their technical assistants." It is called the British Columbia Technical Union. It is in nowise to be classed with the labor trades unions, the founders assert, nor will it affiliate with the labor organizations. The membership, which includes many members of the Engineering Institute of Canada and other national engineering organizations, rose above 100 within a few weeks. About 60 are classified as civil engineers.

The general purposes of the union are: (1) To obtain adequate public recognition of technical work; (2) to establish scales of standard fees for consultants and obtain recognition of the same; (3) to obtain equitable remuneration for salaried technical men and their salaried technical assistants; (4) to secure the consultation and employment of local members of the technical professions for work in British Columbia and to discourage the importation of men for technical work when duly qualified men are available in the province; (5) to protect members of this society when handicapped by extraneous influence in the execution of their professional duties; (6) to coöperate with existing professional societies in furtherance of the above objects, and, while not interfering with their usual activities, to assist them in every legitimate manner which will tend to maintain or improve the efficiency, status and remuneration of the technical professions; (7) to protect the public by encouraging the employment of qualified technical men.

The secretary-treasurer for the coming year is Charles T. Hamilton, 510 Hastings St. West, Vancouver, B. C.

Cities to Save Colorado Railway

Mayors of several Colorado cities recently organized the Northwestern Colorado Tunnel Association, for the main purpose of preventing the threatened abandonment of the Denver & Salt Lake R.R. It will endeavor also to secure the carrying out of the project for the six-mile James Peak tunnel which will eliminate the high altitude, steep grades and snow troubles of the present high-level line through the Corona Pass. R. E. Norval, of Hayden, Colo., was elected chairman.

Civil Service Examinations

New York.—Junior assistant engineer, State Engineer and Highway Department, \$1200-\$1440 per year, May 24. Apply to State Civil Service Commission, Albany, N. Y. File applications before May 24.

New York.—Bridge designer, Public Service Commission, First District, \$1501 to \$2100 per year. Apply to State Civil Service Commission, Albany, N. Y. File application before May 24.

United States

For United States civil service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Highway bridge engineer, \$1800 to \$2100 per year, junior highway bridge engineer, \$1200 to \$1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

Engineer in forest products, \$1860-\$3000 per year; assistant engineer in forest products, \$1200-\$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

Chief of road survey party, \$1800 to \$2100 per year, transitman for road surveys, \$1200 to \$1800 per year, highway draftsman, \$1200 to \$1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

Senior engineer and senior architect, Interstate Commerce Commission, \$1800-\$2700 per year, June 10. File application before June 10.

Valuation engineer, \$3600-\$4800 per year, and assistant valuation engineer, \$2500-\$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

ENGINEERING SOCIETIES

The Master Builders' Association of Central Washington was formed recently with the following officers: President, D. L. Thacker; vice-president, Edward McWilliams; secretary, J. H. Corbett, and treasurer, Harry Boyer. The headquarters are at Yakima.

The Logansport, Ind., Chapter of the American Association of Engineers was recently organized, with the following officers: President, C. T. McGreevy; vice-president, Carl Lux; secretary-treasurer, Ralph Newcomer.

The Canadian Good Roads Congress will hold its annual meeting at Quebec May 20-22, at the time of the informal conference of the provincial ministers of public works and their deputies. In

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING: 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

addition to technical papers there will be an exhibit of materials and road-building methods. The conference of provincial ministers is called to discuss the Federal-aid highway bill.

The Colorado Association of Members of the American Society of Civil Engineers held a regular meeting May 10 at which Milo S. Ketchum, dean of the College of Engineering, University of Colorado, spoke on "The Construction of the United States Government Explosives Plant at Nitro, W. Va."

The Engineering Society of Tulsa, Okla., was organized at a meeting May 1. The following officers were elected: President, J. C. Hughes; vice-president, E. H. Cornelius; secretary-treasurer, S. W. Mitchell.

The Savannah, Ga., Chapter of the American Association of Engineers recently elected the following officers: President, George O. Haskell; vice-presidents, W. J. Kehoe and Percy Sugden; secretary, G. A. Beldan; treasurer, W. A. Whitfield.

The Rochester, N. Y., Engineering Society will be addressed May 16 by E. A. Fisher on "Old Surveys of Rochester." A meeting will be held May 23, at which E. Blough, chief chemist of the Aluminum Co. of America, Pittsburgh, will speak on "Commercial Applications of Aluminum."

The Colorado Society of Engineers held a meeting May 2 at which W. R. Rosche spoke on "The Byproducts of Bituminous Coal and Their Production." A. L. Fellows showed samples of the concrete used in the concrete oil tankers under construction at Alameda, Calif.

The Sacramento, Calif., Chapter of the American Association of Engineers was recently formed. W. B. Carruthers is president, R. A. Bergman is vice-president, and H. A. Lathrop is secretary.

The Associated Engineering Societies of St. Louis held a joint meeting under the auspices of the St. Louis Branch of the American Society of Refrigerating Engineers, May 14. E. W. Gallenkamp, Jr., of the Pilsbry-Becker Engineering & Supply Co., presented a paper on "The Effect of Increased Condenser. Ice Can and Freezing Coil Surface on Power Consumption of Ice Plants."

The Engineers' Society of St. Paul held a meeting May 12, at which P. E. Stevens, consulting engineer who had charge of the expansion of the McDougall-Duluth Co.'s shipbuilding plant, spoke on "Building a Shipyard."

The Brooklyn Engineers' Club was addressed May 8 by Irving Blount, who read a paper on "Final Disposition of Garbage."

The Los Angeles Chapter of the American Association of Engineers was organized recently. E. G. Sheibley is president and J. C. E. McClure is secretary.

The Engineers' Club of Trenton called a meeting May 8 to discuss the proposed Assunpink Way project. Mayor Frederick W. Donnelly of Trenton introduced the subject, and a number of members participated in the discussion.

The Charlotte, N. C., Chapter of the American Association of Engineers was formed recently. J. A. Killian is president and G. T. Asbury is secretary.

The Allied Engineering Association of Charleston, S. C., will hold its next meeting May 19. The annual meeting will be held June 16. The regular meetings are held on the third Monday of each month.

The Louisiana Engineering Society held a meeting May 12 at which Prof. John Smith Kendall, of Tulane University, read a paper on "Jackson Square."

The Salt Lake City Chapter of the American Association of Engineers was organized recently. Maj. O. Simons has been elected temporary secretary.

Personal Notes

GAYLORD CUMMIN has resigned as assistant to the president, Kelsey-Brewer Co., public utility operators, of Grand Rapids, Mich., and will establish offices in New York City as a consultant in municipal and public-utility problems. Mr. Cummin's office will be located temporarily in the office of the Institute of Public Service, 51 Chambers St. Last year he resigned as city manager of Grand Rapids to enter the Kelsey-Brewer Co. He was previously city engineer of Dayton, Ohio.

LIEUT. H. J. WILLIAMS, Engineering Division, Ordnance Department, U. S. A., who recently received his discharge from the service, has been appointed engineer of the Beacon Falls Rubber Shoe Co., Beacon Falls, Conn. Before entering the service Mr. Williams was engaged in private practice in New York City as a consulting engineer, and was also a member of the faculty of the Pratt Institute, Brooklyn.

HENRY H. FOX, estimating engineer, contract department, Turner Construction Co., New York City, has been appointed a vice-president, with headquarters in New York.

MAJ. A. J. SACKETT, formerly chief engineer of the Mason & Hanger Contracting Co., New York City, and R. L. CANNIFF, formerly treasurer, Degnon Contracting Co., New York City, have incorporated the North Atlantic Construction Co., and will conduct a general contracting business under that name.

A. S. ADAMS, who during the war served as supervising engineer of construction, Camp Logan, chief engineer of construction, Ellington Field, Houston, Tex., and in other war work, has opened an office in the Union National Bank Bldg., Houston, Tex., for the private practice of engineering.

J. P. H. PERRY, manager of the contract department, Turner Construction Co., New York City, has been appointed a vice-president, with headquarters in New York.

M. L. LOEWENBERG, recently engineer, Worden-Allen Co., Chicago, and I. S. LOEWENBERG, formerly architect, Swift & Co., Chicago, have become associated under the firm name of LOEWENBERG & LOEWENBERG, engineers and architects, with offices at 29 S. La-Salle St., Chicago.

W. W. TURNER, president of the Turner Concrete Steel Co., has become a general manager of the Turner Construction Co., New York City, in charge of work in the vicinity of Philadelphia, with headquarters in that city. The Turner Concrete Steel Co. has been consolidated with the Turner Construction Company.

CAPT. JOHN F. DRUAR, Engineers, U. S. A., recently discharged from the service, and ROSCOE L. SMITH, recently engaged with the National Board of Fire Underwriters on water-supply and fire-protection work in Army camps, have become associated in partnership to engage in general engineering work, with headquarters in the Globe Bldg., St. Paul, Minn.

EDMUND F. SAXTON, formerly assistant director of the Department of Wharves, Docks and Ferries, Philadelphia, has become treasurer and a director of the John S. Boyd Co., Williamstown, Mass., succeeding Richard A. Strong, resigned. He will be in charge of the engineering work of the company.

MAX TOLTZ, head of the Toltz Engineering Co., W. E. KING, for several years treasurer and manager of

the Toltz Co., and BEAVER WADE DAY, recently engaged in the United States Housing Corporation project at Manitowoc, Wis., have become associated in partnership under the firm name of TOLTZ, KING & DAY, Inc., successors to the Toltz Engineering Co., at 1410 Pioneer Bldg., St. Paul. The new firm will carry on a general consulting and architectural engineering business, specializing in industrial structures.

A. C. SHUIT, who has concluded his work as cost engineer for the United States Housing Corporation on the project at Aberdeen, Md., has been appointed construction engineer, Washington Suburban Sanitary Commission.

THOMAS R. SPENCER, after thirty years' service with the Oregonia Bridge Co., Inc., Lebanon, Ohio, has resigned as general manager of the company, and is succeeded by Capt. A. H. ROBERTSON, JR., U. S. A., who recently received his discharge from the service and who was formerly chief engineer of the Dover Boiler Works, Dover, N. J.

T. V. STEVENS, formerly city manager of Cadillac, Mich., has resigned as senior engineer of the housing division, Emergency Fleet Corporation, to become associated with ALBRIGHT & MEBUS, consulting engineers, Philadelphia.

EDGAR I. WILLIAMS and WALTER R. MAHNKEN have become associated under the firm name of WILLIAMS & MAHNKEN, architects, 30 E. 42nd St., New York City.

A. C. TOZZER, general superintendent of the Turner Construction Co., New York City, has been appointed a vice-president and general manager of the New England territory, with headquarters in Boston.

C. W. L. FILKINS, of Scranton, Penn., has opened an office at Stockbridge, Mass., and will engage in civil engineering and construction work, in connection with his office in the Commercial Trust Bldg., Philadelphia.

C. T. JORDAN, district engineer, State Highway Department of Washington, has been placed in charge of the new office of the department in the County-City Bldg., Seattle.

CHARLES R. MCLAUGHLIN, Philadelphia, has been appointed engineer in charge of construction at the new Pennsylvania State Sanitarium at Mount Alto.

LOUVA G. LENERT, assistant state sanitary engineer, Bureau of Sanitary Engineering, Texas State Board of Health, has resigned to engage in private practice, with offices at Cisco and Breckinridge, Tex.

MORRIS R. SHERRERD, chief engineer of the Department of Streets and Public Improvements, Newark, N. J., has been appointed chief engineer of the North Jersey District Water Supply Commission, and will assume office July 1. It is understood that Mr. Sherrerd will continue his work for the city in the capacity of consulting engineer. Mr. Sherrerd first entered the employ of the City of Newark in 1895. He became engineer and superintendent of the Department of Water and in 1905 was appointed chief engineer of the Department of Streets and Public Improvements.

T. A. SMITH, general superintendent, Turner Construction Co., New York City, has been appointed a vice-president, with headquarters in New York.

H. D. JUDSON, of St. Joseph, Mo., M. S. MURRAY, of Sikeston, M. J. HANICK, of St. Louis, and H. D. GRIFFITH, of Hillsboro, have been appointed deputy highway engineers, Missouri State Highway Commission.

W. B. STEVENSON, acting city engineer of Fargo, N. D., has purchased the business and equipment of the Hopeman Engineering Co., Moorhead, Minn.

JOHN P. HARPER, first assistant state highway engineer of Arkansas, has resigned, and announces his intention of opening an office at Little Rock for the private practice of egineering.

W. E. LYLE, a general superintendent, Turner Construction Co., New York City, has been appointed a general manager in charge of work in western New York, western Pennsylvania, and eastern Ohio, with headquarters in Buffalo.

LYNN B. MILAM, of the firm of Thomas, Milam & Touchstone, attorneys at law, Dallas, Tex., has been appointed supervisor of public utilities of that city, succeeding M. N. Baker.

DONALD D. SNYDER, assistant engineer, Bureau of Engineering, Albany, N. Y., has resigned to become commissioner of public works and city engineer of Rutland, Vt.

A. W. STEPHENS, engineer, Turner Construction Co., has been appointed chief engineer, with headquarters in New York.

J. R. and R. L. BARRY have become associated under the firm name of BARRY & BARRY, civil engineers, Lawton, Okla.

HENRY WOOD, private secretary to Governor Robertson of Oklahoma, has been appointed state highway commissioner, succeeding George B. Noble.

R. C. WILSON, engineer, Turner Construction Co., New York City, has been appointed a general manager, with headquarters in New York.

EDWARD R. SCHOFIELD, draftsman, Bureau of Surveys, Philadelphia, has been appointed assistant engineer.

MAJ. JOHN R. FORDYCE, Engineers, U. S. A., who was constructing quartermaster at Camp Pike, and who recently received his discharge from the service, has announced that he will open an office for the private practice of engineering at Little Rock, Ark.

DR. OBADIAH C. BOGARDUS, Keyport, N. J., has been appointed a member of the North Jersey District Water Supply Commission.

M. D. GLESSNER, of Yuma, Ariz., has been appointed assistant to F. L. SELLEW in irrigation and dam construction in eastern Arizona near St. Johns

OBITUARY

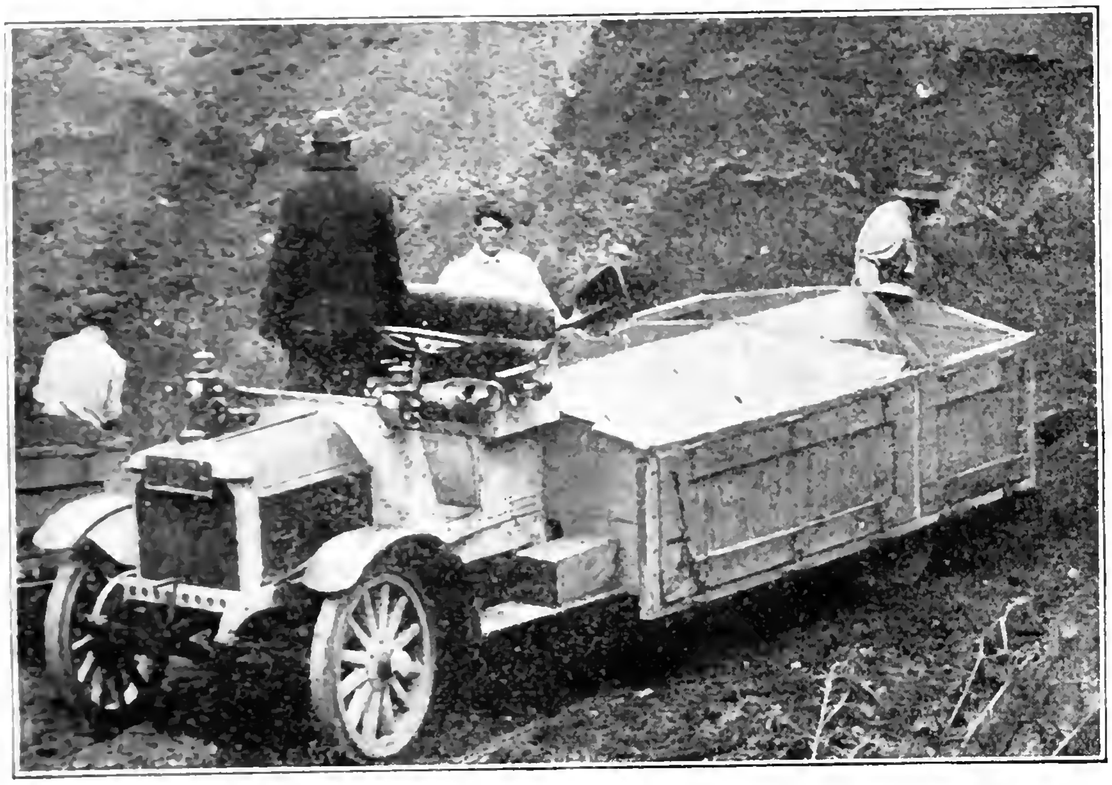
HOMER P. RITTER, hydrographic and geodetic engineer, United States Coast and Geodetic Survey, and member of the Mississippi River Commission, died in Washington, D. C., Apr. 21. He was born in 1850 and studied at the School of Mines, Columbia College, New York City. In 1880 he become United States assistant engineer, Mississippi River Commission on hydrographic and topographic surveys, remaining in Government service to the time of his death. He also served on international boundary surveys as official representative of the Government. In 1904 he commanded the steamer "McArthur," making a survey of Kiska harbor, Aleutian Islands, in the Bering Sea. In 1907 he was appointed a member of the board to investigate and report on the feasibility of a 14-ft. channel in the Mississippi River. In more recent years he was engaged in the revision of charts of New York harbor, Long Island Sound, and other waters.

ADNA DOBSON, city engineer of Lincoln, Neb., who had served in that capacity for 18 years, died May 4. He was born in 1857, and received his technical education in an engineering office. In 1878 he became deputy county surveyor, and afterwards assistant city engineer of Lincoln. After a brief period of private practice he was elected city engineer of Lincoln in 1891, and served four years, afterwards becoming under-secretary of the State Board of Irrigation of Nebraska. After engaging again in private practice for two years he was again elected city engineer of Lincoln in 1900 and again in 1909.

CARL UHLIG, engineer, California Board of State Harbor Commissioners, died in San Francisco May 5, at the age of 72. He had been connected with the engineering department of the Harbor Commission for over 42 years. In 1870 he became an assistant in the United States Coast and Geodetic Survey, four years later being appointed assistant engineer, water-supply office, San Francisco. In 1876 he became assistant engineer and chief draftsman, California Board of State Harbor Commissioners, and remained in the service of the board to the time of his death.

Sectional Truck Body for Hauling Road-Repairing Materials

A sectional, side-dumping motor-truck body for hauling gravel and other materials on road construction and maintenance is shown in the accompanying illustration. It is arranged with four pockets having two different capacities, so that a large or a small amount can be dumped as desired. The low box makes it easy to load the truck by hand shoveling.



LOW SECTIONAL TRUCK BODY IS EASY TO LOAD AND DUMP

In operation, the trucks are loaded at the gravel pit, having the trap doors in the sides held shut by straps on the lever road, which fit into iron slots on the floor of the truck. When the truck is loaded it proceeds to the road, and the compartments are alternately dumped at places and in quantities as desired by pulling the lever forward or back, as required. Free discharge of material is provided for by a peeked floor extending along the middle line of the truck box.

The illustration shows a two-ton Federal motor truck with one of these boxes, which was designed by J. A. Gould, road commissioner at Windsor, Vt. He has found this type of body particularly adapted to his purposes.

National Offices Opened by Trailer Manufacturers

National headquarters for the recently organized Trailer Manufacturers' Association of America, the organization of which was noted in *Engineering News-Record* of Mar. 6, 1919, p. 499, have just been established in New York City, in the World Tower Building, 110 W. 40th St. Matters of interest and importance to the industry will be considered and action will be taken regarding them—for example, ill-advised legislation affecting motor trucks and trailers in several states will be investigated.

It is felt that the opening of the New York headquarters marks a new era in trailer industry. From the new office will originate activities to familiarize the business world with the many applications of trailers to haulage problems and the economies to be effected thereby, with plans for the promotion of the best interests of highway transportation. Fourteen of the leading trailer manufacturers have already joined the organization, of which H. W. Perry, formerly with the National Automobile Chamber of Commerce, is general manager.

Business Notes

The Manufacturers' Sales Co., with offices at 914 American Bank Building, Seattle, Wash., has been organized by H. P. Hammond, of Seattle, to handle concrete products, Terrazzo flooring and building material specialties.

The Sterling Wheelbarrow Co., of Milwaukee, is erecting an addition to its plant, 385 x 165 ft. The new structure will accommodate a two-story office section, including a large display room.

The Bell Locomotive Works, Inc., 11 Pine St., New York City, announces that their former sales manager, J. Stanley McCormack, will return to his old position in the near future upon discharge from the Naval Aviation Corps.

The Joseph Dixon Crucible Co., of Jersey City, N. J., manufacturer of lead pencils and other graphite products, has removed its Philadelphia sales office from 1020 Arch St. to Rooms 801-802 of the Finance Bldg., South Penn Square. The manager of the sales office is W. G. Springer. The Crucible company and the American Graphite Co., a subsidiary, held their annual meetings Apr. 21. The following officers were elected for both companies: George T. Smith, president; George E. Long, vice-president. For the former company J. H. Schermerhorn was elected vice-president and William Koester treasurer; for the latter J. H. Schermerhorn was elected treasurer.

The Booth-Hall Co., designer and builder of electric furnaces, announces the removal of its executive and sales offices from 565 W. Washington Boulevard to Rooms 1007-1008, Hearst Building, 326 W. Madison Street, Chicago.

The American Steam Conveyor Corporation, of Chicago, announces the appointment of N. B. Stewart as district representative in charge of the St. Louis territory. Offices have been opened at 708 Merchants-Laclede Bldg., St. Louis.

The Union Bridge and Iron Co., Seattle and Portland, has been incorporated by Charles G. Huber, specialist in the design and construction of Luten design bridges, and George A. Sears, formerly of the Coast Bridge Co., Portland, Ore.

Trade Publications

The following companies have issued trade publications:

The Silent Hoist Co., 302-304 McDougal St., Brooklyn, N. Y.; leaflet, 4 x 9¼ in., eight pages, illustrated; describes its Model A, 20-hp. gasoline unit.

The American Steam Conveyor Corporation, 326 W. Madson St., Chicago, Ill.; pamphlet, 8½ x 11 in., 12 pages, illustrated. "Reducing Ash-Disposal Costs" is the subject treated.

The Deming Co., Salem, Ohio; catalog, 6¾ x 9¼ in., 37 pages, illustrated; covers vertical single-acting Triplex power pumps.

The John J. Macklem Scaffolding Co., Goshen, Ind.; catalog, 6 x 9½ in., 16 pages, illustrated; shows details of, and describes method of using, sectional scaffolding.

The General Fireproofing Co., Youngstown, Ohio; catalog, 8 x 11 in., 16 pages, illustrated; contains data on the use of "Self-Sentering Trussit and Steel Tile," for roofs, floors, ceilings and partitions.

The Ball Engine Co., Erie, Penn., leaflet, 8½ x 11 in., four pages, illustrated. The subject is the cost of operating Erie steam shovels on road and street gradings.

A Consolidation of Engineering News and Engineering Record | McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

CHARLES WHITING BAKER
Consulting Editor

Volume 82 | NEW YORK, THURSDAY, MAY 22, 1919 | Number 21

Engineering Impossibilities

NO DOUBT there is much truth back of the optimistic saying that to the engineer nothing is impossible. For those who take the saying literally a near-metropolitan daily offers an excellent problem. Speaking of the proposed vehicle tunnel under the Hudson River, the paper says: "Shall the proposed vehicular tunnel be a twin tunnel, or shall it be a single tube with two floors? The single-tube plan is the plan of General Goethals and is favored by many of the New Jersey members of the commission. The twin-tube idea is the proposition of Vipond Davies, and this is favored by some of the New York members. The hope of some is that there may be a happy merger of the two ideas." The happy merger, we must assume, would be two tubes that beat as one. We wait breathlessly the details of the "merger" of these ideas.

A Good Government Salary

SALARIES in the Railroad Administration are good. Monthly wages counted by the thousands are common, and some few fortunates approach the thousand-a-week basis. It is the one branch of Government service where there is an approach to that ideal condition where a man's pay is commensurate with the private reward for the same work. And yet even those of us who have consistently advocated a better Government wage scale are somewhat stunned by the $25,000 a year paid to the Director of Inland Waterways. High cost of living notwithstanding, that is a lot of money for what has been done; it is altogether too much money for a subordinate who can only supervise minor operations under the direction of a none-too-sympathetic administration. Only an independent waterways bureau, which could initiate and carry out a real waterways program, would justify such a salary.

Gambling on Price Reductions

THERE appears in some quarters a tendency among highway contractors to speculate on a drop in material and labor prices. While material prices are in a state of some uncertainty, with chances of small changes in either direction, there is no apparent basis for bidding on the expectation of reduced prices, such as occurred in a recent state highway letting at Albany, N. Y. In some materials, such as cement, assurance has been given that there will be no advance during the calendar year, but the safe interpretation of that assurance is that there will be no decline. In the labor market conditions do not favor lower wages. The labor which has built our roads heretofore is returning to Europe in large number, and an oversupply is not to be looked for. The testimony of many contractors who bid on the New York State work referred to above is that the engineers' estimates for the work were none too high at present prices. And yet these were cut by the low bidders anywhere from 4 to 25%. Surely in the circumstances a word of caution seems in order. It is a big gamble to contract to do work at prices fixed in the hope that the market will decline.

Airplane Mapping

MARKING another of the scientific or technical advances recorded as the result of the great war, airplane photography for producing topographic maps promises many advantages for the future, provided the difficult problems introduced when accuracy is desired can be met. The two articles in this issue are unusually valuable in showing in complete detail just what the present status of this new field is, and presenting clearly the nature of the problems yet to be solved. With our American genius for invention, it is safe to predict that these problems will be solved, and that the production of airplane maps of relatively great accuracy is to be reckoned as a foregone conclusion. Whether the cost will be prohibitive, or so great as to offset entirely the advantages in time saving which are claimed for the methods used, will be a matter for future development. But that there are great possibilities in these methods must be conceded. Their application introduces into a somewhat tedious operation the spirit of adventure.

Half-Section Roads

PERIODICALLY some one suggests the advisability of paving only half the roadway on country highways, leaving the other half soft for the benefit of horse-drawn traffic. In other cases, as proposed in a bill now before the Pennsylvania legislature, soft roads on each side are advocated. Such suggestions generally emanate from those who are interested in livestock, for there can be no doubt that roads of this character are much easier on horses' feet. However, there are constructional disadvantages in these types, and, in the half-section road, there is one feature which tends to make the road dangerous for motor-driven traffic. In this construction it is necessary, on account of drainage, to slope the road away from the center line. Therefore, on curves where the improved strip is on the outside, there is actually a case of reverse banking. Some roads in the East built in this way, notably the Buffalo-Niagara Falls boulevard, are positively dangerous, and have been blamed for many accidents. At the same time reverse banked curves are very uncomfortable for motorists at even moderate speed. Furthermore, the earth side roads are very expensive to maintain, if there is much traffic. The maintenance on the earth section of the Buffalo-Niagara Falls Boulevard, mentioned above, is reported at about $1000 per mile per year.

Where insufficient funds exist to build an entire surface, a combination design may be used as an expedient, with the intention of future widening, but its advisability is doubtful as a permanent improvement.

Wages Reduced In One Industry

FREQUENTLY we hear it stated that it will be impossible henceforth to lower the wage level. Obviously, those who speak in this way do not take the facts into consideration. Wage levels rise and fall with price levels and, in general, it is true that wage levels cannot be materially reduced while the price levels that carried them upward remain at the high mark. Nevertheless, there is a shining example in one of our American industries which shows that wages can be cut in defiance of the high price level. The industry in question is that of copper mining. The signing of the armistice found us overstocked with copper. The condition was one that encouraged the wholesale closing down of mines with the consequent danger of widespread unemployment in the copper-producing districts. Instead of that, the operators elected to keep the mines going at reduced capacity and to retain the forces in as large numbers as possible. With copper, however, selling down to about half its war price, it was obvious that the industry was not in a position to maintain the war wage-scale, and it promptly placed these conditions before the miners. Moreover, when the time came for action the operators did not ruthlessly issue an edict as to the wage reduction, but announced some time in advance the necessity for the change and gave ample time for the miners to digest the situation, to enter their arguments and to offer suggestions. The result was that the miners, appreciating fully the position of the operators, accepted without strikes or any other disturbance the reduced scales, confident that no other course was open to the industry. Many another industry, when the time for wage reductions comes, might take a leaf from the book of the copper producers.

Concealed or Physical Deficit

IN REPORTING to the stockholders of the Delaware & Hudson Co. last week, the president, L. F. Loree, discussed what may be termed the "concealed or physical deficit" as distinguished from the apparent or financial deficit under Federal operation. The financial deficit the Government will make good to the stockholders, for the contracts call, as every reader knows, for a return based on pre-war operation. What of the deficit due to inadequacy of maintenance? Will this be appraised fairly when the Government returns the roads, or will long-drawn-out arguments and legal contests be necessary before this concealed or physical deficit is made good? The Government in taking over the roads gave assurance that the properties would "be maintained during the period of Federal control in as good repair and as complete equipment as when taken over by the Government."

On the Delaware & Hudson system, however, Mr. Loree pointed out, the tie renewals in 1918 were 241,504, as against an average annual tie renewal, during the test period, of 339,575 ties. The deficiency, therefore, was 29%. At the average price per tie in 1918 of $1.12 the deficit in money would be about $110,000. Moreover, the quality of the ties used in 1918 was much below that of the ties used during the test period. At the present time there is in stock not more than 21% of the ties accumulated at corresponding dates in the test period. Somewhat the same condition obtains with reference to rail renewals. They show a deficiency of 28% in tonnage compared with the renewals during the test period, and a deficiency in money of about $102,000. Again, the Railroad Administration has dismantled 131 freight cars and none of them has been replaced, nor does the railroad know the condition of the 90% of its cars used on foreign lines.

Mr. Loree recognized that during the stress of war there were conditions that rendered it difficult to keep the property up to the standards obtaining before Government control, but that does not change the fact that the property is not maintained as the Government agreed to maintain it. Moreover, other properties have been suffering in the same manner.

Obviously, the Government must catch up with this maintenance deficit before the roads are returned to their owners, or must be prepared then to make good the deficit. Any other procedure would be a grave injustice.

Old, Overworked Filter Plants a Serious Health Menace

OBSOLESCENT condition of a water-works and water-purification plant, as in a Middle West town, a condition which is described by a correspondent in the following paragraph, does not occur frequently. Such plants do exist in certain cases, however, and occasionally it takes a typhoid epidemic to jar public opinion sufficiently to force general overhauling. Like a faithful truck horse, the plants need considerate treatment. Quoting the letter:

"The intakes were insufficient as used and one had a serious break about 150 ft. from shore into which drainage from the plant sewer, carrying wash water and mud from the basins, entered. There was only one screen in the raw well to protect the pumps. The low-duty turbine could not draw water through the channel intake—for which purpose it was designed and installed. There was no means whatever of agitating the alum solution made in the tanks, nor means of measuring the raw water to know how much was being treated. No means of measuring or even definitely regulating the flow of the alum solution existed; therefore, it could not be proportioned to the raw water treated. A very short retention period was provided in the settling basins—nominally three hours, but actually some water passed through in less than one hour. Wash water was carried away by troughs badly out of level and leaking to such an extent as to waste much sand. Because of the 3- to 6-in. difference in elevation in the filter bottoms the air wash was almost useless, and dependence had to be placed on wash water which had a vertical rise of only 9½ in., and the very excessive lateral travel of 5 ft. 2 in.

"Is it strange that mud bars a foot wide extended along each filter, and that the bed contained fouled sand like garden soil? The supporting gravel was of all sizes—one filter had only 5 in., none of which was more than ⅜ in. in size, while another had pieces of sandstone up to 5-in. size. The controllers were out of order, as were also the loss-of-head gages.

"The chlorine machine was more than ready for the

scrap heap. There was not only no means of measuring the chlorine applied, but also there was no means of knowing how much water was being filtered, so that the treatment was of the most hazardous kind. The amount of chlorine that the machine could deliver was very limited, and we were often seriously gassed trying to speed it up.

"The filtered water reserve was absolutely inadequate, the domestic demands alone often exceeding the plant capacity plus the storage. If there had been a serious fire at such a time and the bypass could not furnish enough, the pumping-station engineer would have opened a valve allowing the high-duty pumps to take their suction directly from the raw well, and not a bit of chlorine could have been used on this water. The high-duty pumps were in need of many repairs. A booster booklet spoke of this plant as being able to deliver 21,000,000 gal. daily, but how could the filter plant produce even its rated 5,000,000 gallons?"

Many of the construction features in this filter plant were standard practice much less than 20 years ago. Modern sterilization methods have added years of life to these old filters, but it is unfair to expect a plant with crude and wornout apparatus to carry a normal burden. Stream pollution all over the country is steadily on the increase, so that the intervals between infections grow less and less. Plants which were good enough, even excellent, 10 years ago may be dangerous today, for the germs of disease are many times more prevalent in the raw supply. Standards must be higher, laboratory control more rigid, expert advice sought—and followed—more frequently. With the war over, it behooves city officials who have any doubt at all of the integrity of their supply to look into it most seriously before the blood of typhoid victims is upon their heads.

Riveted-Truss Span of Record Length

ALTHOUGH the primary reason for the adoption of riveted joints in the new 644-ft. span of the Pennsylvania Railroad's Ohio River birdge at Louisville, Ky., described on another page of this issue, was the necessity for unity throughout the structure, yet the use of a stiff riveted type is consistent with the practice of Pennsylvania Lines West of Pittsburgh during the past twenty years. This preference is based not alone upon the desire for greater rigidity, but also upon the feeling that the eye-bar type has certain disadvantages, especially in the fact that all bars in a given member do not obtain equal stress, and that unavoidable wear takes place at the pins.

The new 644-ft. span, the length of which resulted from the Government requirement of a 600-ft. clear channel and the desire to utilize the masonry piers of the old bridge, is not only the longest and heaviest simple riveted-truss span in existence, but it is third among the world's simple-truss spans, being exceeded only by the 721-ft. Metropolis span and the 668-ft. St. Louis municipal bridge span, both pin-connected. It is about 4 ft. longer than the 640-ft. suspended span of the Quebec bridge. The next in span length of the simple-truss type is the 620-ft. bridge of the Kentucky & Indiana Terminal R.R., also located at Louisville. All of these American bridges exceed in length the longest simple-truss span in Europe—610½-ft. Homberg span of the Prussian State Ry. over the Rhine at Homberg.

The new span is built of high-carbon steel rather than alloy steel because of the designer's objection to the use of high unit stresses on the score of excessive deflection and a resulting tendency to rack the floor system. Double floor-beams at each panel point, making the stringers discontinuous, not only facilitate erection in panel units, but also reduce the danger of loose rivets in the floor system. Although a high-carbon steel was specified, the unit stress was not increased, the margin being considered necessary to allow for secondary stresses, which were not computed.

One cause of the exceptional weight of the new span lies in heavy details. For example, all compression chord splices, although milled to bear, were fully spliced by providing splice plates and sufficient rivets to take the full stress. Transverse diaphragms for all members, spaced at relatively frequent intervals, and longitudinal diaphragms at the ends of diagonal members to insure stiffness and exact dimensions, also increased the weight, but at the same time were found to facilitate field assembly and aided greatly in keeping the long members in true shape and out of wind. Heavy gusset plates, required by the exceptionally large number of field rivets, taxed the capacity of the rolling mills. For example the 130 x 1½-in. plates at the hip joints are the maximum attainable.

An exceptional feature in the design of this bridge was the adoption of a live load consisting of a uniform train load combined with a single concentration. The reason for the preference of this loading lies in the designer's claim that Cooper's standards do not really represent actual engine loadings, especially for heavier locomotives, which do not have axle concentrations of equal value, nor is the actual wheel spacing the same as that given by Cooper's standards. Experiments which have been made by weighing the main drivers of such locomotives indicate that the actual loads on the main driver axles vary quite widely.

Certain features of the design are noteworthy. For example, the lower chords are built up with a constant base section, composed of vertical webs, eight angles and four narrow horizontal longitudinal plates placed at about the third points vertically and laced together. Outside and inside vertical web plates provide the additional areas required for the heavier chords near the center. The top-chord section is composed of eight angles instead of the usual four angles for lighter trusses. This made necessary the splicing of gusset plates at the joints, these gussets being inserted in the plane of the main web plates—a detail similar to that used in the 525-ft. Ohio connecting bridge at Pittsburgh, on the same road.

The replacement of this historic structure, with its long series of Fink-truss spans, by new double-track trusses of exceptional weight, is another example of the changes forced by the constant increase in locomotive loading. The old trusses, with reinforcement, long and faithfully served their time, but finally had to be abandoned. The difficult problems of erection under traffic, which will be described in a later issue, were successfully solved, and the new steel superstructure, one mile long, now stands as the latest example of heavy riveted-truss design—with its channel span of record length, its series of heavy deck trusses, a through span 370 ft. long and a 260-ft. lift span with the latest improvements.

Present Status of Photographic Mapping From the Air

Airplane Mapping Possible and Practicable, but Two Great Problems, Horizontalization of Camera and Effects of Surface Relief, Must Be Solved

By J. B. Mertie, Jr.
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New developments in the application of photography to the making of topographic maps have resulted directly from the experiences of the war. Mr. Mertie's appraisal of the present situation in aëro-photography and his clear-cut analysis of the difficult problems which remain to be solved are the result of first-hand contact with the airplane mapping investigations carried on by the Survey in coöperation with the United States Engineer Corps. This article is followed by a detailed description of the successful Bagley camera and of the transforming camera developed by F. H. Moffit and the author. Additional information on photo-topographic methods and on the use of air-photographs in the war will be found in the article on "Stereophotographic Surveying" by Otto Lemberger in "Engineering News" of Mar. 27, 1913, p. 602, and in the description by R. K. Tomlin, Jr., in "Engineering News-Record" of May 23, 1918, p. 984, of the work of the Army topographical division in coördinating the work of the mapmakers in the air and on the ground.

Mr. Mertie's paper is published with the permission of the Director of the United States Geological Survey—Editor.

A STEADY demand exists at the present time for information regarding the possibilities and methods of photo-aërial mapping. The Geological Survey is continually receiving requests from individuals, commercial organizations, and even from foreign surveying corps, for information concerning what has been accomplished to date and what developments may reasonably be expected in the near future. The writer, having been associated in the airplane mapping investigations carried on by the Geological Survey in coöperation with the United States Engineer Corps, is reasonably conversant with the present status of airplane mapping, and undertakes herewith to set forth a short summary of results so far achieved, with the twofold intention of furnishing information to those who may be interested, and of correcting a number of erroneous impressions which appear to have been disseminated by ill-conceived and misleading publications on the subject.

Airplane mapping by means of photography is possible and practicable, but has by no means yet been developed to the point where it may be described as a smoothly working process. Problems of the first magnitude remain to be solved before the airplane camera can take the place of the plane table and alidade, and in the author's opinion it is much better to face honestly the difficulties than to gloss them over and optimistically set forth the airplane mapping method as a surveying panacea.

A number of articles have appeared recently which either from ignorance, unbalanced optimism, or from utter disregard of the facts, have described the process of airplane photographic mapping as a finished product, capable of being taken up by an organization and utilized as a complete substitute for the older methods of mapping. Such publications, in their unwarranted advertising of a method as yet imperfect, are most apt to do harm, in the same way that worthy mining enterprises have suffered from the promotion of stock-selling mining swindles. It is certainly to be hoped that a process so full of promise as the one under discussion may be spared the fate of passing through a miasma of temporary failure, with the consequent doubt and controversy, due to premature and unwise schemes of promotion.

Principles of Photographic Surveying—Two Problems

Photographic surveying on the ground has been known and practiced for many years in many countries, including the United States and Canada. A tremendous amount of work has been accomplished in this subject, and the underlying principles are thoroughly worked out and understood. With the advent of the dirigible balloon, however, and later the airplane, a new application of the method was seen and the possibilities of the aërial survey came to be recognized. It is not the purpose of the writer in this article to describe in detail the technique of the subject, but it may not be out of place to state that a photograph of a plane and horizontal surface taken from the air upon a photographic emulsion held parallel to the plane of the horizon is a true map. The lens has acted merely as a point of projection connecting one plane with another, and of course the scale is dependent both on the distance of the lens from the ground and on the distance of the photographic plate or film from the lens.

Any relief upon the surface of the object photographed, however, or any inclination between the plane of the ground and the plane of the plate or film, vitiates at once the results and necessitates the making of compensating corrections. As a matter of fact, the surface of the earth shows everywhere more or less relief, and also in actual practice it has not yet been possible to hold an airplane camera in a truly vertical position. Hence both causes of error are present, and both must be recognized and corrected. To emphasize these facts and to point out a line of progress for the correction of these causes of error is the writer's purpose.

Before passing to the more fundamental problems, a few words concerning cameras may not be amiss. A large variety of aërial cameras has been designed and manufactured, both in this country and abroad, and it is safe to say that none is truly universal in scope. Nor should the cameras be. They have been made to fulfill a variety of purposes, including scout photography along the battle line, more accurate and adequate photography from larger battleplanes, surveying cameras for peace times, cameras for pictorial aërial photography, and others. There have been automatic and nonautomatic types, equipped with various lenses and various types of shutters, and made to take plates or films or both. Also multi-lens cameras have been built, of which the first was probably the eight-lens camera built by Scheimpflug, the Austrian Army officer, and developed by himself and others. A modification

of this type is the three-lens camera, designed by J. W. Bagley of the Geological Survey, now Major Bagley of the Army Engineers.

Mere Mosaics Are Not True Maps

Coming to the subject of aërial mapmaking itself, one is confronted with much confusion of ideas. It has been the practice of some workers to take a series of pictures from the air, fit them together into a photographic mosaic, ignoring the two sources of error previously mentioned, and to call the resulting product a map, or a mosaic map. In truth, it is neither, but only a series of pictures showing distortion, differences of scale within the individual picture as well as between them, and lack of geodetic control, which are fitted and fudged together to present a pleasing appearance. This certainly is far from being a map. Others have gone somewhat further, and by means of a plain enlarging camera have corrected as far as possible the differences in scale, and also by means of a swing-back attachment on the enlarging camera have attempted, though unsuccessfully, to eliminate distortion. Such pictures, when taken over an area which has been covered previously by an accurate ground survey, may be laid out over a network of close control, and fitted together to look moderately well. But this also falls far short of aërial mapmaking, for the results are inaccurate at best, as may be proved by superimposing a transparent tissue showing the true map; nor would such mosaics be convincing even if the two images are made to coincide, for the same results could not be accomplished over an unsurveyed and uncontrolled area. It is quite safe to state that a true aërial map has not yet been made or published in the United States, using the term "map" with the connotation of accuracy usually understood by experienced cartographers. This statement is made advisedly and with full understanding of what has been accomplished up to the present time.

It does not follow, however, that such mosaics are useless, for, on the contrary, there are many ways : which they can be profitably used. Thus, in revising and bringing up to date old maps, or for securing timber culture or other visible data in previously surveyed areas, there is a distinct and useful field for them. Likewise, in the production of route charts for flying, where the need is for a small-scale guide rather than an accurate map, they can be used to advantage. Also, they may be used as an accessory to traversing, in an area where ground control is close enough that the ever-present errors may be recognized and distributed. These are all peace-times uses and take no cognizance of such additional uses that mosaics may have on the battlefield. The point that is made and emphasized, however, is that a mosaic composed of distorted photographs is not a map, and should not be represented as such.

Let us now turn to the map such as would be desired by any surveying corps, or by any commercial or real estate firm, or by any other organization that would ordinarily secure the desired results by instrumental ground surveys. Maps are of different kinds and are made in various scales and with different degrees of accuracy. Thus, there are recognized exploratory, reconnaissance, detail and ultradetail maps, ranging from scales of 1: 1,000,000 or smaller up to an extremely large scale, and on, still farther, to natural-scale maps, or even maps that are magnifications of the objects shown. Also, there are plan maps and relief maps, the former showing natural and cultural features and the latter indicating, by means of hachures, contour lines or other means, the regional relief. Likewise, there are timber maps, geologic maps, soil maps, and other special kinds. The most generally useful map is the modern topographic map, as now produced by the Geological Survey, which shows all natural and cultural features, including also timber areas, and indicates also by means of contour lines the relief of the terrain. The production of such maps, at scales of from 1: 250,000 up to 1: 62,500 is the present aim of most workers from the air.

Modern Topographic Maps—Stabilizing Camera

The modern topographic map presupposes an accurate plan map upon which the contour lines may be drawn. It is possible to derive both the plan and the contour lines from aërial pictures, provided the necessary data are given, but it is impossible to make either of them from uncontrolled pictures fitted together in mosaic form. Let us consider first the plan map, since that is all that has been attempted in the United States to date.

As before stated, no method has as yet been found to hold in a vertical position a camera in a moving airplane. Various methods have been tried, and none has been found to give the desired degree of accuracy, though of course some schemes reduce very materially the deviation from the vertical. One method has been to mount the camera in gimbal rings, and by the use of dash-pots to give the camera the movement of a damped pendulum. The centrifugal force caused by movements of the plane, however, is sufficiently great to cause a pronounced deviation from the vertical; and, in general, it may be stated that any device dependent wholly on the action of gravity is vulnerable in this respect. The writer, in association with Lieutenant Hyde, of the United States Air Service, and F. H. Moffit, of the Geological Survey, has recently tried out such an arrangement controlled by a gyroscope; in effect, a camera mounted as a gyro-pendulum. The result of this work has been decidedly encouraging, and shows that the gyroscope is a most useful accessory. The deviation, however, is still much too great to permit the production of uniformly good register between adjoining negatives. The results of measurements on such prints, so far as the work has been carried at the present time, shows deviations from the vertical ranging up to 2°. It should be mentioned, however, that these results were secured in flying with a J N-4-type Curtiss airplane, and it is likely that the same apparatus if tried out with a more stable type of machine would show smaller deviations.

In this connection it is also worth while to note that it is the maximum and not the mean deviation which concerns the mapmaker, for if one or two pictures are distorted beyond any assigned limit, the control is vitiated. The old proverb that a chain cannot be made stronger than its weakest link is well illustrated in the case of aërial pictures which are intended for map construction. Therefore, if stabilization of the camera itself is the goal in view, it remains to construct a more refined instrument that the one above noted, for a maximum deviation of 2° is much too great. A maximum deviation of $\frac{1}{4}$° from the vertical position is probably closer to the desired result. Yet it must not be overlooked that a gyro-pendulous camera, even at the pres-

ent stage of development, can be used to good advantage as an instrument for traversing, where control points are not too far apart. The errors resulting from tilt may then be distributed and the resulting traverse will be far more detailed and probably more accurate than the usual result gained by ground traversing. Also, mosaics built from such pictures will of course have a greater value than those made from negatives taken without the gyroscope attachment.

An Alternative—Stabilized Reference Point

Another alternative, however, exists than that of complete stabilization of the airplane camera. If each picture can be referred to a stabilized point, so that the tilt of the negative and the direction of the tilt may be ascertained, such data will be sufficient, with the aid of the necessary instruments and procedure, to rectify the negative to the plane of the horizon. This method of attack involves the construction of some piece of apparatus which will maintain a stabilized reference-point during the flight of the airplane; and accessory lenses, mirrors or prisms, together with a synchronizing device which will record the position of this point relative to the film or plate at the moment when each exposure is made. The gyroscope naturally occurs as the means of attaining such a stationary reference-point, and it is believed that this method is perhaps as promising as any. A gyroscope used in this manner will differ from one used in a stabilized camera in that it will have less work to do and can therefore be made lighter and more compact, and the accessory apparatus can also be constructed at a relatively low cost. Taking into account the present state of development of gyroscopic apparatus, and the limitations of the gyroscope itself, it would appear that this method gives promise of a degree of accuracy surpassing that of a stabilized camera.

The sun, being a fixed point in the heavens at any given time on any given day, also suggests itself as a solution of the difficulty. Any apparatus utilizing the sun's shadow, however, has three serious limitations: First, flying could only be done on cloudless days; second, a difficulty will arise in so placing the recording apparatus that it will never be in a shadow cast by any part of the airplane. This involves placing the device at some distance from the camera, whose natural place is in the bottom of the fuselage, and such a separation is likely to cause errors, due partly to lack of close adjustment originally between two separated pieces of apparatus and partly to differential movements due to lack of rigidity of the plane in motion. The third objection is the most serious. A little experimentation by anyone interested in the matter will show that although the sun's shadow will record the degree of tilt of the camera, it will not indicate the direction of such tilt, and it is just as necessary to know the latter as the former. A compass would have to be used to obviate this difficulty, and air compasses are notoriously inaccurate, when by accuracy one refers to the registry of fractions of a degree. Application of the gyroscope, therefore, to this problem appears to hold forth the greater promise of success.

Let us suppose that the amount and direction of tilt are known for each picture. How are these inclined negatives to be transformed to the plane of the horizon; or, in other words, how can orthographic projections be made from them? Reference has already been made to the successful attempts by some workers to attain this result by means of an enlarging camera, equipped with a swing-back. A simple geometrical demonstration is sufficient to prove that rectification to the plane of the horizon by such a method is not possible. The only practicable way in which this result can be achieved by photographic precedure is in a specially designed transforming camera; and the condition that must be met, in order that such transformation should be geometrically possible, is that the plane of the negative, the plane of the transforming lens and the plane of the transformed image meet in a common line in space. A further adjustment is necessary in order that the lens may be properly placed with reference to the line of intersection of the negative and image planes. Transforming cameras built with the necessary movements and adjustments, and constructed as instruments of precision, have been designed by F. H. Moffit, of the Geological Survey, and have been built and successfully used by the Geological Survey and the United States Engineer Corps. This problem of the transformation of inclined negatives to orthographic projections, or of the transformation of negatives from any one plane to any other, may be therefore considered as solved. A paper by F. H. Moffit, presented before the Association of American Geographers, describes the theory, construction, and use of the transforming camera. [This paper is reproduced immediately following this article.—Editor.]

Using Three-point Method

An interesting development which has been recognized in the use of the transforming camera is the possibility of horizontalizing, by a method of trial and error, a negative whose tilt and direction of tilt are unknown, provided the true positions of any three points on the negative are already known. This presupposes, of course, that an accurate and detailed horizontal control has already been established, and that three points in favorable positions can be recognized on each negative. Under such conditions an accurate map can be made, but, as before stated, this is only of academic interest, for the same result could not be duplicated over an unsurveyed area.

Merely to show the geometrical possibility of this procedure, however, F. H. Moffit, assisted by the writer and T. P. Pendleton, of the Geological Survey, constructed during the summer of 1918 a map of a portion of the City of Washington, by this method, using negatives made with the Bagley camera. [See the article which follows.] No corrections, however, were made for relief, and the result is therefore not a true map in the strict sense of that term, but it is believed to be a very close approximation to one. The writer sees one important application of this method. If, for any reason, the control is lacking in some one picture in a set of air negatives, three points may be selected which will show in the overlap with the adjoining horizontalized negative, and the uncontrolled negative may thereby be rectified with less difficulty than would be involved in a mathematical determination of the unknown tilt.

A brief reference to the matter of scale is also in order. It is very hard, even with the best type of instrument for recording altitude, for the pilot to hold a plane at any given elevation. Anyone who has done any flying where the air is "bumpy" will realize the difficulty. If one is flying or trying to fly at an elevation of 5000

ft. a rise or fall of 100 ft. means at once a change of 2% in the scale, perhaps in two adjoining pictures. In making mosaics, when the distortion due to tilt has not been eliminated, this is a very vexing condition, for the tilt itself, in addition to causing distortion, produces also differences in scale throughout any one picture; that is, the scale along a line at one side of a picture will be different from that along a line at the opposite side, and of an unknown magnitude. To attempt to correct by enlargement or reduction, under these conditions, is to undertake the impossible. But when the negative is horizontalized differential changes of scale are automatically eliminated. Hence, for horizontalized negatives, change of scale is met by simple enlargement or reduction in a plain enlarging camera. It is worth while, of course, to study the matter of flying as nearly as possible at a given elevation in order to reduce the labor of enlargement or reduction; but, relative to the other problems involved, the question of scale is a rather minor one, when dealing with horizontalized pictures.

Corrections for Relief

And now, how close are we to a topographic or even a plan map, after complete horizontalization is achieved and after all the pictures are reduced to the same scale? In regions of very low relief, such as our coastal plain areas, the result is a very close approximation to an accurate plan map. But if the pictures were taken in a region of moderate or greater relief the result is not a true plan map, because of distortion caused by the relief itself. This fact is too apparent to need any elaboration, but it is by no means an insuperable difficulty. Methods must be perfected, however, for the application of the necessary corrections, before the true map can be realized. To make this correction involves the determination, either mathematically or graphically, of station points of the camera in the air at the moment of successive exposures, and this can be accomplished by a study of the common points of two horizontalized pictures taken from two different stations. The same comparisons and computations are also necessary in working out contour lines in the making of a topographic map from air pictures. Hence it follows that the making of a true plan map in an area of any considerable relief is intimately bound up with the problem of the construction of topographic contours, and the solution of one of these questions brings also the solution of the other.

One promising method for the achievement of the desired result appears to be in the application of stereo-photogrammetry, particularly by the use of the stereo-comparator. This instrument affords an accurate and elegant solution of the problem, although, of course, the same results may also be obtained by other methods.

Finally, with regard to photo-topographic surveying in general, certain facts should be more generally recognized. In the first place, the making of topographic maps is a specialized science, and is a subject which is not mastered except by prolonged practice. Photo-topography is only a phase of the general science of cartography, and the cumulative results of long experience are just as valuable in photo-topographic mapping as in any other method. The laying out of projections, the subject of triangulation and control, with the consequent computations, the theory and practice of adjustments, and other matters familiar to the topographic engineer, are equally applicable and necessary in photographic surveying. In other words, the making of maps by photography or by any other method should be the work of experienced engineers.

Photographic Practice Subordinate

Correlative with this idea is the other that photographic practice is rather of subordinate importance. By this, the writer does not mean that the photo-topographer should neglect the photographic side of his work, for good pictures are most desirable, though the quality of the map is not necessarily dependent on the securing of perfect negatives. The idea to be emphasized, however, is that the finest pictures may be entirely useless unless accompanied by the necessary engineering data; while, on the other hand, poor pictures if properly controlled may make a perfect map. The experienced photo-topographer attempts to get the best pictures possible, but judges his work by the quality of the finished map and not by the pictorial quality of the pictures from which the map is made.

Summarizing, it may be said that photographic surveying from the air is both possible and practicable. No new principles are involved, but methods and apparatus other than those used in photographic surveying on the ground are needed and are gradually being studied out and developed. It has been shown that the production of an accurate plan map in an area of any considerable relief is intimately connected with the production of the much desired contour map, and that the latter will be produced with little more labor than the former. In areas of low relief, of course, the plan map can be produced as soon as perfect horizontalization becomes an accomplished fact.

The crux of the whole problem lies in horizontalization, and the most pressing need of the present moment is either a completely stabilized airplane camera or a successful attachment which will record the direction and amount that the camera deviates from the true vertical. Also, it should be clearly understood that map-making is an engineer's job, and that pretty pictures do not necessarily make the perfect map. Finally, although maps made by air surveys remain a development of the future, yet we may confidently look forward to an early solution of the various problems involved.

New Road Work Records Made in April

During April, 1919, the Secretary of Agriculture approved project statements for 120 Federal-aid projects, involving the improvement of 923.53 miles of road, at a total estimated cost of $16,261,326.51. On these roads Federal aid amounting to $7,528,550.68 was requested. This represents the largest number of project statements approved, the largest total estimated cost, and the greatest amount of Federal aid requested, during any month since the passage of the Federal-aid road act. The Secretary and the several state highway departments executed 55 project agreements, involving the improvement of 521.51 miles of road, at a total estimated cost of $4,626,415.48, and on which $2,039,614.99 Federal aid was requested and set aside in the United States Treasury. In addition, agreements to cover 72 other projects were placed in process of execution during the month.

Methods Used in Aëro-Photographic Mapping

Outgrowth of Experience in Use of Panoramic Camera in Alaska—Application to Problems of Airplane Photography—Theory of Transforming Camera

This article, published with the permission of the Director of the United States Geological Survey, is a reproduction, practically in full, of a paper by F. H. Moffit, in the "Geographical Review." Mr. Moffit describes in detail the Bagley camera, referred to by Mr. Mertie in the preceding article, and the theory underlying the transforming camera.—EDITOR.

THIS is not intended to be the description of a finished piece of work, but rather a report of progress in the development of a method of mapping which is only in a formative stage. It will not do, therefore, to expect that details will be given with the greatest accuracy and that all the problems connected with the work have been solved, although the general principles on which the method is based are fully established. The direction for progress has been pointed out, but many steps remain to be taken.

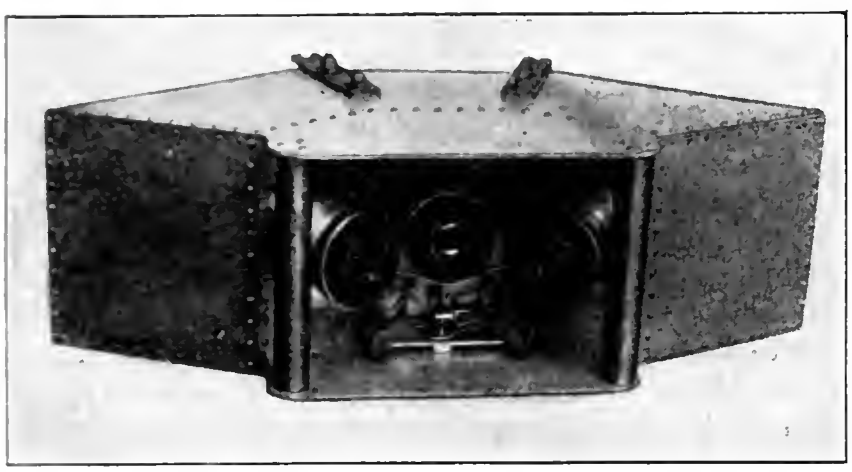


FIG. 1. BOTTOM OF AIRPLANE CAMERA SHOWING THE LENSES AND THE SYNCHRONIZING DEVICE

The work to be described is the outgrowth of experience in using the panoramic camera for topographic mapping in Alaska during the past eight years. The panoramic camera was first used in the Alaskan work of the Geological Survey by C. W. Wright in 1904, but it was not until after he had left the Survey and his work was taken over by J. W. Bagley, now Major Bagley, that the panoramic camera became one of the instruments regularly used for topographic mapping in Alaska. The opportunity to take up and carry on this method was due primarily to Mr. Brooks, now Lieutenant Colonel Brooks, chief of the Alaska division.

With the outbreak of the great war in Europe and the rapid development of the airplane for military purposes, the camera immediately took an important place as a means for gathering military information, including the making of maps. Major Bagley turned his attention to this broader field for the camera and asked the writer, who had had some small part in the previous work, to assist him, but as progress was made it was found that more assistance was needed, particularly in photography, but also in many other ways, and J. B. Mertie was invited to contribute the benefit of his experience.

These investigations, which at first were carried on under the direction of the Council of National Defense and Mr. Brooks of the Alaskan division of the Geological Survey, were later taken over by the Corps of Engineers of the Army and Lieutenant Colonel Marshall of the topographic branch of the Survey, where they have remained to the present time. Money for the first experiments was furnished by the Council of National Defense, but the large sum needed for the construction of airplane cameras and transforming cameras was allotted by the Engineer Corps. I take this opportunity to express to Colonel Marshall, under whose immediate direction I have worked during the past year, my appreciation of his enthusiasm and the generous encouragement he has given Major Bagley and myself.

The fundamental principle on which our investigations is based was first expressed, so far as my knowledge goes, by Capt. Theodore Scheimpflug, an Austrian Army engineer, who gave many years of his life to the study of the problem. He, however, lived before the days of the airplane, and his methods did not meet with the full success they deserved, so that he died without seeing any extensive application of them.

If a camera is carried above a horizontal plane and an exposure is made with the sensitive plate parallel to the plane, the resulting picture is a map whose scale is dependent on the focal length of the lens and the height of the camera above the plane. We apparently have at hand, then, a simpler way for making maps of many regions than the way ordinarily employed, for the airplane makes it possible to pass back and forth over a chosen area at will. Yet two difficulties are met when airplane photographs are employed in making maps. First, it is impracticable if not impossible with any means yet devised to keep the camera in a horizontal position; second, the angle of view of the fast lenses which must be employed in taking photographs from airplanes is small, as that the area covered at each exposure is also small and a great number of pictures must be taken in constructing the map. These, then, are the first problems that must be taken up if an accurate map is to be made at less expense than by the usual surveying methods.

The investigation to be described falls naturally into two divisions, of which the first deals with the airplane camera—that is, with photographing the terrain. To this Major Bagley gave his attention. The second has to do with correcting the inclined airplane pictures, and for the study of the principles involved and the design of the transforming camera the writer is responsible. The questions relating to photographic methods and the construction of charts and computing devices

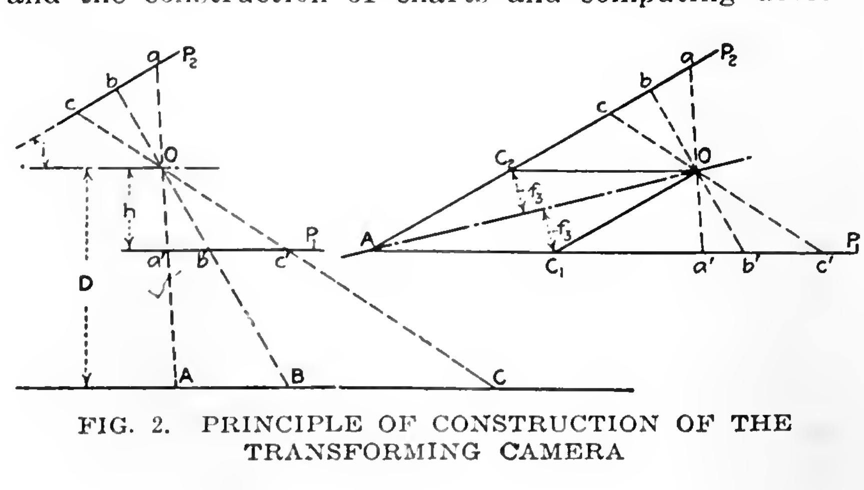


FIG. 2. PRINCIPLE OF CONSTRUCTION OF THE TRANSFORMING CAMERA

for use with the transforming camera fell to Mr. Mertie.

The Airplane Camera—The difficulty of obtaining a lens which shall have speed and at the same time a wide angle of view is met by constructing a multiple camera with its three lenses and focal planes so arranged that the central plane shall be in a horizontal position and the other two shall be inclined at a fixed angle to it.

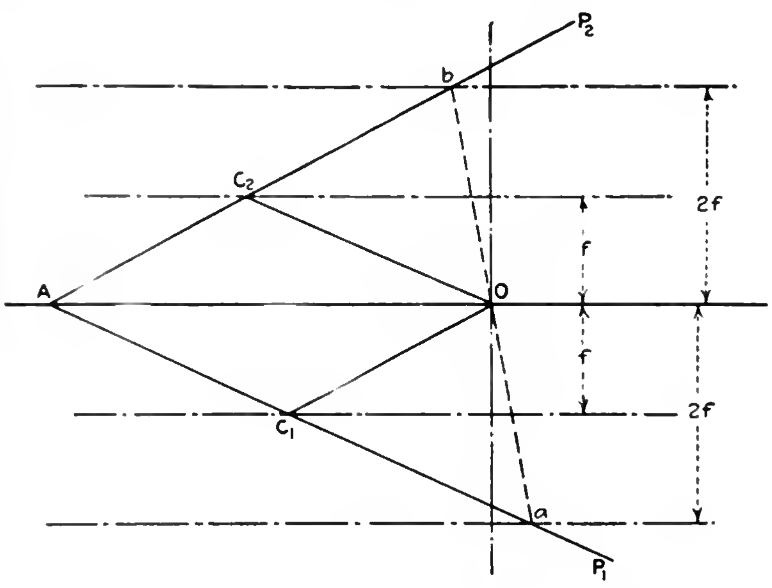


FIG. 3. THE CONDITION FOR FOCUS IN THE TRANSFORMING CAMERA

The side pictures, because of their inclination, include areas outside the field of the central picture, but overlap it slightly so as to give the means of joining them. A photograph of such a camera is shown in Fig. 1.

The camera is about 25 in. high, 22 in. wide, and 7 in. thick from front to back. It consists of two parts, which may be separated from each other. The upper part is the magazine which carries the roll film. The lower part is really three distinct camera boxes, each fitted with its own lens and shutter, joined together.

The two side-focal planes of the camera are inclined to the central plane at an angle of 35°, and as a consequence the angle between the axes of the two side lenses and the central lens is the same. Lenses of about 7-in. focal length are used on the two side boxes and one of about 6 in. on the central box. The automatic shutters, Fig. 1, are released by a special cable release which acts on the triggers of the shutters through a synchronizing device shown in the photograph. This release is so adjusted that the shutters open and close at exactly the same instant. It is necessary that the time of exposure shall be as short as possible, in order that a sharp image may be obtained. This necessity is the result of several causes, chief of which are the vibration of the engine and the angular movement or roll of the plane.

When a film is to be inserted in the camera the magazine is lifted off the boxes, the unexposed spool is placed in position in its supports near the center of the magazine, and the free end is attached to the winding spool in the top of the magazine. After being replaced the magazine is made fast to the lower part of thumb-screws which bring the two sides close together and prevent the entrance of light. The film is 5 in. wide and has a maximum length of about 400 ft. The individual negatives are 5 in. wide and 6 in. long. It was found that pictures taken on the Eastman Company's ordinary "noncurling" film are not marred by static, which so frequently injures airplane photographs, although pictures taken in this camera on other kinds of film, made specially for airplane work, have shown this defect.

Mounting the Camera—To mount the camera in the airplane a hole is cut in the bottom of the fuselage in front of the observer's seat, and a cradle, closed below by a sliding door for the protection of the lenses, is fastened securely to the floor. This cradle is padded with felt or sponge rubber, and the camera is strapped securely in it. Some airplane cameras are mounted on gimbal rings whose movement is damped by a dash-pot arrangement. Such a mounting has been constructed for this camera, but has not yet been tried out. It is not expected that this mounting will keep the camera in its proper position, for seemingly no device dependent on gravity alone for its effect has been able to do this fully. Probably it can do no more than reduce the errors of deviation.

The frequency with which exposures are made at a given altitude in getting pictures with proper overlap depends on the rate of movement of the plane over the ground, which in turn is dependent first on the airplane itself and second on the movement of the surrounding air, for the speed of the plane referred to the ground may be greatly increased or retarded as the plane flies with or against the wind. The time interval between exposures varies roughly from ¼ min. to 1 min. The observer making the exposures, however, does not rely on a time interval for getting properly spaced pictures, but is chiefly dependent on a large negative lens about 6 in. square which is set in the bottom of the fuselage and enables him, as he views objects below him, to judge both the direction and the rate of movement over the terrain.

This camera still lacks one essential feature necessary to make it fill its purpose fully. It should have incorporated in it a device for recording on the film at the time of exposure the amount and the direction of the tilt of the central plate, for, as has been stated, it is not yet possible to keep the camera in a horizontal position. Correction of this fault appears to be only a matter of adapting to the camera some such principle as that of the gyroscope on which others have been at work and which seems now to be brought to condition for practical application.

Principles of Transforming Camera—Pictures taken with the airplane camera just described are subject to

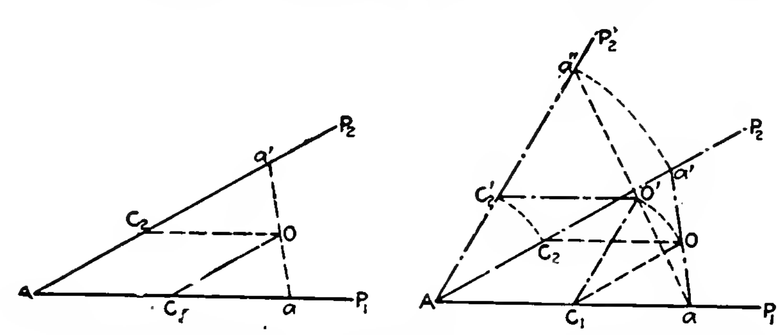


FIG. 4. PRINCIPLE IN APPLICATION OF THE TRANSFORMING CAMERA TO THE RECTIFICATION OF INCLINED PHOTOGRAPHS

errors arising from the construction of the camera itself and from the tilt of the airplane, for only when the plate is taken in a horizontal position is the resulting picture a map. These errors may be corrected graphically by projecting chosen points one by one on a plane representing the plane of the horizon, but the process is long and tedious. It was for the purpose of making these projections photographically that the transforming

camera was designed. Before the working of the transforming camera is described it will be desirable to state two principles on which the construction of the instrument is based. Let A P_1 and A P_2, Fig. 2, be two planes intersecting in the line A, and through any point O pass planes C O and C O parallel to planes A P_1 and A P_2,

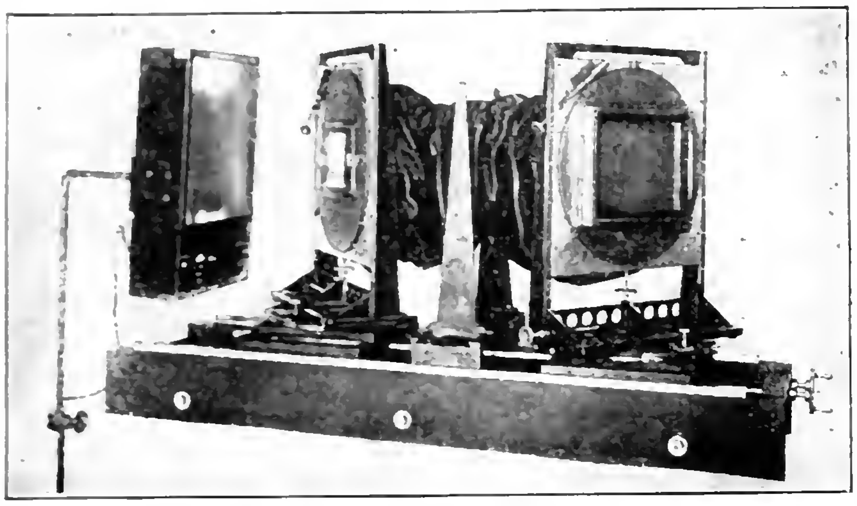


FIG. 5. TRANSFORMING CAMERA, WITH REVOLVING DISKS CARRYING NEGATIVE AND PLATEHOLDER

respectively. Project point a, through point O onto the plane A P_2 in a′.

Now, if we revolve the plane A P_2 about line A, the point a′ is revolved to a″, the point C_2 to C'_2, and O to O′, and it may be demonstrated that the points a, O′, and a″ lie on the same straight line; that is, O′ remains the center of projection for point a and its projection a″ on the revolved plane A P'_2. This principle has an important use in the construction of the transforming camera.

The second principle deals with lenses. Let O, Fig. 3, be a lens of focal length f, whose axis is perpendicular to the plane passing through the optical center of the lens and the intersection of two planes A P_1 and A P_2; and further let O be so situated that it lies on the line which joins a, the intersection of A P_1 with a plane parallel to the focal planes, whose distance from O is twice the focal length, to b, the intersection of A P_2 with a plane whose distance from O is also equal to twice the focal distance. These conditions may be expressed in a slightly different way, thus: Let the plane of the lens, O, pass through the intersection of the planes A P_1 and A P_2 and let O lie in the intersection of two planes, C_1 O and C_2 O, which are parallel respectively to A P_2 and A P_1 and pass through the intersections of planes A P_1 and A P_2 with the focal planes of the camera. If these two conditions are satisfied it may be proved that all points on either plane A P_1 or A P_2 are sharply in focus on the other plane. This fact is the second principle which we need to use. Let us now see how these principles are applied to the correction of pictures taken in an inclined position.

Let P_2, Fig. 4, be a negative on which are photographed the points A, B and C. Let f_1 be the focal length of the lens, i the angle of inclination of the plate, and D the height of the camera above the ground. Points a, b and c are images of the points A, B and C. Now, the size of the image a, b, c (with any given inclination, i,) depends on the focal length of the lens and the height of the camera above the ground. This inclined photograph does not show a, b and c in their true relative positions but it can be made to do so by projecting the image onto some plane parallel to A B, such as P_1 and the scale of the resulting image depends on h, the distance of the plane P_1 from O.

In order to show how this projection may be made photographically, produce the planes P_1 and P_2 till they intersect in A, Fig. 4, and draw C_2 O and C_1 O through O parallel to A P_1 and A P_2. Also replace the lens of the taking camera by another lens whose focal length is f_3, the length of the perpendicular let fall from either C_1 or C_2 to A O. It should be noted that A O is the plane of the new lens. We have now fulfilled the conditions that must be fulfilled if we are to obtain sharp images of the points a, b and c on the plane P_1, but we have limited ourselves to the use of one lens in making any given projection and will require a different lens for every different angle of inclination. If, however, we revolve plane P_2 about the axis A we may vary the distance f_3 and thus, within certain limits, adapt our figure to whatever lens we find is convenient to use in the transforming camera. In the description so far the separation of the principal points of the lens has been disregarded. This was done to simplify the description and is entirely proper, for the same conclusions would have been

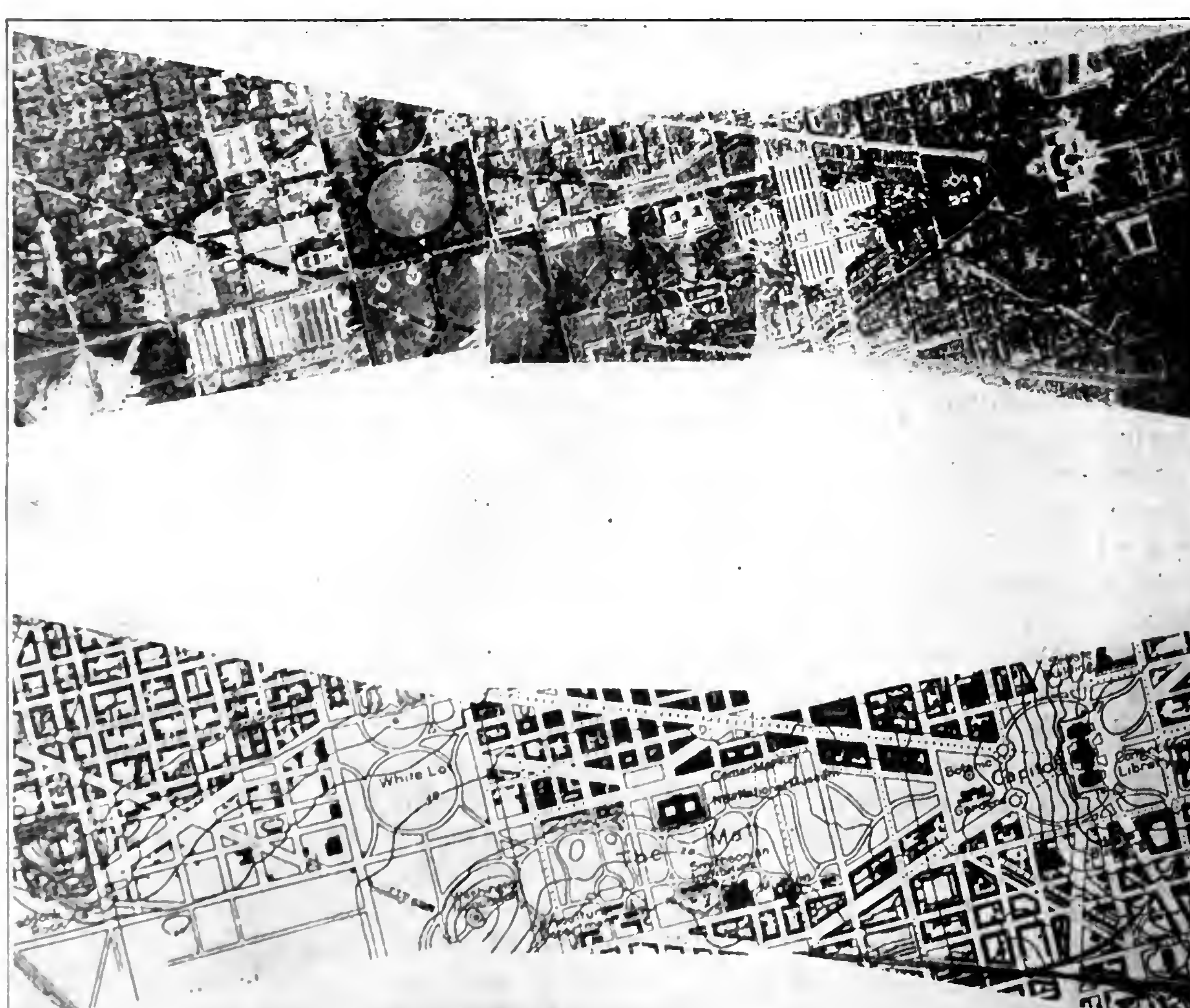


FIG. 6. SET OF THREE PICTURES COMPARED WITH PART OF MAP OF WASHINGTON
The Mall connecting the Capitol, on the right, with the Washington Monument, near the center of the picture, and other prominent landmarks, are easily distinguished.

reached had this been taken into consideration.

The Transforming Camera—The simplest form of transforming a camera capable of transforming photographs taken at different angles of inclination is one in which the two sides are hinged together and have their line of intersections in the plane of the lens. Such a camera is impracticable if the angle of inclination is small or has a wide range of values. The form of camera we have been using is shown in Fig. 5. The two sides, instead of being hinged together, are made to revolve about vertical axes and, together with the lens, are capable of movements that permit all the conditions indicated in the previous diagram to be satisfied. The vertical axes may be moved to and from the lens, and in addition one axis and the lens may be moved transversely. The two axes are so connected with the frame supporting the lens that they and the lens are always in line. The large disks supporting the negative and the sensitive plate may be revolved or they may be moved horizontally in their own planes.

FIG. 7. SERIES OF PHOTOGRAPHS TAKEN WITH THE AIRPLANE CAMERA AFTER BEING REDUCED TO HORIZONTAL PLANE AND JOINED

The transforming camera is an instrument for doing accurate work. It is necessary that the films or plates be put exactly in their proper positions and that the settings of the scales be correct.

In setting up the transforming camera it is assumed that the focal length of all lenses employed, both in the airplane camera and in the transforming camera, are known, and that the inclination of the pictures to the horizon plane is known or can be found. With these data the setting of the instrument can be made after certain simple trigonometric calculations are completed, or the setting may be taken from charts constructed for the purpose. The charts are graphical representations of the trigonometric formulas, and simplify greatly the work of making transformations. The camera is provided with scales and verniers so that the settings may be made with the required accuracy. It is best, nearly always, to have solutions represented graphically.

The inclined airplane photograph shows distant objects on a smaller scale than the near objects, so that the problem of the transformer is to restore a uniform scale to the picture by enlarging or reducing some part of it. Ordinarily, one part of the photograph is enlarged, another is reduced, and the two parts are separated by a line where no change has taken place.

The procedure followed so far in working up the airplane photographs is, first, to transform the side pictures to the plane of the central picture, Fig. 6, and when necessary all three to the horizontal plane, and then by an independent operation to bring all the pictures to the required scale, which as a rule is much smaller than the approximately 1:10,000 scale on which the original pictures were taken. After being brought to the chosen scale the pictures are cut to fit and joined together, Fig. 7. A certain amount of independent horizontal control is needed in this method of mapping as in all others, particularly if an extensive area is to be mapped, but our experience is not yet wide enough to show just how much of such control will be required. It will, of course, depend in part on the scale of the map.

Chief Difficulties—The chief sources of difficulty that arise in making maps from airplane photographs lie first in the lack of suitable means for obtaining the data for transforming the inclined pictures into a truly horizontal position, and, second, in the errors introduced into the pictures by relief of the terrain. The first of these has already been spoken of in describing the airplane camera, and will be solved by installing in the camera the means for recording on the film at the time of exposure the direction and amount of inclination of the central negative. It may be solved in another way if sufficient horizontal control is available, for three or more points on the photograph may be brought into coincidence with corresponding known points plotted on the ground glass of the transforming camera, or, rather, on a tracing paper which can be compared directly with the image on the ground glass, and this of itself brings the picture into the horizontal position.

The second source of difficulty—that arising from relief of the terrain—becomes of greater and greater importance as the relief increases. If the scale of the map is large the error must be taken into consideration even when the relief is small. Apparently, the errors of relief cannot be corrected directly by photographic means, and for the proper location of individual points it becomes necessary to determine the station point or the point on the ground directly below the camera at the moment of exposure, and to find the position of the desired points by intersections from two photographs. This adds an extra operation to the work which it is desirable to avoid where it is possible. Another line of attack on the errors brought in by relief is through the properties

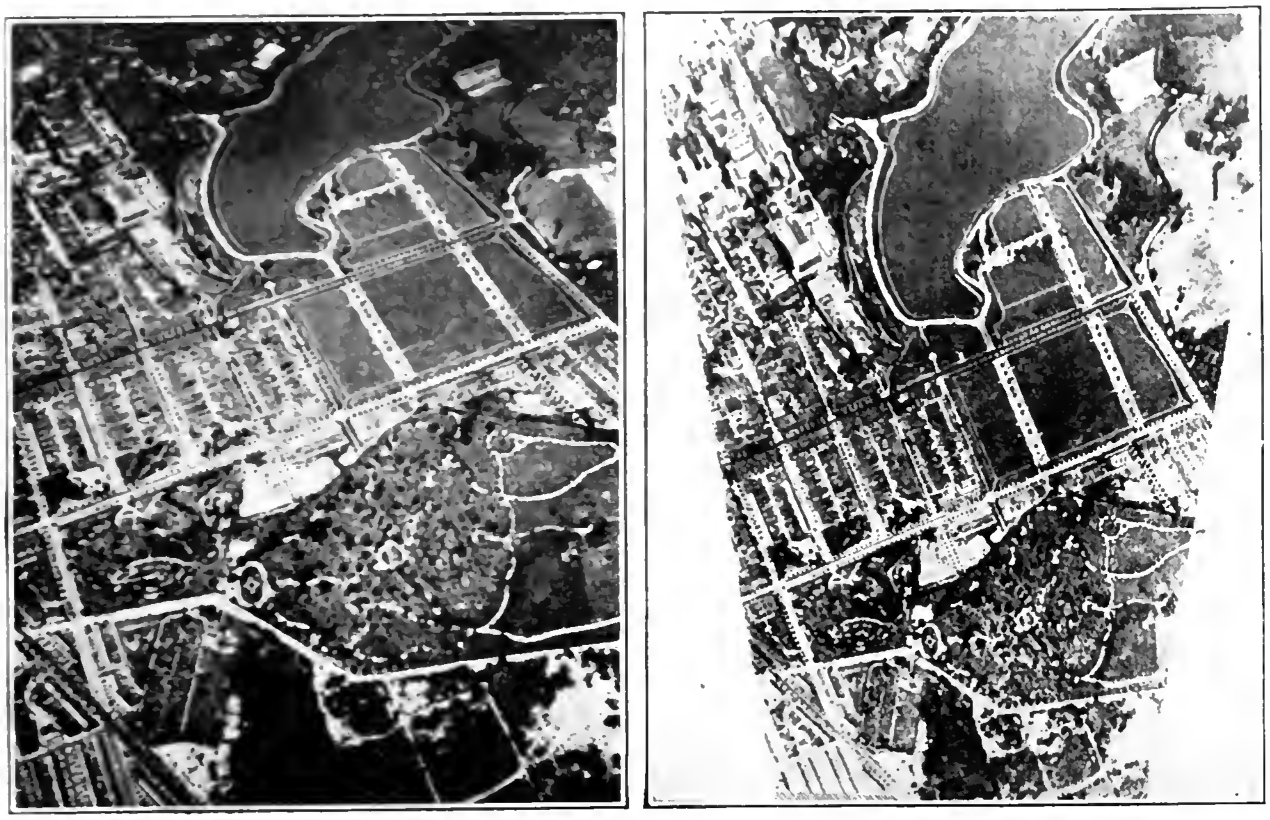


FIG. 8. ON LEFT, ONE OF THE SIDE PICTURES TAKEN WITH AIRPLANE CAMERA; ON RIGHT, SAME PICTURE TRANSFORMED TO THE PLANE OF THE HORIZON

of stereoscopic vision. This involves the use of overlapping pictures and some instrument such as the stereocomparator, constructed for accurately measuring parallax, which may be employed in correcting errors of relief, and if the necessary data are obtained affords an elegant method of drawing the contours to express the relief. This important part of the work is a feature on which we have hardly touched as yet. Fortunately, a certain amount of error due to relief comes within the limits of error for the scale of the maps usually made in this country. "Mosaic" is a term commonly employed to designate most of the maps made from airplane photographs. It will be of interest to make a comparison between such maps and maps made by the method just described.

The design of airplane cameras and the focal lengths of the lenses used vary widely, but the capacity of the lens is practically the same in all. The lens is a "fast" lens of moderate angle whose field of view is further reduced in many instances owing to the size of plate used.

The advantages of the method under consideration may be divided into two classes, those arising from the use of the multiple camera and those due to the use of the transforming camera. It will be well to state again that there would be little advantage in the use of a multiple camera if it were possible to get well corrected fast lenses of wide angle and good illumination. The chief advantage of the multiple camera over the single-lens camera is the increased field of view which makes it possible to cover a given area with fewer flights and therefore in shorter time and at less expense. The area covered by the three pictures of the three-lens camera at a given elevation is about four times the area covered by the central picture alone, and this is roughly the ratio that holds between the three-lens camera and most of the single-lens cameras. Furthermore, the three-lens camera reduces the probability of leaving parts of the terrain unphotographed and make easier the final assembly of the pictures. A uniform overlap in the series of pictures made during successive parallel flights is difficult to maintain, so that frequently it is found either that the overlap is too great or that a part of the terrain is unphotographed. A wide field of view in the airplane camera helps to minimize this difficulty. The advantage due to the use of the transforming camera is chiefly that it makes possible the use of pictures that without it would be unusable or greatly in error because the subject photographed was not parallel to the plate and therefore the pictures do not have a uniform scale, but no advantages arising from it are such that they may not be enjoyed in either method. It would be much more nearly correct to say that until the means is devised for keeping the camera plate in a horizontal position the transforming camera is essential to either method if accurate work is to be done. So far as my knowledge goes, no airplane camera has yet been constructed whose pictures are not subject in some degree to errors arising from the tilt of the plane. In practically all, the error may be, and often is, much greater than any allowable error.

Advantages of Airplane Photographs—The advantages that will arise from the use of photographs taken from the airplane or dirigible airship for the making of maps can hardly be overestimated. These advantages are of many kinds and include among others greatly increased speed, greater accuracy in details, reduction in cost, and, for special purposes such as the use of aircraft pilots, the possibility of representing on the map the actual appearance of the terrain as it is seen from above. Furthermore, it will make possible the mapping of areas which, because they lack roads and other means of transportation, or for other reasons, are now practically inaccessible. When a strip of country from three to five or more miles wide can be photographed at the rate of 75 or 100 miles per hour, depending upon the speed of the airplane, it is not difficult to see that the length of time per square mile devoted to actual field work in the older, established methods now in use must be even hundreds of times greater than in the new.

The errors that arise from the relief of the terrain have been referred to and are fully appreciated, and for that reason it is believed that the first application of the method should be in areas of low relief. Many thousands of square miles of such land are still unmapped in the United States, including most of the Atlantic and Gulf coastal plains as well as great areas in the West. The coastal plain in particular is well adapted to test the merits of the photographic method of mapping, for it is a region of low relief, largely unmapped, and in many parts extremely difficult of access.

Another field of application in which it is believed that the photographic method will be most useful is in the revision of existing maps, as in the addition of features like new roads built since the map was made, or of timbered areas not mapped originally. Only those who have had experience in the study of airplane photographs can realize fully the wealth of material they contain for the mapmaker.

Chicago Chapter, A. A. E., Adopts Schedule of Salaries

From Chief Engineers to Draftsmen, Rodmen and Inspectors on State, County, Municipal, Corporate and Private Work

A COMPREHENSIVE list of salaries for a wide range of engineering positions in varied lines of work has been adopted by the Chicago Chapter of the American Association of Engineers. This has been referred to the association with the suggestion that it be utilized in a nation-wide study of the subject, for the formulation of a general schedule of salaries. The present schedule covers architectural, highway, municipal, state and electric-railway work (steam-railway work has been covered by the parent association); county and rural positions, large engineering organizations, public-utility boards and corporations, telephone work and expert service.

It is explained that the salaries recommended are for positions which provide continuous employment and offer advancement in rank and pay as a reward for efficient service. For seasonal employment, where the work continues from year to year, but is interrupted by idle seasons, it is suggested that the pay should be such as to amount to about half pay during the period of enforced idleness. Thus, for an eight-month season, where the schedule rate is $2400 per year, the pay should be $250 per month. For temporary positions, where there is no developing future, the pay should be 50% above the schedule, in order to provide greater incentive for good work and repay the employee for changing location.

A few revisions were made at a meeting at which the schedule was discussed, and these are included in the lists given below. The work was done by a committee composed of A. M. Van Auken, chairman; W. H. Dean, G. S. Eaton, W. A. Ireland, Langdon Pearse and J. H. Prior.

Proposed Schedule of Salaries Adopted by the Chicago Chapter

Architectural Engineers—The committee states that to those who are not architects the rates seem to be low, but the schedule is thought to be reasonably fair to employer and employee. There appear to be no uniform rules as to education or training required for the positions.

Architect in charge of office	$5000–$8000
Designing draftsman	4000– 5000
Construction design draftsman	4000– 5000
Outside superintendent	4000– 5000
Senior draftsman	2400– 3000
Junior draftsman	1500– 2100
Student draftsman	900– 1200

Road Engineers—This schedule is for a state having 60,000 to 100,000 miles of roads and in which the highway department spends not less than $5,000,000 annually

Chief highway engineer	$8,000–$10,000
Road engineer	5,000– 7,000
Maintenance engineer	4,500– 6,000
Bridge engineer	4,500– 6,000
Engineer of tests	3,000– 4,000
Division engineer (7,000 to 10,000 miles)	3,600– 5,000
Assistant engineer	2,700– 3,600
Resident engineer	2,700– 3,600
Chief designing engineer	3,000– 4,000
Designing engineer	2,700– 3,300
Junior engineer, class A	2,100– 2,700
Junior engineer, class B	1,500– 1,800
Inspector*	1,320– 1,800

*Technical training desirable but not essential, but must have had experience in highway construction if lacking such training.

Municipal Engineers—The proposed schedules for municipal engineers are as follows:

City engineer: annual work, $5,000,000	$12,000–$15,000
City engineer: annual work, $2,500,000	8,000– 10,000
City engineer: annual work, $1,000,000	6,000– 7,500
City engineer: annual work, $500,000	4,000– 5,000
Department engineer	5,000– 7,500
Division engineer	4,000– 7,500
Assistant engineer	3,000– 3,600
Instrumentman (preferably technical graduate)	2,000– 2,400
Rodman (high-school, 2nd grade)	1,080– 1,500
Inspector	1,380– 1,800
Architect	3,000– 5,000
Designing engineer (technical graduate, 10 years' experience)	4,000– 6,000
Designer (technical graduate, 5 years' experience)	3,300– 4,400
Detailer (technical graduate preferably)	2,000– 3,000
Tracer (technical high school)	1,200– 1,800
Draftsman, architectural	1,800– 3,000
Draftsman, map or topographic	1,800– 2,400
Draftsman, structural	1,800– 2,400

Electric Railway Engineers—For the case of railways with 60 miles of track:

Chief engineer (track, structures and transmission lines)	$3,600– $4,800
Assistant engineer (field)	2,400– 3,000
Roadmaster (preferably technical education)	2,400– 3,000
Mechanical-electrical engineer	4,200– 5,400
Office engineer (mechanical-electrical)	2,400– 3,000

For railways with 200 miles of track:

Chief engineer	$4,000– $5,400
Assistant engineer	2,400– 3,000
Roadmaster	2,400– 3,600
Electrical-mechanical engineer	4,500– 6,000
Assistant engineer (electrical-mechanical)	2,400– 3,000

County Surveyor—As a rule this is not a salaried position, but it is of such importance that a sound policy would provide an office and pay for keeping open a stated number of days per week, depending upon the wealth and population of the county. The pay per day for land surveying should be adjusted to correspond with the value of the land, as follows, since the surveyor is responsible and may be sued for damages due to erroneous work:

	Surveyor	Assistant
Land up to $25 per acre	$12.50	$3.75
Land at $25 to $200 per acre	18.00	5.00
Land over $200 per acre	20.00	5.00

A similar rate should be paid for work of the intermittent class or for drainage, levee or road work, with pay for a specific number of days per month to cover consultation and correspondence.

Deputy county surveyor	$3000–$4200
Employees on drafting and instrument work	2100– 2700

County Engineer—Good roads organization in counties spending at least $500,000 annually on highway work:

County highway engineer	$4200
Assistant engineer	3000
Junior engineer, class A	2400
Junior engineer, class B	1800
Inspector (for qualifications see under "Road Engineers")	1500

A similar organization is desirable for levee and drainage work, but must adapt itself to wider variation than the road work. Such adaptations can be made according to the particular work in hand.

State Public Utility Board—For the engineering department of a board in a state having a population of 5,000,000:

Chief engineer	$12,000–$15,000
Assistant chief engineer	9,000– 10,000
Chief of railroad division	8,000– 9,000
Chief of gas division	6,000– 7,500
Chief of telephone division	6,000– 7,500
Chief of waterworks division	6,000– 7,500
Chief of service division	6,000– 7,500
Assistant engineer, grade 1	3,600– 4,800
Assistant engineer, grade 2	3,000– 3,300
Assistant engineer, grade 3	2,400– 2,700
Assistant engineer, grade 4	1,800– 2,100

State Public Improvement Project—For such a project as the Illinois River improvement:

Chief engineer	$15,000
Assistant chief engineer	9,000
Principal assistant engineer	8,000
Bridge engineer	7,500
Office engineer	6,000
Field engineer	6,000
Office and field assistants	Same as in municipal schedule

Large Structural Engineering Organization—Proposed schedules in this field are as follows:

Chief engineer	$12,000
Assistant chief engineer	9,000
Construction engineer	$3,600– 6,000
Inspecting engineer (10 years' experience)	3,000– 4,200
Inspecting engineer, junior grade	1,800– 2,700
Office engineer	4,800– 6,000
Engineer of design	4,200– 5,000
Assistant engineer of design	2,400– 3,000
Engineer of estimates	3,300– 4,000
Squad engineer	3,300– 4,000
Assistant engineer, class 1	3,000– 3,600
Assistant engineer, class 2	2,400– 2,700
Junior engineer (technical education, with or without experience)	1,500– 2,100
Student engineer	1,000– 1,400

Expert Service—An engineer having a standing equal to the chief engineer of a railway or city engineer of a city spending $2,000,000 annually, $100 per day. An engineer who can qualify in court to give expert testimony, $25 per day. Intermediate figures for engineers of intermediate rank. All incidental expenses should be in addition to the rate named and should be paid for. Court testimony simply identifying a map or plan is not considered expert testimony.

Mortar Test Does Not Insure Good Concrete Aggregate

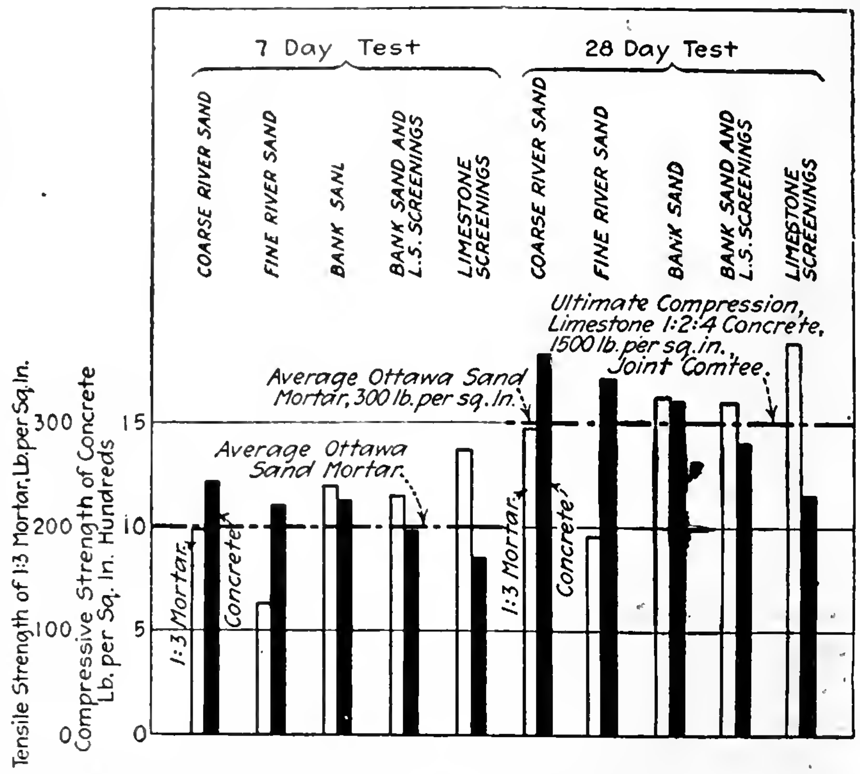
Experiments Show That Commonly Assumed Relation To Standard Ottawa Sand Test Has No Effect on Compressive Strength

By Clement C. Williams
Professor of Civil Engineering, University of Kansas
Lawrence, Kan.

CONCRETE specifications frequently contain the clause "the tensile strength of a mortar made of one part cement to three parts of the aggregate shall be at least 75% of ['equal to,' in the Joint Committee report] the strength of a mortar of one part cement to three parts Ottawa standard sand." Some tests recently made by the writer show that this precaution does not insure an aggregate giving a concrete strong in compression.

The tests included five different materials: A coarse river sand, a fine river sand, a coarse bank sand containing some clay, a mixture of the bank sand and limestone screenings, and limestone screenings crusher run. The screenings contained from 5 to 15% of dust passing an 80-mesh screen. The results of the tests are tabulated herewith and also shown graphically. Each result represents an average of approximately 20 individual tests. The coarse aggregate was somewhat variable, but was chiefly crushed limestone fairly well graded. The concrete was nominally a 1:2:4 mixture.

From these data it is obvious that the fine aggregate which gives a mortar of high tensile strength does not necessarily yield a concrete having a high compressive strength. Moreover, since Ottawa standard sand 1:3 mortar has an average tensile strength at seven days of about 200 lb. per square inch and at 28 days of 300 lb. per square inch, it is also apparent that a fine aggregate which yields a mortar having 75% of this strength or even equal to it may not produce a strong concrete.



COMPARISON OF MORTAR AND CONCRETE TESTS WITH OTTAWA SAND MORTAR TESTS

Not only in these special tests with limestone screenings did this fact become manifest, but similar results were observed with screenings from a local sandstone quarry. In this case the screenings gave a 1:3 mortar that exceeded the standard sand mortar in strength, but they proved to be entirely unfit for making concrete.

A 1:3 mortar is a comparatively lean mortar, especially with Ottawa standard sand, which is nearly uniform in size and contains a large amount of voids (about 40%). It is a matter of common observation in the laboratory that a well graded sand, even if inferior in other respects, will produce a stronger 1:3 mortar than Ottawa standard sand. In the case of a fine aggregate containing a considerable amount of silt, such as crusher-run screenings, the fine particles help fill the voids and bring about a better distribution of the available cement in the lean mortar and hence produce a denser and stronger mortar.

COMPARISON OF MORTAR AND CONCRETE TESTS

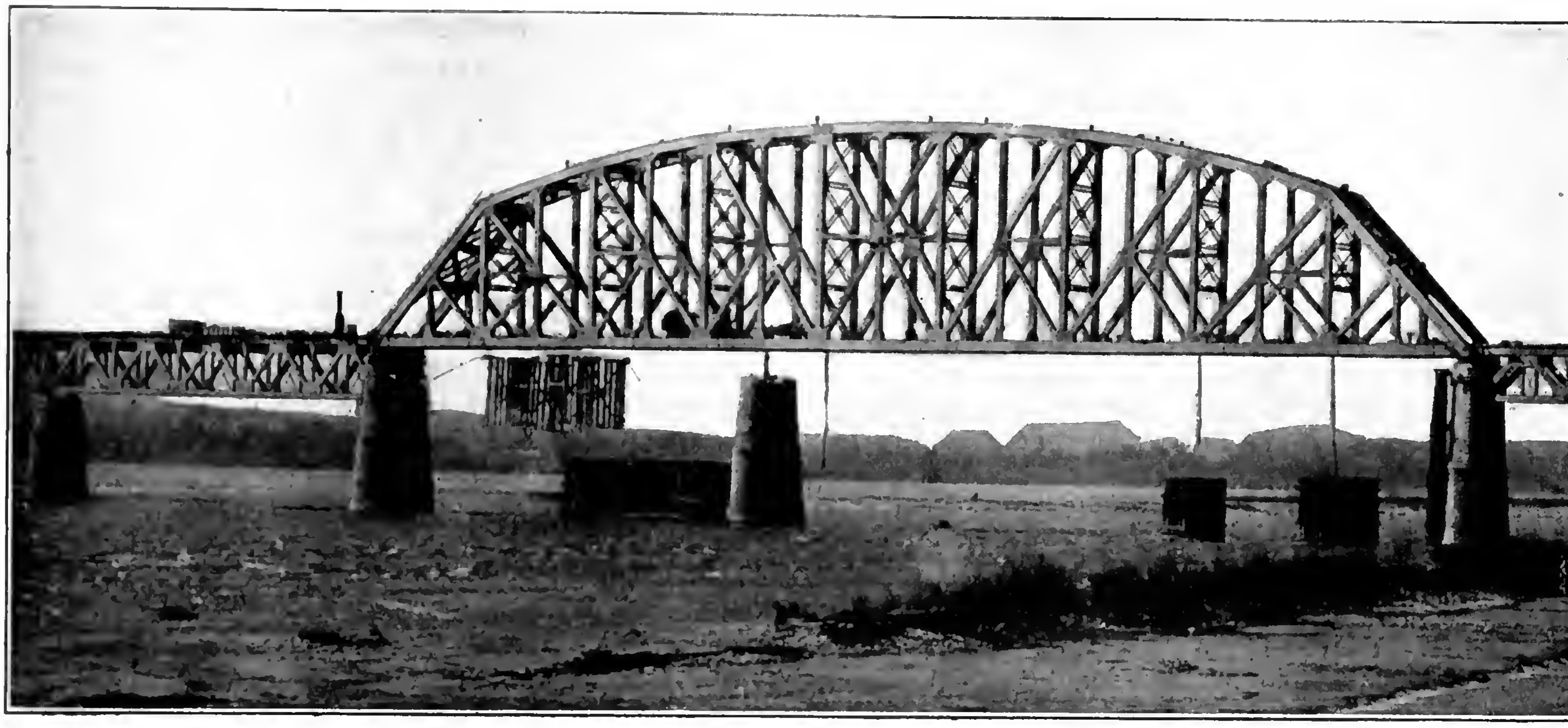
Aggregate	Average Tensile Strength of Mortar Lb. per Sq.In. 7 Days	28 Days	Average Compressive Strength of Concrete Lb. per Sq.In. 7 Days	28 Days
Coarse river sand	201	294	1210	1810
Fine river sand	123	180	1120	1690
Bank sand	239	323	1130	1590
Bank sand and screenings	229	318	1010	1380
Limestone screenings	273	364	847	1160

Incidentally, attention may be called to the fact that while stone screenings prepared in the laboratory free from an excess of dust may produce a strong mortar and give good results as a fine aggregate for concrete, commercial screenings on the market, being crusher run and containing a large proportion of clay and stone dust from the quarry, generally do not yield a strong concrete.

If the mortar test is to be used at all as a criterion for judging fine aggregates, lean mortars should be used to try materials for lean concrete and richer mortars for richer concrete mixtures. The only reliable criterion is a test of the concrete itself made up with the coarse aggregate to be used on the work. However, the old specification that the fine aggregate shall be clean and coarse and shall consist of hard, durable grains well graded in size from finest to coarsest particles, if strictly observed, will give satisfactory results.

Design of New Superstructure of Louisville Bridge With 644-Foot Riveted Span

Historic Bridge One Mile Long Replaced by Double-Track Spans on Same Masonry Piers—Details of Design and of Deck Trusses and Lift Span



RIVETED SPAN 644 FEET LONG REPLACES THE 400-FOOT CHANNEL SPAN OF OLD BRIDGE—OLD INTERMEDIATE PIER BEING REMOVED

REPLACEMENT of the Pennsylvania's historic Fink-truss bridge over the Ohio River at Louisville, Ky., involved the design and erection under exceptional conditions of the longest and heaviest simple-truss riveted span in existence, 643 ft. 10½ in. in length between the 24-in. end pins. The adoption of riveted instead of pin-connected trusses resulted mainly from the fact that when the Government ordered the Louisville Bridge Co., a subsidiary of the Pennsylvania Railroad Co., to provide a 600-ft. clear channel instead of the 400-ft. Indiana channel of the old bridge, the other through span had been designed and fabricated with riveted trusses. To preserve unity in the structure, therefore, the same type was adopted. The 644-ft. truss contains top and bottom chords of special section, 1½-in. gusset plates spliced into the main webs of the chords, and in the web members transverse diaphragms and longitudinal end stiffening diaphragms.

This article describes the principal features of the design of the long span, typical details of the deck trusses and special details of the 260-ft. lift span over the Louisville Canal. The erection of the new trusses around the old structure while traffic was maintained, the remodeling of the masonry piers to carry the new superstructure, and the erection equipment will discussed in a separate article.

The original superstructure of this bridge, built in 1870, was composed of 26 deck truss spans and two through-truss channel spans, the total length center to center of the end masonry supports being 5294 ft. The deck spans were of the Fink-truss type, except the swing span over the Portland Canal at the Kentucky end, which was of the Warren type. This deck swing span was replaced about 17 years ago by a through-truss span. The two original through spans, one 370 ft. and one 400 ft. long, were of the Warren type. The original bridge was described in *Engineering News* of Feb. 8, 1917, p. 217.

When it was decided to replace the old bridge with a new one, it was found that the existing masonry would, with the use of pier girders, be long enough to take the superstructure for a double-track bridge, and it was concluded to make the renewal with a double-track superstructure on the old masonry. To this end, request was made of the War Department for a permit to use such falsework as would be necessary to carry out the erection; at the same time the offer was made to replace the existing swing span by a vertical lift span giving 200 ft. clear opening.

The response from the department was an order not only to provide a lift span for the canal opening, but also to increase the span over the Indiana channel from 400 ft. to a length that would provide a 600-ft. clear opening for the channel.

Required 644-Foot Span.—This order brought about a long battle in the courts regarding the increase in length of the 400-ft. channel span, and a decision was not handed down by the Supreme Court until January, 1917. In the meantime the replacement of the bridge, which was begun in June, 1916, had been proceeding rapidly, and the 370-ft. through-channel span, which was the only other fixed through-truss span in the bridge, was completely designed and fabricated. As the 370-ft. span was designed as a riveted-truss span, in order to preserve unity of design it was decided to build a 644-ft. span of the same type, and the subpanel outline of the long span, as indicated in the diagram herewith, was adopted.

A K-truss outline was also investigated, but for the above reason was not used, although the greater simplic-

ity in detailing of joint connections was recognized as a real advantage.

As the order of the War Department called for a 600-ft. clear opening under the long span, it was necessary, to meet this requirement, to remove the pier between the old 400-ft. span and one of the 245-ft. deck spans just south of it. This brought the south end of the long span (643 ft. 10½ in. between centers of end bearings) over the pier built for supporting the old 245-ft. deck spans, and as this pier was much too small to accommodate the bearings of the long through span, it was extended on both axes by incasing it with a ring of stone masonry securely doweled and clamped to the old pier.

Old Masonry Piers Used

The new double-track deck spans are of the Warren truss type, and the old piers were sufficiently long to accommodate the new spans after being cut down to the required lower level for deck trusses, and capped by steel grillages incased and filled with concrete. All the new spans are therefore of practically the same length as the old spans, except the Indiana channel span and the lift span over the canal.

A striking illustration of the difference in weight of the new and the old structures is seen in the fact that the new 370-ft. span weighs 12,272 lb. per foot as compared with 3050 lb. per foot for the old structure. The new 644-ft. span weighs 19,650 lb. per foot. These great weights resulted largely from high assumed live loads and the unit stresses adopted.

Live Loads and Impact—The live loading specified for this span consisted of a uniform load of 5000 lb. per foot of track and a concentrated single load of 60,000 lb., except for the floor system and web members of trusses, which are designed to support a uniform load of 5500 lb. and a concentration of 66,000 pounds.

In addition to this live load, a shock stress was introduced in the computation of all web members. This stress for verticals was equal to 50% of the concentrated live load, which was increased for diagonals by multiplying by the secant of the angle of inclination.

The wind load was assumed at 900 lb. per foot, moving on the top chord, and 1200 lb. per foot moving on the bottom chord.

Special Steel Adopted—A special high-carbon steel was required for all the main members of this truss. The ultimate strength was specified as 66,000 to 76,000 lb. per square inch, and the yield point, determined by drop of beam, at 38,000 lb. per square inch minimum. For this steel the elongation in 8 in. was required to be 1,400,000 divided by the tensile strength as a minimum, with a reduction of area of 35% minimum allowable, except that for thicknesses 1 in. or over the percentage of elongation might be reduced by 1 for each increase in thickness of ¼ in. or fraction, but not to be less than 16%. Similarly, for steel thicker than 1 in. the percentage of reduction might be reduced by 1 for each ¼ in. or fraction over 1 in., but not below 30%. Rigid requirements for cold bending tests were specified.

In case the ultimate strength fell outside the specified limits by less than 1000 lb., or in case the elastic limit fell below the specified minimum by less than the same amount, all other requirements being fulfilled, then two more tests might be taken, and if both retests filled all the requirements, the material would be accepted. It was required that when a melt of steel was rolled into several shapes, each shape must be separately tested. It was further specified that in case a melt was rolled into plates 1 in. thick or over and the two tensile tests showed any wide variation in physical results, a test should be made on each plate and each plate accepted or rejected according as it met the requirements of the specifications.

Unit Stresses and Make-up of Sections—The unit stresses allowed in tension members were $9000\ (1 + \phi)$, in which ϕ is the ratio of minimum to maximum stress in the member. For compression members, the unit stress $(9000 - 33R)(1 + \phi)$ was allowed, R denoting the ratio of the length to the least radius of gyration. These stresses for the main chords averaged 14,890 for the tension members and about 13,760 for the compression upper chords. For members having reversed stress, the allowable unit was $9000(1 - \phi/2)$. For hangers the unit stress was made $8000(1 + \phi)$.

The main top chord sections are of an exceptionally heavy type using eight angles 8 x 8 in. and 8 x 6 in., with 60-in. webs and 60-in. cover plate. Increase in section for center chords is obtained by adding plates to the outside of the vertical webs.

Special Section for Lower Chord

The lower chord is of special section, as shown by the drawings, in which the constant area consists of eight angles, four horizontal plates, laced, and six 60-in. vertical web plates. The additional areas required for higher stress in the center chords are obtained by adding plates both inside and outside of the vertical webs.

The thickness of main material in top and bottom chords does not exceed ¾ in., the web plates being spliced to the big ¾- or 1½-in. connection plates, which were inserted in the chords with $\frac{1}{32}$- or $\frac{1}{16}$-in. clearance.

In the detailing of all the main members, the plates and lacing bars or angles are placed inside the corner angles. This gives a much more finished effect, with square outlines to improve the general appearance.

Floor and Lateral Systems—The old floor system had to be removed and replaced, under traffic, by the new one, and in the designing of the new floor it was decided to use double floor-beams at each panel point so that each panel of the floor would be independent, and could be erected as a unit. This simplified the erection of the floor system considerably. The use of these double floor-beams also prevents the racking of the floor system, due to deflection of trusses under loads, which takes place in long spans where a continuous floor system is used.

Another special feature is seen in the arrangement of the top lateral system, the diagonals being connected to the top chords at mid-panel, with points of intersection opposite the panel points to which connection is made of struts. Curved gussets were used throughout the sway bracing, the radius being 4 ft. Intermediate sway bracing was introduced only at the main vertical posts, two panels apart.

Design of Chords, Web Members and Chord Splices—In the design of the cords, maximum stress was computed for an assumption of full loading on both tracks simultaneously. In designing the web system, the maximum and minimum stresses were found by the following assumptions: (1) For maximum stresses—trains on each track headed same way, directly opposite each other and passing simultaneously across the bridge; (2) for minimum stresses—trains on each track, headed same way but opposite to the direction causing maximum,

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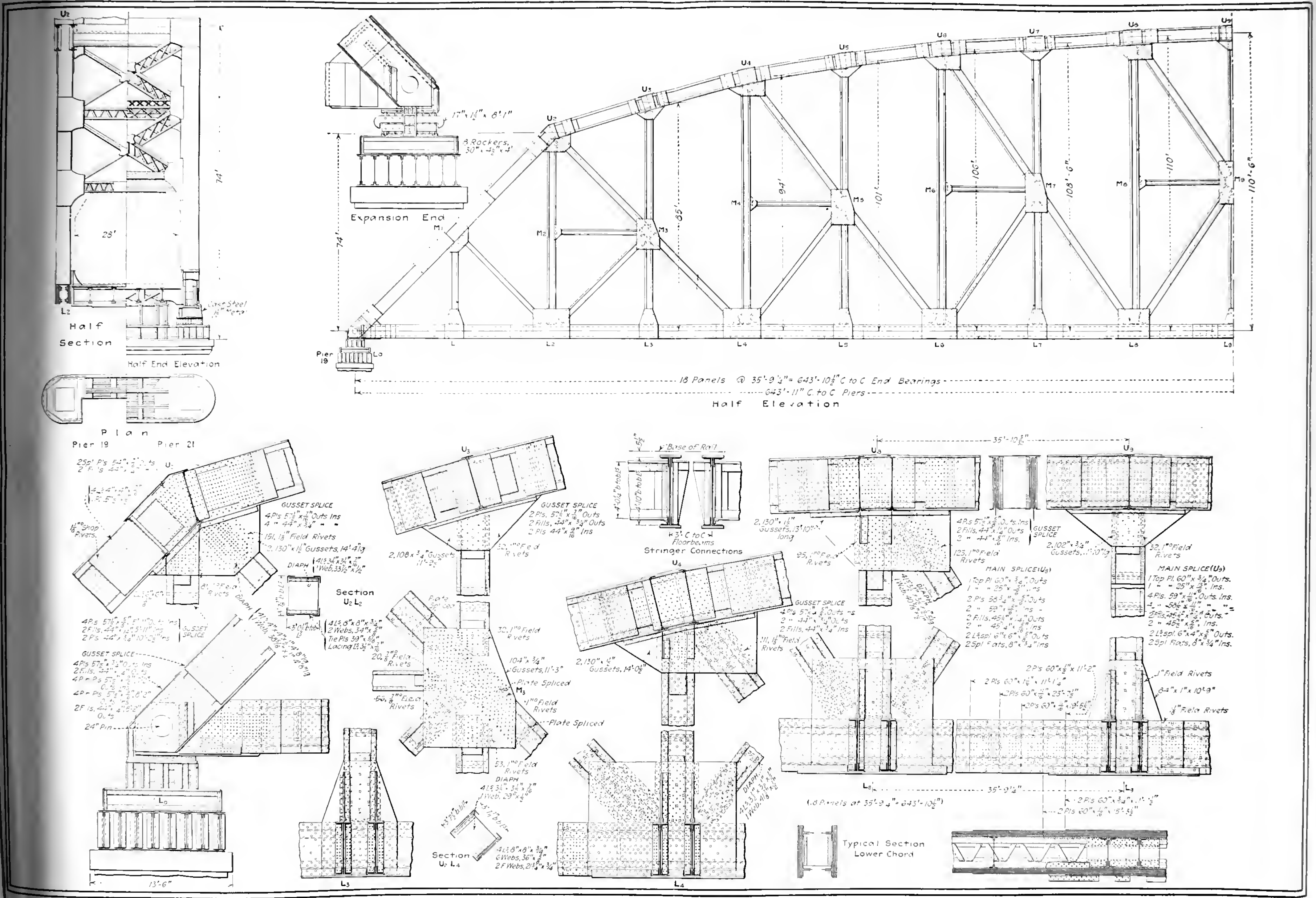
Accompanying article on new superstructure of Pennsylvania Railroad bridge at Louisville, Ky., *Engineering News-Record*, May 22, p. 1047



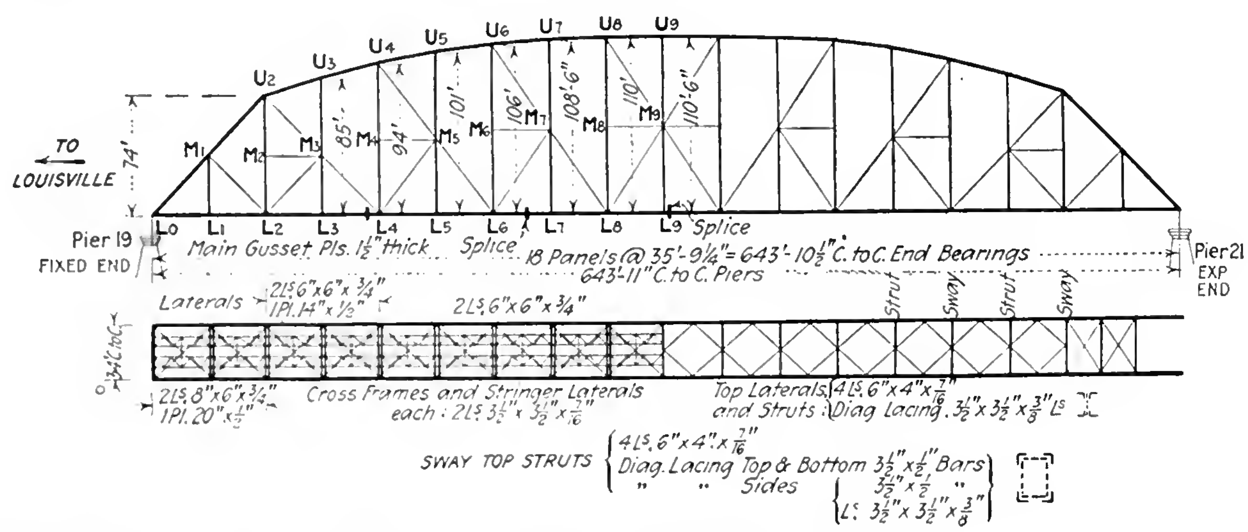
GENERAL ELEVATION, TYPICAL JOINT DETAILS AND CHORD SPLICES OF 644-FOOT RIVETED TRUSS OF THE PENNSYLVANIA RAILROAD'S BRIDGE OVER THE OHIO RIVER AT LOUISVILLE, KY.

the trains directly opposite and passing simultaneously across the bridge.

While the above method was used in obtaining the maximum and minimum stresses for the web members subject to reversal of live-load stresses, the value of ϕ used in connection with the above stresses was based on *immediately successive* values of a maximum and a minimum. It is obvious that the minimum stress described above cannot immediately succeed a maximum stress, or vice versa, until both trains causing the maximum have passed off the bridge and two more trains come on the bridge advancing in the opposite direction, which cannot be considered as producing immediately successive stresses.

It was, therefore, assumed that in order that a maximum and a minimum stress could be immediately successive, the maximum stress was produced by one train on the near track, and the minimum stress by one train on the far track, but facing in the opposite direction. Since the tracks are 13 ft. apart center to center and the trusses are 34 ft. center to center, 69% of the maximum live-load stress was considered

GENERAL DIMENSIONS OF 644-FOOT SPAN — SECTIONS FOR LATERAL BRACING



STRESSES AND SECTIONS FOR 644-FOOT TRUSS OF OHIO RIVE BRIDGE AT LOUISVILLE, KY.

Member	Dead Load Stress*	Live Load Stresses Unif.	Live Load Stresses Conc.	Shock	Total Stress	l/r	Unit Stress, Lb. per Sq.In.
Lo-L4	2919.9	1486.8	62.0	....	4468.7	....	14,890
L4-L6	3923.8	1998.0	83.2	....	6005.0	....	14,890
L6-L8	4440.0	2260.8	94.2	....	6795.0	....	14,890
L8-L9	4744.0	2415.6	100.7	....	7260.3	....	14,890
U2-U3	—3966.3	—2019.6	—84.2	....	—6070.1	20.7	13,760
U3-U4	—3909.7	—1990.8	—83.0	....	—5983.5	20.4	13,770
U4-U5	—4404.6	—2242.8	—93.5	....	—6740.9	20.9	13,740
U5-U6	—4362.2	—2221.2	—92.6	....	—6676.0	20.7	13,760
U6-U7	—4637.9	—2361.6	—98.4	....	—7097.9	21.1	13,730
U7-U8	—4630.9	—2358.0	—98.3	....	—7086.9	21.1	13,730
U8-U9	—4630.9	—2358.0	—98.3	....	—7086.9	21.1	13,730
Lo-M1	—4192.5	—2300.0	—81.8	46.2	—6620.5	29.5	13,120
M1-U2	—3945.1	—2232.0	—81.8	46.2	—6305.1	29.5	13,050
U2-M3	1491.8	1000.0 —156.0	40.9 —25.7	46.2 —46.2	1263.9† 2578.9		14,710
M3-L4	1244.3	932.0 —224.0	40.9 —25.7	46.2 —46.2	948.4† 2263.4		14,330
U4-M5	869.6	776.0 —284.0	36.3 —31.0	42.9 —42.9	511.7† 1724.8		13,680
M5-L6	643.4	712.0 —348.4	36.3 —31.0	42.9 —42.9	221.5† 1434.6		12,890
U6-M7	544.4	688.0 —384.0	37.6 —31.7	39.6 —39.6	89.1† 1309.6		12,380
M7-L8	332.3	628.0 —444.0	37.6 —31.7	39.6 —39.6	—183.0 1037.5		10,900
U8-M9	84.8	532.0 —532.0	37.0 —37.0	39.6 —39.6	693.4! —523.8	71.7	3,930
M9-L8	—212.1	472.0 —592.0	37.0 —37.0	39.6 —39.6	336.5† —880.7	71.7	7,040
M1-L2	—247.5	—140.0	—46.2	—46.2	—479.9	64.6	10,405
L2-M3	—247.5	—140.0	—46.2	—46.2	—479.9	64.6	10,405
L4-M5	—226.2	—28.0	—41.6	—42.9	—438.7	74.0	9,940
L6-M7	212.1	—120.0	—39.6	—39.6	—411.3	80.1	9,630
U2-L2	424.2	400.0	66.0	33.0	923.2		13,140
U4-L4	—643.4	—536.0 332.0	—25.1 36.3	—33.0 33.0	—242.1† —1237.5	49.0	11,010
U6-L6	—268.7	—440.0 448.0	—24.4 37.0	—33.0 33.0	249.3† —766.1	55.3	8,440
U8-L8	28.3	—380.0 524.0	—23.1 35.0	—33.0 33.0	—407.8† 620.3		7,900
U3-M3	70.7	112.5	....	....	183.2		12,470
U5-M5	99.0	127.5	....	....	226.5		12,920
U7-M7	—14.1	67.5	....	....	53.4		7,810
U9-M9	14.1	67.5	....	....	53.4		7,810
Hangers	212.1	200.0	66.0	33.0	511.1		11,320
Reaction	—3181.5	—1800.0	—66.0	—33.0	—5080.5		15,440

Member	Section	Holes Out	Area, Sq.In. Gross	Area, Sq.In. Net
Lo-L4	8 Ls. 8x8x$\frac{3}{4}$ in. 4 Pls. 12x$\frac{5}{8}$ in. 6 Webs 60x$\frac{11}{16}$ in.	16 8 54	369.02	308.12
L4-L6 Add	2 Ins. Pls. 25$\frac{1}{2}$x$\frac{3}{4}$ in. 2 Webs 60x$\frac{3}{4}$ in.	10 18	497.27	412.74
L6-L9	Add 2 Webs 60x$\frac{3}{4}$ in.	18	587.27	487.55
L6-L8	Omit 2 ins. pls. 25$\frac{1}{2}$x$\frac{3}{4}$ in.		549.02	458.36
U2-U4	1 Top Cov. 60x$\frac{3}{4}$ in. 4 Outs. Ls 8x6x$\frac{3}{4}$ in. 4 Ins. Ls 8x8x$\frac{3}{4}$ in. 4 Webs 60x$\frac{25}{32}$ in. 4 Webs 60x$\frac{9}{16}$ in.		453.06	
U4-U6	Add 2 outs. Pls. 43$\frac{3}{4}$x$\frac{1}{2}$ in.		496.81	
U6-U8 U8-U8′	Add 2 Ins. Pls. 43$\frac{3}{4}$x$\frac{7}{16}$ in.		535.09	
M1-U2	1 Top Cov. 60x$\frac{3}{4}$ in. 4 Outs. Ls 8x6x$\frac{3}{4}$ in. 4 Ins. Ls 8x8x$\frac{3}{4}$ in. 4 Webs 60x$\frac{25}{32}$ in. 4 Webs 60x$\frac{9}{16}$ in. 2 Outs. Pls. 43$\frac{3}{4}$x$\frac{1}{2}$ in.		496.81	
Lo-M1	Add 2 Ins. Pls. 43$\frac{3}{4}$x$\frac{3}{4}$ in.		562.43	
U2-L4	4 Ls. 8x8x$\frac{3}{4}$ in 6 Pls. 36x$\frac{5}{8}$ in. 2 Pls. 21$\frac{3}{4}$x$\frac{3}{4}$ in.	8 36 8	213.40	178.90
U4-L6	4 Ls. 8x8x$\frac{3}{4}$ in. 4 Pls. 34x$\frac{9}{16}$ in. 2 Pls. 19$\frac{3}{4}$x$\frac{3}{4}$ in.	8 20 6	151.89	130.17
U6-L8 U8-M9 L8-M9	4 Ls. 8x8x$\frac{3}{4}$ in. 4 Pls. 34x$\frac{7}{16}$ in. 2 Pls. 19$\frac{3}{4}$x$\frac{3}{4}$ in.	8 20 6	134.89	115.60
Sub-Diags.	4 Ls. 6x6x$\frac{1}{2}$ in. 2 Pls. 24x$\frac{1}{2}$ in.		47.0	
U2-L2	4 Ls. 8x8x$\frac{3}{4}$ in. 2 Pls. 34x$\frac{5}{8}$ in.	8 10	88.26	76.0!
U4-L4	4 Ls. 8x8x$\frac{3}{4}$ in. 4 Pls. 34x$\frac{9}{16}$ in.		122.26	
U6-L6 U8-L8	4 Ls. 8x8x$\frac{3}{4}$ in. 4 Pls. 34x$\frac{7}{16}$ in.	8 20	105.26	90.51
Sub. Posts	4 Ls. 6x4x$\frac{7}{16}$ in. 2 Pls. 34$\frac{1}{2}$x$\frac{7}{16}$ in.	8 20	46.94	39.06
Hangers	4 Ls. 6x6x$\frac{1}{2}$ in. 2 Pls. 34$\frac{1}{2}$x$\frac{1}{2}$ in.	8 10	57.50	48.50
Hor.Struts	4 Ls. 6x4x$\frac{7}{16}$ in. 2 Pls. 20x$\frac{7}{16}$ in.			
	8 Rollers 30x8$\frac{1}{2}$ in. x 4 ft. Built Grillage			

* Dead load stress computed for 9,823 lb. per foot of truss. All total stresses given in thousand pound units.
† Minimum stress to determine Φ.

in connection with 31 per cent. of the minimum live-load stress.

The location of the splices in the lower chord was fixed by erection requirements, which explains why a field splice occurs at L_7, the point of maximum stress. This splice is exceptionally heavy, and, although symmetrical about the center line, considerable care was required in computation to insure sufficient net section, and at the same time provide enough rivets to develop the value of the plate. The top-chord shop splice at U_9 is also especially heavy, because all compression members were required to be fully spliced, even though the main sections were milled to bear

The maximum grip of the $1\frac{1}{8}$-in. rivets in these heavy splices was $8\frac{1}{16}$ in. It will be noted that countersunk shop rivets are used to hold the plates together for the purpose of preventing separation under the process of reaming. These stitch rivets proved to be very effective in facilitating the work of assembling in the shop and reaming in place, as was required for all main trusses, and also in field riveting.

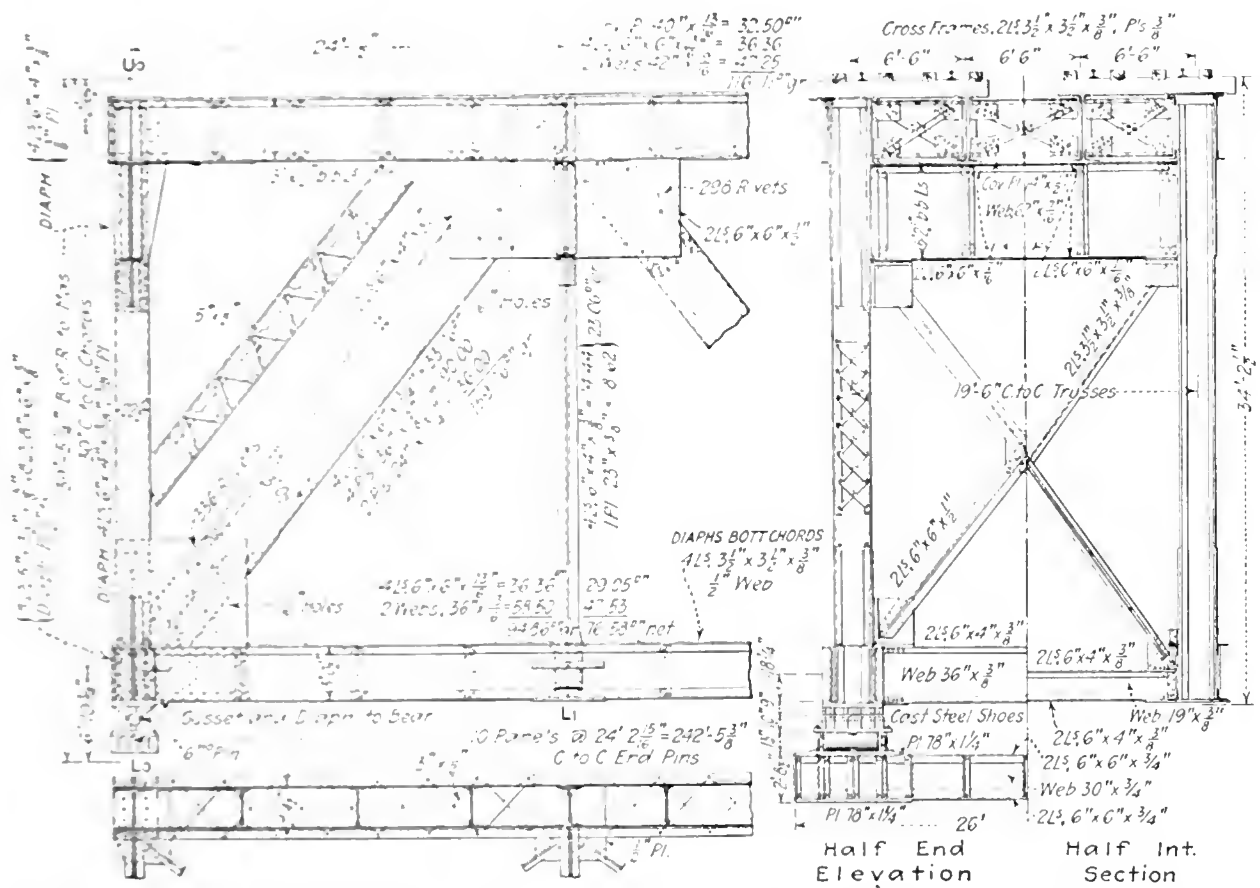
The length of the main plates in these heavy 5-ft. chords was of course limited by the available mill sizes for sheared plates, about 35 ft. This required shop splicing, as is indicated by some of the drawings. Typical joint details are also shown, the heavy hitch angles and the free use of diaphragms being noteworthy. The size of the gusset connection plates was limited by the maximum possible mill sizes, the largest gusset being 130 x $1\frac{1}{2}$ in. at the hip joint U_7.

The hitch angles were made as long as the gusset plates would permit. Longitudinal diaphragms were designed to keep the ends of the main members to exact dimension and facilitate erection, to distribute the stress, and for added stiffness. The intermediate diaphragms in all main members were especially valuable in keeping such large sections out of wind. Drain holes in the plates of these diaphragms were provided to permit the water to run off and prevent rusting.

As seen in the detail drawing, the end shoe is of unusually heavy design and is bored for 24-in. pin; at the expansion end the span is supported upon segmental rockers of $2\frac{1}{2}$ ft. diameter. The main bearing plate is supported by exceptionally heavy grillage girders, as illustrated in the drawing. These substantial pier caps simplified the placement of the end shoes, as any relatively small inaccuracy would not be of such importance as if they were set directly on the masonry.

Typical Details of Deck Spans—The Warren or triangular type was selected for the deck trusses because of its advantages in economy and simplicity of details. The cross-section and the typical details of the 242-ft. deck spans are reproduced, particularly to show the floor construction with track ties supported directly on the top chords of the trusses, the sway bracing, and the details at the main panel points. Hitch angles, countersunk stitch rivets, longitudinal and transverse plate and angle diaphragms were used for the main end diagonals in a manner similar to the corresponding details in the 644-ft. span. The lower struts of the sway bracing were made particularly stiff, and required special hitch connections, as indicated.

The lift span to replace the drawbridge had been promised by the railroad company with the object of providing a clear channel for the full width of the canal. The greater proportion of all the water traffic is passed through this canal and not through the main channel of the river.



TYPICAL DETAILS OF 242-FOOT DECK TRUSSES CARRYING FLOOR ON TOP CHORDS


LIFT SPAN CAN BE RAISED 32.5 FEET IN 45 SECONDS

Lift Span Features—This span, 260 ft. long between centers of end bearings, is also of the riveted-truss type with triangular web system, and with curved upper chords. It can be lifted 32.5 ft. in 45 sec. The design of the lifting mechanism has certain modifications found from experience with the lift span of the Pennsylvania R.R. in Chicago to be advantageous, as follows: Chains with cast-iron links, as seen in one of the photographs, are swung from the towers to the bottom of the counterweight for counterbalancing the steel cables and maintaining balance for all positions of the span. An effective pneumatic cushioning device, which acted in connection with a centering device, was developed. In order to keep the lifting cables at fixed angles and prevent movement and consequent wear on the equalizer pins, cast-steel rope clamps were designed, held in position by high-strength steel links, providing for sixteen 2¼-in. cables to carry a total load of 660,000 lb., one quarter of the span weight.

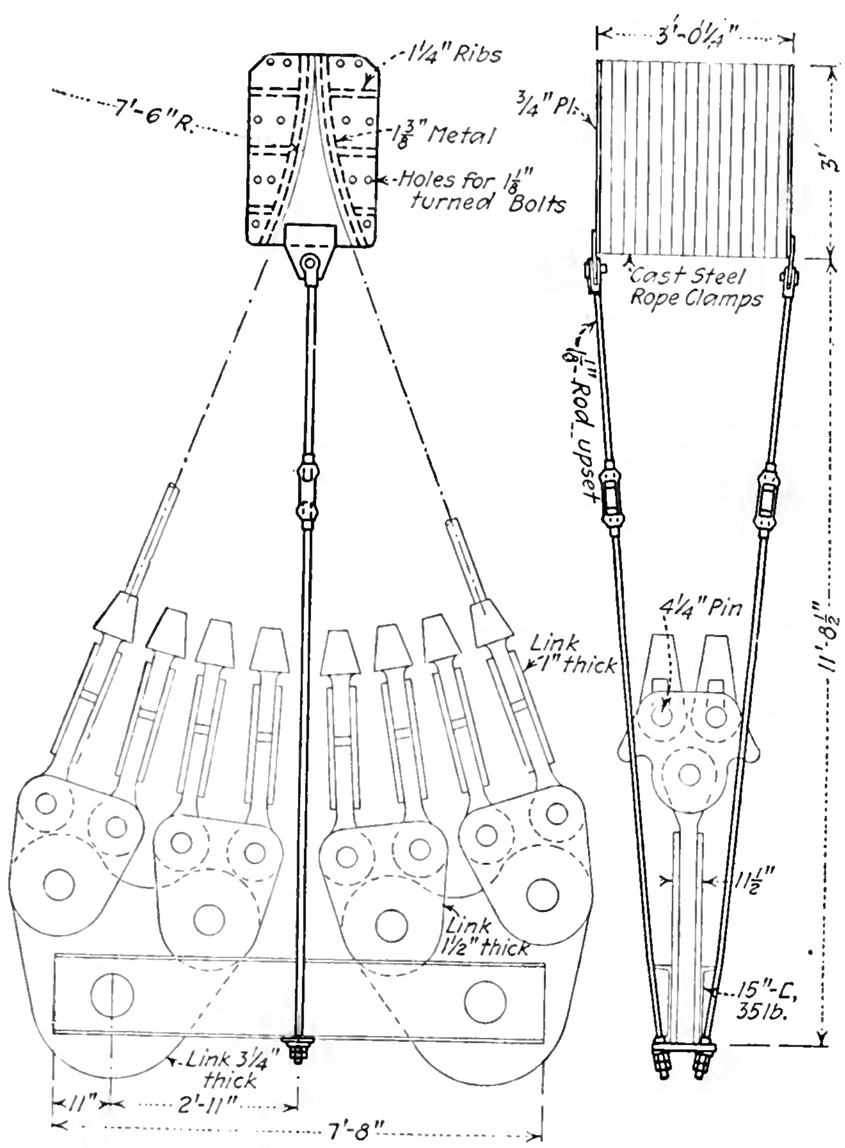
The counterweight sheaves, the heaviest yet constructed, are built up of steel plates, angles and castings. Each rim segment is fastened to the side plates by sufficient rivets to take the entire load coming upon it from the ropes. Between the segments ½-in. spaces were left, to avoid trouble if the lengths of the segments should overrun. Originally, it was intended to fill these spaces with hemp, but the cutting tools gave trouble when the machining of the grooves was begun, and it was necessary to fill them with babbitt. Trouble from bad fit of the side plates on the hub casting was eliminated by making the side plates bear directly on the shaft, instead of on the hub casting. The hole for the shaft was bored out after the sheave had been completely assembled and riveted. The hub is keyed to the shaft by three 1½ x 1-in. keys, secured from longitudinal movement by setscrews. The bearings are lined with phosphor-bronze bushings.

On account of the relatively large amount of play in the vertical guides, they do not center the span closely enough for the rail locks, which have very little play. Therefore a transverse centering casting, having small play, is placed at the middle of each end floor-beam. This is an improvement over the previous practice of using centering castings at each L_0 point, in which case considerable play had to be left in order to provide for expansion and contraction, and they did not center the span accurately enough for the locks.

To eliminate the jar when the span comes to a bearing, air buffers near each end of each of the end floor-beams were provided. Adjustable needle valves on the exhaust ports of these buffers permitted the variation of the resistance at will. Bridge locks were not used, but the counterweights were made about six tons lighter than the span, the excess weight of the latter overcoming any tendency for it to rise.

The towers are 105 ft. high from the top of the masonry to the center line of the 15-ft. main cable sheaves; the span when lifted 32 ft. gives a clear headroom of 79 ft. above the pool level of the canal. Provision was made in the detailing of the connections between floor-beams and vertical posts of the lift span to permit the former to be raised vertically if necessary, to provide for a change in grade of this approach over the canal. This was done because of the possibility of later grade-separation development in the City of Louisville.

J. C. Bland, engineer of bridges, Pennsylvania Lines



ASSEMBLY OF EQUALIZERS AND ROPE CLAMPS—LIFT SPAN, LOUISVILLE BRIDGE

West of Pittsburgh, personally designed the through-truss spans, and all details were developed under his supervision, using the standard specifications of the Pennsylvania Lines West. The contractor for the manufacture and erection of the entire bridge was the Pennsylvania Steel Co., which before the termination of the work was absorbed by the Bethlehem Steel Bridge Corporation. The erection was done under the supervision of W. W. Priest, assistant engineer of bridges, Pennsylvania Lines West. The mill and shop inspection, as also the field inspection, was in the hands of F. M. Masters, of Harrisburg.

The work was begun and all contracts were made by the Louisville Bridge Co., the original owners, which company was succeeded by the Louisville Bridge & Terminal Co., a subsidiary of the Pennsylvania company, the present owners of the property.

Freight Distribution by Motor Trucks

Having 900,000 sq.ft. of warehouse storage capacity, closely connected with the terminals of the New York State Barge Canal, Callan Bros. of New York City, receive and distribute merchandise in that city and throughout New England, New Jersey, Delaware, Pennsylvania, and other seaboard states, by operating forty 7½-ton trucks on schedules indicated in the following table:

	Miles	Hours per Trip
New York to Philadelphia	100	12
New York to Baltimore	188	22
New York to Dover, Del	172	21
New York to Waterbury, Conn	95	11
New York to New Haven, Conn	77	9
New York to Bridgeport, Conn	58	8
New York to Hartford, Conn	113	16
New York to Springfield, Mass	139	18
New York to Worcester, Mass	190	23

Operation of Fine Sewage Screens at Long Beach, California

Tests Indicate That Screens Remove 16.3 Per Cent. of Solids—Screenings Incinerated by Gas—Operating Costs

EXPERIENCE with the Riensch-Wurl screens for more than two years at Long Beach, Calif., indicates that gas is cheaper than oil as a fuel to incinerate the screenings, that the screens need renewal after two to three years' use, that the average cost per 1,000,000 gal. has been $10.92, and that the installation has served its purpose of keeping the beach clean in an inoffensive manner.

A description of this 14-ft screen with $\frac{1}{32}$-in. slotted holes, handling 2,600,000 gal. of domestic sewage of 22,000 persons appeared in the *Engineering News* of May 4, 1916, p. 836. The operation as described in a report by engineers of the state board of health is as follows:

The cans of screenings are hoisted by hand by means of a chain-and-gear-set suspended from a track on the roof, and emptied into the top of an incinerator. The incinerator is 7 x 15 ft. in plan, and 8 ft. high. It is of brick and is lined with firebrick. On the inside are three platforms, equally spaced one above the other, built of firebrick with openings about 1 in. wide between the rows of bricks in the two upper platforms so that they serve as grates. At one end of each of the upper platforms is a large opening through which heat and fumes may pass. These openings are at opposite ends of the platforms, so that the circulation is forward and back and forward again as the current travels downward and out toward the chimney. The screenings are placed on the top platform, where heat is applied in the form of burning gas blown in on top of the screenings together with a blast of air. Occasionally during the burning the screenings are raked over, which causes part of them, together with ashes, to drop through the grate openings onto the platform below.

Gas Substituted for Oil to Burn Screenings

Prior to April, 1917, oil was used as a fuel for incinerating. Natural gas was then substituted because it was easier to handle and cleaner. Also, with oil at present prices gas is more economical.

The volume of screenings is measured in the can whenever a can is emptied into the incinerator. The screenings have practically the same weight as water. An average of five hours a day is required for burning. The screenings of each 24 hours are all burned at once. About one wheelbarrowful of ashes is produced during each burning. For an estimated average flow of 2,600,000 gal. daily the screens removed about 70 cu.ft., with a moisture content of about 87%. Burning with oil required 0.8 gal. per cubic foot at a cost of 2.5c. The gas consumption was 81.4 cu.ft. per cubic foot of screenings, at a cost of 3.5 cents.

The electric power used averages about 75 kw.-hr. per day, of which about 55 kw. are used to operate the screening plant, and the remainder for pumping.

Under normal operation there is an almost complete absence of offensive odors. No indications of sewage are visible in the ocean. Around the outlet sea gulls are notably rare.

Some experiments carried on with composting screenings gave rise to slight odors in the immediate vicinity of the work. The experiment consisted of preparing a bed of sand 6 in. deep, placing over it 6 in. of screenings and then covering with 6 in. of sand. After a few days the entire volume of sand and screenings was spaded and mixed. Another experiment consisted of drying the sludge in a nearby fish canning plant used to dry fish offal. Analysis indicated a value of $35 per ton dry on the basis of $5 per ton per nitrogen unit.

After about two years' use the brass screen plates began to show wear. The brushes rub the plates in a line transverse to the slot openings, which probably facilitates rapid wear around the slots and also tends to hasten clogging. It is intended to try out a new type of plate in which the slots will be sawed along the line of travel of the brushes on their upward sweep. The brushes are renewed twice a year at a cost of $44 a set.

Tests to Determine Work of Screens

Tests made in May, 1916, on eight composite consecutive samples, each sample representing about 2½-hour periods in one-half-hourly portions taken from 10:15 a.m. to 4 p.m. the next day, gave an average removal of 43.5% with a minimum of 10% and a maximum of 62.7%, as indicated by settleable suspended matter. At the time the test was made the 50-cc. samples dried and weighed in the Gooch crucible did not give very dependable results. The amount used was so small that it appeared a large error crept into the results. Some of the screened samples tested in this manner showed a higher residue than the raw sewage, which condition is accounted for more by the inability to obtain fairly average samples of raw sewage than by inefficient screening. The test was not considered very satisfactory.

Later tests were made in 1918, under the direction of W. J. Knowlton of the Los Angeles sewer department, by J. W. Geeks, head of the substructure department. The following notes are abstracted from his report:

No odor was noticeable 200 ft. from the plant. When the fire is drawn from the incinerator the incompletely consumed ash is the greatest source of odor, but the ash is quickly disposed of.

Samples to determine the amount of solids removed were taken below the screen rather than above, because of the more uniform character of the effluent. Above the screen representative sampling was impossible because of the heavy flow of solid matter on the invert moving at a slow rate. A sample 4 x 4 in. in cross-section was taken, extending from the surface to the invert, but this, compared with samples taken at and below the screen, showed a ridiculously large amount of solid matter.

Two-gallon samples were collected every hour and placed in a 7-cu.ft. sludge can. After they had settled 20 hours the clear water was siphoned off and the resi-

OPERATING EXPENSES PER MILLION GALLONS

Fuel oil	$0.700
Fuel gas	0.909
Electric power	0.868
Electric lighting	0.128
Salaries	2.690
Supplies	0.359
Repairs	0.213
Office overhead	0.383
Interest at 5% on investment	2.097
Depreciation	2.574
	$10.921

due was collected and weighed, when the moisture was judged to be the same as that of the screenings. Proper corrections were made for variation of quantity of flow and of "density"—i.e., the relation of the flow of the sludge to the flow of sewage. Dried samples indicated that the error in the method was within 6% of being correct.

Data obtained May 7, 13 and 14, and on Jan. 3 and 4, 1918, when the average, maximum and minimum daily rates were 2.6, 3.9 and 1.5 million gallons, indicated 1810 lb. per 1,000,000 gal. removed, equivalent to 16.2 per cent.

Unit costs based on a period between Mar. 31, 1917, and Apr. 28, 1918, from records kept by Charles B. Murphy, superintendent, are given by Mr. Geek as shown by the accompanying table.

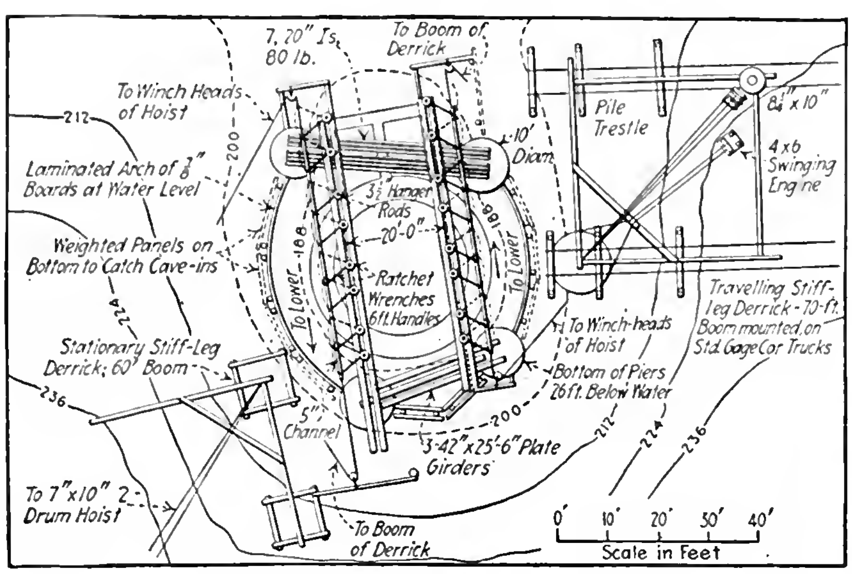
The investment per 1000 population within the sewered district is $181.80, and the yearly operating cost per each thousand of the city's population is $181.20.

Sinking a Concrete Pumping Station in a River

House Consisting of Concrete Cylinder 30 Feet in Diameter Is Lowered While Being Built From Frame Controlled by Ratchet Wrenches Tied Together for Simultaneous Movement

By Keith O. Guthrie
Engineering Contractor, Schenectady, N. Y.

Feed and condensing water for the General Electric Co.'s Schenectady, N. Y., plant is now supplied from an abandoned stretch of the Erie Canal maintained at level from a new pumping station on the nearby Mohawk River. The main house for this station, a cylindrical concrete shaft, was built in the severe winter



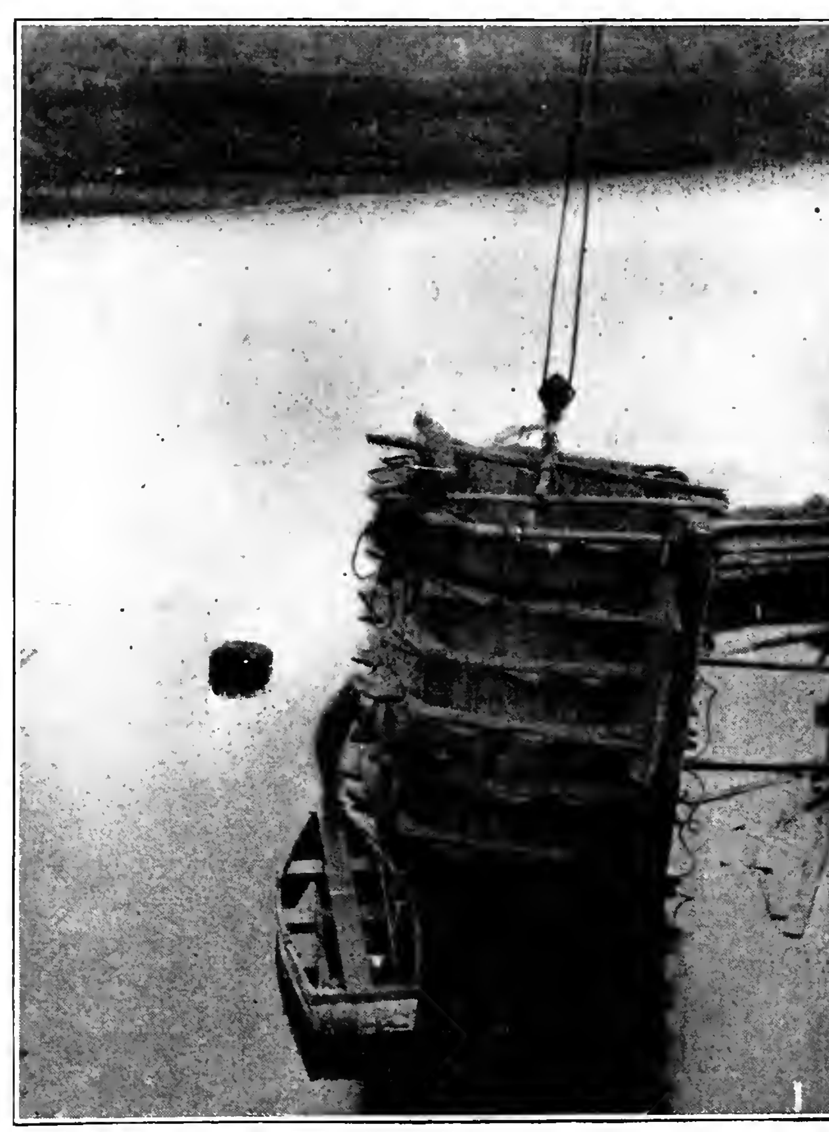
LAYOUT OF PLANT AND STRUCTURE USED IN SINKING CONCRETE CYLINDER PUMPING STRUCTURE

of 1917-18 by a novel method. Temporary piers were sunk around the site, and on them, as foundations, a platform forming the bottom of the house was hung by rods, which were controlled by wrenches tied together so as to permit simultaneous operation. The house was then built up on this platform, and was lowered as the walls progressed in height.

The station is located between the river and the canal where the river bank is only 80 ft. from the towpath and on the outside of a bend in the river, making it likely that the current would make the intake free from silt. It is in the water, the contours of the bottom running around 188 where 212 is the normal shore line. The pump-room floor is 15½ ft. below normal summer river level and about 40 ft. below record stage. The material at the site is a compact, coarse, water-bearing gravel, unsuited to any kind of cofferdam.

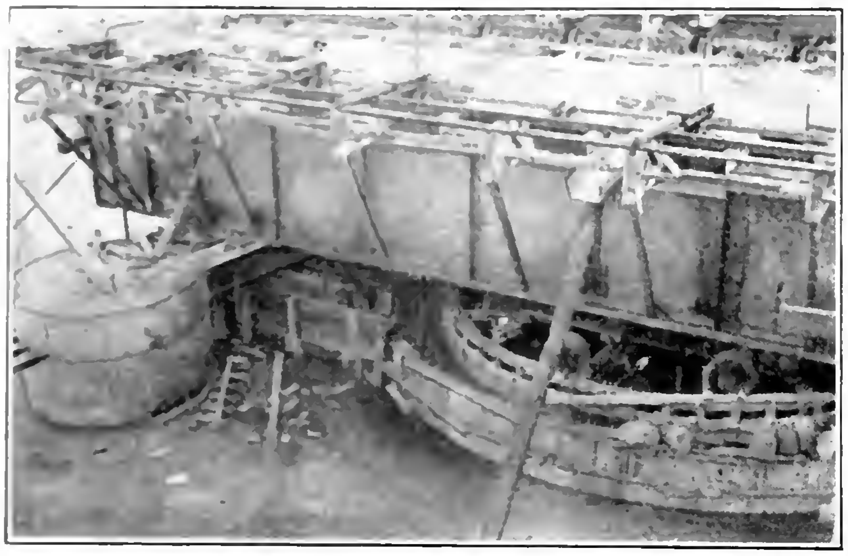
At the start of the work a 2½-yd. dipper dredge made 16 ft. of water over the site of the house and for about 20 ft. around it. The spoil was removed in scows. At the same time, stiffleg derricks were erected on either side of the cut; these operated 1¼-yd. clamshells and completed the excavation to 24 ft. below water level.

When excavation had been roughly completed, four piers were built around the location of the house, as shown in one of the drawings. The forms for these piers were round barrels, of 10-ft. inside diameter, and 30 ft. long, with outside ribs of 2 x 10-in. plank lapped and well spiked. To provide a cutting edge and also weight for sinking, a reinforced-concrete ring was attached to the bottom of each form. The complete form units weighed about eight tons, and were set in place by the derricks and guyed. It was desired to have these piers extend at least 2 ft. below the grade



LOWERING FORM FOR SUPPORTING PIER INTO MOHAWK RIVER

of the excavation for the house, so as to secure the full bearing power of the gravel. The forms were sunk quite readily by excavating inside them with the clamshell. As soon as a form reached grade, nine 45-ft.



CONCRETE BEING PLACED AT SAME TIME HOUSE IS LOWERED

piles were driven inside with a five-ton steam-hammer to practical refusal, which came at from 15- to 20-ft. penetration. Concrete was then placed by tremie, and the piers were brought to 9 ft. above water and capped with a grillage of old rails.

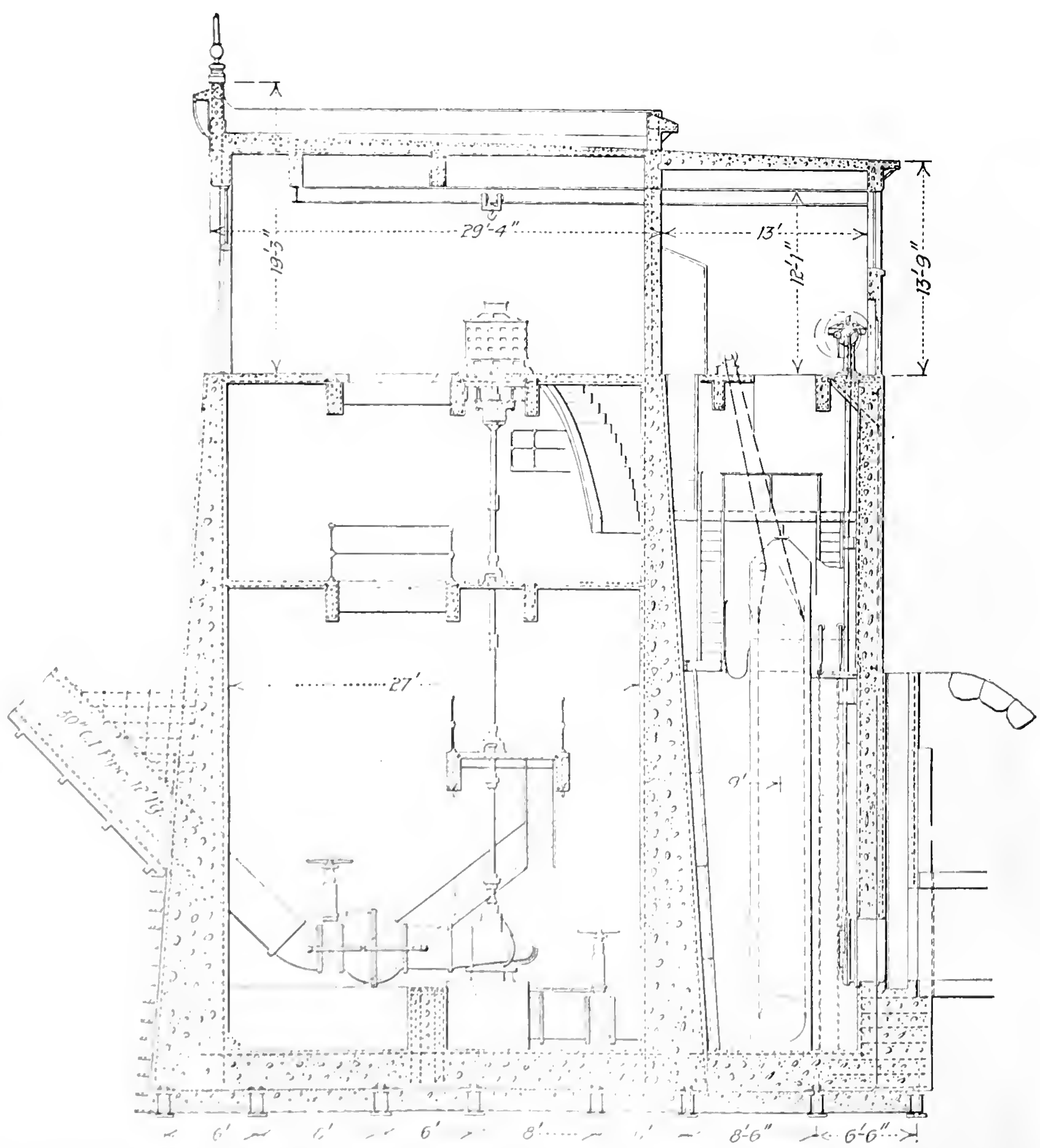
The two inshore piers were then bridged by three 42-in. plate-girders, and the two outshore piers by eight 20-in. 80-lb. I-beams. Both the girders and the I-beams were girdled with heavy clamps, and the space between the webs was filled with concrete from pier to pier, to resist lateral buckling under load. In addition, the girders and beams were securely anchored into the pier tops, to minimize the danger of any pier leaning.

Seated on the cross-beams and the cross-girders were two pairs of heavy plate-girders, from which hung the suspender rods that carried the house itself. The girders of each pair were spaced with the flanges just far enough apart to pass the connecting sleeve-nuts of the rods. The girder pairs were spaced on 20-ft. centers. Pains were taken to give the main girders evenly distributed bearing as well as an anchorage to the beams and cross-girders on which they were seated. The girders of one pair were 6 ft. deep by 58 ft. long, of the other pair 7 ft. deep by 67 ft. long. Both sets were built to Cooper's E-50 specifications and were bought from the American Bridge Co. out of a bridge built for a railway project that was abandoned.

To secure maximum supporting power from the main girders, they were cantilevered at the screen-well end for about 12 ft., giving roughly the same bending moment at the outshore piers as at the middle of the long span.

Eight $3\frac{1}{2}$-in. V-threaded rods were hung from the top flanges of each pair of girders. At each rod the girders were bridged with a pair of 10-in. 30-lb. channels on which rested the washer carrying the lowering nut. To obviate the danger of the nut cutting under a load of at least 30 tons and possibly much more, the washers were made of two $1\frac{1}{2}$-in. plates, of 16-in. diameter, with the faces in contact faced, oil-grooved in opposite directions, and packed in light grease.

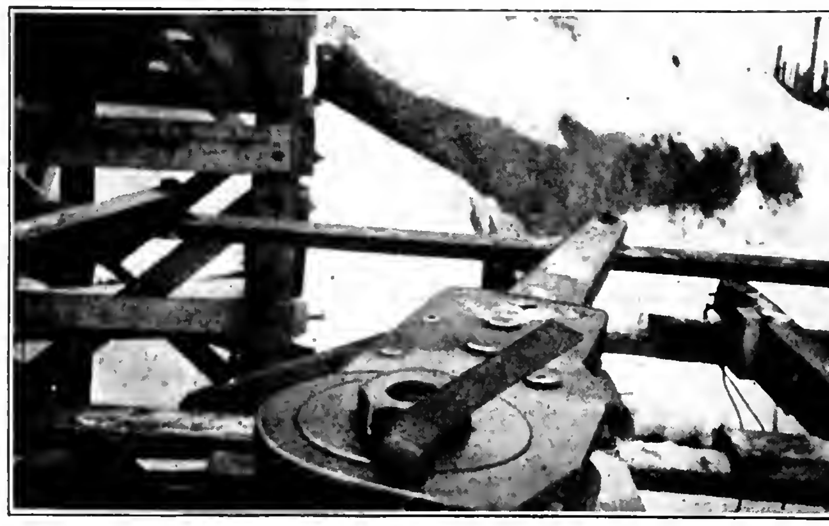
The lowering nuts were 12 in. long, of standard hexagon section, and were engaged by ratchet wrenches with 6-ft. handles, as shown in the views. The ends of the wrench handles were bolted to 5-in. channels, one on either side of the house. Lines ran from each end of the channels to derrick hoists seated on temporary trestles outside the house area. These lines operated the wrenches back and forth in unison, each movement giving the nuts one-sixth turn. Electric door-switches, engaged by the moving channels, rang bells in the engine-rooms to indicate to the hoist-runners the limits of the stroke.



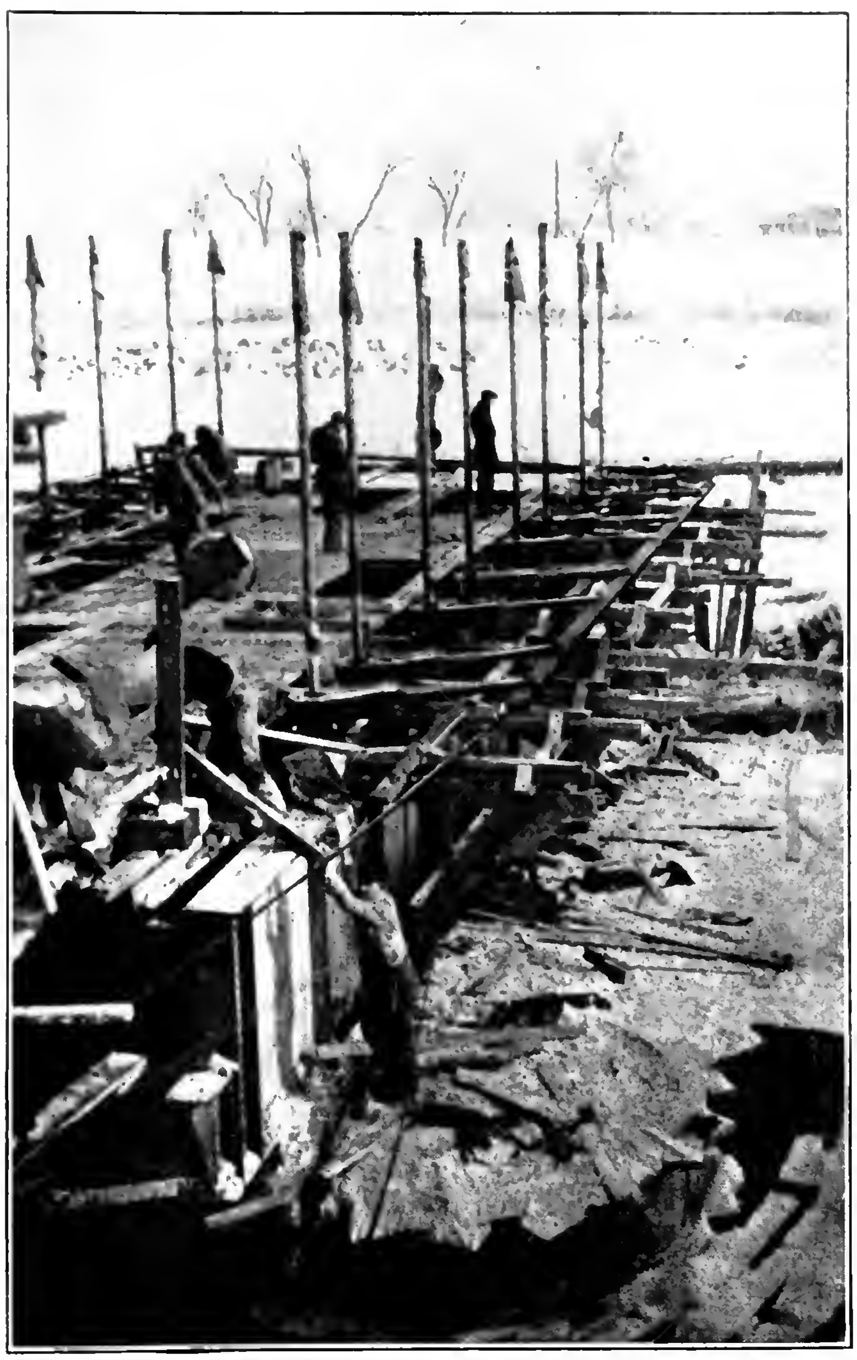
VERTICAL SECTION THROUGH PUMPING STATION SHOWING ALSO DETAILS OF SUPPORTING FLOOR

Opposite rods supported pairs of 15-in. I-beams which formed a floor under the entire house. As erected, these beams just reached the water. They were tied together with $\frac{3}{4}$-in. tie-rods, on 4-ft. spacing, and separated by a 4-in. wooden floor resting on the bottom flanges. After the first ring of the outside forms was set, resting directly on the floor-beams, a subfloor of concrete was placed, covering the top flanges 2 in. and with an 18-in. fillet at the outside form. On this subfloor and up the outside forms were laid five layers of patent roofing felt very thoroughly mopped with waterproofing pitch. This work was done by Craig & Vrooman, of Schenectady. The reinforcement, inside wall forms, and forms for the inverted floor-beams were then placed and concreted. The house was lowered at the same time, keeping the level of the concrete about 1 ft. out of the water. The best progress in lowering at any time was 15 in. in an hour.

The outside forms were built 1 ft. higher than the inside, to provide a lap for the waterproofing of the succeeding lift. No difficulty was experienced in lowering fresh concrete into the water. Frequently, concrete in the walls an hour old was under water—amply protected by the five-ply waterproofing. This waterproofing passed a remarkable test one night when a thaw up the valley caused a sudden rise in the river. Before a gang could be brought out from the city and concreting started, the water level was 20 in. above the concrete in the walls, and at one point 3 ft. There was not so much as a drop of leakage through the outside forms. While it has always been customary to place waterproofing against such a masonry wall, this was dispensed with on the work, to save time and expense. It is believed that the wooden forms—always under water—will prove a permanent protection.



CLOSE VIEW OF ONE OF THE RATCHET WRENCHES



OPERATING WRENCHES ON ONE SIDE TIED TOGETHER FOR SIMULTANEOUS OPERATION

It was felt in advance that the chief danger in this method of lowering a heavy structure lay in the possible settlement of one of the piers. It was conceivable that a material relative settlement of one pier would concentrate the entire weight on a few rods, overloading and even snapping them, with consequent disaster. To guard against this possibility, a great deal of care was taken with the piling and concreting of each pier. The rods were made heavier than required for even loading, and the subfloor, on which the house proper was built, was made flexible in one direction. The first pour of the house, including the floor and a portion of the walls, weighed about 600 tons. This was cast without being lowered into the water, with the idea that this entire load would be likely to bring about immediate and maximum settlement and, being fairly flexible up to this point, would adjust itself to any relative settlement of the piers. As it developed, however, there was no observable settlement in any pier.

A further fear was entertained that, through unequal running off of the lowering nuts, some of the rods might be overloaded. Considerable thought was given to the application of strain-gages, but it was soon found that an underloaded rod shifted on its support as the heavy wrench swung back and forth, while an overload rod groaned. A one-sixth turn of the nut—about $\frac{1}{20}$ in. on the rod—was usually sufficient to equalize the loading.

The hanging equipment went through a very severe test in the early part of February. The house had been lowered 16 ft. into the water, a set of forms made ready for a new pour, and the entire structure covered with a board house as protection against the severe cold. A fire, started presumably by a salamander, consumed forms, runways, and protection housing, to the water edge. The girder webs were badly buckled and one girder sagged 2 in., but, after the forms were made good, the lowering was resumed without any difficulty except in lubricating the lowering nuts.

The method of construction was developed by the writer, and the station design was worked out by him in consultation with A. W. Nesbit, superintendent of

power, and C. G. Hulth, superintendent of grounds and buildings, of the General Electric Co. W. R. Abbott acted as construction engineer and James J. Fahey as superintendent.

Flat Slab Substituted for Groined Roof of Reservoir

Money Saved in Dayton Water-Works Structure Due to Less Concrete and Excavation and Simpler Forms

By H. C. Wight
Superintendent, Division of Water, Dayton, Ohio

Groined arch roofs have been the practice in concrete flat-top reservoirs for a number of years. Only occasionally has another type of design been utilized. In the recently completed reservoir for the water-works of the City of Dayton a flat-slab reinforced-concrete roof was substituted for the groined roof originally designed and it is the opinion of the engineers that this revision, together with a lower amount of excavation required in the new design, resulted in a considerable saving to the city.

An additional water-supply for the city has been under way for about five years. One of the main improvements, planned in 1917 and completed last autumn, had a capacity of 10,000,000 gal. It is located in the hills to the south of the city, on a site of about four acres. It is in a flat-top reinforced-concrete structure sunk about half its depth in the original surface and covered over with 2 ft. of loam to keep the water cool and to prevent freezing.

INSIDE OF DAYTON RESERVOIR JUST AFTER FORMS WERE STRIPPED

HEAVY GRAVITY CONCRETE WALL FORMS SIDE OF FLAT-SLAB TOPPED RESERVOIR

The contract was first offered July 31, 1917, at which time bids were received on the groined-arch type of construction. These bids were rejected on account of their being excessive. Apparently, the contractors were afraid of the groined arch on account of the complicated form carpenter work required and the shortage in that war year of carpenters. Accordingly, a second design was made, and alternate bids were opened Sept. 17 of that year for the groined arch and the new flat-slab type.

These bids were rejected on account of a technicality and a third letting on the same types occurred on Oct. 5. Contractors in this letting were allowed to submit alternate designs and bids, and the award was made on the flat-slab design at an amount about $60,000 less than the lowest bid in the first letting and $10,000 less than the lowest groined-arch bid in the last letting. The unit prices on this low-groined arch bid, however, were considerably lower than the bid accepted, and it is doubtful if the margin of profit for the contractor would have been as large.

The design accepted was submitted by the contractor, the Danis-Hunt Co. of Dayton, Ohio, and was prepared by Nelson J. Bell, engineer with Schenk & Williams, architects, of Dayton, Ohio. The savings in this design are due to three things: The formwork, the excavation and the concrete.

At this time lumber was very hard to get, owing to the heavy demand. The flat-slab roof design was much simpler, so far as formwork went, and the lumber was used actually some three times with a very small amount of cutting.

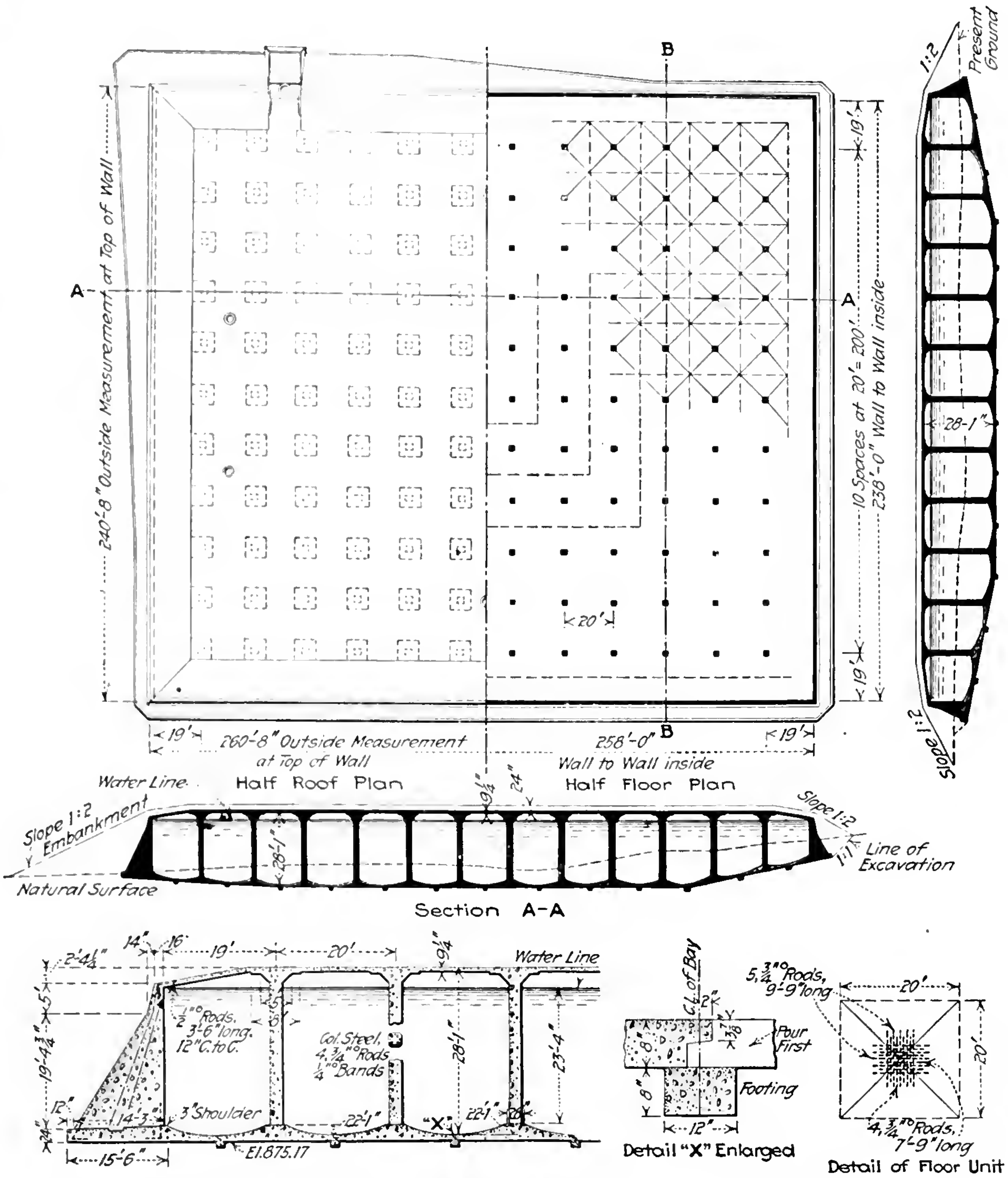
The class of saw-and-hatchet men available could handle the work with reasonable speed. In excavation, the fact that the new design utilized a bottom slope, as shown in the drawing, saved some 7000 cu.yd., about 26,000 yd. of dirt being handled as compared with the 32,700 that were estimated for the straight-bottom groined arch.

This would have been more had the reservoir been located on level ground instead of on the side of a gradual slope.

The third saving effected in the concrete is due to the fact that the groined arch required 8820 cu.yd., as compared with 7902 cu.yd. for the flat slab. However, in the actual construction the roof was increased from

8 in. to 9.25 in., so somewhat more concrete was used. The final payment was $136,760, as against the bid of $133,934, which compares with the $193,412 bid on the first groined arch.

General details of the reservoir are shown in the accompanying drawing. As will be seen, it has a groined-arch floor with gravity side walls retaining the embankment and a flat-slab roof supported on columns on 20-ft. centers, footing on the rise of the floor groins. The bottom is sloped up on all sides for reasons of economy, as stated. The retaining walls, as shown, are built separate from the floor with a dap joint there and at the vertical construction joints. The groined-arch floor is also designed to be laid in square sections with expansion joints, as shown in the details. Under each joint there is a concrete block 12 in. square by 8 in. thick. There has been no leakage through these joints to speak of. The only place waterproofing or asphaltum was used was in the roof, over the joints there. The reservoir was designed and constructed under the direction of J. E. Barlow, director, Department of Public Service, with the writer as superintendent of the Water Division. Leonard Metcalf, Boston, was consulting engineer.



RESERVOIR HAS FLAT-SLAB REINFORCED-CONCRETE ROOF

Speed and List in Side Launching of Ohio River Boat

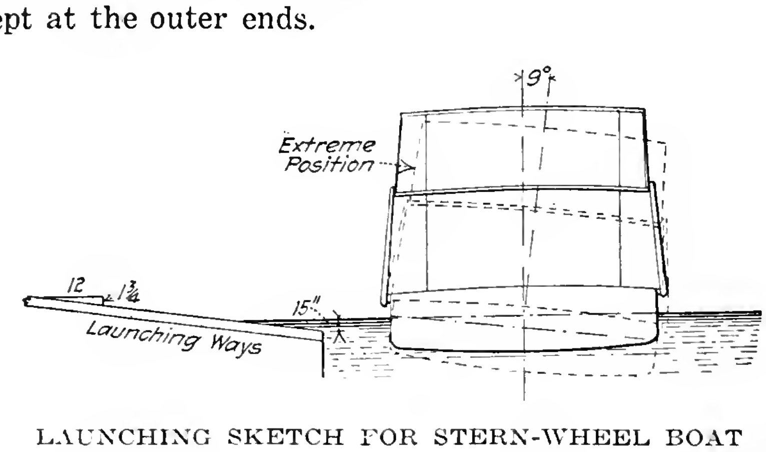
At the launching of the stern-wheel river towboat "Warren Elsey" at Neville Island, near Pittsburgh, Mar. 29, engineers for the Dravo Contracting Co. of Pittsburgh, the builder, made observations of the behavior of the vessel during the launch.

Briefly, they found that the boat was moving at a speed of 16 ft. per second when she left the ways, which were laid on a slope of 1¾ in. in 12. Upon striking the water the boat listed 9°, as determined by a glass U-tube, with legs spaced 3 ft., half filled with thin paint; an attempt to measure the list by a pendulum consisting of a 10-lb. weight on a 24-in. arm was unsatisfactory. On recovery the boat listed 5° in the opposite direction. At the time of dropping from the ways it dipped 18 in. lower at the stern than after it came to rest, presumably because of the inertia of the machinery. The boat moved square to the ways, dropping off with not over 6 in. lead of one end over the other, as determined by two observers sighting past range poles.

An unusual feature of this launching, for Ohio River practice, was that the boat was practically complete, all equipment having been installed on the ways, including engines, boilers and stern wheel. Its launching weight was 367 tons, corresponding to a draft of 2 ft. 8¾ in. forward and 4 ft. 3⅜ in. aft.

The boat itself is of steel, but the crew's quarters on the upper deck are of wood. Its length over all is 162 ft., and the length of the hull 137 ft. 5 in.; its beam is 27 ft. and its depth 6½ ft. It carries a wheel 20 ft. in diameter by 18½ ft. long. Power is furnished by tandem-compound engines 14 and 30 in. by 72 inches.

The vessel was carried on four pairs of launching cradles equally spaced. Of these the stern cradle carried the heaviest load, 111 tons, equivalent to 4.1 tons per square foot on the sliding surface. As indicated in the sketch herewith, the water ends of the ways are submerged 15 in. The ways rest on concrete piers except at the outer ends.



LAUNCHING SKETCH FOR STERN-WHEEL BOAT

Concrete Used to Patch Worn Brick Paving

Old Surfacings, Broken Up by Excessive Loads, Have Been Successfully Repaired by this Method in Cuyahoga County, Ohio

PATCHING with concrete is the method used to repair some of the older, brick-paved roads in Cuyahoga County, Ohio. The patches vary in size from small areas to those covering 400 to 500 sq.ft. Repairs of this kind were made on a road leading west from Cleveland, where the brick paving had been partly broken up, due to its light construction, by dense traffic, consisting largely of heavy loads for the American Shipbuilding Company's plant at Lorain, Ohio. The repairs are shown in the accompanying views.

The brick surface, which was placed some years ago, rests on a 2-in. sand cushion over a 6-in. base of rolled slag. While unsuited for the heavy traffic it is now called upon to carry, reconstruction was out of the question during the war, so that the best method available had to be used to keep it in serviceable condition. Experiments were first made by repairing the broken parts with crushed stone and cut-back bitumen, but this type of patch did not give satisfactory results. Concrete was then tried, and has proved successful.

CONCRETE PATCH BEING MADE ON WORN BRICK HIGHWAY IN CUYAHOGA COUNTY, OHIO

All worn and broken brick are removed, the projecting halves of alternate brick being broken off, so that a vertical base is provided. The old base is dug out, and the subgrade is tamped. A new base of 1 : 2½ : 5 concrete is then placed, using crushed slag for the coarse aggregate. On this is laid a 2-in. wearing course of 1 : 1 : 2 concrete made with crushed granite ¼ to ¾ in. in size as the coarse aggregate. The patches are from 10 to 12 in. in thickness. The concrete is struck off level with the surrounding pavement and is finished with a concrete pavement roller, where practicable. Care is taken to make sure that the patch does not project above the adjacent brick surface. It is protected from traffic for at least two weeks, a precaution which is considered of the greatest importance.

COMPLETED CONCRETE PATCHES IN BRICK ROAD

The work is done by a maintenance gang, using materials which have been distributed along the road in the required quantities. The concrete is mixed by hand for the smaller patches and a small mixer is used for the more extensive repairs. Where patches extend more than half across the pavement the surface is reconstructed in sections so that traffic will be hindered as little as possible.

The work is carried out under the direction of J. F. Gannon, superintendent of road repairs for Cuyahoga County.

Fire-Service Connections Menace Pure Water Supply of Cities

THE relation between domestic and fire supplies of water in small towns received careful consideration at the recent meeting of the Minnesota Section of the American Water-Works Association, at Minneapolis. That the state board of health, which must pass on all plans for small cities, has had considerable trouble in correcting some undesirable conditions was shown in a discussion of the dangers of polluting a public water-supply by means of private fire-supply connections, following papers on "Water-Works as Fire Protection," by H. F. Blomquist, of St. Paul, and "Features of Design in Small Water-Works" by F. H. Bass, of Minneapolis. A resolution was passed requesting the parent association to appoint a committee to secure standard practice and coöperative action in order to combine fire protection and sanitary conditions, with a view to placing these features under local or state control.

That legal responsibility for pure water rests on the municipal officials is indicated by the decision in the Mankato case, according to a paper by John Wilson, of Duluth. This case arose from sewage pollution of the artesian supply, due to floods in the Minnesota River in 1908.

Mr. Wilson pointed out that fire supplies planned to supplement the municipal supply are responsible for any contamination due to such supplementary supply. A resolution was passed opposing the use of cross-connections between a polluted fire supply and a pure or purified public supply. This resolution also commended the state board of health for its work along these lines.

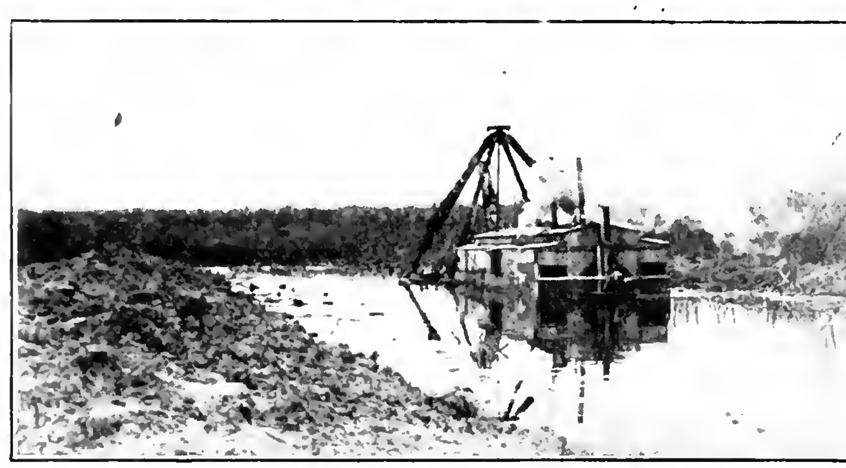
Inspection of Drainage Ditch Cross-Sections After Contract Dredging

Soundings First Made by Level Rod Gave Way to Lead and Line Following Along Tape—Boat Used by Sounding Man Was Pulled Across by Means of Tape

BY E. S. BLAINE
Engineer, Residency No. 4, Little River Drainage District, Kennett, Mo.

NEARLY 650 miles of floating dipper dredge work has been completed by the Little River Drainage District in southeastern Missouri. Previous to the legislation which made this district possible, the jurisdiction of a drainage district in this state was limited to one county. The engineering work was usually done by the county surveyor. We have been unable to hear of a case where the ditch was cross-sectioned behind the dredge. The "inspection" was usually done by rowing along the center of the ditch, or riding along it in a motorboat and sounding with a pole at more or less frequent intervals, depending upon the speed of the boat. Too often even this "formality" was dispensed with. The work was then accepted by the "engineer." As it was desired not to accept work when no more was known about its actual condition than such meager data would permit, a set of "Instructions for Resident Engineers" in this district was issued, outlining methods for inspection. The outline was added to, or revised, as improvements developed. This article tells of the methods that have been used and explains their development.

The size of the ditches varies from 4-ft. bottom and average depth of 8 ft. to 123-ft. bottom and average depth of 11 ft. All ditches have 1 to 1 slopes specified. The land within the district has a surface so nearly a plane that it was considered an unnecessary refinement to cross-section the natural surface, except in special cases where an old channel was appropriated, or where a large river crossing or some local irregularity of considerable magnitude made such cross-sections necessary. Levels were run along the center line and benchmarks set approximately one-fourth mile apart. The cut at each station, description of benchmarks and alignment notes were all placed on the profile. Tables were made for the different base widths, giving the quantities of excavation, for level sections, in a prism 100 ft. long, at 0.1-ft. intervals. For estimating the yardage, the quantities were taken from the tables for the center cuts written on the profile.



FIGS. 1 TO 4. PROGRESS VIEWS ON DITCH NO. 1, LITTLE RIVER DRAINAGE DISTRICT, MISSOURI
1. Cypress and tupelo timber along ditch line. 2. Looking up the pilot cuts. 3. Setting slope stakes; note man and boat on either side. 4. A 4½-yard dredge at work.

After the excavation, cross-sections were taken at each station on all the ditches. These cross-sections were used for computing the yardage in special instances only, as follows: River crossings and other local irregularities in the natural surface; pilot cuts where part of the prism was excavated; reaches where it was necessary to excavate below ditch grade to get material for raising spoil-bank levees to an established grade; where the work consisted of improving an existing channel. The rest of the cross-sections were taken for the purpose of insuring the removal of all the material in the specified prism. At times it was necessary to take as many as four sets of cross-sections before the ditch was brought to grade.

As the excavation was under water at all times, the cross-sections were taken by means of sounding from the water surface along a tape stretched across the ditch. It was not practicable to pick out the irregularities and limit the number of readings by the governing points, as is done where the work is visible, so soundings were taken at regular intervals. For the small ditches, the interval was 3 ft., except that a reading was taken 2 ft. from each bank to show up better the actual slope being excavated. On the large ditches the soundings were taken at intervals of 3 ft. on each slope and 5 ft. across the bottom.

The inspection of a reach of ditch would proceed in the following order: On arrival at the work, if on one of the smaller ditches, the chaining was picked up, preferably ahead of the dredge or from a reference point on one side, and the chaining was connected up with previous work. If on the larger ditches, points were located on the spoil bank from reference points which had previously been established to one side of the right-of-way far enough to insure their not being disturbed by the work. A base line was then run parallel to the center line and a known distance from it. All stakes were cut from timber along the ditch, and were marked on the side facing the ditch, to permit their being read from a boat. This saved a great deal of time and labor when looking for a bench mark or reference point, as most of the moving from point to point was done in boats. Due to openings in the spoil banks at

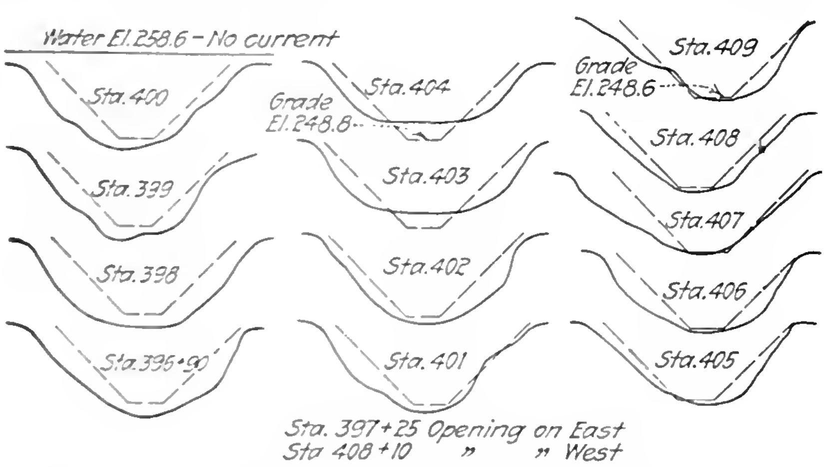


FIG. 5. SAMPLE OF DITCH CROSS-SECTION NOTES

intervals of 1000 ft., it was seldom possible to walk very far along the spoil banks without getting wet to the waist, as the openings usually had too much water in them for wading in hip boots, and we only used wading pants or "waders" when absolutely necessary and never in preference to a duck boat or dugout. After a few trials at walking along a new dump thrown up by a dipper dredge working in gumbo or clay one soon learns to use that route only when absolutely necessary to accomplish a definite object. It might be asked why the berms were not available for our work. This was due to their being under from 1 to 4 ft. of water for at least a mile behind the dredge, and they had a surface profile much resembling, on a large scale, the teeth in a cross-cut saw. This irregular surface was caused by the spud feet, or anchor feet, as all but four of the dredges used bank spuds. The spuds left depressions 2 to 4 ft. deep each time the dredge moved up. The surface of the berm was further roughened by the dipper when scraping loose stumps and roll from it.

After the ditch was chained, the elevation of the water surface was found and a gage set near the dredge, giving the cut from water surface to grade line. At least two benchmarks were used in finding this elevation. Where there was an appreciable current in the ditch, the elevation was taken at each end of the reach, and where the reach was long and had diversions into old channels intermediate elevations were necessary. A Chicago tape was then stretched across the ditch. The recorder handled the chain on one side while the chainman held the other end on the opposite bank and the rodman did the sounding from a boat which he pulled across by means of the tape. Three men were used for most of the work, but some of it was done with only two, and where the current or the wind was too strong to permit the boat being held in line by means of tension on the chain, a fourth man was necessary to row or paddle the boat. To standardize the work, the zero end of the tape was always placed on the east or south side of the ditch. The recorder also noted the visible defects, such as logs and loose stumps, on the berms or in the openings; loosened or overhanging stumps in the edges of the ditch; trees leaning toward the ditch and high stumps on the berms which had been overlooked or were inaccessible when clearing was accepted.

On the small ditches a piece of light rope was fastened to the zero end of the chain. The rodman would sound until he found the edge of the ditch and direct the shifting of the chain until the zero end was located at this point where the recorder would fasten it by means of a lining rod, set through a loop in the rope, into the slope of the spoil bank. On the larger ditches the zero end of the chain was placed on the base line and the soundings were thus accurately located with respect to the center line. When cross-sections were taken on pilot cuts where the spoil had all been placed on one side, it was usually necessary for the man holding the tape, on the side having no spoil bank, to wear waders if the weather was cold, and sometimes the cross-sections had to be located at points where a high place was available for him to stand, the move from one point to the next being made in a boat.

When work was found to be above grade or too narrow, the contractor was required to correct it, and another set of cross-sections was taken.

Method of Recording

During the early part of the work the cross-section notes were recorded in the usual manner, the soundings replacing the rod readings and the elevation of the water surface replacing the usual H. I. The reductions to sea-level datum were then made by subtracting the soundings from the elevation of the water surface, and the cross-sections were plotted and inked in. These sheets were sent to the main office, where blueprints were made, and returned to the resident engineer, who then issued orders for any necessary correction and mailed copy of the order and blueprint of the cross-sections to the contractor. As each engineer had supervision over the work of about nine dredges during the peak of the construction work, at least four of them averaging from one to two miles per month, the office work consumed time needed badly in the field, while the total time necessary to get the prints back to the contractor was still more important where the work was on small ditches. It took from one-half to one day to reach a dredge from a postoffice and it usually required a lot of difficult "hiking," wading and a long motorboat or "duck-boat" ride; so, due to the difficulty in reaching the dredge, the contractor rarely received mail more often than once a week.

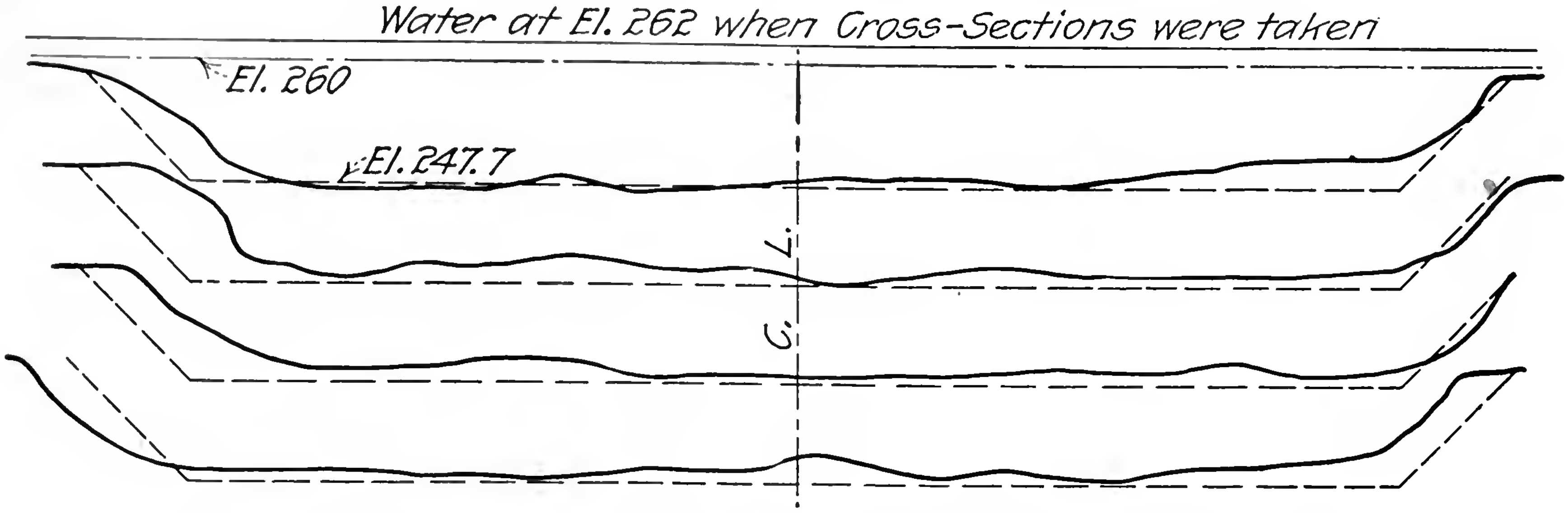


FIG. 6. CROSS-SECTIONS OF DITCH NO. 1 AS SPECIFIED AND AS FIRST LEFT BY DREDGER

The contractor supposed that the work was properly done. The example shows the need of a base line to obtain proper alignment when bringing ditch to grade. This ditch has a base width of 123 feet.

By the time the order reached him the dredge would be about a mile from the work requiring correction.

An improvement in the method of recording the notes was suggested. It received a trial and was found practicable for the small ditches where the need for a quicker method was so apparent in order to cut down delay in "kicking back." This delay was serious at times where it caused the recrossing of a river or slough which had a swift current flowing out of, or across the ditch. The method involved the use of specially made up blocks, or tablets, of cross-section paper held in a suitable stiff-backed cover. The tablets were of letter size, composed of thin paper ruled each way into ten divisions to the inch, with every third sheet blank or unruled. Instead of giving the heavy lines an even sea-level elevation, the heavy line was used as the water surface and the soundings were plotted down from them as the rodman called them off. Three copies were made by the use of carbon paper and a hard pencil in plotting. The distance from the water surface to the grade line was computed and marked on each section. Templets having the specified slope and bottom width, to a scale of 10 ft. per inch, were cut from thin celluloid. The proper templet would be laid on the section, centrally located with respect to the section as excavated, and with its base coinciding with the grade point. The theoretical prism was then drawn in and the amount of material, if any, inside the specified lines would be indicated. The order was then written and delivered to the contractor, along with the unruled copy of the cross-sections, before the work was left. The second copy was kept in the resident engineer's file, and the original was inked in and mailed to the chief engineer. The elevation of the water at the time the sections were taken was recorded on the sheet so that they could be referred to sea-level datum if desired. When the method was proposed it was feared that tablets bound so that the ruling would coincide would involve an excessive expenditure, but no difficulty was encountered in procuring tablets of this size, bound in this manner, at a reasonable cost. A "Lyflat Holder," sold by Buxton & Skinner of St. Louis, was used as a clip for the tablets in the field. Fig. 5 is a sample sheet of notes recorded in this manner.

On the larger ditches the work progressed more slowly in distance covered, and the need for quick service was not so much felt. The handling, in the field, of a book large enough to permit the plotting of sections having a top width of 150 ft. would be somewhat difficult, so no tablets were made for this class of work. The notes were recorded in a notebook, reduced to sea-level datum, and platted in the office. On these ditches the cross-sections were taken from a base line parallel to the center line. While this was not considered absolutely necessary, except when the cross-sections were used to compute the quantities, it was the means of settling several arguments due to the dredge operator on the night shift "getting lost" and departing badly from the line, and also permitted us to secure a better alignment when sections showed the excavated prism to be too narrow. Fig. 6 illustrates an extreme but actual case of this kind. With the sections referred to a base line, it was at once apparent which side should be widened, while without the base-line control it was impossible to tell this unless the water was low and the contraction of considerable magnitude.

Sounding Line Used

During the early stages of the work the sounding was done with a level rod, but the disadvantages connected with its use were so numerous that other means were tried until a satisfactory one was found.

The soundings often ran as deep as 15 ft., and in an extreme case 22 ft. A level rod was useless at these depths. Even at depths up to 8 ft. it was extremely tiresome to work with even a very light rod made for the purpose, due to its resistance to lateral movement through the water and because one hand only was available, the other being occupied in moving the boat along the tape. The figures being necessarily small, it was difficult from a standing position to read the rod at the water surface. We found it impossible for the rodman to tell, from his position in the boat, when the rod was plumb. In order to make any time at all with a rod, it had to be drawn nearly out of the water while moving laterally, and then thrown down with considerable force to overcome buoyancy and the lateral forces of the wind or the current.

There is found in the bottom of all dredge ditches in silt or clay soil ½ to 2 ft. of thin mud. It requires very little pressure on a thin rod to cause it to penetrate this slush, and the force used in throwing the rod down is usually sufficient to cause it to sink through the semi-fluid mud. While this gives the true value of the depth actually reached by the dipper, it gives a more or less false value with respect to the actual amount of material removed. The use of a spread footing or shoe to

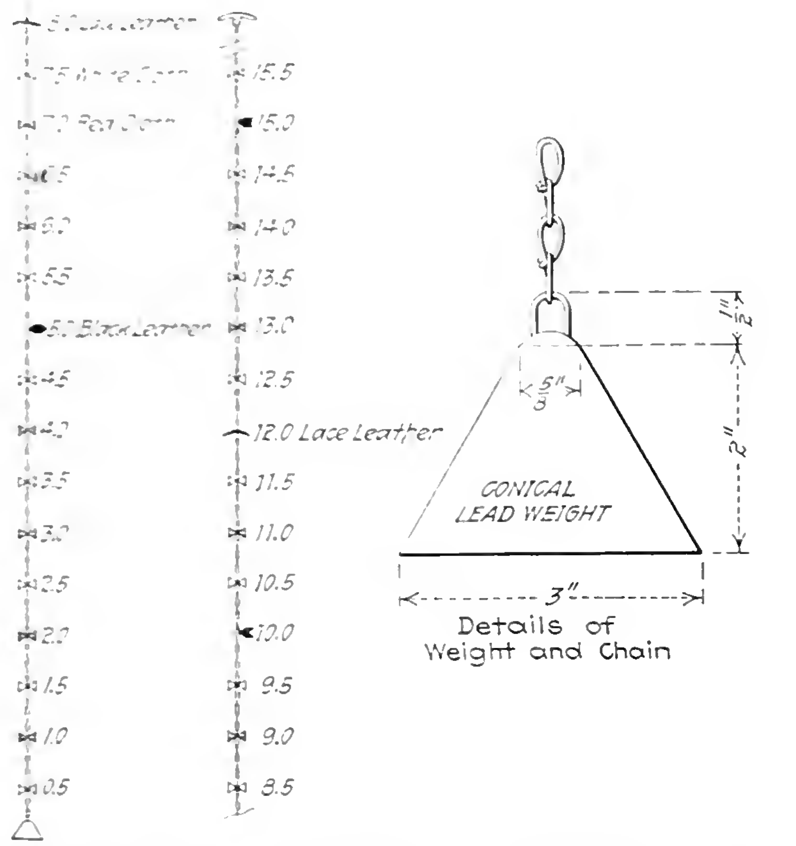


FIG. 7 SOUNDING LINE USED ON DRAINAGE DITCHES

increase the bearing area of the rod was not practical, as it in no way helped the resistance to lateral movement, made the rod harder to handle vertically, and slowed up the work. It is easy to see that the errors incident to the use of a rod are all in the contractor's favor, and a few of them made verbal complaint when its use was discontinued.

Three Kinds of Chain Tried

When looking for a means of overcoming these difficulties, a lead line, such as is used on the river boats, at once suggested itself. We required greater accuracy than that required on a river boat, and a chain promised to give better results than a rope, both as to constant length and ease of marking. Three kinds of chain were tried before one was found that gave satisfaction. First, brass sash-chain was tried, the links of which were stamped from sheet brass and looped through each other. This was far from satisfactory. When the weight caught on a root or other projection under water, and the 18-ft. chain was subjected to considerable tension, it would permanently increase in length 0.3 or 0.4 ft., and when accidentally stepped on while in the boat the links would be flattened and the chain would lose much of its flexibility. A steel chain was then tried, the links of which were made up of flat steel wire. This chain stood the accidental strains put upon it without material increase in length, but tangled and kinked to so great an extent that it had to be abandoned. Finally, a chain having locked links made of No. 18 round steel wire was tried and answered all the requirements. (See Fig. 7 for a sketch of the system of marking and details of the chain and weight.) The marking of the chain proved a simple problem, as 0.5-ft. intervals made it possible to read to within 0.1 ft., which was a greater refinement than is justified with dipper-dredge work.

A leather tab was sewed at each 5-ft. mark. The intermediate footmarks, with the exception of those at 8 and 12 ft., were indicated with small pieces of red cloth tied through the links nearest the correct distance. Pieces of lace leather were tied at the 8- and 12-ft. marks, as depths 1 ft. either side of these marks prevailed. Small strips of white cloth were used to indicate the 0.5-ft. marks.

The weight was made of lead or cheap babbitt metal cast in the form of a cone, with a wire staple projecting from the top. Two pounds proved ample to weight the line on a greater part of the work. Where more weight was found necessary an iron nut or some washers placed over the weight furnished the additional stability. With this weight and line, the measurements, or soundings, were those along a plumb line, except in swift water, and as the chain offered very little resistance to water it had only to be lifted a foot or so when moving to the next point.

With the chain taut, the weight used was not heavy enough to penetrate the slush, and therefore the results more nearly approximated the correct ones. Some of the contractors objected to this method, on the ground that on other work, which had been sounded with a pole, the slush was disregarded. In other instances, where the contractor had previously sounded the ditch with a pole and found it apparently to grade, and our measurements would show it above grade, the contractor had to be "shown" by checking the line and measurements.

Only Small Quantity of Work in Swift Water

On stretches of pilot cut connecting two reaches of finished ditch, which were short enough to act as contractions in the larger channel, the current was, at times, too swift for accurate work with the line, but this objection also applied to a rod, and as dams were placed across them except during a high water, the quantity of work that was done in really swift water was comparatively small.

The chain was checked up at least once a month, and the placing of the marks was corrected if the error was found to be sufficient to justify it.

After the stakes were set and other preliminary work was done, this method permitted us to cross-section 50 stations of the largest ditch in ten hours. These cross-sections averaged 30 soundings each, making possible a total of 1500 readings per day and representing 250,000 cu.yd. of excavation. There were only a few instances where there was enough work to require a full day of straight sounding.

While it is departing somewhat from the subject as indicated by the title, it may be of interest to some to mention another detail of the construction work, illustrating the difficulty encountered in doing work which in principle is the limit of simplicity. It was required to set slope stakes on each side of the ditch across a flag field one-half mile long. The ground was near enough a plane to permit the stakes being placed in a straight line. The obstacle consisted of 5 ft. of water and 1 ft. of soft mud. Ten-foot "stakes" were used, and the rodman worked in a boat. A fore-sight was set from a reference point by working in boats. The instrument tripod was made 10 ft. long by splicing poles on the legs with wire. The instrumentman lined the stakes in from a boat held in position behind the instrument by means of more poles. There were other cases where compass lines were run in this manner.

L. L. Hidinger is chief engineer of the Little River Drainage District.

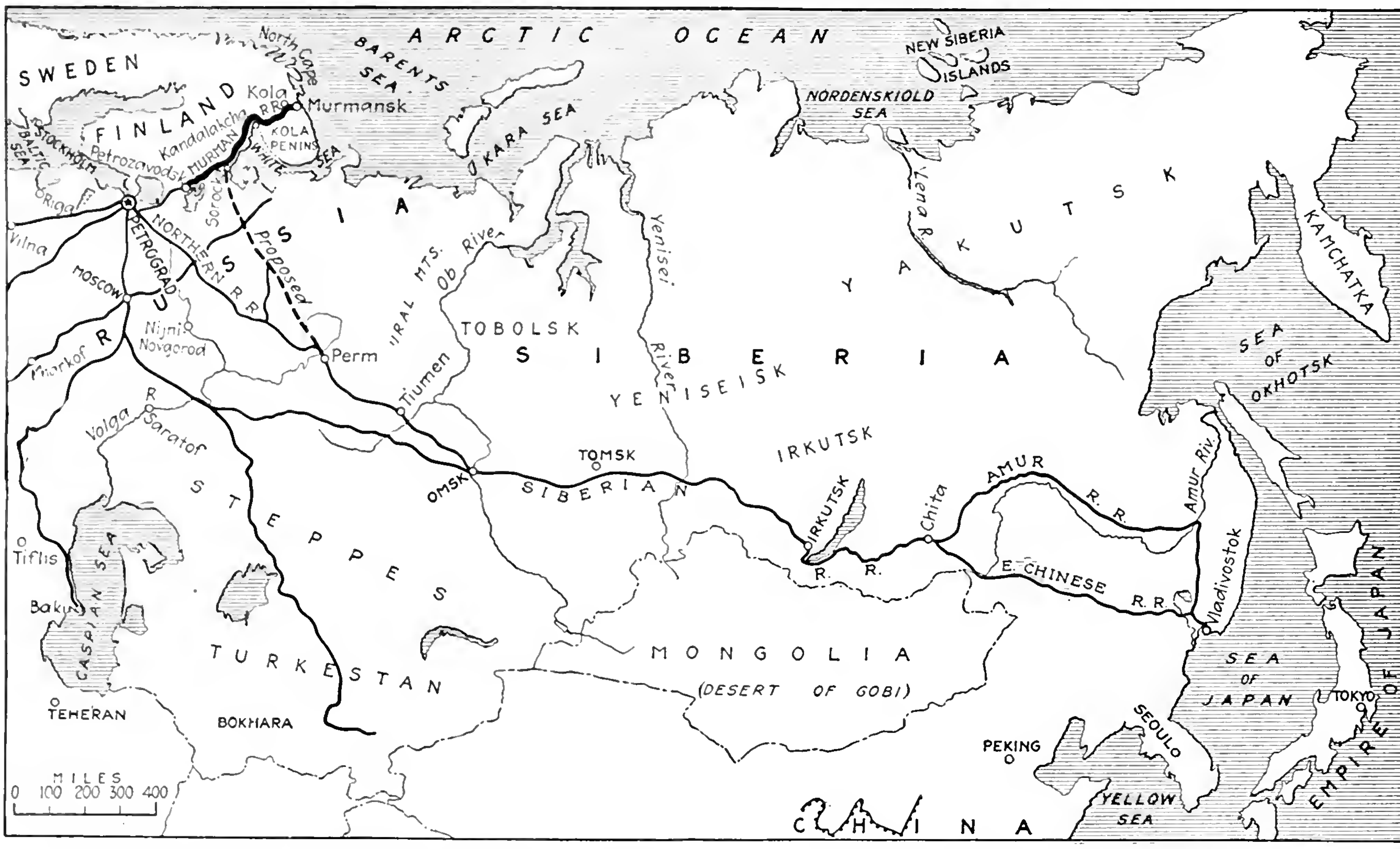
Murman Railroad: New Outlet to Sea in Russia

Ice-Free Port on the Gulf of Kola Is Reached by Connection From Northern Railroad—Freight From Siberia for Export Provided With Shorter Route

By V. Goriachkovsky
Vice President, Youroveta Home and Foreign Trade Company, Incorporated, New York City

VAST possibilities for development of Russia as soon as conditions become settled make a description of the railroad connecting the new port of Murmansk, situated on the Gulf of Kola which never freezes, although it is one of the most northerly ports in Russia, of special interest at this time. This road was built during the second year of the war as a result of the necessity for Russia to have a direct connection with the allies. All communication through the Black Sea was cut off when Turkey declared war and closed the Dardanelles. The Baltic Sea was closed by Germany. The only access left was through the north, by the White Sea and Archangel harbor, but the latter is closed every year for a period of five to seven months during the winter when drift ice clogs the White Sea outlet to the Arctic Ocean, and renders navigation impossible. This article outlines the general conditions and the details of the construction of the Murman R. R., 650 miles long, successfully completed in 18 months, beginning in the spring of 1915, with the author as chief engineer. While this article is based upon an informal address delivered at a meeting of the American Society of Civil Engineers in New York, additional descriptive matter has been introduced.

Starting from the port of Murmansk on the north, located on the Gulf of Kola, which, owing to the Gulf Stream coming from Central America around the Norwegian coast, is open to navigation all the year around and has natural facilities making it accessible to ocean-going steamers of the largest tonnage and deepest displacement, the Murman R.R. follows the Kola River valley, near Imandra Lake, up the Neva River valley, spans Kandalakcha Bay, touches the towns of Kem and Soroka, and reaches the town of Petrozavodsk. From this point to its connection with the Vologda-Petrograd R.R. at Zwanka, the railroad was formerly privately owned. The new road was projected in 1915 as a Government railroad to connect with the latter existing road, which was then bought by the Government. It was laid out by the late Czar Nicholas personally, who wanted the railroad constructed on old Russian territory and not through Finland, on the advice of his short-sighted experts and friends.



PRINCIPAL EXISTING RAILROADS IN RUSSIA AND PROPOSED CONNECTION WITH NEW MURMAN RAILROAD

The line of the Murman R.R. runs along the eastern part of the so-called Scandinavian Shield territory. This territory was profoundly affected by the glacial epoch; the powerful glaciers descending from the Scandinavian Finnish heights brought great destruction and deposited masses of glacial material in their wake. When the ice melted away, the numerous basins and hollows became filled with water, and gave origin to lakes, many of which have either entirely disappeared, or have been transformed into marshes and turf pits. The railway, therefore, was built partly through mountainous country of irregular hills of granite and partly through swamps divided by lines of mountain rocks, or along the steep slopes of rivers and lakes.

The climate, of course, was very severe, with long winters. The first snow falls on the Kola peninsula in August. The mean temperature in winter is 14° F. During the winter months the thermometer hovers around —23° F. There is no sunrise during two months, a period known as the "polar night." It is fairly warm in summer, with a mean temperature of about 51°, and the sun does not descend below the horizon at all; this is the season of the "midnight sun."

The port of Murmansk lies nearer to America than any other Russian harbor, and is nearer to Siberia than any other ice-free port in Europe. As soon as the new railroad from Soroka to Perm, noted on the map by the dotted line, is built, the freight from the Ural region and from western Siberia can be shipped to Archangel and Murmansk, as the distance by this route will be considerably shorter than that by Vologda. Thus the distance from Perm or Omsk to Archangel will be reduced by 282 miles, giving Archangel a tremendous advantage over Petrograd, as during the winter, when the port of Archangel is covered with ice, the freight for shipment abroad will be sent by Murmansk, which is 133 miles nearer Omsk than is Libau. The latter port before the war was the harbor for importing to Siberia

TYPICAL CUT THROUGH GRANITE OR DIORITE

all American goods, and for exporting a million tons of goods, mostly butter, from Siberia.

Siberia ships such products of animal husbandry as butter, cheese, meat, bacon, hogs, bristles, wool, etc. In the eastern direction American agricultural implements, dredging machinery for the mining industries, steam shovels and road-building machines, separators for milk, turbines, timber-sawing machines, chemicals, automobiles, cloths, cotton, etc., are transported.

In addition to the through freight, this proposed new connecting line would carry a tremendous quantity of local shipments. It is stated by Professor I. D. Simpson in the *London Geographical Journal* of June, 1918:

"I believe that this region will one day prove to be something infinitely more profitable to Russia than Alaska has proved to the United States."

As it was expected that the future trade through the new harbor would be large, the harbor of Alexandrovsk, which had been selected many years ago by Count S. Witte, was examined to see whether it was sufficiently adapted for the purpose. It was found that the bays were surrounded by high granite cliffs without sufficient space near the water for placing a big railroad terminal with the necessary tracks, yards, etc. For this reason Alexandrovsk had to be abandoned and another location sought. Finally, in the Kola inlet near the Semenovo Islands was discovered the location for the future harbor, which the author named Murmansk. This location was selected as the best harbor in the whole Kola Bay, which is here 1½ miles across and 32 ft. deep near the piers and 70 ft. deep in the middle.

Country, Inhabitants and Occupations

The country over which the railroad is located is unexplored. The difficulty in traveling prevented the making of geological surveys, although iron ore and silver lead ore are found in many places, and traces of gold have been found. Copper ore and zinc, also asbestos and mica, have been discovered in several locations. The population is small; before the railroad was constructed there were only 14,000 inhabitants, consisting of Russians, Lapps, Finns and Karelians, in the Kola peninsula. Here the Russians were never under the Tartar yoke, and therefore speak very pure Russian. The first Russian settlement at Kola is recorded as early as the year 1264. Agriculture and animal husbandry are undeveloped. Among the domestic animals are reindeer, for transportation of mail and passengers, but few cattle and horses. The chief occupation is fishing.

The lumber trade is of great importance, the country in northern Russia being covered by forests exceeding 325,000 square miles in extent. For the most part these forests have not been explored, except along the banks of rivers where rafting is possible. The best forests, with very thick growth, are near the southern part of the railroad in the Olonetz district, and further from the sea in the Kem district. There is very profitable hunting for wild birds and wild animals. There are no roads, the inhabitants do not know what a wagon is, and to communicate in summer they use rivers and numerous lakes, although traveling in canoes is difficult because many cataracts make portage necessary.

Surveying had to be begun in the winter of 1914-15 in order to prepare for construction in the summer, beginning in the month of May. There were very few villages along the proposed line, making it necessary to live in tents or sometimes to sleep in a sledge with the temperature far below zero. For the survey and construction of the railroad the whole line, 650 miles long, was divided into three administrative districts: First, from Petrograd to Soroka; second from Soroka to Kandalakcha, and third from Kandalakcha to Murmansk. At the head of each district was a special assistant engineer, who had had wide experience in railroad construction in rugged sections of Siberia; to these were subordinated the section superintendents, each of whom was in charge of about 50 miles of line.

There were no previous surveys available except one of the first district, which was made about 15 years before. The maps of that territory were by no means exact or detailed, having been drawn on a scale of 1 in. : 10 versts (6.63 miles); these maps were not based on measurements but were composed principally in accordance with data obtained from local forest administrations, from inhabitants or travelers. They could be used only for preliminary and approximate figuring, as they contained neither altitudes nor exact distances. In the second and third districts preliminary surveys had to be made in the winter in order to obtain necessary al-

titudes by the aid of barometers, while in laying out the first districts the previous survey could be used for data on altitudes and location of river beds.

The leader of each surveying party received detailed instructions regarding the layout of the proposed line, and also auxiliary tables to aid in the location of stations and passing sidings. It was required to survey a single-track line with a capacity of seven daily trains in each direction for the first year, but with a view to allowing 13 trains in laying out first-class sidings, and finally increasing the capacity to 23 daily trains in each direction after the second-class sidings are laid. The theoretical running time of the trains between two consecutive stations was calculated, and tables were prepared giving the speed of normal trains pulled by standard locomotives on various grades, curves and straight sections. By the aid of these tables it was easy to compute the required traveling time from one station to the following.

All the calculations of distances were based on tape measurements in the field,and all altitudes were determined by the aid of leveling instruments. When the running time of trains had been calculated according to the tables, a suitable level site was selected for the future station. From there the engineers started again in the direction of the line and continued their reconnoissance, while separate parties of engineers remained on the line already determined in order to prepare profiles of especially difficult sections and to locate the line on slopes so as to minimize the amount of earthwork. As the territory was entirely without population, the location of the stations was determined exclusively by the endeavor to apportion the distances between stations as nearly as possible in accordance with the required running time of trains.

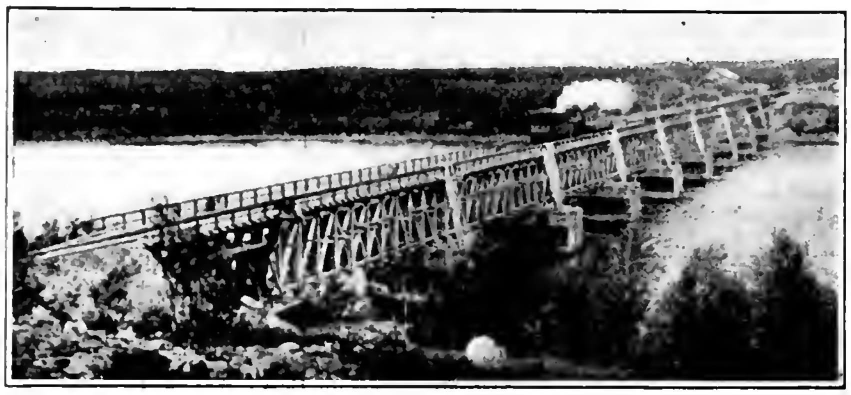
The specified conditions for the construction of the road were as follows: Minimum radius of curvature, 2100 ft., although in special cases 1050 ft. was used; 0.6% maximum grade from Soroka to Murmansk and 0.8% from Soroka to Petrozavodsk. In order to accelerate construction and reduce the amount of earthwork the road, however, was built on a 1.5% grade. The restoration of the originally planned 0.8% or 0.6% grade will require little reconstruction as the excess grades are nowhere of great length, and the track will remain in the same location.

Construction of Bridges

The bridges across all rivers and creeks are of wooden construction and designed to be easily replaced by permanent bridges later on. Therefore, at the larger rivers they were built on auxiliary lines, so that the future permanent steel bridges could be constructed on the main line alongside the wooden bridges without interrupting traffic. The small wooden bridges will be replaced later by stone culverts, and their construction was such as to permit the setting of the masonry supports without interfering with the movement of trains.

The bridges, 1112 in number, of timber construction, were designed with a view to reduce the amount of iron to a minimum and to use the simplest type. They were standardized as follows: Spans of 14 ft. or less, plain round logs; spans from 14 ft. to 35 ft., braced timbers; spans from 35 ft. to 70 ft., special trusses consisting of upper and lower chords connected by a system of diagonals and vertical web members. The trusses were as simple as possible; for example, the web members were not hewed to cylindrical shape, but butts and tops were joined alternately; all connections were made without notching or rabbetting the logs, using steel plates and screws. The bridges were tested by loading with two locomotives and a loaded train.

Foundations for the wooden bridges were usually of piles, except in stony ground where boxes, constructed of logs and filled with stones, were used. These boxes or cribs, in the case of the swifter rivers, were constructed



TEMPORARY BRIDGE ACROSS KEM RIVER—800 FEET LONG, 70-FOOT SPANS

with double walls and with a bottom for the inner compartments only. This was found quite effective in preventing washouts in the spring torrents, the stone contained between the two outer walls of the box dropping down to fill the place of material under the base, it being necessary only to fill up with stones the outside compartment of the box when the contents had settled.

Special Difficulties at Swamps

The swamps needed special examination, and had to be thoroughly explored. These swamps, covered by deep snows, never freeze. Their depths were determined by long poles, the shallow places being designated on the surface by yellow flags, while the deep places were indicated by red flags. Separate crews of workmen assigned to this work facilitated the final survey. The swamps consisted mostly of peat, which filled them to the bottom. These swamps covered more than 200 miles, or about 30% of the line. The laying of the line on this swampy ground required special and different methods of construction. Very often a temporary line, consisting of a number of longitudinal and traverse beams, had to be laid first, partly with the object of allowing the first train to go through and make it possible to fill in the swamps with sand and gravel.

Laying the track followed immediately after the construction of bridges, embankments and cuts, and had to be carried on through the autumn and winter. As the work was very urgent, track-laying continued throughout the 24 hours of the day. For making embankments and excavations 100,000 workmen and 15,000 horses were needed, 30 big steam shovels, 120 miles of light, narrow-gage railroad, 20 locomotives and about 2000 cars. The final work was completed during the summer of 1917, when embankments were raised and cuts were deepened, so that the grades became easier, sharp curves were reduced, and the greater part of the road-bed sufficiently ballasted. Sidings were laid out, and at the stations double, independent water-supplies were constructed, and preliminary wooden roundhouses and locomotive shops for small repairs, with offices and warehouses, etc., were completed. All the buildings were of

WAGON ROAD THROUGH SWAMP OVER WHICH THOUSANDS OF TONS OF MATERIALS WERE TRANSPORTED

wood, even the water towers, which were completely equipped with pumps and vertical boilers. Movable electric stations were placed in box cars, with all equipment necessary to furnish electric lights. In Murmansk a big electric station was constructed for the purpose of lighting up the harbor, terminal station, roundhouses, houses and barracks.

The last spike was driven Nov. 5, 1916. Of the whole of the 650 miles of the Murman railroad, 30% is above the polar circle, making it the most northern railroad in the world. As soon as the last rails were joined traffic started, although unfortunately the allies had not felt that the road would be open so soon and had sent to Vladivostok most of the munitions, 750,000 tons of which never reached the front. As a result, the Murman railroad was idle until January, when the first steamer arrived at Murmansk. From that time, in the most busy month the average number of cars loaded with war goods was 120 a day, about the same number as was being loaded and shipped from Vladivostok, which is eight times further from the front than Murmansk. All munitions arriving at Murmansk were successfully transported to the front.

Construction of Piers at Murmansk

Most of the ports in Russia are similar to those of the German type, with long wharves or quays following the shore line and with warehouses, parallel to the tracks, for storage. In the design and construction of the port of Murmansk, the American system of separate piers at right angles to the shore line was followed. These piers are of timber construction built on piles; the tracks on the piers were located so as to bring the cars alongside the steamships. Most of the incoming cargo had to be unloaded by the aid of deck cranes on the ships and then transferred to the port warehouses by trains. For unloading heavy units a traveling locomotive crane of 20-ton capacity was used; for freight exceeding 20 tons a floating crane of 35-ton capacity was employed.

There are no warehouses on the piers, as the latter are intended only for transfer of freight from steamships to cars, or vice versa. In 1917 several piers were completed which provided unloading facilities and mooring space for seven ocean-going steamships.

There were excavated about 15,000,000 cu. yd. of earth; more than 50% of this excavation was transported to embankments, an average distance of about 3000 ft. Excavations in granite were blasted out by dynamite, and amounted to about 2,000,000 cubic yards.

Workers were gathered from all parts of Russia, Siberia and the Caucasus, and included Russians, Poles, Tartars, Armenians, Kirghes, Kalmuks and prisoners of of war—Hungarians, Germans, Turks, Austrians—and even Chinese, altogether more than 100,000 men. Many troubles arose because of the differences in customs, religions and races. Slavonic prisoners always fought with the Germans and had to be separated from them. The Tartars refused to use meat, as the cattle were not slaughtered according to their religious custom, and they carried their prejudice even to the point of refusing to use the meat brought in the same wagon as that used by the Christians. The Mohammedans in Murmansk refused to eat food, recently arrived from America, when, according to their religious rules they must fast until sunset, and as it was then summer, when the sun does not set in Murmansk, it was necessary to bring them to Kandalakcha where they saw the sun set behind the mountains, and thus their lives were saved.

There are great possibilities for engineering in Russia, which has only 43,300 miles of railways, while in America there are about 260,000 miles. Many towns are without public utilities and municipal improvements such as water-supplies, sewerage systems, electric-light and power stations, etc. Russia has immense quantities of various kinds of raw materials awaiting the reconstruction of her industries.

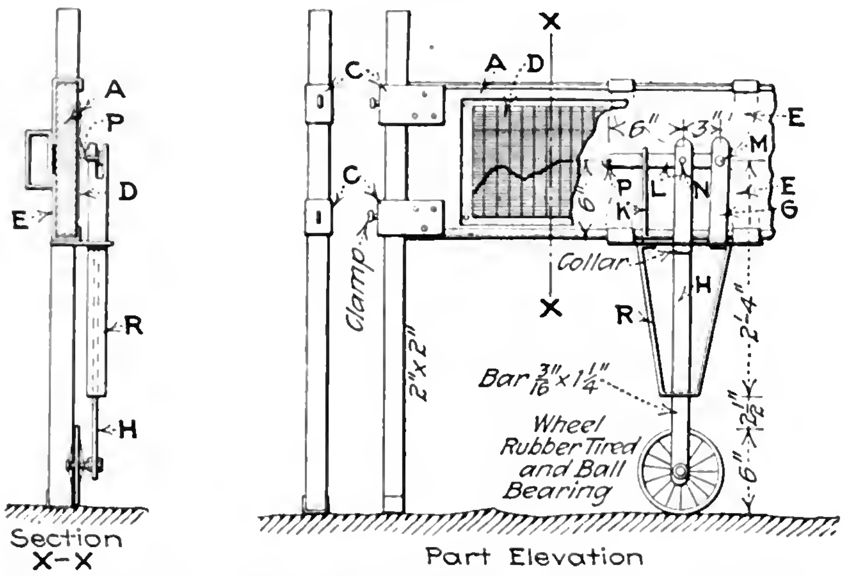
Contour of Pavement Traced to Exaggerated Scale

Device Measures Irregularities of Surface and Plots Profile With the Ordinates Multiplied by Three

MEASURING the irregularities in the surface of pavements and plotting them to an exaggerated scale on paper is performed by the instrument developed by F. A. Hermans, engineer of grade crossings, New York State Highway Department. While the method is somewhat similar to that described in *Engineering News-Record* of Oct. 17, 1918, p. 708, the exaggeration of the variations is said to be distinctly new. This feature should make it easier to study the results of a series of measurements where differences are small.

Referring to the diagram of the apparatus showing the details, A is a dressed plank of any desired length having two clamps, C, at each end. Through these clamps two square rods pass, which support the plank in a horizontal position. D is a suitably ruled piece of paper which is tacked to the plank. L is a lever pencil arm which is pivoted to the support at M and has a pencil point at P. A frame E buckles around the plank top and bottom and holds the support for the pencil arm and the guide for the vertical arm H. As the vertical bar attached to the wheel moves up and down, due to the irregularity of the surface, these irregularities are traced on the paper, three times their actual size. This results from the pencil arm being divided between the pencil and the fulcrum as 3 is to 6, by the point of connection with the vertical arm H.

When it is desired to map the surface of a pavement, the apparatus is set up at the proper elevation, and the



PIVOTED PENCIL ARM WITH UNEQUAL LEVERAGE EXAGGERATES VERTICAL VARIATIONS OF SURFACE

paper is tacked on at any desired height with reference to the pencil point at the point of starting. The frame E is then slid from one end of the plank to the other, the pencil marking out the profile. It is believed that a small knob would be better than the large 6-in. wheel, as it would register more truly the undulations of the pavement.

By setting up the device in connection with a bench mark, and placing the zero line of the paper horizontal and at the same elevation each time, seasonal variations may be measured and studied.

It is also asserted that the instrument is useful for studying variations caused by the shoving of asphalt surfaces due to traffic, the spreading of road crusts, and the amount of wear in a road under various concentrations of traffic.

Mileage of Main State Highways

State highways in the United States which come under the classification of main highways total about 203,523 miles, according to statistics just compiled by the American Automobile Association. Forty-four states have established definite systems of trunk highways, either by legislative action or action by state and local officials. It is pointed out that if the Federal Government takes over a system of from 50,000 to 75,000 miles it will cut the state systems by only from 20 to 25%, which would not affect materially the necessity for state highway departments.

The mileage of main state highways by states is given in the accompanying table that has been issued by the association:

State	Mileage	State	Mileage
Alabama	2,700	Nevada	1,400
Arizona	1,600	New Hampshire	1,390
Arkansas	3,000	New Jersey	3,147
California	3,000	New Mexico	6,250
Colorado	7,083	New York	12,287
Connecticut	950	North Carolina	3,356
Delaware	650	North Dakota	4,000
Florida	Not given	Ohio	9,880
Georgia	5,500	Oklahoma	10,700
Idaho	2,200	Oregon	4,805
Illinois	4,800	Pennsylvania	10,235
Indiana	2,000	Rhode Island	800
Iowa	6,000	South Carolina	2,550
Kansas	......	South Dakota	6,000
Kentucky	8,000	Tennessee	Not given
Louisiana	5,000	Texas	12,620
Maine	1,353	Utah	3,660
Maryland	1,300	Vermont	4,300
Massachusetts	1,200	Virginia	3,740
Michigan	4,500	Washington	3,374
Minnesota	12,700	West Virginia	4,600
Mississippi	......	Wisconsin	5,000
Missouri	7,500	Wyoming	3,100
Montana	2,400		
Nebraska	4,000	Total	203,523

Arizona Has New Water Code

By G. E. P. Smith
Professor of Irrigation Engineering, University of Arizona, Tucson, Ariz.

Arizona is to have a comprehensive water code, passed by the legislature just at the end of the session, although the opposition was so strong as nearly to defeat the bill. The main purposes of the code are the protection of vested and initiated rights to the use of water, protection of the interests of the public in the water-supplies, and encouragement for the highest possible development of such supplies.

Arizona, like 15 other Western states, will have one central office, where landowners and investors will be able to ascertain the extent of stream flow in any watershed and the existing rights to its use. The office of state water commissioner is created. Unusually great authority is centered in the commissioner, but provision is made for the right of appeal in all cases to the superior courts. The commissioner is appointed for a long term, six years, and it is hoped that the state water department will be and will remain absolutely divorced from politics for all time.

In the provision for the adjudication of all existing water rights, the code follows closely the Oregon method, which is based on the Wyoming law—but with certain fundamental improvements. After the accumulation of the data needed for the determination of water rights on a watershed, and after hearings of contests, the commissioner will prepare an order of determination, showing priority and extent of each water right. This order will be filed in the superior court, where additional hearings will be held before the order is affirmed by the court, but the order of the commissioner "shall be in full force and effect from the date of its entry in the records of his office."

Water Distribution Supervised

For supervision over the distribution of water, the state will be divided into water districts, each with a water superintendent and assistants. In general, the code permits the supervision to extend down to the individual water users, but on account of the opposition of certain valleys in which court decrees have already been obtained, all decreed rights are to be recognized *in toto*, and such rights will be incorporated into the orders of determination covering entire watersheds. The only objection to this is that in some cases excessive rates of flow have been decreed. The state water commissioner will divide the water of a river between the court water commissioners and such others as are entitled to its use.

The law provides for the approval of plans for dams and for inspection during construction, and for investigations of the water resources of the state. It contains the reciprocity clause of the Oregon code, providing for diversions in one state for use in another, and it contains the noncapitalization clause of the California law. It provides a special appropriation of money for the adjudication of the Gila River, exclusive of the Salt, and that will be the first work undertaken. The waters of the Gila are used in eight counties, and heretofore there has been no adequate legal machinery for determining relative rights in two or more counties.

The transference of water rights was the subject of much contention. As finally passed, the law permits

the transference of rights "if for any natural cause beyond the control of the owner it should at any time become impracticable to beneficially or economically use water for irrigation of any land to which water is appurtenant." In such case the right may be transferred "to other land under the same canal."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Takes Exception to Classification of Railroad Engineers

Sir—The inclosed clipping [reproduced below] from the May issue of the *Monad*, published by the American Association of Engineers, should be a matter of concern to every technical engineer who regards himself as a professional man and looks forward to the day when an enlightened public shall accord him the recognition and esteem which his attainments warrant.

It is generally conceded, among engineers, that most of our present-day difficulties in securing recognition arise from our past failure to consider our own welfare, either as individuals or as a profession. Our sins have been of omission rather than of commission, and it is true that we have harmed only ourselves. It is just as true that we are beginning to see our mistake and are trying, to a certain extent, to go back and get a fresh start. A classification of railroad engineers such as this, emanating from such a source, sets a precedent which, if allowed to pass unchallenged, may prove a hindrance to our efforts. An exception to it, taken at this time, may rob it of much of its unintentionally harmful effect. As one engineer who hopes for a bright and useful future for his profession, I take that exception.

Cleveland, Ohio. ERNEST R. TAYLOR.

[The clipping referred to above follows.—EDITOR.]

JUST THE THING WE PROTEST

CLASSIFICATION OF ENGINEERS REQUIRED

(Supplement No. 15 to Circular No. 2—Rates of Pay, Men With Technical Training.)

It has been ruled by the Director, Division of Operation, that assistant civil engineers, draftsmen, or other men of technical training or experience who are not employed in the Maintenance of Way Department but are on the staff of the chief engineer, valuation engineer, or the general staff of the Mechanical Department, and are not classified as officials, should be classed as clerks and come within the application of either Supplement No. 7 (Article 6) or Supplement No. 8 (Article 2) to General Order No. 27.

Criticizes the Seelye Joint

Sir—In *Engineering News-Record*, of Mar. 20, 1919, p. 556, there is illustrated what is termed the Seelye joint. This is a method of joining wood timbers where under tension, as in roof trusses.

This joint is an adaptation of the old mortise bolt which is quite common in various kinds of wood framing but which has not been used in the particular manner described, for obvious reasons.

The Seelye joint, at the junction of the end rafter and the bottom chord, has no provision for vertical shear. The majority of roof trusses have a knee-brace near the end of the bottom chord, which brace exerts a vertical shear. There are also frequent loadings from the use of chain blocks or trolleys which exert vertical shear. To take up this shear, it is necessary to have the column cap, which Mr. Seelye illustrates as a part of the old-style truss. The cap should be placed under the Seelye truss and omitted in the old-style design. When the bottom chord of the truss projects beyond the end of the rafter, either an iron strap or a double timber dap will take up all the strain very nicely.

It is not economy to cut a vertical tie-rod in two pieces and make two mortise bolts, as Mr. Seelye illustrates in the vertical member of his truss.

No carpenter would consider making a clumsy tension joint in the bottom chord of a roof truss of the kind Mr. Seelye illustrates. If a tension joint is to be made it is customary to halve the two ends of the timbers for considerable distance back and introduce shear pins.

In general, the splicing of timbers for tension members is now nearly out of date. If a full-length timber cannot be obtained for the bottom chord of a roof truss it is preferable to use a built-up section. Five 1⅝ x 8-in. plank, surfaced on one side to uniform thickness, will make an 8 x 8-in. built-up chord, of which the tension value anywhere will be 52,000 lb., at an assumed tension value of 1000 lb. per square inch.

Los Angeles, Calif. MAX J. WELCH.

[This letter has been submitted to Mr. Seelye and he has made the following reply.—EDITOR.]

Sir—In reply to Mr. Welch's criticisms, I would submit the following explanations of the joint:

The vertical shear is taken entirely by the end post.

Loads, such as shafting, may be taken on the lower chord by the use of lagscrews or small bolts, as indicated in the original cut.

The purpose of the bolster in the old joint is to counteract eccentricity due to the fact that the lower chord transmits its tension to the end post three lugs in its top surface only.

As to economy, a contractor has recently adopted this detail for a large number of lower chord splices in preference to fishplates and laminated chord alternates.

Why should lower chord splices become "out of date" when our timber supply is decreasing in the large sizes available? ELWYN E. SEELYE.

New York City.

Quick-Release Keelblock Not New

Sir—The article appearing on p. 881 of your issue of May 1, entitled "A New Quick-Release Keelblock," is an example of the partial truth in the old saying, "There is nothing new under the sun." I do not wish to be understood as suggesting that the idea illustrated is not quite original in so far as Eugene Lantz is concerned, but I take this opportunity of advising you that similar wedge-blocks were used as keelblocks in repairing steamers for the Union Steamship Co. of New Zealand at its Wellington slipway and its dry dock at Port Chalmers, N. Z., as far back as 1901, and by the British Admiralty at the Calliope dry dock at Auckland, N. Z., about the same time. These instances are of my own personal knowledge.

Hans Berents, consulting engineer, of Shanghai, China, tells me that he used similar wedge-blocks in

the erection of the bridges for the Anhui Ry. in China in 1910. Mr. Berents points out the necessity for taking care that the tapered keys do not project at their small ends beyond the face of the block, so as to eliminate the danger of accidentally knocking the keys loose.

F. H. FRANKLAND,
New York City. Consulting Engineer.

Engineers' Estimates in Relation to Careful Bidding

Sir—Road-building is developing so rapidly that it promises to become one of the biggest industries in the country. Contractors who have heretofore done other work may engage in road-building before long. This makes careful and businesslike bidding exceptionally important, and leads me to venture a word of caution with respect to engineers' estimates of cost.

In states where bids must not go over the engineer's estimate it is very important that estimates be made high enough to allow making a reasonable profit. Otherwise the work will be improperly done by unscrupulous contractors, or small bidders will secure the work and carry it along very slowly and inefficiently—ultimately without profit to themselves and without satisfaction to the engineer.

Should the engineer give out his estimate? I have reluctantly concluded that he should not. Some contractors will bid on the engineer's estimate, which may or may not be prepared carefully. A contractor who guides his bid by the estimate may then easily get into debt; and, on the other hand, the contractor who has carefully investigated the work, and who should really build the job, has no chance in the competition. Several states, notably Pennsylvania, do not publish the engineer's estimate. The practice should be made general.

Kansas City, Mo. CONSTRUCTION ENGINEER.

Nomographic Chart in Cofferdam Design

Sir—In *Engineering News-Record* of Apr. 10, 1919, p. 708, was a very interesting article by F. R. Sweeny on the design of single-wall cofferdams. The author derives formulas for the spacing of the wales and the thickness of the sheeting, and shows how to apply these formulas by the use of a diagram and a chart accompanying the article.

The construction of the author's Fig. 2 and the table on p. 710 must have been quite laborious and time-consuming. A splendid opportunity is there afforded to show the superiority of the straight-line or nomographic type of chart over the ordinary rectangular coördinate diagram.

Fig. 1 is a chart for solving the author's Eq. 3.

$$D_N = 0.314\,\frac{d}{s}\sqrt{\frac{kb}{wc}}\ (\sqrt{N^3} = \sqrt{(N-1)^3}$$

A similar chart can readily be designed for Eq. 6.

In this diagram, every variable is provided for and a complete solution of each formula is obtained from the diagram, no table of correction constants being neces-

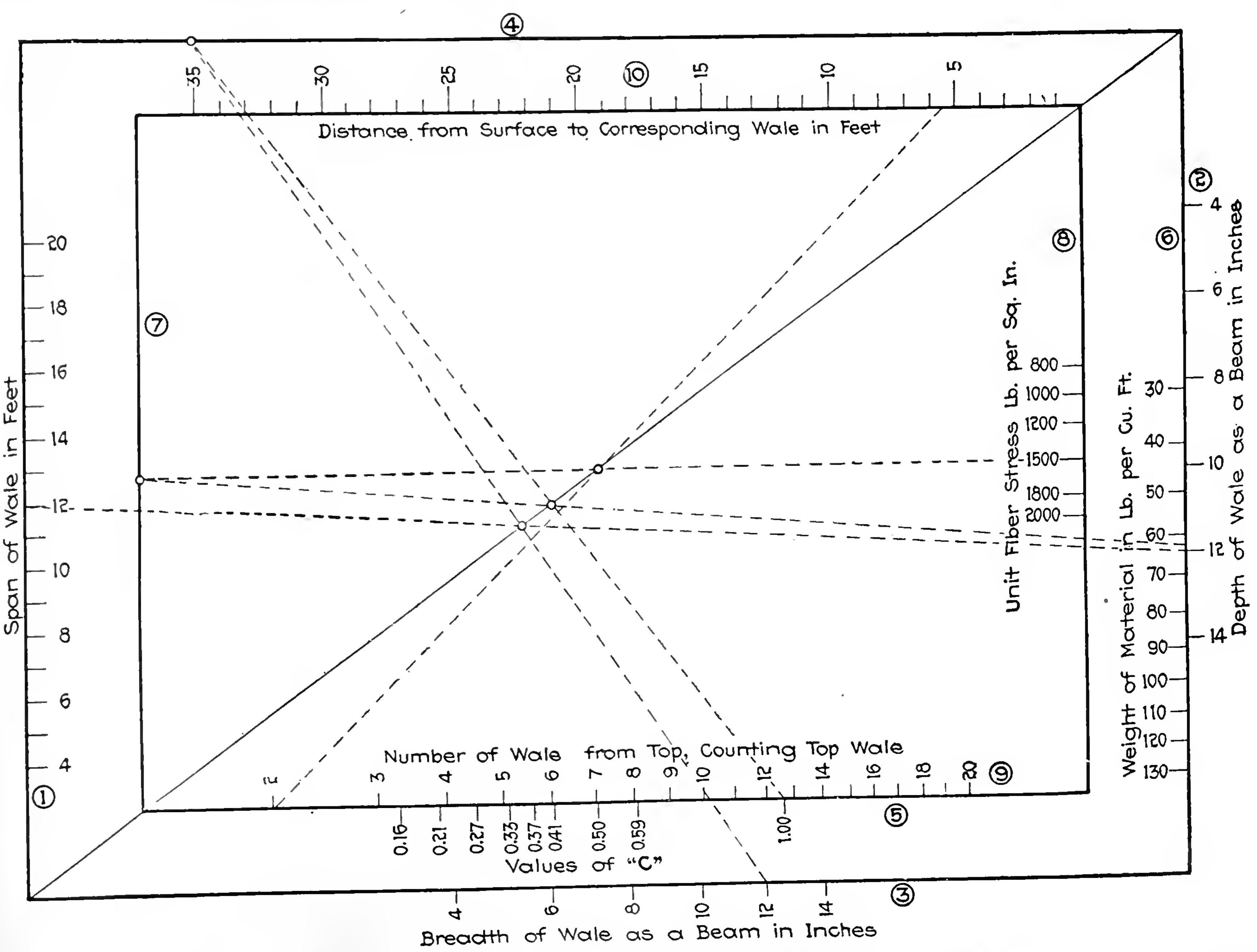


FIG. 1. NOMOGRAPHIC CHART DESIGNED FOR SOLUTION OF COFFERDAM SIZES

sary. All lines of the diagram are straight lines, which is a factor of great importance in all charts, both in construction and interpolation. The diagram can b constructed complete in less than two hours.

The method of using the diagram is as follows: Lay a straight-edge from the proper s on axis (1) to d on axis (2) and mark its intersection on the diagonal. Rotate the straight-edge about this last point and bring it to b on axis (3). Mark the intersection on axis (4). Rotate the straight-edge about this last point, and bring it on to c on axis (5), and then mark the intersection on the diagonal. Rotate about this point on the diagonal, bringing straight-edge on to w on axis (6) and then mark the intersection on axis (7). Hold this laast point and swing straight-edge about it to read k on axis (8), marking where the diagonal is crossed. Now by rotating the straight-edge about this intersection on the diagonal and bringing it to successive values of N on axis (9), the corresponding values of D and t may be read on axis (10). After a couple of solutions have been performed on the diagrams, the operation becomes almost automatic.

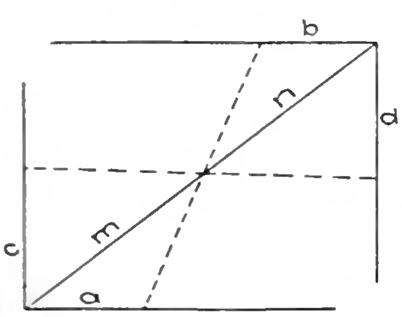


FIG. 2. BASIS OF CHART DESIGN

The chart is of the particular form of nomographs known as proportional charts and is based on similar triangles. In Fig. 2, $a/b = m/n$ and $m/n = c/d$, therefore $a/b = c/d$ where a, b, and c are certain functions laid off on the axes as shown to scales of S_1, S_2, and S_3 respectively. Then, if d is a fourth function laid off to scale S_4, where $S_1/S_2 = S_3/S_4$, the values of a, b, c, and d read on the axes will satisfy the equation $a/b = c/d$. This principle may be extended to more than four variables by an increase in the number of axes. Thus in Fig. 1 eight variables are handled.

The author's Eq. 3 may be written

$$3.18\,D = \frac{d\,k^{1/2}\,b^{1/2}\,P}{s\,w^{1/2}\,c^{1/2}}$$

where $P = (1/N^3 - 1/(N-1)^3)$. P is computed for different values of N and tabulated. Let $Q = \frac{d\,b^{1/2}}{s}$ and the equation becomes $3.18\,D/P = k^{1/2}Q/w^{1/2}\,c^{1/2}$. Then let $1/R = Qw^{1/2}\,c^{1/2}$, and the equation reduces to $3.18\,D/P = k^{1/2}/R$. Q and R are simply factors introduced to aid in the plotting. Each will have an axis but, since we are not interested in their numerical value, those axes need not be graduated.

Since $Q\,b^{1/2} = d/s$, if $b^{1/2}$ is plotted to a scale of 1/0.6, d to $\frac{1}{3}$, and s to $\frac{1}{4}$, the scale of Q may be found from $\frac{\text{scale of } Q}{\frac{1}{0.6}} = \frac{\frac{1}{3}}{\frac{1}{4}}$, from which the scale of $Q = 1/0.45$.

Then, since $w^{1/2}\,R = Q\,c^{1/2}$, if $w^{1/2}$ is plotted to scale of $\frac{1}{2}$ and $c^{1/2}$ to $\frac{1}{0.2}$, $\frac{\frac{1}{2}}{\text{scale of } R} = \frac{\frac{1}{0.45}}{\frac{1}{0.2}}$ from which scale of $R = \frac{1}{0.889}$.

P was plotted to a scale of 1/1 and 3.18 D to $\frac{1}{16}$ and from $\frac{1}{\frac{1}{\frac{1}{16}}} = \frac{1}{\frac{0.889}{\text{scale of } k^{1/2}}}$ the scale of $k^{1/2}$ was found to be 1/14.22.

Fig. 3 shows in diagrammatic form the layout for Eq. 3. This layout should always be made before construction of the actual diagram is begun. It is the key to the situation. The scales should be so chosen as to give a well balanced diagram and bring all the straight-edge intersections within the chart.

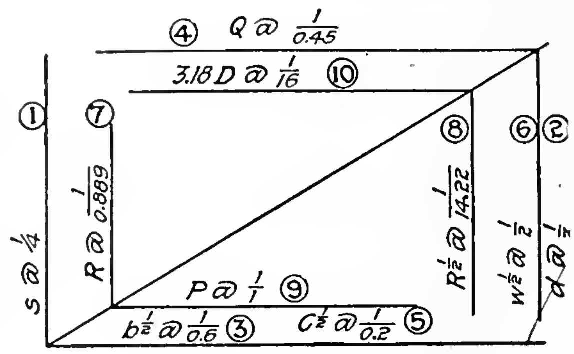


FIG. 3.

The solutions for the following values of the variables is shown in Fig. 1 by dotted lines; $s = 12$ ft.; $d = 12$ in.; $b = 12$ in.; $c = 1.0$; $w = 62.5$; $k = 1500$ lb. per square inch; and second wale. The values of D and t are found to be $D = 5.5$ ft. and $t =$ slightly over two inches.

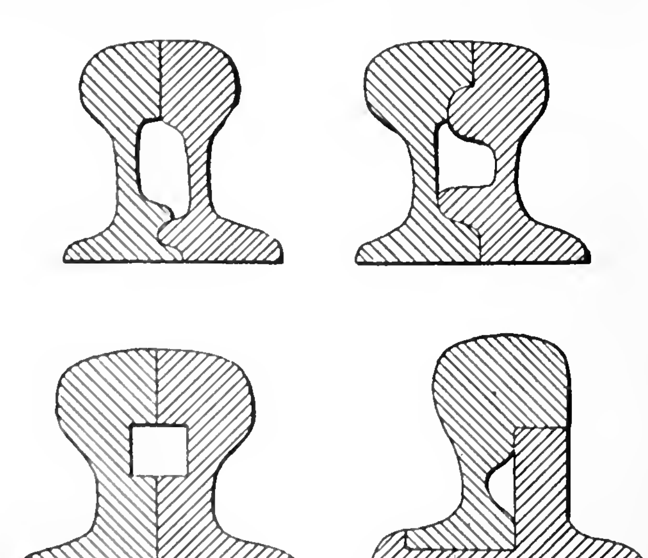
"Graphical and Mechanical Computation," by Professor Lipka, John Wiley & Sons, contains many valuable suggestions for the engineer in plotting charts of all kinds.

WARREN A. LYON,
Captain Corps of Engineers, United States Army.
Camp A. A. Humphreys, Virginia.

More on Old Compound Rail Sections

Sir—Compound rails of the type illustrated by the sections given on pp. 441 and 684 of *Engineering News-Record* of Feb. 27 and Apr. 3, 1919, were used to a considerable extent in the early days of railways. A paper by J. Elfreth Watkins on the development of rail and track, in the *Transactions* of the American Society of Civil Engineers, April, 1890, shows five such sections which were in use in New York State about 1855. These were of iron and weighed 65 to 75 lb. per yard. Three of them had the longitudinal joint in the middle of the head, while in the others the head was solid with half of its width supported on an L-shaped bar forming half of the web and flange. My impression is that similar sections were used on a number of old roads in the territory of the present Baltimore & Ohio Railroad.

Difficulty in maintaining splice joints with the old T-rails having pear-shaped heads is given as the reason


COMPOUND RAILS IN USE IN 1855

for the use of compound rails. They are said to have made good track at first, but in the absence of effective nut-locks it was difficult to hold the parts together rigidly, while in the divided head the wear was irregular, being especially severe on the inner section, thus causing rough track. An objection not mentioned in the paper is the tendency of frost to remain along the joint and thus cause the engine wheels to slip.

Mr. Watkins suggested the possibility that an improved compound rail made of steel and having secure bolted connections might be "the rail of the future," but, though there have been some modern designs, they have met with little consideration as competitors of the solid rail. RAILWAY.

Chicago.

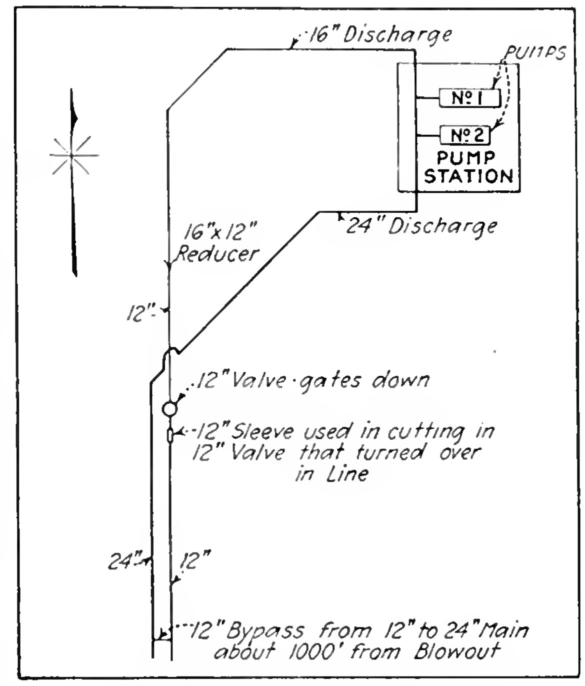
A Gate Valve That Turned in the Ground

Sir—The accompanying view shows the nearly horizontal position in which a 12-in. gate valve was found on digging down to it on account of a leak. The valve is on a force main near the water-works pumping station. The various connections are as shown in the sketch.

The valve was inadvertently left closed, and nothing was known of the fact until a blowout occurred. My explanation is that with the gate down and the nipple and sleeve on the discharge side of the valve, the pulsa-

VALVE TURNED TO A NEARLY HORIZONTAL POSITION

tions from the pumps tended to push the valve off the end of the pipe and to close the space in the sleeve, left there when the cut was made. The continued strain finally caused a leak to start somewhere in the valve or sleeve joints, and it was several days before an attempt to repair the leak was made. Meanwhile, the leak became so bad we could put off attention no longer, and upon attempting to close the valve to shut off the water we could not reach the head nut. So we went back to the pumping station and shut off the water on the 16-in. line. We noticed that there was a great amount of movement in the piping and valve, so much so that with a sounding rod put down against the main one could distinctly feel the movement of the sleeve and valve with each stroke of the pump. The closing of the 16-in. valve just outside the pumping station stopped the major portion of the leakage and all of the vibration, as this left just the return line from the bypass connection shown in the sketch. The fact that the top of the valve rested against a large, heavy valve box, which in turn rested against a granite curbing, is all that kept the valve from turning further around than it did. The soil was light, fine sand, and when it became wet from the first small leak there was practically no lateral resistance to the movement of the valve until it carried the valve box over against the heavy curbstone. No attempt was made to right the valve. It was left in the position shown in the view, and a chamber was built around it so that a hand wheel could be put on the stem in place of a head nut.



SKETCH SHOWING LOCATION OF GATE VALVE

In nearly 20 years' experience this is the first incident of the sort I have known. The pulsations of the pump are the only explanation of the turning of the valve that I can offer. The moral is: Never leave a valve closed on a main line if there is a chance that it will give way. McKEAN MOFFITT,

Superintendent of Water and Sewers.

Wilmington, N. C.

Latin and Greek for Engineering Students

Sir—The suggestion of Dean Cooley in your issue of May 8, 1919, p. 930, that Latin and Greek be incorporated into the engineering curriculum, once more opens the discussion between the so-called cultural and industrial arts. It was long held that the study of Latin, Greek and the allied finer arts made for breadth and depth of the intellect, while the study of the sciences served a utilitarian purpose only. A falser distinction never was made. Cultural studies are those which promote not alone intellectual happiness and contentment but physical comforts also.

I do not deny that the study of Latin and Greek is an enjoyable one. I enjoyed both. But today the sole result of such cultivation is that, in working on mathematical equations, I can express myself fluently in the Greek alphabet, while my less gifted brethren must restrict themselves to English. I have often felt that I would have enjoyed myself as much and paved the way for future intellectual enjoyment had I spent the time on the study of natural history and the political sciences. I would be now in a better position to appreciate what is taking place and what has taken place in the world.

It is time to stop decrying the engineer as a man inherently without culture. It is not true. If the engineer cannot find time to become a *dilettante* in the fine arts, it is because he is too poorly paid; not because he lacks the cultural training. Herbert Spencer pointed out long ago the cultural effects of the pursuit of the scientific studies and the illusory effects of the cultivation of the dead languages. It is not necessary to repeat his unanswerable arguments.

New York City. G. PAASWELL.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Road-Construction Camp Rationing When Convict Labor Is Used

CONTRACTORS and others using convict labor for road and bridge work should give special attention to the proper feeding of the men in the construction camps, according to the biennial report of the State Highway Department of Arizona. It has been found that failure to supply satisfactory food will cause trouble more quickly than any other single item of complaint. It is believed that this will also be found to be the case in free-labor camps.

Other Articles in This Issue of Interest to Contractors:

On the work of the Arizona Highway Department the cooks and assistants were selected from among the prisoners. The rations were varied, and every effort was made to have them prepared and served in an attractive manner. In the desert regions it is necessary at times to use canned goods and dried fruits, but in general it is the aim to supply fresh fruits and vegetables in preference to all forms of canned goods. The accompanying table shows the kind and amount of food allotted to each convict during a period of one month at the Clifton camp, Arizona, having from 90 to 100 men:

RATIONS PER MAN PER MONTH

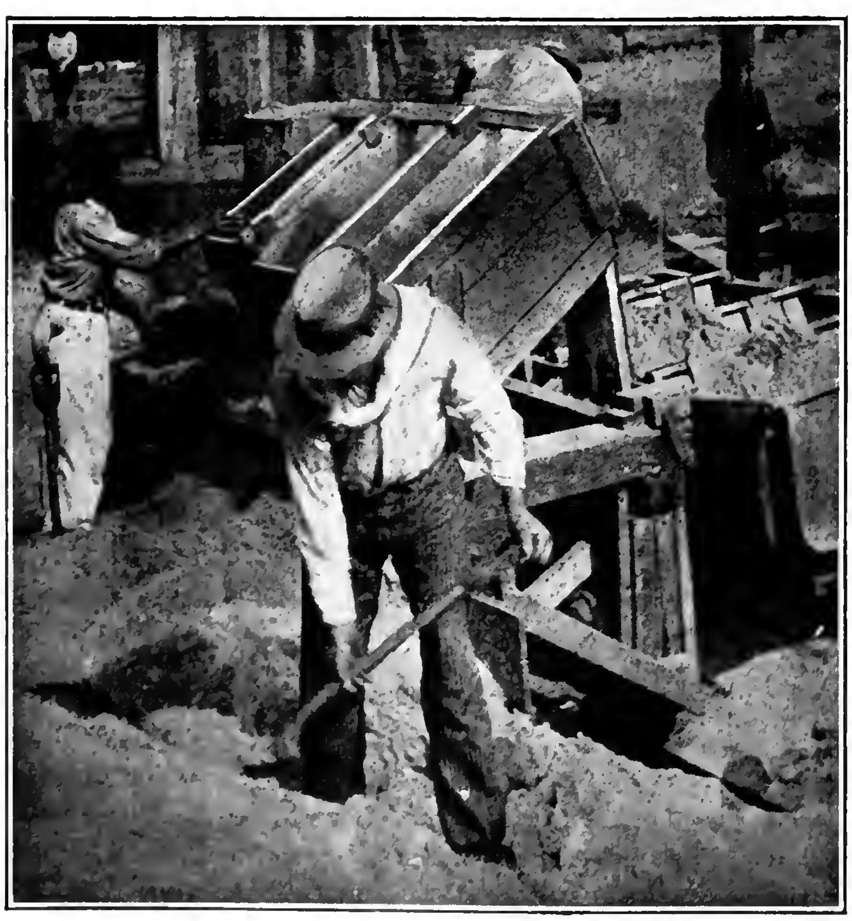
	Pounds		Pounds
Flour, wheat	12.0	Fresh beef, pork or mutton	23.5
Flour, milo maize	1.6	Flour, barley	2.0
Rolled oats	1.7	Cornmeal	22.0
Sugar	3.0	Macaroni	0.8
Prunes	1.5	Vermicelli	0.2
Canned peas	2.4	Dried apples	2.0
Dried peaches	0.1	Dried apricots	4.0
Canned tomatoes	4.4	Canned corn	6.0
Cottolene	4.0	Bacon	5.2
Beans	1.6	Ham	1.6
Onions	3.7	Lard	1.5
Velva syrup	5.0	Condensed milk	3.9
Coffee	2.6	Potatoes	17.0
Rice	1.7	Eggs	17.0
Cheese	1.0		

Properly Proportioned Batches Hauled to Mixer by Trucks

MOTOR trucks with specially arranged bodies were used to haul properly proportioned batches of concrete material to the mixer in building the Welsh-Mercer County Line road, in McDowell County, West Virginia. The stone and the sand were measured into specially constructed compartments on the trucks at the railroad siding, and hauled to and dumped directly into the concrete-mixer hopper, thus eliminating the extra handling which is necessary when materials are dumped upon the subgrade.

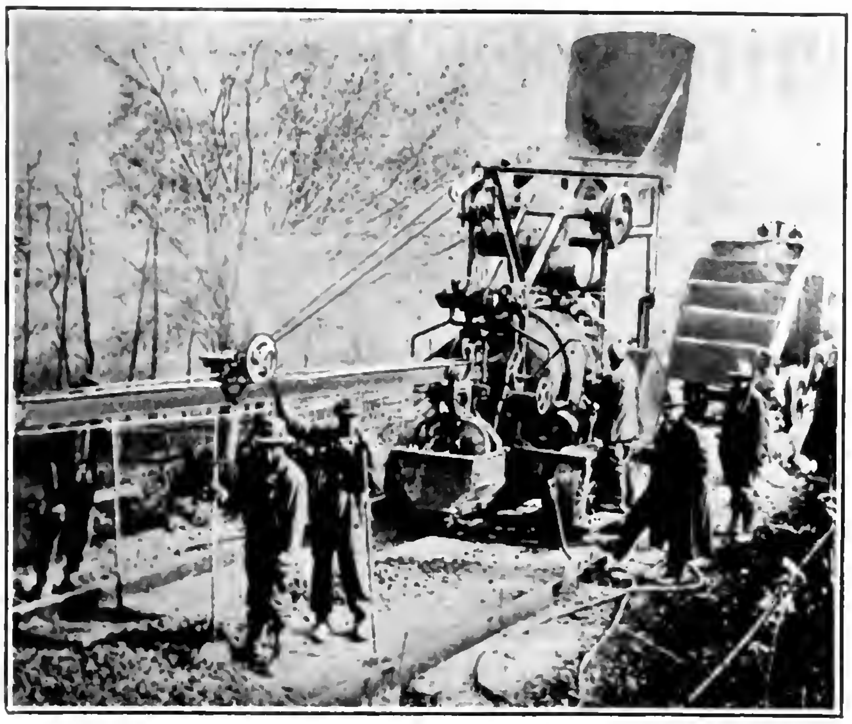
Ordinary motor trucks were used, the bodies being divided into four compartments by means of hinged trap-doors. The hinge edge of the door is formed of an ordinary gas pipe resting upon the top of the steel truck body and held in position by a strap-iron socket bolted to the frame. The lower edge of the door, which fits the bottom of the truck, is free except that it is attached to the front of the truck body by a cable to be released at the will of the truck driver. An illustration shows one of these trucks backed up at the mixer with one compartment dumped, and waiting for the hopper to drop and receive the next batch. The cables are so arranged that the batches can be dumped in succession.

Proportioning the concrete materials is accomplished at the railroad siding by the following method: The truck is run under the stone bin, and each compartment is filled with stone up to a mark which is painted upon the inside of the truck body. It then proceeds to the sandpile along the siding, where hinged measuring boxes are arranged on a small car running upon a narrow-gage track along the side of the sandpile, as



HINGED SAND-MEASURING BOXES ON CAR RUNNING BESIDE SAND PILE

shown. The sand boxes are placed the same distance apart center to center as the compartments in the trucks, and as soon as the trucks have reached their position at the side of the narrow-gage car the boxes which have been previously filled with sand are ended up by hand and dumped into the compartments. On



SECTIONAL TRUCKS USED TO DELIVER PROPORTIONED BATCHES OF MATERIAL

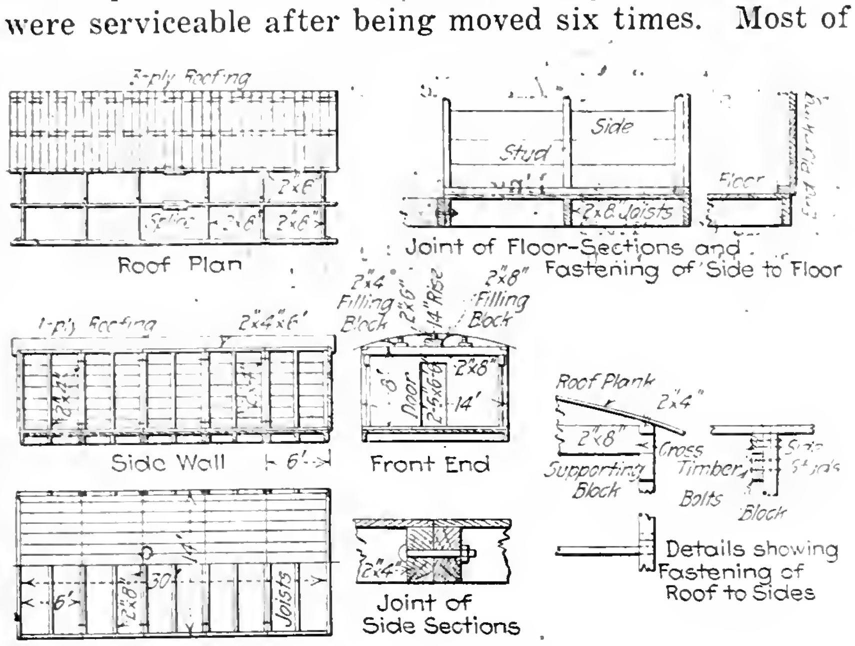
work having a sand as well as a stone elevator, this measuring could be done in the truck body.

The contractor for the work was the Harrison Engineering & Construction Corporation, Buffalo, N. Y.

Laborers Build Sectional Camp Houses

WOOD camp buildings built up in 6-ft. sections by laborers instead of carpenters as is usual, are shown in the accompanying drawings, the sections being put together with bolts through the abutting floor joists, side studs and roof beams. Each 6 x 14-ft. section is composed of floor joists, studs and roof-beams, with plank floor and sheathing. The roof is of the turtle-back type, composed of 16-ft. transverse planks bent over stringers blocked up on the roof-beams so as to give a rise of 14 in. At the eaves these planks are secured to sticks notched into the ends of the roof-beams. This roof planking is applied after the sections have been erected.

After erection the roof of the completed building is covered with three-ply roofing paper, fastened by nails and tin washers. Doors are provided in the ends, and a certain number of sections have windows framed into the sides. The sections are readily disconnected, packed for shipment and reassembled. Some of the buildings were serviceable after being moved six times. Most of



SECTIONAL CONSTRUCTION FOR CAMP BUILDINGS

the buildings are 30 or 36 ft. long, but shorter lengths are employed for such special structures as storehouses and camp hospitals.

These camp houses were built in sections at the site by laborers under the direction of a boss carpenter, as no carpenters for building the houses in the usual way were available. In two weeks 60 houses were built by about 20 men; one group of six men building the sections, a second gang of six men erecting the sections, and a third gang of eight men putting on the roofs and the paper sheathing. This was the average distribution; at first all the men were engaged in building sections, and toward the end most of them were applying the paper. One carpenter-foreman supervised the three gangs. The laborers were paid 40c. per hour.

These buildings are used by the Walsh Construction Co. on its work of double-tracking the Indianapolis division of the Cleveland, Cincinnati, Chicago & St. Louis R.R. (See *Engineering News-Record* of Mar. 13, 1919, p. 524). The drawings from which the illustration was made were furnished by T. E. Earle, resident engineer for the railroad.

Compressed Air Line Connected to Water Mains for Fire Protection

A "SCISSORS" expansion joint in a wrought-iron compressed-air line, and a connection of the same air line to a cast-iron water main, are features adopted at the shipbuilding plant of the Beaumont Shipbuilding & Dry Dock Co., Beaumont, Tex. E. B. Van De Greyn, chief engineer, considers the scissors expansion joint more efficient in construction work than the ordinary telescoping expansion joint. It also has the advantage of being home-made, requiring mainly only nipples and elbows.

For fire protection, a connecting pipe runs from the cast-iron water main to the air line, the valve in which is, of course, ordinarily kept closed, and no water enters the air line. However, in case of fire the many small air lines which go to all parts of the work are at once made available as water lines by simply opening this valve. Boxes with such connections are distributed at frequent intervals throughout the yard.

J. W. Link is president and general manager of the Beaumont Shipbuilding & Dry Dock Company.

Cracked Water Jackets Repaired by Rust Joints or With Steel Cement

RUST joints, familiar to every contractor, can be used successfully to repair cracked water jackets on tractor engines, when the crack does not exceed $\frac{1}{32}$ in. in width. Drain off the water and close the drain cock. Seal the outside of the crack with putty or tallow. Using a solution of 1 lb. sal ammoniac to 1 gal. of water, fill the water jacket high enough to submerge the crack, and let stand 30 minutes. Then drain the water and run the engine for a few minutes to warm the jacket. Refill the jacket with the solution, let stand, drain and reheat. Repeat this operation three or four times, and a joint will be formed which will not leak. Wider cracks can be closed with steel cement applied according to the directions printed on the containers. These recipes are vouched for by the International Harvester Companies.

News of the Week

New York, May 22, 1919

Civil Engineers' Society Plans for Convention at Minneapolis

At the American Society of Civil Engineers' forty-ninth convention, at Minneapolis-St. Paul June 17-20, the president, F. S. Curtis, will deliver the annual address at the opening meeting, at which Howard N. Winchell, president of the American Institute of Mining and Metallurgical Engineers, will also deliver an address on the "Mines of Minnesota," and F. C. Shenehon will speak on "Engineering Activities of the Twin Cities." The second day will be occupied by an automobile trip to various points of interest, and the party will be entertained by the Engineers' Society of St. Paul. The third day will be devoted to two all-day excursions, either one by trolley to Lake Minnetonka, or one by automobile (about 50 miles) to the Taylors' Falls plant, by invitation of the Northern States Power Company.

For the afternoon of June 20 an excursion to Duluth and the Missabe range iron mines is scheduled. On arrival at Duluth the party will be the guests of the Duluth Association of Members of the American Society of Civil Engineers and the Duluth Engineers' Club on an evening trip by steamer on the Duluth-Superior harbor. On Saturday morning a special train will be taken to the mines at Hibbing and, under the auspices of the Engineers' Club of Northern Minnesota, the party will then proceed by automobile 30 miles along the iron range to see the development of the Mesaba open pit mines at Eveleth. From there the party will proceed to the ore-shipping port of Two Harbors, where the ore docks will be inspected.

More Units of 23rd Engineers Scheduled for Early Return

The War Department has announced that three additional companies of the 23rd Engineers (highway engineers) have been placed on the priority list to be returned to the United States from France. The three companies are G, H and I. The Washington representative of *Engineering News-Record* reports that it is expected that additional companies of the 23rd will be ordered home from day to day.

Shipyards Authorized To Take Foreign Orders

Orders issued by President Wilson May 13 allow American shipyards to build ships for foreign account in so far as the work will not interfere with the building program for American registry. It is understood that all such foreign contracts will be placed under the supervision of the Shipping Board.

Employment Bureaus

Engineering Societies' Employment Bureau, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Committee Appointed To Coöperate With Bureau of Public Roads

Appointment of a committee of state highway officials to coöperate with the Federal Bureau of Public Roads in carrying out the provisions of the Federal-aid road act and its amendments has been announced through the Department of Agriculture. A. R. Hirst, state highway engineer of Wisconsin, and president of the American Association of State Highway Officials, made the appointments, as follows: George P. Coleman, state highway commissioner of Virginia; S. E. Bradt, state superintendent of highways of Illinois; Charles J. Bennett, state highway commissioner of Connecticut; W. S. Keller, state highway engineer of Alabama, and Ira R. Browning, state road engineer of Utah. The committee will act in an advisory capacity to the bureau.

Fast Work Done in Building of 8800-Ton Ship

Built in 27 working days, the 8800-ton steamship "City of Eureka" was launched at Portland, Ore., May 8 by the Columbia River Shipbuilding Corporation. In building the ship work was carried on continuously, in three shifts. The performance established a new shipyard record for the Pacific Coast.

A. A. E. Convention Features Pay and Employment

Society Inter-Relations Considered, and Proposed Laws Affecting Engineers To Be Published

Salary schedules, employment problems and opportunities, proper compensation, and society inter-relations were the main features discussed at the annual convention of the American Association of Engineers May 12-13 in Chicago. Ninety delegates from 13 of the chapters and three clubs were present, although the attendance was 186 at the largest session.

Changes made in the constitution are as follows: A national practice committee is authorized, to report on questions of ethical policy and conduct. a grade of candidate junior is added; chapters are to recommend grading of candidates; junior members may now vote but not hold office; the latest past-president is to be a director; the board is authorized to make mutual agreements with other societies. (This is in confirmation of the affiliation plan carried out with the Cleveland Engineering Society.) The warmest discussion of the convention was over the proposal to fix the entrance fees at \$5 or \$10. The present by-law was retained; entrance fees, therefore, will continue to increase automatically by \$2 for each 500 members above 1000, the count to be made in December and fixed for a year. Apprehension that the fees would be so high as to keep out younger members gave way to the idea of the increased service that could be rendered through the larger income.

Following an explanation of the similarity in work of the Engineering Institute of Canada with that of the association, by Fraser S. Keith, secretary of the former body, it was voted to leave the Canadian field to the institute and to coöperate fully with it. An indication of the desire of other organizations to enter into some agreement was a telegram from the Oregon Engineering Society asking for a proposal either to enter as a chapter or to make joint membership possible.

A. M. Van Auken, chairman of the committee on compensation of the Chicago Chapter, presented a comprehensive 19-page report, containing schedules, which had been made to the chapter on May 3. (See page 1005 of this issue.) Adoption was not asked for, but it was recommended that the national body use the data and schedules in a nation-wide study and seek to formulate a more comprehensive schedule.

A recommendation was adopted pro-

viding that abstracts of all laws applying to engineers and surveyors, which degrade and hurtfully affect the engineer, should be collected, published along with suggestions for better laws in the interest of the public and the good of the profession, and should receive the widest publicity. The St. Louis Chapter presented a schedule for the municipal engineers of that city, which was indorsed.

H. G. D. Nutting, in his paper on "Ways and Means of Obtaining Proper Compensation," indicated five ways which may be used to help the man who cannot develop sufficient initiative along selling lines. His suggestions were: Increase the demand; limit the number by license; limit the number of technical graduates (questionable); union methods (questionable); limit the fake correspondence school courses; limit the fake employment agencies with alluring offers.

F. H. Myers, speaking on the employment department, indicated that 10% of the dues is now spent on this activity. From 300 to 350 members are on the list to receive the bulletin of positions open. Circular letters to employers get 5% returns. For the week ending May 10, twenty-one men were placed in positions averaging $150 per month, at a cost of $45. Had these men gone to employment agencies the cost would have been $1890.

The next annual convention will be held in St. Louis. The results of the letter ballot for officers are as follows: President, F. H. Newell; vice-presidents, W. W. DeBerard and F. A. Evans; new directors, W. W. K. Sparrow, P. E. Harroun, R. Burnham, F. D. Richards, A. A. Matthews and E. F. Collins.

New York Governor Vetoes Water-Power Commission

Governor Smith of New York has vetoed the Sage Water-Power Commission bill which appropriated $100,000 to ascertain the cost of development, transformation and distribution of water-powers and urge upon the Federal Government the state's right of full control of boundary waters. Apparently the Governor did not think it desirable to spend more money in investigatory work and is in favor of some definite legislation which will permit immediate state water-power development.

State Purchase of Interstate Toll Bridges

A law approved by Governor Sproul of Pennsylvania, May 15, provides means for coöperation of the state with New Jersey in purchasing toll bridges over the Delaware River. The Board of Public Grounds and Buildings is to act for Pennsylvania in conjunction with a similar body designated by New Jersey. Purchase may be by agreement or under condemnation, but in fixing the fair value of the bridge and its approaches the commission must take into consideration the value of the franchise.

New President of American Association of Engineers

Dr. F. H. Newell, head of the department of civil engineering, College of Engineering, University of Illinois, was elected president of the American Association of Engineers at the annual meeting in Chicago last week. He has had an active part in reform movements in the engineering profession in the past few years, and has served as president of the Committee on Engineering Coöperation from its organization in Buffalo in 1915 to the present time. He was one of the founders of the Washington Engineering Society and served as its president.

Elected President of American Association of Engineers

F. H. NEWELL

Dr. Newell served as the first chief engineer of the United States Reclamation Service from 1902 to 1907, and from 1907 to 1914 he was director of the Service.

He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers and the Western Society of Engineers, and is one of the original members of Engineering Council.

Preliminary Program of Concrete Institute Annual Meeting

At the annual meeting of the American Concrete Institute, to be held at the Hotel Traymore in Atlantic City, June 27-28, special attention is to be paid to the subject of concrete ships and of the developments which have arisen in their design and construction. Thus, there are two papers of particular interest to general concrete construction: "The Effect of Vibration During Placing on the Strength of Concrete," by Prof. D. A. Abrams, and "An Investigation Into the Economic Possibilities of Light-Weight Aggregate in Building Construction," by A. W. Stephens. There will be, besides, four papers on concrete ships proper: "Construction of Concrete Barges," by S. C. Hollister; "Layout and Equipment of the Government's Concrete Shipyards," by A. L. Bush; "Problems in the Design of Concrete Ships," by J. Glaettli, Jr., and "Problems in the Construction of Concrete Ships," by R. J. Wig. Special tests made in the investigation of concrete ships are to be treated in a paper entitled "Results of Investigation on Shear, Impact, and Bond Made for Concrete-Ship Studies," by W. A. Slater, and the development of the new strain measurer to determine the stresses in ships is taken up in a paper by F. R. McMillan entitled, "The Strainagraph and Its Application to Concrete Ships." Other important papers are: "Fire Tests of Concrete Columns," by W. A. Hull; "Temperature Cracks in Chimneys," by J. G. Mingle; "Concrete Work on the Brooklyn Army Base," by A. C. Tozzer; three papers on fuel oil tanks, by H. B. Andrews, H. B. Walton, and J. C. Pearson and G. A. Smith, and "Concrete Railroad Tracks," by A. C. Irwin. On June 27, at 8 p.m., a joint session will be held with the American Society for Testing Materials.

Mining Engineers to Hold Fall Meeting in Chicago

The fall meeting of the American Institute of Mining and Metallurgical Engineers will be held in Chicago Sept. 22-26, according to present arrangements. It is planned to make the meeting of considerable importance to the industry, and subjects of vital concern to iron and steel interests will be discussed. In addition to technical papers, a program of excursions to various points in the Chicago district will be arranged, including trips to the steel mills at Gary, oil refineries at Whiting, and to the La Salle district, where there are cement, coal and zinc industries.

New York Removes Motor Truck From Personal Tax Class

Through a provision in a revenue bill just signed by the Governor of New York, motor trucks are removed from the personal-property classification and are placed upon the same basis in this respect as the passenger vehicle. The only revenue levy that can now be collected from the commercial truck is the regular license fee.

No change was made in the license fee which has held for the past two years. This provides that a truck of one-ton gross weight or under shall be taxed $10 per year, and that $5 shall be added for each extra ton of gross weight. Thus the license fee for a five-ton truck whose gross weight would be about 2000 lb. would be around $55. The bill provides that this license fee shall cover all taxes whatsoever; thus cities and other Governmental units would be prohibited from levying taxes or requiring special licenses. Provisions have also been made for increasing the license fees on passenger vehicles, which means a tax up to $60 for the larger and higher-priced cars

Annual Meeting of Highway Traffic Association

Discusses Regulation of Motor Express and Traffic Control on Feeder Roads—Officers Elected

The organization and the development of highway transport, as well as the proper construction and control of the highways made necessary by this development, were the subjects of discussion at the annual meeting of the National Highway Traffic Association held at the Automobile Club of America, in New York City, May 14. The program, announced in *Engineering News-Record* of May 8, 1919, p. 938, was followed very closely. The subjects which brought out the most discussion were regulation of the motor express service and the control of traffic on feeder roads.

During the afternoon session practically every speaker touched upon the subject of the desirability of enfranchising motor express companies. It was stated that the principal reasons why motor express companies are failing are (1) Ignorance as to the cost of operation, and (2) inability to raise prices on account of cut-throat competition even if costs are known. It was the general opinion that legislation should be passed to limit the number of companies operating over any one route. Some, however, felt that franchises should not be given to motor transportation companies, and they suggested a campaign of education as to the cost of operation.

In the evening session, after the presidential address by Arthur H. Blanchard in which he defined the subjects to be followed in the study of "Highway Transport Engineering," and addresses on "The Townsend Highway Bill," by H. G. Shirley, secretary, Federal Highway Council, and "Highway Requirements," by W. G. Thompson, state highway engineer of New Jersey, a discussion of the control and construction of feeder roads was opened by E. J. Mehren, editor of *Engineering News-Record*, followed by George H. Pride, president of the Heavy Haulage Co., of New York. This discussion showed a wide difference of opinion as to the feasibility and desirability of restricting heavy traffic on side roads. It was pointed out that a very large percentage of present highways will not stand up under motor-truck traffic such as is proposed, with an allowed maximum load of 28,000 lb. However, no solution of the problem of keeping trucks off the feeder roads was reached. The fact was brought out that even legislative regulations at present in force are constantly broken, and it seems almost impossible to make the regulations effective. At the close of the session an instructive educational film for the promotion of good-roads sentiment was shown by the Universal Film Manufacturing Co.

The following officers were elected for the ensuing year: President, Prof. Arthur H. Blanchard; vice-presidents, David Beecroft and John T. Stanton; secretary, Elmer Thompson; treasurer, George H. Pride. The following directors were elected: Gen. T. Coleman du Pont, of Delaware; William P. Eno, of the District of Columbia; William P. Beatty, of Illinois; Charles Henry Davis, of Massachusetts; Walter R. Addicks, of New York; R. J. Corbitt, of North Carolina, and Philip A. Koehring, of Wisconsin.

Highway Bond Issue Vetoed by New York State Governor

Governor Smith of New York has vetoed the proposed state highway bond issue for $20,000,000. The funds from this bond issue were to be used largely in meeting the allotment of Federal-aid moneys to the state. He approved an appropriation of $25,000 for the employment of prisoners on state and county highways.

The ground given by the Governor for disapproving of the bond issue was that the bill was so framed that the manner in which the money is to be used would be determined by the legislature. He stated that in the past money so distributed had been treated as political patronage, and that highways were designated, not with the idea of serving the greatest number of people, but with the idea of benefiting the men with the most political influence. While this money was to have been used in combination with Federal aid, it is hoped that some other means may be found to supply the necessary funds, so that the work will not be delayed.

California to Vote on Highway Bond Issue for $40,000,000

A special election has been ordered by Governor Stephens, of California, for the purpose of submitting an amendment to the constitution providing for the issuance of $40,000,000 in highway bonds. This bond issue, which is in addition to several made in recent years, is for the purpose of making extensions to the state highway system.

Good-Roads Sentiment Strong in California

That good-roads sentiment is strong in California is evidenced by the vote upon a bond issue for $4,800,000 in Fresno County. Although this bond issue is larger than that voted by some states, it was carried by a majority of 7 to 1. Seven precincts voted unanimously for the bonds. It is felt that this is an indication of the vote which will be recorded in favor of the forthcoming state bond issue for $40,000,000.

Plan $5,000,000 Water Bond Issue in Tulsa

At a meeting of the Allied Civic Committee in Tulsa, Okla., May 9, which was called by W. C. Steger, chairman, final plans for holding a city election for the purpose of voting $5,000,000 in bonds for building a new water-supply system from Spavinaw Creek to Tulsa were formulated.

Cement Companies Combine for Foreign Trade

Ten Manufacturers, Taking Advantage of Webb Act, Organize Cement Export Company

Portland cement manufacturers have just formed a company for foreign sales only, under the provisions of the Webb act. Ten companies have already joined the organization, which is known as the Cement Export Co. and has offices in New York City, and invitations to participate in the new organization have been extended to all Eastern cement manufacturers.

The following were elected directors of the company: Emil Loeb, Coplay Cement Manufacturing Co.; J. Brobston, Dexter Portland Cement Co.; J. A. Horner, Nazareth Cement Co.; L. C. Morton, Phoenix Cement Co.; George F. Bayle, Glens Falls Portland Cement Co.; J. W. Fuller, Allentown Portland Cement Co.; Frank H. Smith, Lawrence Cement Co.; Charles F. Conn, Giant Portland Cement Co.; Morris Kind, Hercules Cement Corporation, and F. W. Kelley, Helderberg Cement Company.

It is announced that arrangements are under negotiation with the Bureau of Standards to test all cement delivered by the export company and to certify that the cement fulfills all the requirements of the standard specifications of the American Society for Testing Materials.

As portland cement for domestic shipments is almost entirely delivered in paper or cotton sacks, and as most export shipments are called for in wooden barrels, the matter of cooperage is of great importance. Tentative plans have been outlined for the erection of a barrel-manufacturing plant at tidewater, with a large storage warehouse equipped with barrel-packing machinery in connection therewith. By having a large stock of cement in storage at tidewater at all times, the company, it is believed, will be able to take better advantage of the present somewhat limited shipping facilities to South American countries. While the Cement Export Co. expects that its activities will largely be confined to Latin-American countries, it will be in a position to supply cement to European countries if conditions make this desirable.

Feeder Cables a Factor in Bridge Fire

A small fire that broke out on an emergency footwalk on the Williamsburg Bridge over the East River, New York, May 18, led to a heavy short-circuit of electric feeder cables strung directly under the walk. A short length of the walk and a considerable amount of cable were destroyed, and one steel track stringer was damaged enough to require replacement. Because of the part played by the feeder cables in this accident, Public Service Commissioner Nixon has undertaken to provide ducts or other inclosure for the cables.

Disintegrated Sewer Concrete Requires Repairs

Stretch of Sewer in a Chicago Industrial District Breaks Down Below Water Line

Disintegrated concrete appears over nearly one-eighth of the inside area of a 63-in. concrete sewer built in Chicago in 1908. Extended investigation of the faulty structure by one of the editors of *Engineering News-Record* disclosed the following remarkable conditions: In many places the disintegration reaches entirely through the shell. The concrete at these places is rotten; it can be dug away and picked apart with the fingers. When excavated and hoisted to the surface in the process of repairing the sewer few pieces of this spoiled concrete are as large as a man's fist, and much of the débris is as fragmentary as was the original gravel aggregate.

The faulty sewer is a portion of the eight-mile sewerage system of the Clearing Industrial District, located in the southwestern outskirts of Chicago. These sewers are not a part of the Chicago city system; they were built and are owned by the district. Of the total system, only Sec. 7, which is the sewer on 63rd St., exhibits disintegration. This section is 7924 ft. long and is a monolithic concrete sewer 63 in. in diameter, with an 8-in. and 12-in. shell. It was built in 1908; it was the last of all the sections, and it was built as a separate contract.

Portland-cement concrete was employed. The cement was given the usual tests by a reliable commercial testing laboratory and was passed by the laboratory as satisfactory. The sand and gravel were from pits which have furnished aggregate for many successful concrete structures, and both passed inspection. The proportions were 1 : 2½ : 5. All concrete was machine-mixed. A fairly dry mixture was employed. Construction methods followed ordinary good practice. The invert concrete was placed first, then forms were set up, and the remainder of the concrete was placed from the top. There were no longitudinal construction joints. The trench was in stiff clay, giving excellent backing for the structure.

Disintegration affected the whole length of the section. It is more severe in some stretches than in others, but there is no regularity in the alternation of the more and the less damaged stretches. The damage is confined to the bottom and to the sides below the horizontal diameter. It is mostly at the normal water line. Above this level on the sides there is an occasional bad spot. The roof is invariably hard and sound. Disintegration often extends through the shell. Where it exists it is complete; the concrete has no coherence or strength. The extent of the damage is indicated by the amount of repairs entailed in the 1300 ft. of sewer on which work has been completed. Repairs were necessary on 79% of the length and on 11.8% of the internal area. Indications are that these proportions will be less as the work proceeds toward the head of the section.

In this connection attention should be called to the disintegration of the concrete in one of the Chicago stockyards sewers, reported in *Engineering News* of Sept. 14, 1916, p. 486. In that case, however, the sewage was notoriously putrid, and the disintegration was practically entirely in the arch above the water level.

The sewage in the Clearing district is the waste of industrial plants, house sewage and storm water. Only the wastes from the Commercial Chemical Co. can be suspected. The disintegration is as prevalent in the sewer 600 ft. above the point where the chemical wastes enter as it is below this point, and is no greater near the entrance than it is at more distant points. Furthermore, the disintegration ceases where Sec. 7 joins Sec. 5, constructed at another time. All the system, it should be noted here, except Sec. 7, was built of puzzolan cement and at a previous date, and none of its length shows any disintegration. It is only the 2000 ft. of Sec. 7 which is not in perfect condition.

The damaged sewer is being thoroughly repaired by its owners. Samples of the disintegrated concrete are being submitted to a number of experts for analysis and tests. When these are completed the results will be available for whatever they may be worth.

Benjamin G. Lamme Recipient of Edison Medal

Benjamin G. Lamme, chief engineer of the Westinghouse Electric & Mfg. Co., received May 16 the Edison medal awarded by the American Institute of Electrical Engineers for "invention and development of electrical machinery." The Edison medal was founded by an association composed of friends and associates of Thomas A. Edison, and is awarded annually for meritorious achievement in electrical science, electrical engineering or the electric arts. The award of this medal is one of the highest honors that can be conferred upon an American or Canadian electrical engineer. and among those who have received it are George Westinghouse, Elihu Thomson, Frank J. Sprague, Alexander Graham Bell and Nikola Tesla.

This honor to Mr. Lamme follows closely his appointment to membership on the Naval Consulting Board, which also emanated from the recommendation of the American Institute of Electrical Engineers.

Among the achievements of Mr. Lamme in the engineering field may be mentioned the development of the alternating-current motor, the "harnessing" of Niagara Falls, the design of the equipment used in the electrification of the New York, New Haven & Hartford R.R., the Pennsylvania, the Norfolk & Western and other railroads.

Civil Service Examinations

United States

For United States civil service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Engineer in forest products, $1860-$3000 per year; assistant engineer in forest products, $1200-$1800 per year, Forest Products Laboratory, Madison, Wis., May 27. File applications before May 27.

Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File application before June 10.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Engineering Societies

Calendar

Annual Meetings

NATIONAL CONFERENCE ON CITY PLANNING; 19 Congress St., Boston; May 26-28, Niagara Falls and Buffalo.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

The Pittsburgh Chapter of the American Association of Engineers will give a banquet and ball at the William Penn Hotel in honor of the engineers of the Army and Navy who have returned from the service. **The Engineers' Society of Western Pennsylvania** and **the Pittsburgh Association of Members of the American Society of Civil Engineers** have been asked to coöperate in the program.

The Portland, Ore., Chapter of the American Association of Engineers recently elected the following officers: President, W. H. Marsh; vice-presi-

dents, A. H. McKeen, T. W. Saul and O. Laurgaard; secretary, R. W. Barnes, and treasurer, C. F. Thomas. A committee was appointed to consider the Oregon law for the licensing of engineers, as well as a committee to report on the pay of technical engineers in railroad service.

The Detroit Engineering Society held a joint meeting, May 16, with the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers. The meeting was addressed by Col. R. A. Millikan, of the Council of National Defense, Washington, D. C., and professor of physics, University of Chicago, who spoke on the "Influence of the War Upon Scientific and Engineering Development in the United States."

The Society of Engineers of Eastern New York elected the following officers at the annual meeting held in Albany, May 12: President, James G. Blunt; vice president, John H. McElroy; secretary, Arthur Bibb, and treasurer, Edgar Croasdale.

The Tri-State Water and Light Association of the Carolinas and Georgia will hold its ninth annual meeting at Greenwood, S. C., June 17-19. W. F. Stieglitz, Columbia, S. C., is secretary-treasurer.

The Engineers' Club of Cincinnati held a joint meeting with the Cincinnati Chapter of the American Society of Mechanical Engineers, May 15. The meeting was addressed by Ernest F. Du Brul, on "Trade with South America."

The Rochester, N. Y., Engineering Society will hold its annual meeting June 13.

The Western Society of Engineers was addressed May 12 by E. M. Haas, of the Austin Co., who spoke on "Modern Tendencies in Engine-House Design."

The Colorado Society of Engineers held a special meeting May 13, at which resolutions were adopted opposing measures providing for a board of control of Denver and creating a public service commission.

The Rochester, N. Y., Society of Technical Draftsmen will be addressed May 29 by Maurice A. Wilder on "Application of Mathematics in the Drafting Room." The annual meeting of the society will be held June 26.

Personal Notes

HOMER L. FERGUSON, president and general manager of the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., has been elected president of the Chamber of Commerce of the United States, having been a member of the Board of Directors since 1914. He was born in 1873 and was graduated from the United States Naval Academy in 1892 and from Glasgow University in 1895. For 11 years he was a constructor in the United States Navy, and in 1905 became general manager of the shipbuilding company of which he is now president. He is a member of the Society of Naval Architects and Marine Engineers, the Society of Naval Engineers, the Engineers' Club of New York, and the Army and Navy Club of Washington.

BRIG. GEN. DOUGLAS MCARTHUR, 42nd Division, U. S. A., has been appointed superintendent of the United States Military Academy. During the first three months after this country entered the war General McArthur served as chief of the Army censorship in this country, with the grade of major, Corps of Engineers. He then sailed with the Rainbow Division as chief of staff, with the rank of colonel. He was engaged in much of the actual fighting and has received decorations from the American, British and French Governments. Previous to the entry of this country into war, General McArthur was on regular station duty with the Corps of Engineers.

WILBUR H. JUDY, who since 1914 has been connected with the water-impounding system and has served as chief inspector of the operating department of the City of San Diego, Calif., has been appointed manager of operation of the city. His first engineering work was with the Allis-Chalmers Manufacturing Co., Milwaukee, and he was later employed on the hydro-electric project of the Pacific Electric & Power Co. near Fresno, Calif.

EDWARD H. BOUTON and MAJ. EZRA B. WHITMAN, of the firm of NORTON, BIRD & WHITMAN, consulting engineers, New York City and Baltimore, former water engineer of Baltimore, who has recently been on duty at Camp Meade, Maryland, sailed from New York, May 17, for England, whence they expect to proceed to Poland to investigate the field there for the establishment of public utilities, such as water and sewerage systems, railroad and highway improvements. They do not expect to leave England for Poland until after the peace treaty is signed.

MAJ. CHARLES H. MILLER, Engineers, U. S. A., has returned to this country and has resumed his work in the firm of the Miller-Butterworth Co., Inc., engineers and contractors, Little Rock, Ark. He received his commission as major of engineers in June, 1917, and was sent to Deming, N. M., as constructing quartermaster of Camp Cody. He was later assigned to the command of the 2nd Battalion, 23rd Engineers, which sailed for France in the month of March, 1918.

M. MANCUSI-UNGARO and L. R. GILBERT have become associated under the firm name of UNGARO & GILBERT, civil engineers and architects, with offices in the First National Bank Building, Bound Brook, N. J. Mr. Ungaro was previously engaged in private practice in Newark, N. J., until entering Government work at Bound Brook. Mr. Gilbert was connected with the Calco Chemical Co. and previously with the New York State Engineering Department.

W. J. DOUGLAS, who recently resigned as engineer of maintenance, Panama Canal, and vice-president of the Panama Railroad Co., in which positions he has served since June, 1918, has returned to New York City and will resume his work as a member of the firm of Barclay Parsons & Klapp, consulting engineers. In the absence of Governor Harding during the past twelve months, Mr. Douglas was acting Governor of the Canal Zone.

C. GRADY CATES, for the past four years chief engineer of the Roanoke Iron & Bridge Works, Inc., Roanoke, Va., has resigned to become chief engineer and assistant general manager of the American Truck Body Co., which has recently been organized, with factory at Martinsville, Va.

MAJ. EDWARD STUART, Sanitary Corps, U. S. A., who recently received his discharge from the service after returning from the Balkans, where he was detailed as sanitary adviser to the Serbian Army and Government, has sailed for France as a member of the Tuberculosis Commission of the Rockefeller Foundation.

D. L. REABORN, for the past four years superintendent of the Mt. Rainier National Park, Washington, and formerly division engineer, Los Angeles aqueduct, has resigned as superintendent of the park to become chief engineer of the Western Willite Road Construction Co., with headquarters in Los Angeles.

LIEUT. E. B. STEARNS, Air Service, U. S. A., who was recently discharged from the service, has been appointed sales manager for the H. K. Ferguson Co., engineers and contractors, Cleveland. He was formerly associated with the Pitt Engineering Co., Pittsburgh.

CAPT. EDWARD STEIDLE, formerly 30th Engineers, U. S. A., and more recently attached to the First Gas Regiment, Chemical Warfare Division, has returned to this country and will resume his connection with the Carnegie Institute of Technology, in mining and field work.

J. W. HOWARD has finished his work in the Ordnance Department of the Army and has resumed the practice of engineering, specializing in roads and pavements, with testing laboratory in Newark, N. J., and offices at 1 Broadway, New York City.

J. D'ESPOSITO, assistant chief engineer of the Chicago Union Station Co., has been appointed chief engineer, succeeding THOMAS RODD, who, it is understood, will become consulting engineer. During the period of the war

Mr. D'Esposito served in the Emergency Fleet Corporation, wooden ship division, as assistant to James O. Heyworth.

BRIG. GEN. WILLIAM H. ROSE, U. S. A., director of purchase, Division of Purchase, Storage and Traffic, has resigned from the service and has become associated with Lockwood, Greene & Co., industrial engineers, as manager of the New York office. General Rose was a major in the Corps of Engineers.

CAPT. C. R. TWISS, for the past 14 years city engineer of Vicksburg, Miss., has resigned to become associated with the I. R. Packard Construction Co., Chicago, and will be in charge of the company's contracts in Arkansas.

EDWARD B. HAROLD, formerly of the New York sales office of the Universal Portland Cement Co., has been made manager of the highway department of the Clinton Wire Cloth Co., with office at 949 Broadway, New York City.

MAJ. A. C. KING, Construction Division, U. S. A., who has been in charge of the electrical section, has resumed his work as one of the chief officers of the Illinois Appraisal Co., with offices in Washington and Chicago.

R. L. SCHMID has been appointed assistant division engineer, Nashville, Chattanooga & St. Louis R.R., with headquarters at Nashville, succeeding J. L. FERGUS, appointed assistant engineer, as noted elsewhere.

FREDERICK A. RHODES, consulting engineer, San Diego, Calif., has been appointed city engineer. He is 39 years old and is a graduate of the Cogswell Polytechnic School, San Francisco.

H. E. TURNER, formerly assistant division engineer, Denver & Rio Grande Ry., Utah Lines, with headquarters in Salt Lake City, has become resident engineer in charge of concrete-highway construction, State Road Commission of Utah.

MARCH F. CHASE, formerly director, explosives division, War Industries Board, has become consulting engineer for the Leonard Construction Co., New York City. The offices of the company have recently been moved to 6 Church Street.

FRED J. DEUTSCHMAN, Aurora, Ill., has been appointed city engineer of Mitchell, S. D., succeeding S. H. Smith, who recently resigned. Mr. Deutschman was previously city engineer of Belleville, Ill.

RAY S. BLINN, formerly city manager of Westerville, Ohio, has been appointed city manager of Lapeer, Mich. He was previously director of public service of Mount Vernon, Ohio.

MAJ. CHARLES S. PILLSBURY, U. S. A., who has been attached to the Aviation Section of the Signal Corps in France in charge of construction work since 1917, has been made a member of the Legion of Honor by the French Government. Major Pillsbury was formerly assistant general sales manager, Chicago Bridge & Iron Works, Chicago.

LIEUT. JAMES R. COMLY, Engineers, U. S. A., has received his discharge from the service and has returned to the engineering department of the San Diego & Arizona Railway.

ALLEN H. STUBBS, formerly of the Department of Engineering, University of Nebraska, has become manager of the Kansas City office of HEDRICK & HUFF bridge engineers.

OLIVER G. SHAFER and ROBERT W. HANSON have become associated under the firm name of SHAFER & HANSON, general contractors, Caldwell, Ohio, successors to Oliver G. Shafer, highway contractor.

ELBERT M. CHANDLER, chief engineer of the Naches Selah Irrigation District, has resigned to become first chief engineer for the Washington State Reclamation Service, with headquarters at Olympia.

D. E. COUNTS, superintendent of bridges and buildings, Nashville, Chattanooga & St. Louis R.R., whose headquarters have previously been in Atlanta, is now located at Chattanooga.

ALBERT T. CANFIELD, assistant engineer, architectural department, Union Pacific R.R., with headquarters at Omaha, has resigned to become associated with the SHERMAN ENGINEERING Co., Kansas City.

CAPT. H. E. DARTON, formerly of the 162nd Depot Brigade, Camp Pike, has been appointed first assistant state highway engineer of Arkansas, succeeding JOHN P. HARPER, resigned.

J. L. FERGUS, assistant division engineer, Nashville, Chattanooga & St. Louis R.R., with headquarters at Nashville, has been appointed assistant engineer.

SAMUEL A. GREELEY, hydraulic and sanitary engineer, formerly at 64 W. Randolph St., Chicago, has removed to 39 W. Adams Street.

J. C. CORCORAN, assistant engineer, New York Central R.R., with office in Albany, has been appointed chief signal inspector, east of Buffalo, with headquarters at the same point.

FREDRICK W. CARPENTER, of Flushing, N. Y., has been appointed executive officer of the Wilmington, Del., Bridge Commission.

ENSIGN BERTRAM B. MOORE, U. S. N. R. F., has received his discharge from the service and has resumed his work with the engineering bureau of the City of San Diego, Calif.

MAJ. ARTHUR M. SHAW, Corps of Engineers, U. S. A., announces that upon his release from active duty about June 1 he plans to reopen his office in New Orleans for the private practice of engineering and will engage in hydraulic, railroad, industrial plant and river and harbor work.

F. J. BACHELDER, consulting engineer, Chicago, announces the opening of a new office in Washington, D. C.

WALTER DEUTCHER, acting city engineer of Aurora, Ill., has been appointed city engineer.

W. C. DICKEY, for the past six years city engineer of Conneaut, Ohio, has resigned to become associated with A. E. Vrooman & Co., Painesville, Ohio.

PHILLIP L. MINOR, engineer, National Tube Co., Pittsburgh, has been appointed borough engineer, Ellwood City, Penn.

JOHN ABERCROMBIE, for many years county surveyor, Alexandria, Minn., has opened offices at that point for the private practice of engineering.

OBITUARY

EMIL SWENSSON, consulting engineer, Pittsburgh, died in that city, May 13, at the age of 61. He was born in Sweden in 1858 and was educated in the public schools of Halmstad in a scientific course. He was graduated from the Technical Institute at Gothenburg, Sweden, in 1878. He came to the United States in 1880 and engaged in engineering work. In 1885 Mr. Swensson entered the service of the Phoenix Bridge Co. as draftsman, and two years later became connected with the Keystone Bridge Co., afterward the Carnegie Steel Co., of which he was made assistant to the chief engineer and later superintendent of the Keystone Bridge Works. Leaving the Carnegie Steel Co. about 12 years ago Mr. Swensson entered private practice, and since that time has been engaged in a large number of important works.

H. C. ALLEN, state highway engineer of Idaho, died at Sprague, Wash., May 4. He was appointed to the position of state highway engineer a year and a half ago. Previously he was city engineer of Great Falls, Mont. From Great Falls he went to Spokane, Wash., and laid out the irrigation system for the Hercules ranch. He was later employed as an engineer for the Day Bros. mine at Wallace, Idaho, and was also engineer at the Tamarack and Custer mine, at the time of his appointment as state highway engineer.

DOUGLAS W. TAYLOR, highway engineer of Multnomah County, Oregon, died in Portland, May 3. He was a son of the late D. W. Taylor, who for some years served as city engineer of Portland. Mr. Taylor was born in 1885 and was graduated from the University of Oregon in 1906. Since then he was engaged in engineering work in northwestern Oregon.

Rates for Industrial Insurance in State of Washington

The State of Washington has a monopoly of the industrial insurance business in that state. The advocates of this plan assert that it is the only method by which compensation benefits can be extended to all classes of risks which would be excluded by private corporations. The employers are protected by a state fund, and it is said they are well satisfied with the system. The accompanying table gives the rate per year per $100 of payroll for the various classes of industry. The information was furnished by Frank W. Harris, C.E., statistician for the Industrial Insurance Department, Olympia, Wash. Detailed information will be furnished on request by the industrial department.

COST OF WASHINGTON STATE INDUSTRIAL INSURANCE PER YEAR PER $100 OF PAYROLL*

Class	Industries	Cost
1	Tunnels, sewers, drilling wells, etc.	$2.64
2	Bridges and trestles, mill-wrighting, tanks, towers, etc.	4.19
3	Canals, piledriving, breakwaters, etc.	4.76
5	Carpenter work, plastering, roof-work, etc.	1.91
6	Conduit work, electric power plant, etc.	1.41
7	Railroad construction, logging railroad, etc.	2.82
8	Concrete paving, roadwork, etc.	1.20
9	Shipbuilding, etc.	1.36
10	Logging, sawmills, etc.	2.01
12	Dredging, etc.	1.43
13	Steamheat or power plants, etc.	1.34
14	Street and interurban railways	.95
15	Telephone and telegraph	.86
16	Coal mines	3.15
17	Quarries, gravel pits, etc.	3.16
18	Smelters, rolling mills, etc.	1.44
19	Gas works	.58
21	Flour mills, grain elevators, etc.	.85
22	Laundries and dye works	.34
24	Paper and pulp	.99
29	Cooperage, sash and doors, boxes, etc.	1.24
31	Building material, cement manufacturing, etc.	1.77
33	Fish canneries	1.01
34	Auto repair, foundries, machine shops, etc.	.76
35	Brick and tile, briquettes, etc.	1.02
37	Breweries, bottling works, etc.	.84
28	Textiles, cordage, etc.	.33
39	Foodstuffs, bakeries, etc.	.36
40	Condensed milk, creameries, etc.	.23
41	Lithographing, printing, etc.	.10
42	Longshoring, etc.	2.07
43	Packing houses, tanneries, etc.	.98
44	Cold storage, ice plants, etc.	.87
45	Moving pictures, theatres, etc.	.16
47	Creosoting piles, etc.	.77
48	Elective adoption	.35

*Averages for years 1913 to 1917.

Record Gyratory Crusher Built at Allentown, Pennsylvania

What is reported to be the largest gyratory stone crusher ever built has just been completed in the shops of the Traylor Engineering & Mfg. Co., at Allentown, Penn. The machine, which is shown set up in the accompanying view, is to be used for crushing limestone for chemical purposes, flux, etc. It has two jaw openings each 60 x 190 in. and an estimated capacity of 2500 tons per hour, reducing to 8 in. The crusher complete weighs about 800,000 lb., is 17 ft. 8 in. high from foundation to top of hopper and has a shaft 21 ft. long and 40 in. in diameter.

GYRATORY CRUSHER WITH OUTPUT OF 2500 TONS PER HOUR

In the view herewith, where it is set up in the shop, the enormous size may be well gaged by the men who are standing on the ladder.

Business Notes

The Railway and Power Equipment Co., Woolworth Bldg., New York City, which was recently incorporated to take over the business conducted during the past 20 years by Charles F. Johnson, in New York, Buffalo, Cleveland, Philadelphia, Chicago and Toronto, announces that it is receiving many foreign inquiries for machinery and equipment. It proposes to conduct a world-wide business in all kinds of new steel products, steam, electric and hydraulic machinery, railway equipment, machine tools and contractors' equipment. The engineering and construction departments will design and construct, and aid in financing, important enterprises at home and abroad.

The Westinghouse Electric & Mfg. Co., of East Pittsburgh, Penn., announces the appointment of A. E. Hitchner as manager of the mining section of the industrial sales department. Mr. Hitchner has had extensive experience in handling mining machinery, having been in charge of the Wilkes-Barre office of the company, and in his new position will manage the sale of apparatus for use in the mining industry.

The Blaw-Knox Co. of Pittsburgh has taken over the manufacture and field operation of the Uni-Form system of reinforced-concrete floor and roof construction, and has incorporated it in the steel forms department of the company. Nils F. Ambursen, chief engineer of the Ambursen Hydraulic Construction Co., will assume the duties of chief engineer of the building form department, and W. L. Church, formerly of the Westinghouse Church Kerr Co. and of Lockwood, Green & Co., engineers, is retained as consulting engineer on the operation of the Uni-Form system.

The Canton Culvert and Silo Co., of Canton, Ohio, announces that Judge F. E. De Haven, of La Grange, Ky., has resigned his position as judge of the fiscal court of Oldham County to become their company's traveling salesman in Kentucky. It is also announced that L. W. Hurley, of Lansing, Mich., has accepted a position as representative in Michigan.

Daniel T. Pierce, formerly assistant to the president of the General Asphalt Co., has just returned from more than a year's service in France, and is temporarily established at Room 1031, 120 Broadway, New York City. Mr. Pierce will represent certain Franco-Italian interests and will also act for American manufacturers seeking business in France and other European countries.

The Northern Waterproofing Co., the Waterproofing and Construction Co., Inc., and the Standard Surfacing Co. give notice that they have amalgamated, with business address at 195 Lexington Ave., New York City. While these companies have combined, they will conduct business under their respective names.

The Minneapolis Steel & Machinery Co., Minnehaha Ave. and 29th St., Minneapolis, announces the extension and development of its New York office at 154 Nassau St. to facilitate the handling of domestic sales in the East. J. A. Teach, contracting, mechanical and construction engineer, is now making his headquarters at the New York office. C. W. Hadden will continue his duties as export manager.

Trade Publications

The following companies have issued trade publications:

The C. H. & E. Manufacturing Co., Inc., Clinton and Mineral Sts., Milwaukee, Wis.; folder, 7½ x 11 in., four pages, illustrated; describes the C. H. & E. expansion joint for pipe lines and its installation, with piping system.

The Truscon Steel Co., Youngstown, Ohio; folder, 8⅜ x 11 in., four pages, illustrated; describes the use of "mesh" and "rib" metal for reinforcing concrete roads.

The Portland Cement Association, 111 W. Washington St., Chicago, Ill.; booklet, 6 x 9 in., 19 pages, illustrated; contains "Facts About Concrete Roads."

A Consolidation of Engineering News and Engineering Record | McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor | CHARLES WHITING BAKER, Consulting Editor

Volume 82 | NEW YORK, THURSDAY, MAY 29, 1919 | Number 22

Government Tax on Information

ON AND after July 1 it will be necessary to charge subscribers of ***Engineering News-Record*** living west of the Mississippi River an extra $1 per year to cover partially the increased cost of postage.

Zone rates of postage, adopted as a war measure, became effective on magazines July 1, 1918, thus reestablishing a system abolished as obsolete in 1863. The zone rates, however, are to persist after the war, and are to increase in four successive steps, reaching their maximum July 1, 1921. The publishers had hoped that the law would be repealed, and for that reason bore the burden themselves for the first year. On the first of next July, however, when the second increment becomes effective, it will be necessary to add a postage charge for zones farthest from the point of publication.

The postage on a copy of ***Engineering News-Record*** under the old law was about 72c. a year to any point in the country. In the year beginning July 1, 1919, it will be $2.38, $2.90 and $3.16, respectively, in the sixth, seventh and eighth zones, in which the states west of the Mississippi lie. When the zone rates are fully effective these rates will become $3.94, $4.98 and $5.50, respectively, so that further increases in subscription price to cover added postage seem inevitable.

In studying the law, when first passed, it was proposed to add a postage charge in each zone, but the clerical difficulties introduced were so great that it was found necessary to lay a flat increase on the greater distances. The added amount for postage decided on for the sixth zone was adopted also for the seventh and eighth zones, thus covering all the territory west of the Mississippi.

Therefore, with all subscriptions, new and renewals, sent in on and after July 1 from points west of the Mississippi River an extra $1 should be added for zone postage.

The publishers greatly regret the necessity for taking this step. It has been forced upon them by legislation which places information in the same class as merchandise and penalizes the educational efforts of those who live in the most distant parts of the country. Progress in postal matters has always been marked by a change from the zone system to a flat basis; throughout the world the theory is accepted that there should not be a distance tax on education and enlightenment. Under that theory a 5c. stamp carries a letter to Guatemala, to South Africa or to Japan.

We have no doubt that when the restrictive and sectionalizing character of this legislation becomes apparent the people will demand its repeal.

THE PUBLISHERS.

Septic Tank Patent Settlement in Sight

THE proposed settlement of the Cameron septic tank patent litigation, noted on p. 1084, promises to bring to an end a long and stubborn contest in which many engineers and municipalities have coöperated to resist what they believe to have been invalid claims. The sum to be paid, in which any alleged infringer may join and thus be freed from possible litigation, is so small as to seem like a virtual confession of either the weakness of the case or else of exhausted resources on the part of the claimant. Nevertheless, the remarkable league of states, cities, companies and individual engineers who have stood united in the long fight is presumably wise to accept the compromise, on the ground that the expense will be trifling and the freedom from further annoyance worth while. Those interested in joint civic and private action to defend patent claims will be repaid for obtaining the printed information summarizing this settlement agreement.

Exhibit Promoted by Engineers

WHILE we have been talking about the need for fuller realization by engineers of their local civic responsibilities, an example has been set which deserves hearty commendation. We refer to the industrial exhibition recently held in the 23rd Regiment Armory in Brooklyn, N. Y., under the auspices of the Brooklyn Engineers' Club. Beginning with a few loans shown at the club house, the exhibition reached such a size that only the largest armory in Brooklyn could house it. The main object sought by the club was to place the industrial importance of the Borough of Brooklyn before its citizens in a clear light, with a view to creating and maintaining an active public interest and a pride in Brooklyn's manufacturing progress. The club long ago realized that engineers should take a larger part in civic matters and that a great power for good can be secured from the coöperation of responsible engineering bodies, manufacturers and business men in bringing about civic improvements. An engineering society which shows so keen an appreciation of the responsibility of the engineer in the present age of industrialism as did the Brooklyn Engineers' Club in this case should be congratulated and emulated.

Organization in Lumber Camps

WHEN the Spruce Production Division was organized, and sought to secure a greater rate of production in the Northwest woods, the first obstacle was the labor problem. Labor was in a sullen, ugly mood throughout the Northwest camps. Efficiency was way below par, and there were dissatisfaction and grievance on the part of employer and employee. How General Disque brought employer and employee together on the common ground of loyalty is one of the

important chapters of war-time production. It has a significance now in the fact that the Loyal Legion of Loggers and Lumbermen, the organization 110,000 strong which grew out of General Disque's plan, has elected to continue permanently. In other words, the benefits of a common or joint council as the ruling body in the great industry were so patent to all that the workers themselves voted to continue the organization even after the pressure of war-time necessity had been removed. There is excellent example for other industries, and food for thought for both employer and employee, in the operating plan of the Loyal Legion of Loggers and Lumbermen.

Wanted—A Cheap, Acceptable House

ENGINEERS have not had much to do with building dwelling houses. The single house is so obviously the architect's field that when the number is multiplied, and whole villages are built at once, it is the architect who dominates the design and construction of the houses themselves and leaves to the engineer the public utilities alone. Such was the case with the Government housing program carried out during the war. In consequence, we find that practically nothing valuable was developed by this forced work, in the way of novel or economical house design. The engineer is accustomed to multiple production, to the reduction of pieces and effort by the repetition of the unit. The architect, on the other hand, is concerned with the general effect, and concentrates on the perfection of the unit itself. Much was saved in the Government housing by the development of contracting methods such as are outlined by Mr. Meltzer on another page, but the impression cannot be avoided that some cheaper, and equally pleasing, form of multiple housing could have been developed than the succession of suburban villas which look so delightful in the architect's perspective but which lend themselves so little to economies of production. War emergencies have passed, but the housing shortage is worse than ever. Engineers cannot escape their duty of entering this field. Can they not impress their ideas on the design of the house itself, so that there may result that only solution of the present deadlock between high prices and necessity for shelter—reduced unit costs due to efficient design as well as efficient management of construction?

America's Legacy

IN THE concluding sentence of his address before the National Machine Tool Manufacturers' Association, Charles F. Lang, president of the Lakewood Engineering Co., expressed the thought that, whereas Greece had given us art and Rome law and organization, America would give to the ages a solution of the problem of the "proper distribution of wealth and happiness and education among the masses." Certainly, there is warrant for thinking at the present time that America will make real progress in these directions. Back of Mr. Lang's thought, however, is something very much larger than he had room to develop in that sentence. There is something spiritual, and in that lies all the hope for America's thinkers and America's industrial leaders doing their utmost to reach a real solution of the industrial problem. Mere spreading of wealth will not of itself bring a social order of which we would be proud. A better spreading of the world's goods would be but the means to a geater end. The fullest spiritual development of the individual will come when a qualitative standard again becomes the object of human endeavor, replacing the quantitative standard which has debased our industrial age. That thought is inherent in Mr. Lang's expression when he speaks of happiness and education, for happiness does not consist in the enjoyment of purely material things, nor can education be worthy of the name if it be nothing more than a surface polish, leaving below an undeveloped soul and a weak character. The thought expanded, as it lay in Mr. Lang's mind, is indeed an idea worthy of a great people. It will come only through sacrifice by those who control and direct our destinies, and through an awakening of the nation as a whole to a realization of how our industrial structure ramifies through and vitally affects the life of every individual.

Human Side of Labor and the Engineer Must Be Recognized

CONSIDERATION of the laborer in his human and personal relations rather than as merely an impersonal physical machine is becoming increasingly necessary. That this is being recognized by engineers who have to handle labor was shown by opinions voiced at the recent meeting of the American Railway Engineering Association, as noted in *Engineering News-Record* of Apr. 10, 1919, p. 698, the subject coming up in a discussion of plans for camp buildings and boarding cars, as submitted by the committee on economics of railway labor.

Much of the attention to the physical welfare of laborers has been based upon improving the human machine as an asset of the employer, and has been confined largely to housing and feeding. But there is a growing recognition of the fact that the employer or superior must be willing to consider the worker as an individual and to assist his development in his own—the laborer's—personal interest. In doing this he will help to make the men better citizens, besides cultivating a spirit of loyalty and coöperation instead of indifference or perhaps antagonism.

Higher efficiency is the demand of the time, but in the discussion noted it was pointed out by R. H. Ford, Rock Island Lines, that at present there is low efficiency of common labor as employed on railway construction and maintenance. This condition he attributed largely to the poor grade of housing and feeding that the railways have been content to provide, because they have failed to appreciate even the benefits resulting to themselves from better care of their men. In Mr. Ford's opinion, the great improvement made in recent years in this respect is but the beginning of a much broader improvement. Regard for the human element in the problem, for the benefit of the laborer rather than the employer, was emphasized by J. L. Campbell, of the El Paso & Southwestern R. R. He urged that it is necessary to recognize the fact that the laborer—like any other man—has ideas and aspirations of his own, beyond his mere daily needs and his employment.

Perhaps one reason for the shifting habits of common labor is the fact that welfare methods ordinarily do not go beyond the housing and feeding of the men. Under such conditions there may be no particular inducement for them to stay in any one place. The next employer or job or camp may be better, or if it is worse there is another further on. Checking oppor-

tunities for such casual movement may have some effect, but a better solution seems to be in considering the men as individuals and fellow human beings. This does not imply the babying or coddling of the men, but simply a square man-to-man treatment that will benefit not only the laborer but also the employer and the community.

While the discussion mentioned had relation to common labor, particularly on railway work, the same conditions apply to the skilled laborer and the engineer employee. That employers have shown slight regard for the human aspects of the young engineer and technical beginner is probably a large cause of the unrest and dissatisfaction among the men from whom the engineering profession of the future must be recruited. A new attitude toward and a new sense of responsibility for the technical man and the workman, on the part of the employer, promoting a different relation between employer and employee, may be foreseen among the coming changes.

Scrapping Tons of Good Highway Bridge Metal Because of Local Corrosion

SEVERAL recent cases of highway-bridge repair call attention to the abnormal liability to deterioration of steel at the level of the decking and in certain locations under the floor. The life of many bridges is determined by loss of strength at these points, though elsewhere the full initial strength remains. Facts of experience amply justify the statement that the life of a steel highway bridge is unlimited if trouble at points of special corrosion is taken care of—and, of course, provided cleaning and painting are not neglected. For this reason the engineer's aim must be to eliminate local troubles.

In one case serious loss of strength resulted from corrosion of the web members of a through truss at the point where they pass through the wooden decking. Dirt and moisture, accumulating in the slots cut in the decking for the passage of the posts and diagonals, cut into the metal like a chisel. With concrete deck the same thing would have happened, the members passing through the floor by similar openings (or even much larger ones.) There was also abnormal corrosion at certain points under the floor, as where spiking pieces rested on stringer flanges so that moisture could be retained between the contact surfaces, and where floor planking came so close to the top of a floor-beam that dirt could pocket between them. These conditions are in all respects typical. They establish very definitely the fact that past highway-bridge practice has not given sufficiently careful attention to the protection of steel at and under the floor.

Studies for repairing a Chicago viaduct over railway tracks recently brought out the same general truth, in a totally different set of circumstances. Locomotive gases (acting below the deck level) were the corroding agency in this case. They weakened the bottom chord and stringers so that only half their original strength remained, while the rest of the structure was as good as new; emergency repairs were the only means of avoiding immediate replacement of the entire structure. Enough was known of locomotive-blast corrosion, at the time this viaduct was designed, to enable the after-history to be fairly well foreseen. Yet, with a hopefulness out of all experience, the designer, following the precedent set by many other bridge designers, counted on paint protection to resist this corrosive action. On the occasion of the repair work, however, the engineer who analyzed the case could not escape the broadly general conclusion that highway bridges over tracks should have no part of their steel structure located below the floor.

This is a very sweeping recommendation. As such, however, it is welcome evidence of bold and decided thinking in the matter of the local-corrosion problem. No progress has been made in the past under the plan of letting local corrosion take care of itself, but progress may result if we will face the facts and use every available expedient in the effort to prevent the undesired destruction.

Floors suspended below the truss chords, and so designed as to curtain the smoke away from the steel, would require some interesting modifications of typical design details. A concrete floor slab or a suspended ceiling would have to be used, and in the case of timber-floor highway bridges, as in the case first mentioned, the application of the principle might prove difficult. But any solution of the local-corrosion problem is worth discussion. Under past practice many tons of highway bridges have been thrown into the scrap heap because a few pounds of metal were eaten away by local corrosion.

Care in Foundation Work

NEGLECT in the examination of foundation conditions or in the design or construction of a substructure is sure to cause trouble sooner or later. This trite warning needs constant reiteration in view of the recurrence of failures. The settlement and failure of the Minneapolis armory described in this issue is a new instance. Two months ago the settlement brought to light a peculiarly prominent example. An equally remarkable case in another field was the failure of a drawbridge pivot pier because grossly faulty construction and inspection resulted in making the base only half as large as the body of the pier, as described in *Engineering News-Record* of Sept. 13, 1917, p. 484. Shortly before that time, water-works construction contributed a similar example in the Cleveland filter-house difficulties.

Piles of inadequate number and length in a deep bed of soft mud were responsible for the settlement that wrecked the Minneapolis building. Apart from the question of whether the soil conditions had been considered, it is clear that improper construction and inspection were factors in the case. The piles sank a foot or more under the final blow of the hammer, yet a heavy structure was built on them. The settlement that was to be looked for began even during construction, but apparently nothing more was done about it than leveling up the irregular floor with additional concrete.

Experience thus gives ample warrant for the caution that foundation work preëminently demands zeal and care—too much rather than too little. This applies equally to preliminary investigation, to design and to construction and its supervision. Failures have occurred in spite of all care, but that is an added reason for special thoroughness. The responsibility rests on the engineer; in case of a failure, even if he is blameless, the public is likely to place the blame upon him and the engineering profession.

How One Contractor Went About a Housing Job

Building 450 Small Dwellings for Shipyard Workers in Limited Time Required Organization of Forces and Planning of Operations in Different Manner From That of Usual Large-Contract Job

By Joseph Meltzer
Of Joseph Meltzer & Co., Contractors and Engineers, Boston, Mass.

LARGE-size housing operations involve as much material and labor as the ordinary construction job of similar cost, but the wide area over which the work is done, and the multiplicity of small similar units it involves, make them quite different in many ways from the usual contract operation. The problems in one such war-time job, Project 62 of the United States Housing Corporation at Quincy, Mass., for the workers of the Fore River shipyard, were both engrossing and difficult. First and foremost came the problem of grouping operations and sections of the work and arranging them in sequence for all classes of labor; second came the problem of obtaining the material and delivering and storing it in a way which would eliminate double handling and delay in the work; third came the proper coördination of field and office-organization help; fourth, the problem of grouping labor units under foremen and subforemen so that shirking and idling would be cut down to a minimum.

The project consisted of 256 houses, one-third of which were single six-room houses, and two-thirds double houses with four rooms in each part. Most of them were of common frame construction, with brick first floor, and a few were entirely of brick. The foundations were built entirely of concrete, using the run of the bank for the concrete aggregate, with no waterproofing or exterior finish except for surfacing with a thin grout above the grade line. The frames of the houses were of the ordinary type, with a 2 x 4-in. studding, 4 x 6-in. corner posts, clapboard or shingled as was required by the architect, with double floors throughout, and with mineral-coated asphalt shingles for most of the roofs and slate for others.

The entire project was divided into three tracts, the Arnold St., River St. and the Baker Basin tracts. The first and last tracts were further subdivided into three areas each, thus making seven areas with about 36 houses to an area. The landscape architecture suggests a well formed design throughout, with a logical and systematic layout, taking advantage of the natural grades for economy. The houses were designed for permanence, the rooms were well formed, giving plenty of closet space and suggesting compactness, neatness and economy. The color schemes of the exterior walls and the roofs will present a very pleasing effect when completed. The United States Housing Corporation, through its architect, its landscape architect and the city engineer, designed the houses, laid them out in proper coördination and designed the public utilities. These plans were all ready when the contractor made up his estimate.

HOUSES OF SAME INTERIOR LAYOUT WERE VARIED IN EXTERNAL APPEARANCE

The detailed estimate, with its fine subdivisions into every kind of material that goes towards the making of a single house, was such that at a glance the entire aggregate of commodities could be taken off from a list. This was no small part of the job. As there were 28 different types of houses in the project, each commodity—such as concrete, boarding, rough framing, brickwork, shingles, etc.—had to be itemized per type of house and summarized both for the group of houses and the total number of houses. This was accomplished with the help of the corporation's field cost engineer. As a general rule, a contractor, in bidding on any construction project, does not go into minute detail but rather bunches groups of work. It was therefore a departure from the ordinary methods of the contractor's estimating department. As an example of the fine subdivisions, the rough framing had to be divided in the different sizes and different lengths and spread over the 256 houses, giving the number of pieces of each length for each type number.

The contractor's organization of forces followed the axiom that a triangle is safer standing on its base than on its apex. In other words, the scheming of the contractor's organization was done in such a way as not to make it top-heavy.

The construction work was commenced Sept. 9, 1918, four days after the award of the contract and four weeks before the contract was signed. Excavation was begun immediately after a tent was pitched, emergency equipment and material were brought in by trucks, and first small gang of 15 men started. The contractor's force then consisted of a few labor foremen, one office man and the assistant works manager. From that day on the field organization as well as the office organization began to form.

September and October were the most trying times for a contractor in which to organize a working force. The weather was bad, extremely bad. The influenza epidemic in the neighborhood was on the upward climb,

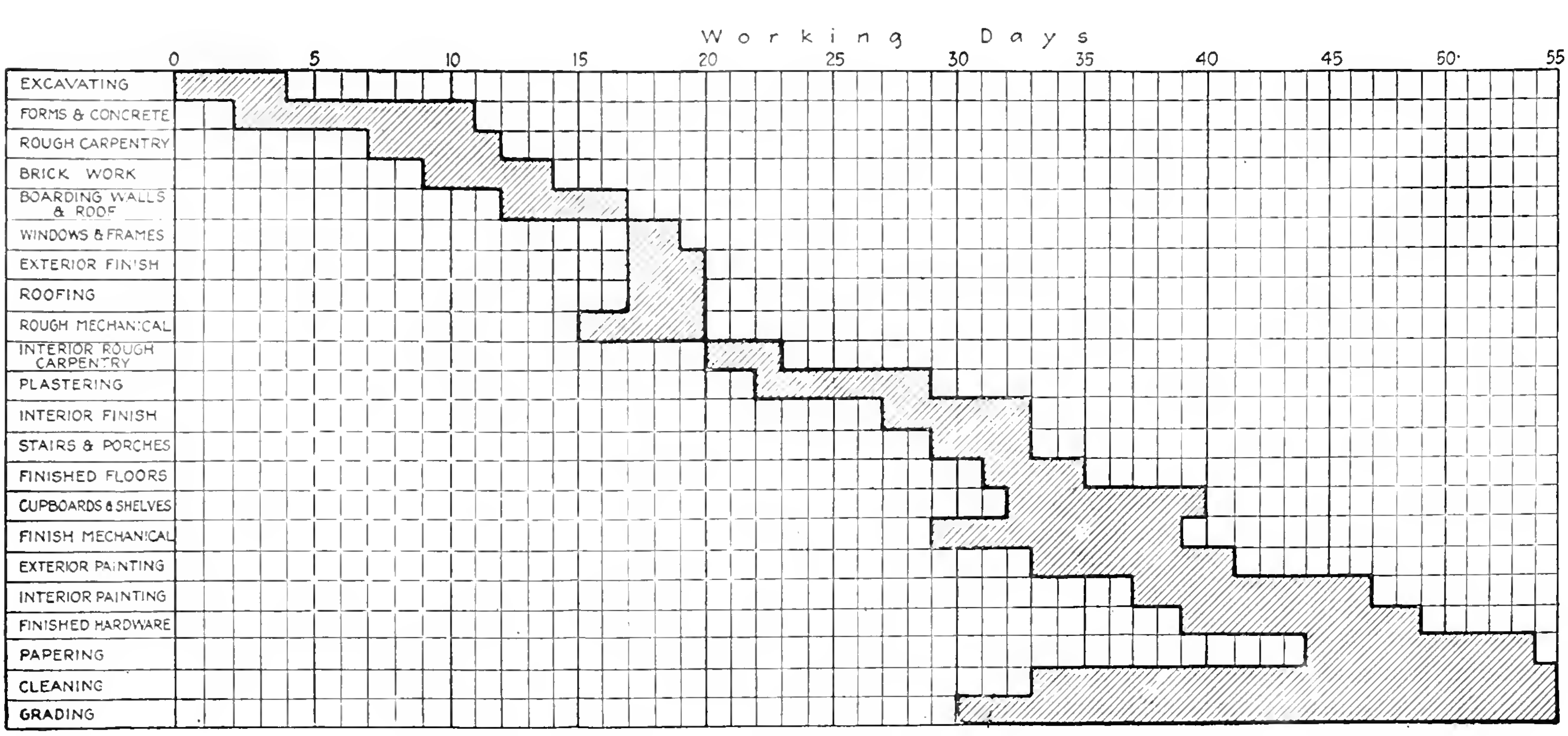
SHOWING RUNWAY OVER HOUSE FOOTINGS IN FOREGROUND TO FACILITATE OPERATIONS

taking its victims where least expected, and it took every ounce of energy to persuade the laboring class to go to the Quincy job at a wage scale that offered no inducements. However, in spite of all these difficulties, in three weeks' time an office organization consisting of approximately 30 employees and a field organization approximating 500 were gathered and put into working order toward a definite goal—rapid work, economical construction and efficient handling of labor.

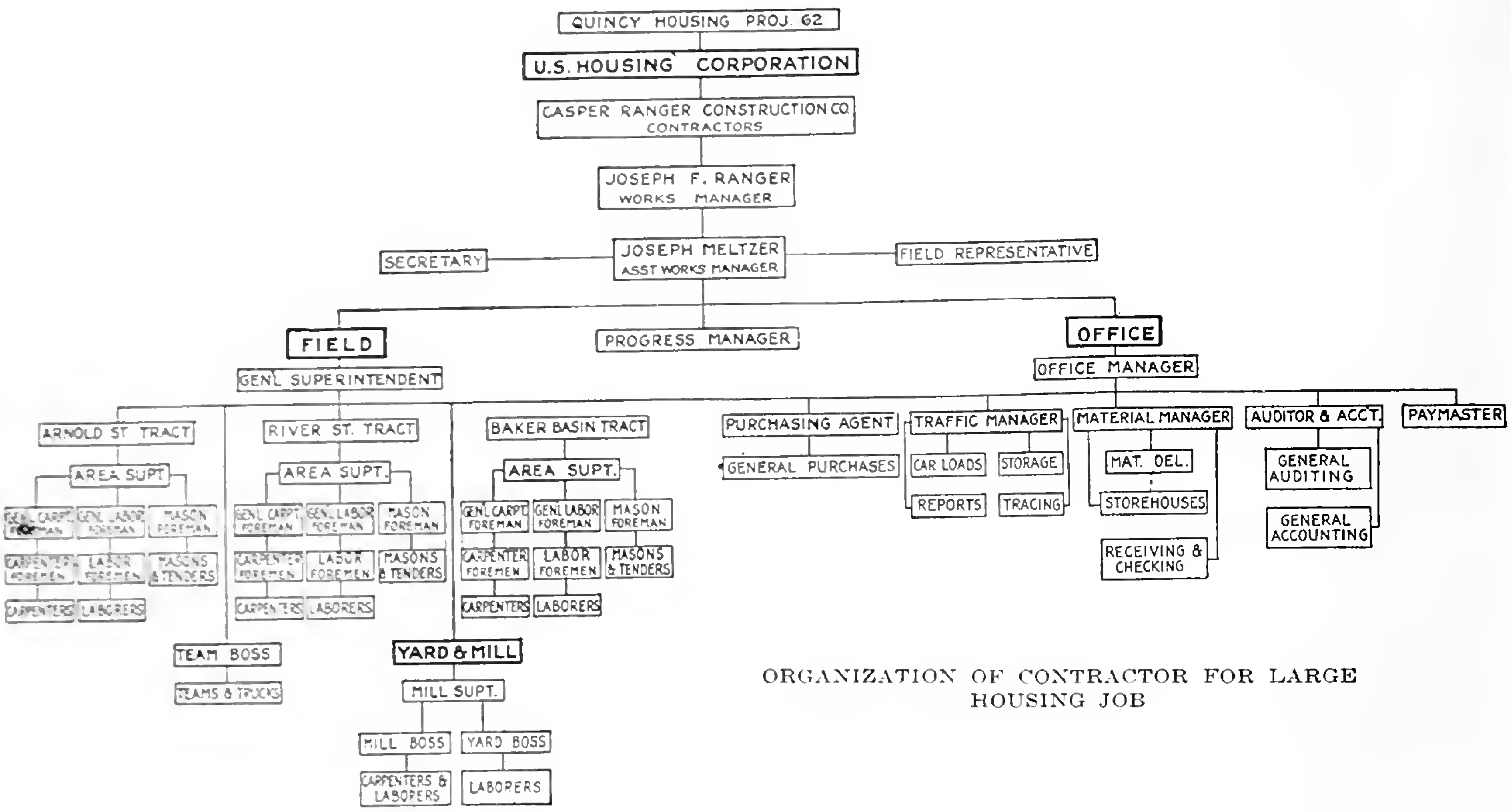
Gangs were organized to do excavation, other gangs were organized to do concrete work and still others were organized to place forms and to strip forms. These gangs followed one another in series, so that very little time was lost betwen movements. As soon as it was possible to remove the forms, the framework was started and brought to completion in very short time. Usually between eight and 10 men constituted a gang for placing the concrete work and from six to eight carpenters constituted a gang for putting up the framing and boarding.

The excavation on two of the areas was accomplished by horse scrapers and hand shoveling. On the Baker Basin tract, however, as well as in one or two instances on the Arnold St. tract, steam shovels were used.

Particular attention was paid to the top soil and subsoil with a view to saving every available square yard for planting and seeding around the houses. This was accomplished by using two horse scrapers and piling up the top soil and loam between the houses so that double handling would be avoided. The pressure of time, the inability to obtain the required amount of labor, and the rapidly approaching cold weather, hampered



HOW WORK WAS PLANNED ON ONE GROUP OF 15 HOUSES



ORGANIZATION OF CONTRACTOR FOR LARGE HOUSING JOB

the contractor in handling the top-soil excavation in the most efficient manner. However, taking everything into consideration, very little rehandling of the top soil was necessary. The excavation, which consisted in the main of gravel and sand in a proportion suitable for concrete aggregate, was effected by scrapers, plows and hand shoveling. Every possible bit of gravel that was fitted for concrete work was saved and used for that purpose.

Just as soon as a cellar would be completely excavated, the concrete footings for the walls were placed, mixed by hand or machine, and forms for the concrete walls were immediately set. Square-edged spruce and hemlock boards were used as well as tongue-and-groove North Carolina pine, although the writer prefers square-edged material. The concrete for the walls was mixed in one-batch gasoline-operated mixers mounted on wheels, which proved very economical. These machines were easily moved from one cellar to another and runways were quickly set up. At times two or three cellars would be poured from a centrally located mixer. Each mixer would pour the foundation of a double house in one day.

The framing for the entire project was handled from central mill located on the Arnold St. tract; all of it was cut and framed, numbered, marked and shipped to the various houses. When the concrete forms were partially stripped gangs of carpenters were organized, usually from six to eight to a house, to place the ready-cut framing, do the rough boarding and lay the rough flooring, all in one operation. These gangs were kept moving from house to house, from four to eight gangs being used on each area.

As soon as the rough framing was completed and interior studding placed, the plumber would organize a gang of two for each house to do the roughing-in work, between two and eight gangs being used on each area at different times. The electrical subcontractor organized similar gangs, working in conjunction with the plumbers and getting the houses ready for lathing and plastering. The sequence of operation after the lathing was in place—such as plastering, hanging sash, interior finish, finish flooring, etc.—was kept up systematically, so that each gang followed another with very little loss of time.

The public utilities being handled under a separate contract and installed by a different contractor, it was in most cases done in such a way as not to hold up the work. The public-utilities contractor used a large steam trencher for excavation for his sewer and water pipes throughout the job. In only a few instances was hand shoveling used. His work embraced the sewer, water and gas piping, and road work from subgrade to finish grade and granolithic sidewalks.

A difficult problem presented itself in the proper scheduling of the material so that commodities would all arrive consecutively and as needed. As the project was situated, all the material necessarily arrived by rail. The contractor scheduled his material so that no more than 15 or 16 cars would come in one day, and in such quantities as were needed weekly, in order to eliminate unnecessary rehandling. Shortly after the award of the contract the War Industries Board organized to purchase all material on Government contracts. This immediately upset all the contractor's material schedules, and material began to pour in at the Quincy station very rapidly, as many as 35 cars coming in one day; in a very short time, due to labor insufficiency, the yard was greatly congested, holding as many as 105 cars at once. It was necessary to build storehouses for the cement, the lime, the interior finish and other material which could not be exposed to the weather, and also to rent several storehouses to accommodate interior trim and other material.

The unloading of all material, especially the lumber, was a somewhat slow process, as the Government officials insisted on a very close check. At the beginning of the job all material was checked by both the contractor's checker and the Government checker. This was later eliminated and brought down to a more businesslike

basis by employing experienced lumber surveyors, and on the whole the unloading was considerably speeded up. All the material was delivered by motor trucks, and all the lumber except lumber for forms was delivered to the mill lumber yard and distributed in piles according to sizes and lengths, as is customary in lumber yards. The cement and the lime were stored in temporary and rented storehouses when these materials arrived in larger quantities than were immediately needed on the different areas. However, whenever possible these perishable materials were delivered directly on the job from the cars, to fill requirements. The other material, such as shingles, roofing, brick, etc., were delivered directly to the house lots in the quantities called for on the official estimate. All standing finish, doors, sash, etc., which had to be protected from the weather, were temporarily stored and then distributed to the different house lots to fill requirements. The central mill was equipped with electrically operated equipment, among which were the following: Two cut-off saws, three band saws, four circular saws, one bed planer, two buzz planers, one miter and other apparatus to make the mill complete. As a necessary adjunct the mill was equipped with a saw setter's outfit, grinders, emery wheels, etc. The mill proved a very profitable unit and decreased considerably the cost of framing and handling. The entire framing for each house was properly scheduled by an experienced man, thus eliminating the duplication of effort and the possible waste of lumber.

ACCOUNT		UNIT	COST FOR PERIOD			COST TO DATE		
1 H (Arnold Street)			QUANTITY	UNIT	TOTAL	QUANTITY	UNIT	TOTAL
11.3	(Pe(8)Rgh.Grading	c.y.	910	1.15	1053	9555	.73	5278
12.11	Excavation	c.y.	816	3.22	2528	12174	2.28	27765
13.111	Sub.Conc.Forms	s.f.	15715	.12	1911	195507	.11	21259
13.112	Sub.Conc.OtherWrk.	c.y.	157	6.50	1021	3111	3.86	12030
13.22	Super BrickWork	M	64.6	39.08	2525	167.6	41.85	7015
13.24	Tile	s.f.	---	---	---	5097	.15	817
14.1	Carpentry, rough	m.b.f.	197.6	23.95	4735	822.9	30.64	25217
14.2	ExteriorMlwk.	1%	7% Complete	212.84	1484	13% Complete	212.84	2912
14.3	Interior "	1%	---	---	---	---	---	---
15.5	Roofing Asphalt	sq.	66	3.19	211	66	3.19	211
16.	Sheet Metal	1%	21% Comp.	3.56	75	21% Comp.	3.56	75
17.1	IronWrk.Struc.	1%	59% "	5.98	350	95% "	5.98	572
18.2	PlasteringInt.	sy.	---	---	---	---	---	---
19.	Plumbing	1%	8% "	88.65	357	15% "	88.65	1400
20.	Heating	1%	20% "	20.84	275	25% "	20.84	527
21.1	Lighting, wiring	1%	9% "	23.58	225	32% "	23.58	771
22.1	Floors, concrete	s.f.	4423	.06	282	4423	.06	262
22.3	Floors, wood	s.f.	---	---	---	---	---	---
25.1	Painting, ext.	1%	3% Comp.	35.23	96	3% Comp.	35.23	96
25.2	Painting, int.	1%	---	---	---	---	---	---
30.	Cleaning Up	1%	22% "	25.50	563	44% "	25.50	1198
38.3	Vit. Pipe, Drains Dry wells	1%	Loss time 1% Complete		13	27% "	18.38	497
				TOTAL	17785		TOTAL	110802
		Note:	Item 12.11 (Excavation) includes rock and wet excavation. Item 14.1 and 14.3 (Each Group) Rough and Finish Hardware included					

FACSIMILE OF PROGRESS COST RECORD, SHOWING FINE SUBDIVISIONS

Unqualified Men Called Themselves Carpenters

One must remember that the laborer who applied for a job during the months of October and November was not a building laborer. Owing to the second Army draft men of all classes and of all occupations sought Government employment so that they might be classed as employed in an essential industry. The project at one time was overrun with tailors, waiters, farm hands and quarrymen, a class of labor which had to be sifted. The turnover on the job, therefore, was immense. In the carpentry line such difficulties were not encountered, but, owing to the many cantonment jobs that were in operation during the previous 15 months, many helpers classed themselves without right as carpenters, which only necessitated their expulsion after a few days' trial.

All this necessarily made for higher cost of construction, and it was only through the careful watchfulness of the individual foremen that the cost was held down to the lowest possible margin.

The progress department would report progress each day on each individual house, also the kind of work performed each day on each individual house. The same department kept a perpetual chart showing the gradual progress. These reports were submitted to the assistant works manager, who would chart each day's work graphically and numerically. By this method constant watch was kept on the cost of the job, the size of the organization, the progress of the job and the ratio of output to cost. In a word, it was the intention and aim to follow up the work as if the entire job was a big machine shop where maximum output and minimum cost are the aim.

In order to create coöperation and friendly feeling between the heads of the departments and a high *esprit de corps*, weekly organization meetings were called. At these meetings the results of the past week's work were discussed, criticisms were made promptly, and everybody present was urged to clear himself of all difficulties confronting him. Thus, each head acquired a view of the workings of the other departments and a proper perspective as to his place in the organization and the necessity for working in harmony. These meetings proved very beneficial to the job.

Among the Government's representatives were H. G. Ganson, traveling superintendent, and Walter H. Cook, project manager. Both proved to be of material help not only in their practical advice but in their hearty encouragement. The architect for the job was James E. McLaughlin of Boston. The landscape architect was Herbert J. Kellaway, and Ernest W. Branch was the engineer. The Casper Ranger Construction Co. was the general contractor, for which the writer acted as assistant works manager, having complete charge of the operation until Jan. 1. Joseph F. Ranger acted as the works manager. The entire work was done on the basis of actual cost plus a fixed fee. The approximate estimate of the cost of the work was $1,600,000, or about $3500 per house. This did not include the utilities such as water-supplies, sewers, streets and sidewalks, which were let under a separate contract to Dennis E. Crowley of Quincy, Mass.

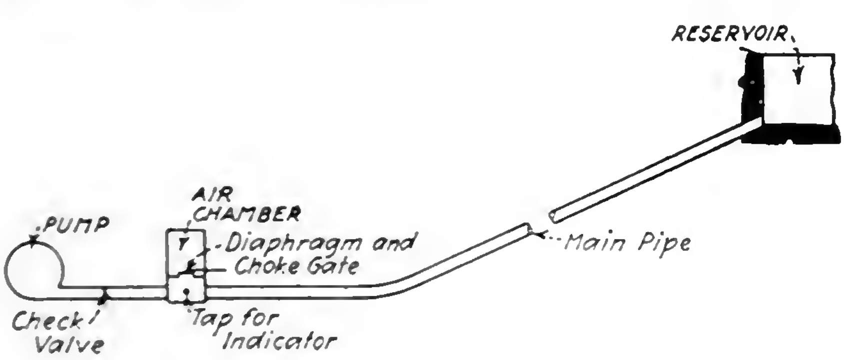
Graphical Records of Surge Pressures in Pipe Lines

Tests Made to Determine Effect of Varying Air-Chamber Conditions and Changing Choke Gate Area

By Ralph Bennett
Los Angeles, Calif

NUMEROUS curves showing the actual effect of varying the conditions on two pipe lines equipped with air chambers have been made by an apparatus which produced a time-pressure record of the variations which took place at shut-down in these pumping lines. Results of a series of surge tests on these 18-in. and 24-in. lines are given. As originally installed, the 18-in. line was equipped with a plain air chamber, while the 24-in. pipe was without any protection against shock. The test results for the 18-in. line were used to design the air chamber for the 24-in. line.

In order to secure a continuous record of actual pressure variations, the pencil mechanism of a steam indicator was so arranged that it produced its mark on a strip moved by the clockwork train taken from a high-speed recording voltmeter. The machine, though difficult to set up, gave sufficiently accurate records for the purpose. It was subject to the usual disadvantages of the steam indicator when used on water. Thus, it is probable that the shoulder seen on the trailing end of the waves is due to piston lag, since at that point in the stroke the piston would have been riding quietly in the



GENERAL ARRANGEMENT OF TEST APPARATUS

cylinder and so may have stuck slightly. Minor variations in the paper speed also occurred, as the indicator pencil dragged more on the chart than did the original voltmeter pen.

Inasmuch as the energy stored in an air chamber is a function of the volume and pressure of the contained air and not of the shape of the chamber, the volume has been used in referring to the air effects. Sufficient data as to the conditions are given to permit of translating to other units.

The curve-tracing device was connected at the base of the air chamber, as is shown in the accompanying sketch, the reading being the pressure of the line. In one case the instrument was transferred to a point above the diaphragm to obtain a record of tank-pressure changes. This has been superimposed on the pipe-line record in an otherwise similar test (Fig. 9.) The curve is very interesting in that it shows graphically the time and intensity relation of the internal and external pressures when an almost perfect damping is attained in a single swing.

The vertical scales shown on the curves are those corresponding to the spring used. Owing to indicator friction as well as secondary pressure disturbances, the

RESULTS OF TESTS OF 18-INCH PIPE LINE

Volume of air, cu.ft.	Pressure wave amplitude from starting pressure plus Lb. per square inch	minus	Time of half wave Sec.
0	—	—	2.36*
14	36	25	3.12
20	32	23	3.65
35	26	19	4.75
50	23	16	5.83
75	19	12	6.5
100	16	11	7.4
118	16	9	7.0

*This figure is calculated; all others are observed values.

actual peak values may vary considerably from the curve value. The horizontal scale of time must be averaged, as minor irregularities of drum movement affected the record. The time given for the waves is that of the half wave after shut-down is complete and the column is vibrating as a free but loaded pendulum.

The lines were supplied by motor-driven centrifugal pumps, directly in line with the main pipe and but a few feet beyond the air chamber, and equipped with squirrel-cage motors controlled by oil compensators. As the rotating elements of such units are very light, the shut-down caused by opening the oil switch was as nearly instantaneous as can be obtained. The pumps had check valves which closed at about the point of flow reversal.

Tests were first made on the 18-in. line, and from them the necessary data for a proper tank on the 24-in. line was secured. This 18-in. line was of riveted steel, as follows: 0.0625 in. thick, 971 ft.; 0.078 in. thick, 816 ft.; and 0.1094 in. thick, 1400 ft.; average thickness 0.087 in., total length 3187 ft. The maximum head was 240 ft. (104 lb. per square inch) and the grade uniform, with no sharp bends nor obstructions. No laterals were open during the test. The pipe terminates in the bottom of a reservoir 150 ft. across and 12 ft. deep.

The air chamber at the pump is 36 in. in diameter and 10½ ft. long above the line, which passes directly through it. The two-stage centrifugal pump, delivering by test 954 gal. per minute, gave a line velocity of 1.2 ft. per second. A swing check valve was used.

Shutdown tests were made on this line, using varying quantities of air in the chamber. No provision for contracting the entrance to the air chamber was available, and it was not possible to vary the flow in the line.

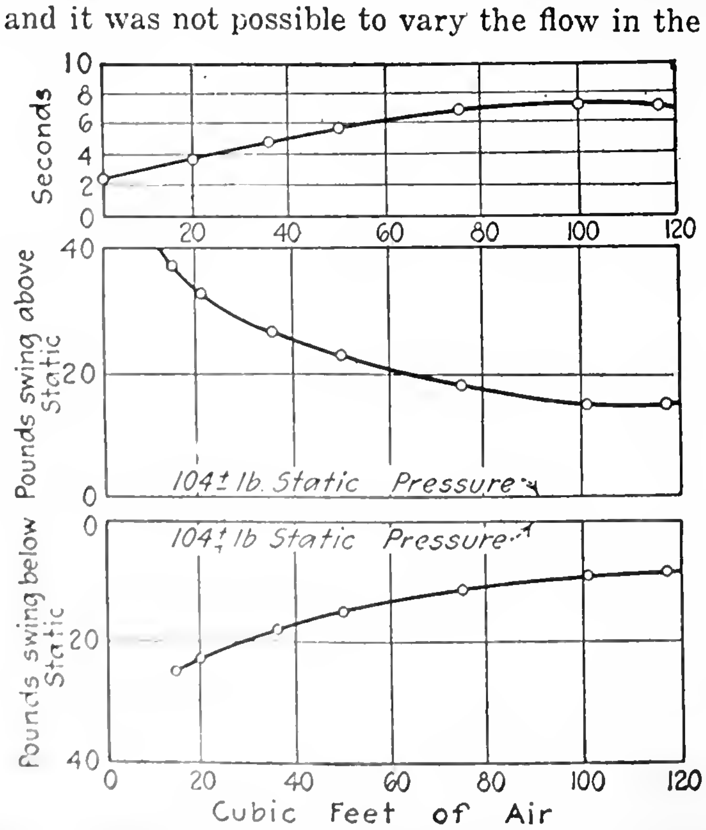
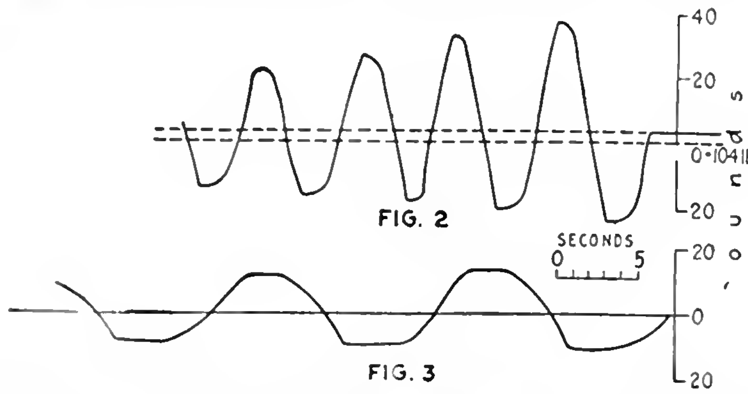


FIG. 1 PRESSURE VARIATION WITH AIR VOLUME—18-INCH PIPE TESTS

The results of these tests are given in the table and by the curves in Figs. 1, 2 and 3.

The data on the 24-in. riveted-steel pipe line are as follows: 0.078 in. thick, 4757 ft.; 0.109 in. thick, 1954



FIGS. 2, 3. GRAPHS FROM TESTS OF 18-INCH PIPE LINE
Fig. 2, air, 14 cubic feet; Fig. 3, air, 118 cubic feet.

ft.; and 0.172 in. thick, 80 ft.; average thickness, 0.086 in., total length 6791 ft.; maximum head 160 ft. (70 lb. per square inch, including friction); grade uniform and without sharp bends or obstructions; no laterals open during test; pipe terminates on the bottom of a reservoir 100 ft. in diameter and 10 ft. deep.

The air chamber is 48 in. in diameter, with 15 ft. effective height, connected to the line through a rectangular opening in a plate diaphragm which can be closed by a slide. Water is supplied by a two-stage centrifugal pump delivering by test 1881 gal. per minute and producing a line velocity of 1.33 ft. per second. The check valve on this pump was an egg-shaped plunger controlled as to speed of closing by a bypassed plunger.

The free action was as rapid as that of a swing check. Most of the curves were obtained with little or no retardation of this valve. Experiment proved that delayed action resulted in additional shock if the water column had reversed before the valve acted.

Tests on this line were made for numerous volumes of air, using also many different choke openings. The calculations had shown that the 24-in. line could be held to a rise of less than 10% of normal by an air chamber having an air space of about 65 cu.ft. connected to the line through an opening of 30-sq.in. area.

Fig. 4 shows the card obtained with 67 cu.ft. of air and a 25.87-sq.in. choke. Under this condition, the fall of pressure at shutdown is very severe, and the oscillations die down very quickly. The condition desired is one in which the greatest possible absorption of energy occurs across the choke from the instant of shutdown. The best condition occurs when the first half wave (in this case negative) is the one in which the greatest loss occurs. The ability of the line to stand reduction in pressure will frequently limit the possible control.

Note on this curve the great distortion of the fundamental wave by the shock from the check valve. This superimposed pressure may at times become very serious, but, as stated above, any attempt to control it by slow valve action is a move in the wrong direction. Better results would be obtained by a loaded valve.

Fig. 5 was obtained with the same air content, 67 cu.ft. and a 32-sq.in. choke. The check-valve disturbance is much as before. The indicator was put on the line before the pump was started, and the entire cycle from standstill to standstill is shown. Note that the shock due to the rapid start of the pump is more severe than is that due to the shutdown surge.

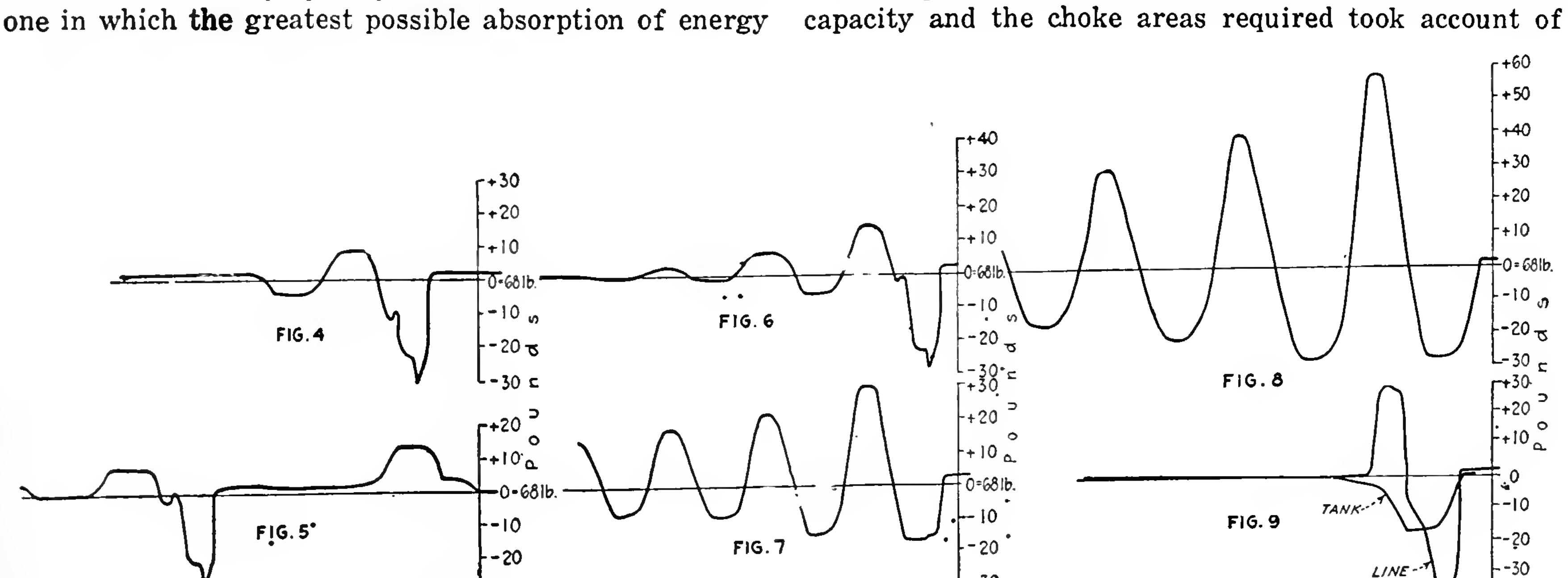
The quantity of air and the closeness of the choke can be varied within limits with about the above results but any considerable decrease in the amount of air reduces the ability of the tank to absorb energy and increases both the pressure peaks and the number of undulations required for full absorption of the energy in the water. Curves in Figs. 6 and 7 show these effects very clearly. Fig. 6 shows good control with 35-cu.ft. air and a 25.8-sq.in. choke, while Fig. 7, with the same volume, produces an excessive shock.

If the tank contains ample air but is too freely connected to the line, a condition results similar to that shown in Fig. 8, which was taken when the air supply, 90 cu.ft., was more than ample for full pressure control but with an excessive opening, 68 square inches.

Inasmuch as the commonest danger to ordinary pumping lines and to most water-wheel lines is due to excess pressure, most attention is directed to the effect of the upward surge. But the pressure limiting work is most effectively done in the first downward swing, as noted above, and the safe reduction in pressure is the usual limit to the control.

While the condition of full-load shutdown is more apt to occur in pumping lines than in wheel-penstocks, yet the effect of governing is of vital importance in the latter case, and a choke air chamber will be beneficial on any change of velocity.

The equations used in working up the air-chamber capacity and the choke areas required took account of



FIGS. 4 TO 9. GRAPHS FROM TESTS OF 24-INCH PIPE LINE
Fig. 4, air, 67 cubic feet; choke, 25.9 square inches. Fig. 5, air, 67 cubic feet; choke, 32.0 square inches. Fig. 6, air, 35 cubic feet; choke, 25.8 square inches. Fig. 7, air, 35 cubic feet; choke, 45.0 square inches. Fig. 8, air, 90 cubic feet; choke, 68.0 square inches. Fig. 9, superimposed tank and line pressures.

the elasticity of the water and of the pipe, but not of the effect of internal friction in the air. It is probable that large and important tanks would have to be figured with due allowance for all losses.

The lines tested were connected with plants supplied with energy by the Southern California Edison Co., and the company's apparatus was used in making the tests. R. J. C. Wood of the company acted with the writer throughout the work, and to his unusual ability in this class of work are due the results obtained.

Coming Status of the Employee in Industry

Advantages of Stock Ownership by the Workers—Duty of Industry to Society in Developing and Protecting the Men

The following paragraphs on the future status of the worker in American industry are taken from an address by Charles F. Lang, president of the Lakewood Engineering Company, before the annual convention of the National Machine Tool Builders' Association in Atlantic City, May 12. He points out the advantages of stock ownership by the employee, and credits the employee with the ability to exercise a salutary influence upon the management of the company. He also points out the duty which industry bears to society for the "health, mentality and welfare" of the worker—EDITOR.

WITH the financial inflation which this war has made necessary, with the world-wide shortage of labor, with the shelves of the world empty, America, with one-third of the world's gold, with her finances in splendid shape, with her tremendous productive capacity, with her marvelously productive labor, and with a less acute labor shortage than any other country in the world, can and should and will face the future with absolute confidence, for it cannot be doubted that she is entering upon a period of unusual prosperity and opportunity such as has never before come to any nation. One of the first things Noah did after the flood was to get drunk. And America's greatest danger for the future is that she may become drunk with power. She must enter this new era with certain principles and ideals or she will not realize her opportunities, and one of the greatest of these ideals is that there shall be such a distribution of wealth among all her citizens as will make for the happiness and well being of all her people.

Profit Sharing to Be Universal

Far-seeing men have already sensed this opportunity, and these ideals are being expressed—yes, and carried out—by business men in their relations with their employees in a spirit of coöperation not dreamed of a decade ago, and I predict that coöperation between employer and employee—profit-sharing, if you please, will become a universal rule of business with all successful concerns in less than another decade, and, I believe, with profit to all concerned, invested capital as well as labor, executive as well as laborer.

No real national policy of this kind has yet been developed, but toward the formation of such a policy leaders of thought in capital and labor must give their attention.

I am proud of the spirit of the present generation which is so earnestly thinking along these lines. The present form of corporation so readily lends itself to securing this coöperation that it is rapidly becoming a habit for American business concerns to encourage their employees to purchase stock in the company, but I fear the employees are not as rapidly as they should accepting this opportunity to share in the profits of the business for which they are working. But I believe the time is rapidly approaching when there will be a real partnership all the way down the line, when the stockholders of many of our business concerns will be the employees, and those sharing in the profits of the business (the more thrifty, of course, to a greater degree than the careless and shiftless) will be the men working for the concern. I see no dangers in the development of such a system. It is a well known, but nevertheless interesting, fact that your average stockholder never shows up at a stockholders' meeting unless his dividends are cut, and I don't believe the employee-stockholder will be a very much different kind of an animal, except that if he does become alarmed because his dividends are cut he will try to find the reason why, and may discover that he himself, because of the kind of service he has rendered his company, is one of the reasons for this, and that a lot of his fellow workmen are others of the reasons, and that between them they will try to discover a way, by more efficient service, to avoid a repetition of the unfortunate circumstance. It has never seemed very difficult for the American people to select the right man as their chief executive, and it is remarkable how few mistakes have been made in this direction in American history. In the democracy of business I think just as few mistakes will be made by the stockholding employees in the selection of various executives. In other words, peculiar fitness for particular responsibilities seem to be quickly and intuitively recognized by the American people, whether in their national affairs or in their business affairs. (More particularly, perhaps, in their business affairs, for I am inclined to agree with an official of the Chinese government who was over here not long ago and who raised the question as to why we did not require our congressmen to take an examination as to their qualifications to serve before we elected them.)

Advantages of Employee Stockholders

I submit that a system whereby the employees are stockholders might be far better than the present one, where, perhaps, an individual owning the majority of stock will keep himself in office and in responsibility long after his usefulness to the organization has gone, for he himself is always the last man to see this and to resign voluntarily. As the president of a large corporation recently said to me: "I am not a majority stockholder in my company and don't want to be. I do, however, own quite a block of stock, and when the time comes that I am no longer fit to be president of the company the other fellows will find it out before I do, and by asking me to get out will save for me the investment I have in the company; whereas, if I wait too long, I might lose my whole investment as well as my job."

I do want to say one further word as to coöperation between business and society as a whole. I cannot see how the American business man today in the conduct of his business can avoid his responsibility to society, for the health, mentality and welfare of the men employed in his institution. And I do not say this with any paternalistic idea in mind; it is, rather, a patriotic duty, and not a fatherly kindness. For, if all our men

are kept in health and happiness, due to proper and pleasant working and sanitary conditions, their productivity is increased, thereby increasing the national wealth and comfort.

Again, getting down to fundamentals, every workman dying before his time, because of the unhealthful or unsanitary conditions under which he is compelled to work, and leaving behind him a family for which he has been unable to provide a competence, merely represents another one of those losses which must be borne by society as a whole, which means that each individual member of it must bear his proportion. This is entirely aside from the sentimental and humanitarian side of the problem.

Again, it is the duty of the employer as well as the employees to compel such of the employees who neglect to do so, to live and bring up their families under clean and sanitary conditions of both mind and body—of both *mind* and body—for no employee has the right to endanger the health or happiness of his fellow employees, however careless he may care to be about his own.

These remarks apply with greater force to the the development of the mentality of the men. Low mentality makes for social unrest. We Americans are too apt to complain of the ignorance and lack of judgment of workmen, when, as a matter of fact, the responsibility for that ignorance is upon ourselves.

America Can Solve Industrial Problem

The Chaldeans, I believe, were the inventors of books; the Greeks left us a heritage of art; Rome gave to the world standards of law and organization which are still followed; the daring navigators of western Europe carried through a marvelous period of discovery; Germany, with all her faults, has given to the world many wonderful advancements in science. I cannot but feel that America will leave as her heritage a solution of the problem of the proper distribution of wealth and happiness and education among the masses; in other words, will show to the world how a government can truly be a government "of the people, by the people, and for the people," because the people are capable of making it that kind of a government.

Iowa Assembly Had 25 Occupations Represented—No Engineers

Although 25 different occupations were represented in the late General Assembly of Iowa, there was not a single representative of the engineering profession among the legislators. This fact was ascertained from J. H. Dunlap, who compiled the list of occupations in the course of the campaign for the passage of the engineers' registration bill. The professions and trades represented were as follows: Bankers, farmers, manufacturers, merchants, lawyers, druggists, coal and ice dealers, lumber dealers, investment salesmen, grain dealers, school principals, publishers, stockmen, auditors, physicians and surgeons, college presidents, editors, students, real-estate dealers, insurance agents, commercial travelers, teamsters and switchmen. In Professor Dunlap's opinion, the fact that no engineer's name appears reveals the common lack of interest in community affairs which the engineer is just beginning to realize is responsible for much of what he is criticizing in his present professional position.

A. A. E. Compensation Committee Report

In a report on compensation made at the recent annual convention of the American Association of Engineers the following conclusions, on which to base a salary schedule, were reached:

1. That the profession of engineering, taken as a whole, is insufficiently paid, or is not paid in proportion to the high degree of responsibility entailed or the technical training required to perform the work.
2. That the principle of a square deal for everybody should underlie all rules of compensation, and that technical men must demonstrate their worth both to their employers and the public before they receive the compensation due them.
3. That this demonstration should be made by individual salesmanship, and by proper methods of publicity directed by this association to establish coöperation between employers and employees and to insure proper recognition of the services of the engineer by the public.
4. That while salesmanship may produce results in individual cases, it is necessary to operate collectively for the rank and file of engineers, and desirable that some forms of grades for engineering services be adopted with a minimum rate of pay for each grade.
5. That the rates suggested herein are not the maximum standards, but rather indicate the rate of pay of anyone who can perform the line of work, and that individual effort should be encouraged to the fullest extent and be paid accordingly.
6. That in the determination of a just compensation, consideration must be given to the effort or cost of the educational training; the years and character of experience in the particular line, as well as total years experience; length of time in employer's service; character and personality; degree of efficiency and special qualifications.
7. That the uncontrolled law of supply and demand is not a just method by which to determine the compensation for valuable services. Therefore, steps should be taken to control its operation so that it may not become oppressive especially in the lower grades of service.

The following specific recommendations were made:

1. That the hours of employment for technical men of grades 1, 2 and 3, hereafter defined, should not exceed eight hours per day or 48 hours per week.
2. That overtime in above grades should be paid for at an increased rate.
3. That no one in charge of engineering or construction forces should be paid less than any man for whose work he is responsible.
4. That when by a superior's orders an employee is shifted to a point requiring him to change his place of abode, the employer should bear the entire expense of moving him and his family.
5. That employees should be given national holidays and not less than one day's vacation for each month employed during the year, and that provision should be made for disability due to the hazard of employment.

California Road Repairs and Vehicle Fees

A large part of the money for maintaining the California state highways is derived from motor-vehicle license fees, which are, in general, on the basis of 40c. per horsepower per annum, with an additional fee based on weight for those trucks which use other than pneumatic tires. The fees collected are used first to pay the expenses of the motor-vehicle department, after which the balance is equally divided between the state and the several counties, to be used solely for road work. The half going to the counties is apportioned among them on the basis of the amount received from the residents of each county. In California at the beginning of the year there was a total of 300,000 motor vehicles, or one for every 10 persons.

Motor Equipment of United States Army Engineer Corps

Motor Truck Adapted to Many Purposes — Portable Carpenter, Machine, Blacksmith and Printing Shops and Searchlights

WHILE it is well known that motor trucks have been adapted to many purposes by the Corps of Engineers of the United States Army during the war, ocular demonstration of the facts had been largely withheld in this country until the recent parade promoting the Victory Loan in New York City. Devices exhibited in this parade demonstrated the great flexibility of the motor truck as a tool and suggest similar adaptations in civil pursuits. Such equipment might easily be of service on any widely scattered construction or maintenance operation, where it would be advantageous to make repairs *in situ*, rather than convey the part to and from machine shops. Portable tool trucks and sleeping quarters for small maintenance and construction gangs are also suggested.

The pictures given herewith are fairly representative of the various uses to which trucks were put. Beside those shown, other applications of the truck to war purposes may be mentioned, as follows: Water-purification plants; airplane transportation trucks; motor kitchens; motor bath-houses and ice machines.

FIG. 1 PORTABLE CARPENTER SHOP WITH SIDE OPEN

In addition to the devices named there are, of course, the transportation trucks and the fighting machines such as tanks and artillery tractors, which may be considered as motor-transportation features developed by the war.

That efficiency as well as flexibility characterized practically all the motor apparatus used in France may be seen from the following statement made by Maj. George A. Green, assistant chief engineer of the tank corps of the British Army and, before the war, chief engineer of the Fifth Avenue Coach Co., of New York City. He stated before the first semi-annual motor-transportation conference held at the Colt-Stratton Building, New York City, that during 18 months' service in France, all of which was in the forward fighting area, he had not seen a single motor truck broken down from other causes than ditching and direct hits by shells.

Already many special peace-time motor installations have been developed, particularly in municipal and

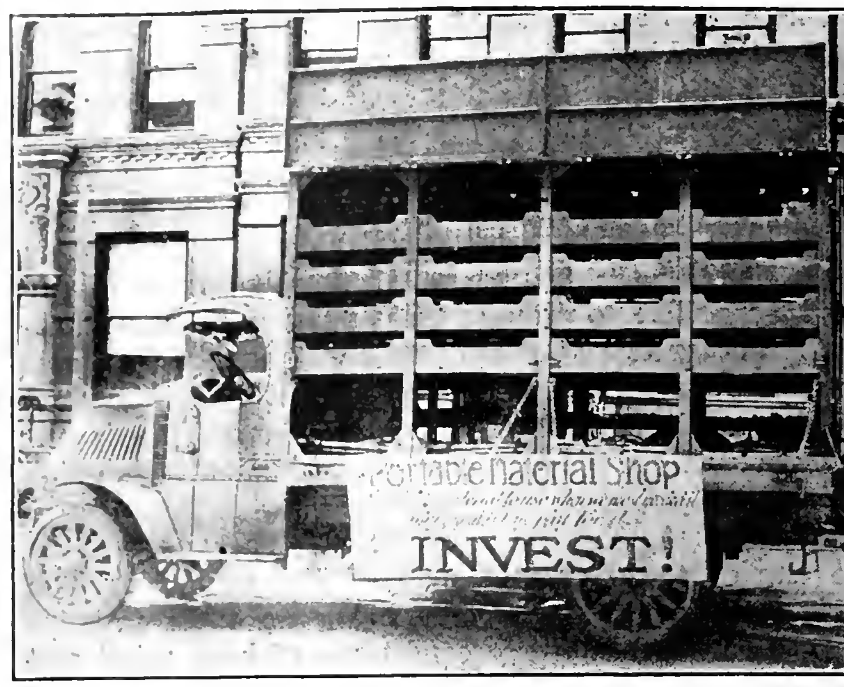


FIG. 2. MATERIAL TRUCK CONTAINS 600 ITEMS OF TOOLS, SUPPLIES AND OTHER EQUIPMENT

street work. It is thought that the successes along this line in warfare will stimulate additional experimentation in the use of trucks for special purposes.

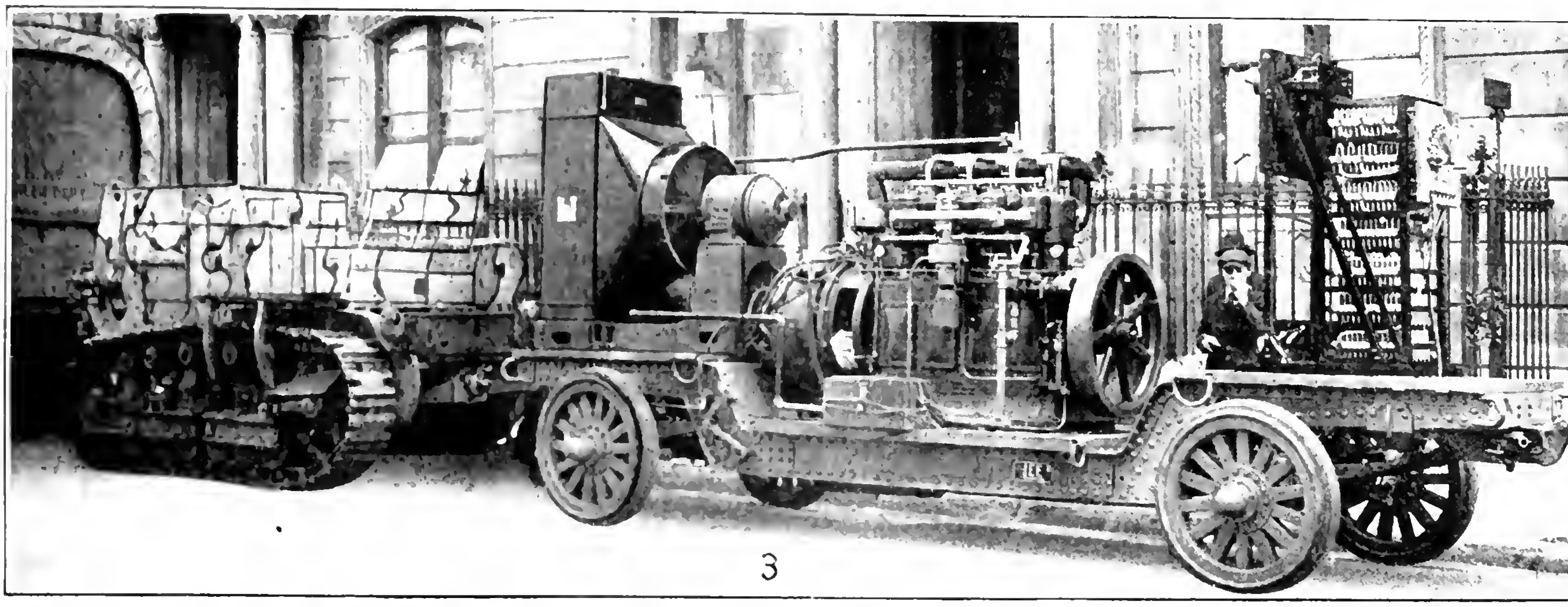
In all the special trucks developed by the Corps of Engineers, compactness is the chief characteristic. The necessity for this may be seen when it is stated that some of the portable shops contained as many as 10 different pieces of machinery, while the complete list of machine tools and supplies ran as high as 800 pieces. To get this all on one truck required the utmost economy in arrangement. When the war ended there were 95 of these portable shops in the service and 30 material trucks. The chassis for the shops and material trucks were of 5½-ton capacity.

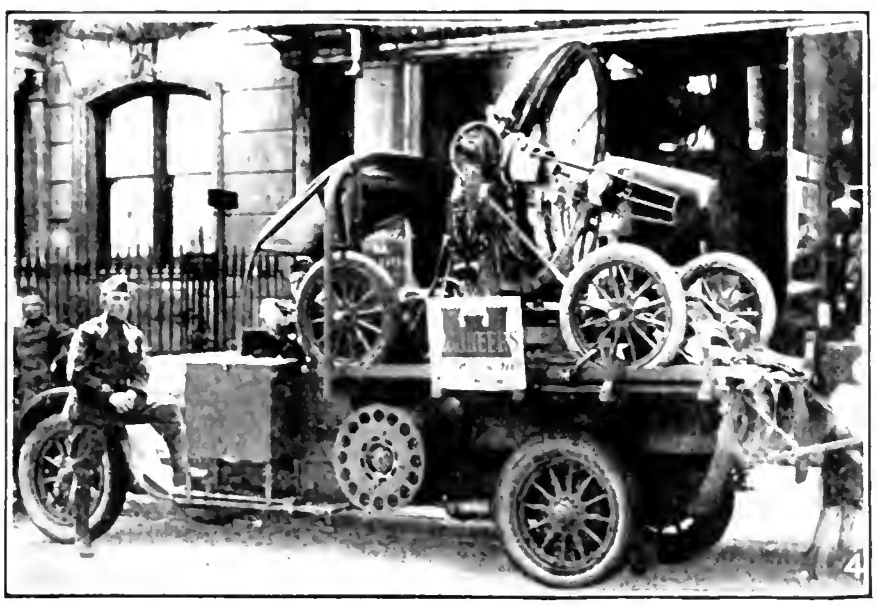
Among other devices developed by the corps, but which were not in service when the armistice was signed, is a small crane, for hoisting materials, mounted upon a motor truck so that it can move from place to place, and a portable pile driver which it is thought will be useful in highway and other construction where it is necessary to drive piles. The pile driver was designed to be drawn by horses, but it could easily be mounted upon a motor truck. While the pile driver is being transported, the leads, which are 30 ft. in height with a spread of 17 in., are folded up. The driver is operated with a 25-hp. gasoline engine, and can be placed in operation within 15 min. after arrival.

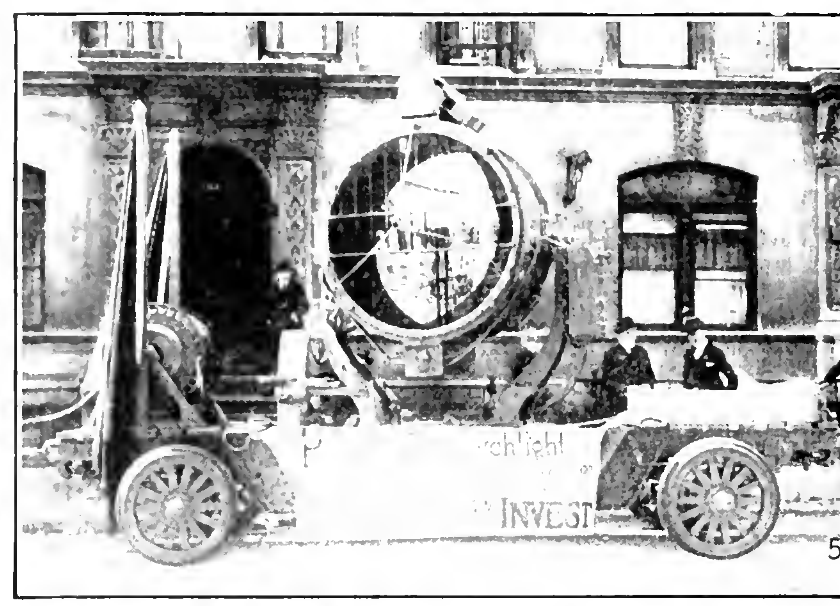
Referring to the pictures: The carpenter shop, Fig. 1, is arranged to do all light wood work. As shown, the side is let down and the curtain at the upper part is pulled up for working. It contains a boring machine, a drill press, a bench grinder, a work bench, a saw bench, a double-purchase winch, and a power plant and switchboard, besides the necessary tools and supplies. It costs, complete, about $8500.

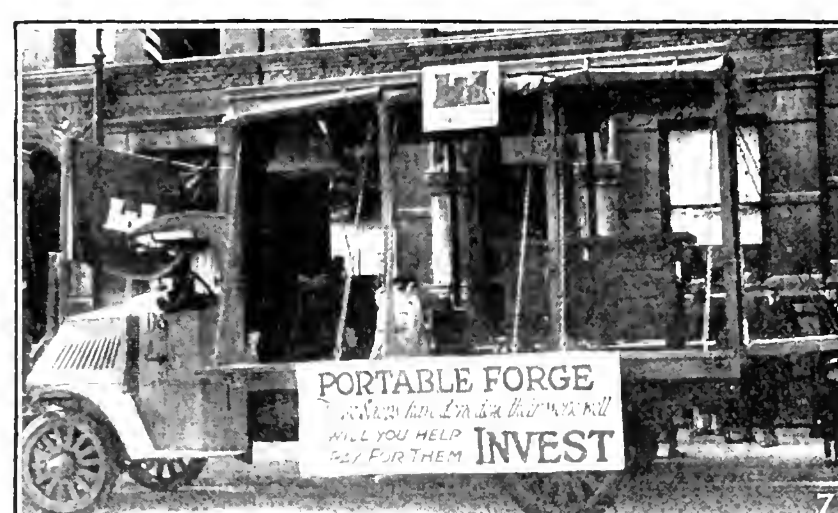
Fig. 2 shows a material truck with the side opened up for removing tools. Each truck contains about 600 items of tools and supplies. The height appears greater in the view than it actually is, because the upper portion of the sheet-iron side is folded up at the top. The sides are arranged so that they may be securely locked. The cost is about $8000.

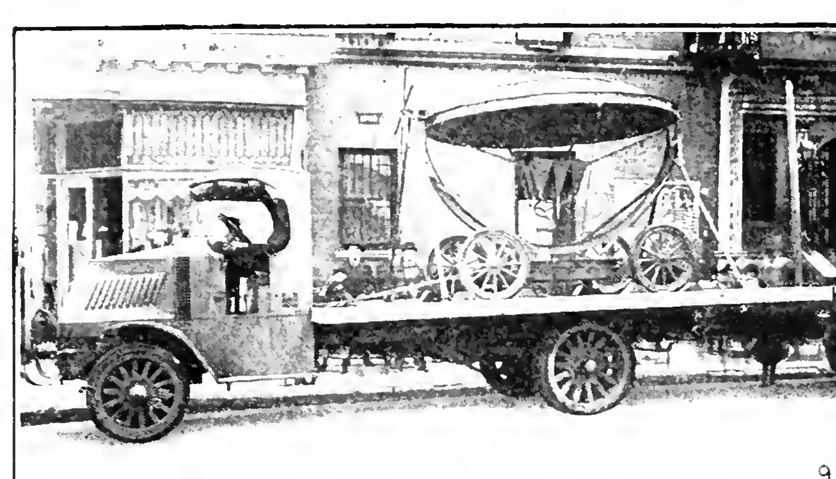
Of the other portable shops, the machine shop, Fig. 6, contains a work bench, a drill press, a portable electric drill, grinders, an electric hammer, a 14-in. lathe, an











FIGS. 3-9. 3. TRACTOR AND SEARCHLIGHT POWER PLANT. 4. OPEN-TYPE 60-IN. SEARCHLIGHT ON TRUCK. 5. SIXTY-INCH BARREL TYPE SEARCHLIGHT, WORKS WITH APPARATUS SHOWN IN FIG. 3. 6. MACHINE SHOP. 7. BLACKSMITH SHOP. 8. PRINTING SHOP. 9. PARABOLOID SOUND-RANGING APPARATUS

oxyacetylene welding outfit with a power plant and necessary tools and supplies. The complete shop costs about $9500. The blacksmith shop, Fig. 7, is also used in handling plumbing and tin-shop work when necessary. It contains a work bench, a forge, hoists, a pipe-threading machine, a shear and punch, vises, a welding and cutting outfit and power plant tools and supplies. The cost is about $8000.

Fig. 8 shows a portable printing shop used in making maps. During the parade this shop was turning out two-color posters, 20 x 30 in. in size, advertising the Victory Loan. All the shops are electric-lighted.

Figs. 3, 4 and 5 show the various searchlight appliances used for detecting airplanes. Figs. 3 and 5 go *en train*, the tractor hauling the power house and the searchlight to any desired location. The searchlight is of the 60-in., high-intensity, barrel type, developed by the Corps of Engineers. It has a turntable base which is hidden behind the Liberty Loan sign. By means of 500 ft. of cable the light can be operated anywhere within that radius from the power plant. The power plant consists of a gasoline engine directly connected with a dynamo, and, like the searchlight, is permanently mounted on a trailer.

Fig. 4 shows a 60-in. open, high-intensity type of searchlight, which is mounted upon rubber-tired wheels, so that it can be removed from the small truck and operated within a radius of 500 ft. from the same. The power for running this searchlight is mounted in the truck back of the cable roll. This searchlight has 2,500,000 candlepower. Tests of the searchlight used in detecting airplanes have shown a 43% visibility at 15,000 ft. and an 85% visibility at 12,000 feet.

The paraboloid sound-ranging apparatus shown in Fig. 9 was merely mounted upon this truck for the purpose of the parade. It is used in testing the location of artillery by the sound of the explosions.

Colleges Should Play a Part in Highway Program

Weakness of Road-Engineering Courses Compared With Great Need for Trained Road Engineers and Material Inspectors

By R. L. Morrison
Professor of Highway Engineering, Agricultural and Mechanical College of Texas, College Station, Tex.

There is no single line of activity to which more public attention is being directed at present than to the development of highways. During the war the amount and importance of highway transportation greatly increased, but new construction was practically at a standstill and even maintenance was reduced to an absolute minimum. With the ending of hostilities and the removal of legal restrictions upon road work, plans were immediately made for an era of roadbuilding such as this country has never known before. What part are the colleges to play in this road-development program? Are they leading or directing the movement? Are they doing extensive research work on highway problems? Are they training highway engineers to spend economically and efficiently millions of dollars?

Speaking generally, these questions must be answered in the negative. Of the 126 engineering schools of college grade, probably not more than a dozen devote as much as five term-hours to highway engineering, or have their highway course given by teachers with any practical experience as highway engineers. Practically every leading engineering school has at least one specialist in railway engineering, in sanitary engineering, and in structural engineering, but the highway specialists are conspicuously absent. Is there sufficient reason why colleges should offer more than a two- or three-hour course in highway engineering, or why the instructors should have any broader knowledge than can be obtained by a study of the textbooks used by the students, when the colleges are already criticized for specializing too much in undergraduate work?

The branch of engineering which most nearly resembles highway engineering is railroad engineering. When a young engineer in employed in railroad work after taking a college course which usually includes several courses in railway engineering, he works under the immediate supervision of, say, a trained and experienced resident engineer, and no matter how limited the young man's knowledge of practical railroading may be, he has every opportunity to learn and cannot go far wrong.

Untrained Men in Charge of Work

On the other hand, the 2,500,000 miles of public roads in this country are very largely in charge of men absolutely untrained and inexperienced in highway or any other engineering work, and who are constantly changing as a result of political changes. That there is enormous waste of money spent on roads is known to everyone. Comparatively few roads are adapted to the traffic which they are called upon to bear, improper materials are often used, and the standardization of methods and types is just beginning. The young man entering highway work may be employed as a county engineer within two or three years after graduation, with no experienced superior to guide him, or he may be in charge of work for a state highway department and located miles from his superior. In the latter case the engineer under whom he is working may be as new at highway work as he is.

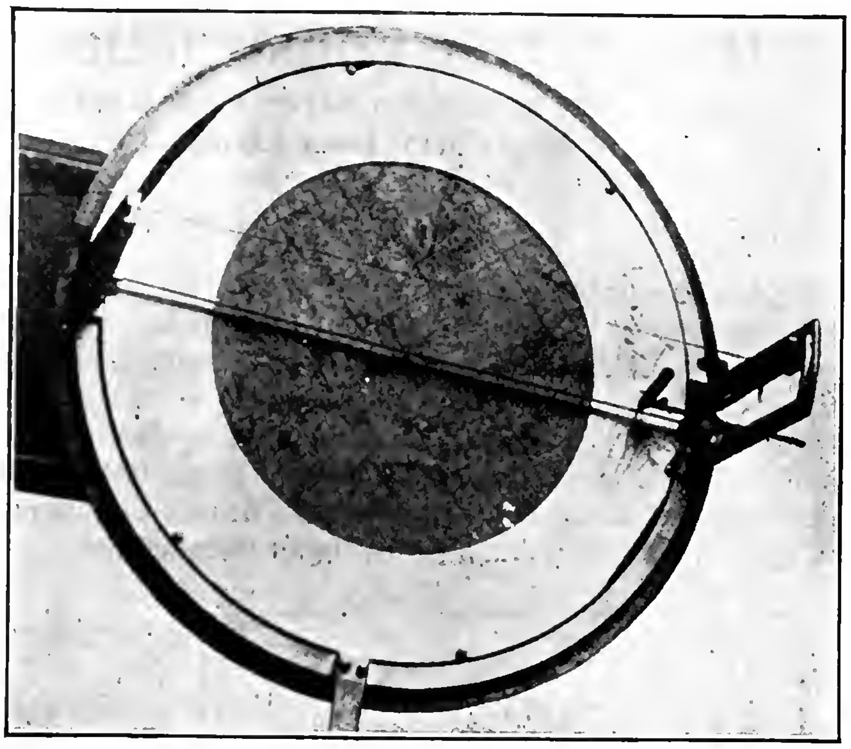
In no other field do so many engineers get responsible positions without previous experience in the work they are undertaking, and there is probably no other field which is attracting so many engineers at the present time. It would seem that this combination of circumstances alone is sufficient to justify the colleges in specializing in highway engineering.

Although there are of course many engineers all over the country who are thoroughly versed in all the details of highway work, there is also a large number who are called upon, for instance, to use large quantities of bituminous materials without having had any opportunity to make a study of such materials. They find that this is an extremely difficult subject to master without an instructor, so they use the materials by trade names only, or else they are forced to copy specifications which they do not understand and which may not be applicable to their particular conditions. If they wish to have intelligent laboratory control of their bituminous work, where they can find the necessary testing engineers? How many colleges are equipped to given adequate classroom and laboratory instruction in the subject of bituminous road materials? And if the colleges cannot train testing engineers, where do they come from? The answer is that as a rule they do not come.

In addition to training engineers, there is an opportunity for the colleges to be of great public service by giving "short courses" for local road officials who are not engineers. A few institutions have accomplished a great deal along this line, especially in coöperation with state highway departments. Valuable missionary work can also be done, especially in those states having the fewest good roads, by means of public lectures, bulletins, press articles, exhibits, etc. thus educating the public to appreciate and demand not only good roads but also proper methods of construction, maintenance, financing, and administration in general.

With this great opportunity before them, it is to be hoped that the engineering colleges will decide to do something more than turn out young men who are prepared to learn something about highway engineering, provided they can find someone to teach them.

"Fire Finder" for Lookout Stations of Forest Service



AN INSTRUMENT DEVELOPED BY THE FOREST SERVICE, TO LOCATE FOREST FIRES

AN INSTRUMENT combining some of the functions of the plane-table and the transit has recently been developed for locating forest fires from the mountain lookout stations of the United States Forest Service. Enough of the instruments were manufactured in Portland, Ore., early in 1918 to equip many of the important lookout stations in the Northwest, and it is reported that they gave satisfactory service last summer. In some cases fires were accurately located at a distance of 50 miles. Acting on the good record in actual use of the instruments, the Forest Service has recently adopted it as standard. It is known as the Osborne fire finder, as it was developed by William B. Osborne, Jr., of the Portland office of the Forest Service.

The instrument head consists of two parts, a lower iron plate equipped with leveling screws and lock nuts, and an upper iron plate of 24-in. diameter which pivots on the lower plate and bears on its periphery a circle graduated to 15 min. To this upper plate is fitted a heavy iron ring which can be revolved independently and which carries front and rear sights and a vernier for reading the horizontal circle. The vernier is graduated to read to 15 min. The sights are of brass, the rear sight being slotted as in a surveyor's compass, with the addition of a fixed peephole, the front sight being open with a vertical horsehair. The apparatus for measuring the vertical angle of the line of sight is attached to the front sight, and consists of a perforated brass belt running vertically on spiked wheels and controlled by a milled wheel and pinion. This belt carries a pointer and an indicator set horizontally at right angles to the line of sight.

The indicator slides over an etched tangent graduation attached to the outer face of the sight and reading to minutes. The same pinion which moves the belt and pointer carries a cogged wheel for moving a pencil-bearing rack forward and backward across the upper plate of the instrument, but along the line of sight. This enables the observer to sketch the panoramic profile, the sketch being made on a ring of heavy white celluloid, 21 in. in diameter and 4½ in. wide, which is placed on the upper plate of the instrument. The pencil is held in contact with the celluloid by a spring, and the profile is sketched by the observer looking through the peephole in the rear sight, keeping the pointer and horsehair of the front sight on the skyline or other line to be sketched, and slowly rotating the sight-bearing ring.

A map of the country under observation is fastened to the upper plate, beneath the celluloid ring before mentioned, the center point of the map representing the observation point. The instrument rests on a track mounted on a 1½-in. baseboard 28 in. long. The observer can move it along this track without disturbing the orientation or level, thus avoiding the posts of the lookout cabin that might obstruct the view.

In operating the instrument, the observer looks through the fixed peep of the rear sight and brings the pointer of the front sight to bear on the fire. The instrument being already oriented, he reads the azimuth of the line of sight on the horizontal circle and the vertical angle of the line of sight on the front sight graduation. He then obtains on the map of the locality a projection of the line of sight by means of a graduated steel tape which extends from the rear to the front sight. The zero of this tape is at the center of the map, and by the platting pencil he obtains the position of the fire on the panoramic profile.

The location of the fire is then determined by (1) platting the intersection of the lines of sight when the fire is reported from two stations; or (2) by using the vertical angle to plat the intersection of the line of sight with a profile or cross-section of the country along that line of sight; or (3) by estimating the location of the fire from its apparent position relative to other points which are platted on the map; or (4) by estimating the location of the fire from the position indicated for it on the panoramic profile, which latter estimate may be made at night when the features of the landscape are not visible.

Increase of Highway Costs in California

Highway costs in California did not change much in the period between 1912 and 1916, according to state highway officials, when the average cost of the standard concrete pavement, which was 4 in. thick and 15 ft. wide, amounted to $6200 per mile, exclusive of grading and culverts. In 1917, however this cost rose to $8400, and in 1918 the average was $10,800 per mile.

Design and Construction of Navy Concrete Oil Barges

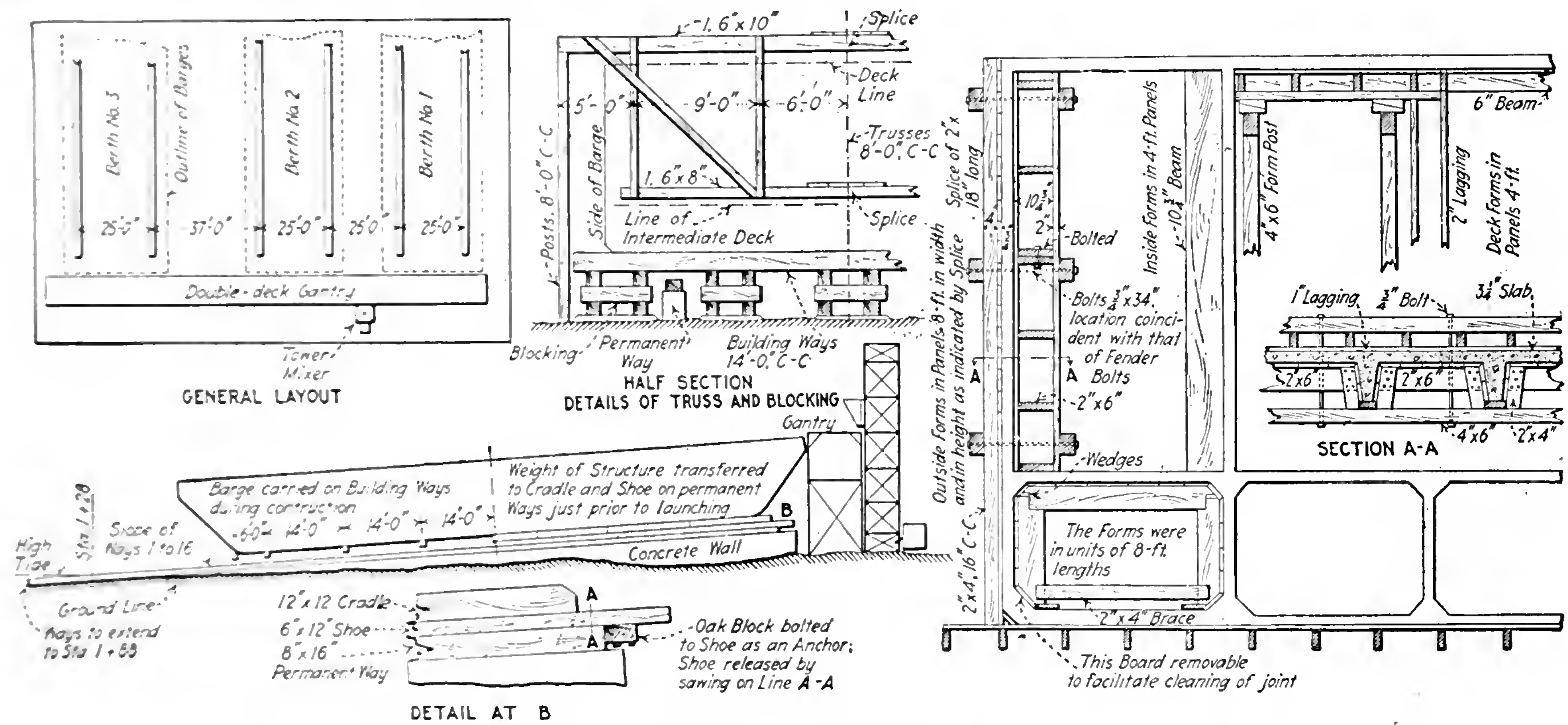
Boats Built at Hudson River Yard Have Oil Holds Protected by Air Compartments and Also May Carry Deck Loads—Concrete Poured From Trestle at Rear of Boats

By R. M. Burkhalter
Engineer, Louis L. Brown Company, New York City

THREE concrete oil barges for the United States Navy were successfully built and launched last season at the Hudson River yard of the Louis L. Brown Co., at Verplanck, N. Y. These vessels were designed in general outline by the department, but details were supplied by the contractor. They are being used as oil carriers, and differ from the common design of concrete barges in that they have below-decks compartments for 3000 bbl. of oil and a deck capable of carrying a 500-ton cargo, although both loads cannot be carried at the same time.

The principal dimensions of the barge are: Length 112 ft., beam 35 ft. and depth 13 ft. 4 in. As shown in one of the drawings, the barge has an intermediate deck below which six fore and aft bulkheads run the entire length of the barge. Above this intermediate deck are four fore and aft bulkheads which provide three spaces for oil compartments and two outboard compartments without cargo. By this arrangement an air compartment is everywhere provided between the oil compartments and the skin of the barge. There are, in addition, three transverse bulkheads above and below the intermediate deck, making a total of 32 separate compartments in the barge. The amount of cargo space and of air space below deck are practically equal.

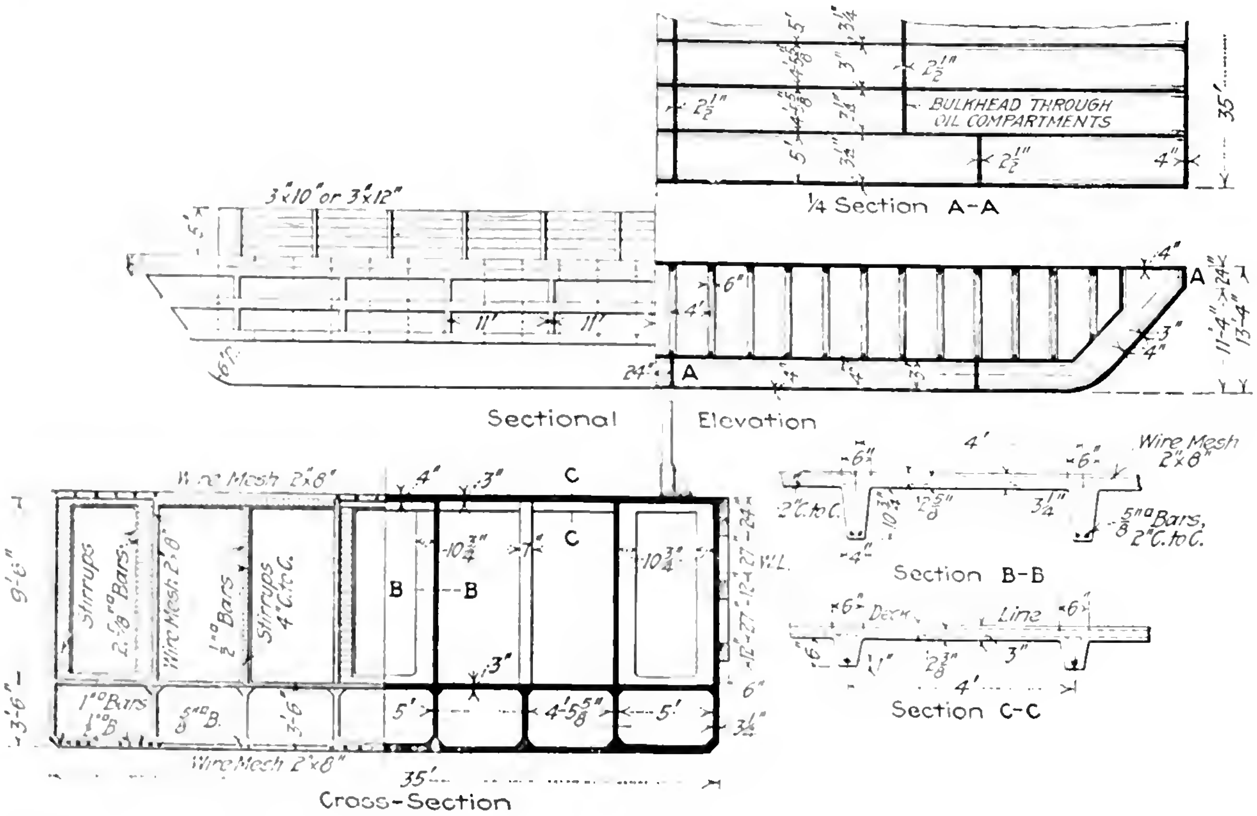
The transverse frames, above the intermediate deck only, are 4 ft. c. to c. They consist of vertical beams of 10¾-in. depth and horizontal beams of 6-in. depth so placed that the frames formed rectangles, three of which appear in the cross-section of the barge. The vertical members of these rectangles are beams receiving, through the slab, oil pressure or water pressure. The top members of the rectangle serve as deck beams and as struts between the two verticals; the bottom members serve as struts only. Thus there is produced a strong, rectangular frame which serves to transmit the deck load to the hull and to stiffen the boat transversely, corresponding to the strong frames in the usual marine design. Longitudinal strength is obtained by using fore and aft bulkheads. These bulkheads are 3 in. thick, stiffened every 4 ft. by vertical beams which extend down to the intermediate deck. Stiffeners were not considered necessary below the intermediate deck, since the unsupported height was only 3 ft. Rods placed in the hull and deck slabs below and above these bulkheads. cause the structure to conform to the requirements of a plate girder. By placing reinforcement on both hull and deck either flange is capable of taking tension; that is, the girder is effective as a plain or as a cantilever beam, so that it can take care of hogging and sagging strains. Actually, the vessel could be supported at its two ends only or by its middle third without overstressing the members.



FORM AND YARD LAYOUT FOR NAVY OIL BARGES BUILT AT VERPLANCK, N. Y.

The slabs in the bottom are 4 in. thick and in the side 3½ in. The reinforcement used is welded wire and deformed bars. In the slab the reinforcement was entirely of mesh, of which two layers were used in order to provide for the negative moment. Rods were used for beam reinforcement. In addition, a number of rods were placed to take care of the strains induced by hogging and sagging action. Much care was used in the choice of concrete materials, and the final choice was a special mixture of limestone screenings and ⅜-in. crushed limestone. The virtue of this product is the perfect grading of materials from the fineness of portland cement to the ⅜-in. aggregate.

In the design the stresses used were 12,000 lb. per square inch in steel and 800 lb. per square inch in concrete. The stress in concrete was taken as 37½% of an ultimate strength of 3000 lb. Tests made by the



DETAILS OF THE DESIGN OF NAVY OIL BARGES BUILT BY L. L. BROWN COMPANY

made with the horizontal did not increase.

In order to carry on the work economically, a two-level gantry was erected across the upper end of the barges and a concrete tower was provided to deliver concrete to these levels. This gantry connected with platforms down the center of the barge. A concrete water tank was built and water was piped to all parts of the work, so that an ample supply was available for wetting down the concrete. In the actual placing of the concrete the manner of placing was considered of greater importance than the quantity placed. The pouring of a complete barge in one operation was not attempted. Joints were foreseen; their locations were chosen and the bonding of new concrete to old was provided for. For instance, a horizontal joint was made at the level of the intermediate deck. At this point a large area of bonding was obtained, together with a maximum of reinforcement with the condition of no shears, since the slab support is here vertical.

In building the barges the bottom forms were first laid on the ways, extending up both rakes, and on this form were placed the two layers of mesh and the longi-

United States Navy showed the concrete to have a strength uniformly greater than the 3000 lb. assumed above. The average of these tests was 4000 lb. per square inch, with a maximum of 5400 lb. per square inch. The test specimens were cylinders 6 in. in diameter by 12 in. long, made by the resident inspector from concrete taken from the mixer during the actual pouring of the barges.

The layout of the yard and installation essential to construction is shown in one of the drawings. The berths are 50 ft. c. to c., and each berth has two ways 25 ft. c. to c. Each way consists of a concrete wall 18 in. thick, extending from the shore line back 150 ft. on a slope of ¾ in. to 1 ft., or 1 to 16. On top of the wall was placed an 8 x 16-in. timber secured to the concrete, as the fixed or permanent way on which the traveling shoe found bearing. Each berth also has concrete slabs in the ground between the ways, and on these foundations timber blocking was built up to a height 6 in. above the top of the permanent way timber. On this blocking were placed transversely building ways of 12 x 12-in. timber and of such length that they exceed the width of the barge by 2 or 3 ft. On these building ways the bottom forms were built, the entire structure being supported on the ways until within a week of launching.

After the concreting of the barge has attained sufficient strength, the building ways are removed and blocks substituted. On the day of the launching the 6 x 12-in. shoe was placed on the permanent way, well greased, the space between the shoe and the hull was well packed with timber, and the blocks were removed. With all blocks removed and the boat resting on the shoes, the component of gravity along the way was resisted by anchorage of the 6 x 12-in. shoes at the offshore end. The sawing of the two shoes simultaneously effected the release of the barge at the time desired and insured an equal start on the two ways. The ways were extended into the water sufficiently to satisfy the condition that at all times during the launching the moment of buoyancy about the end of the ways was greater than the moment of the weight of the barge about that point. In other words, the angle which the bottom of the barge

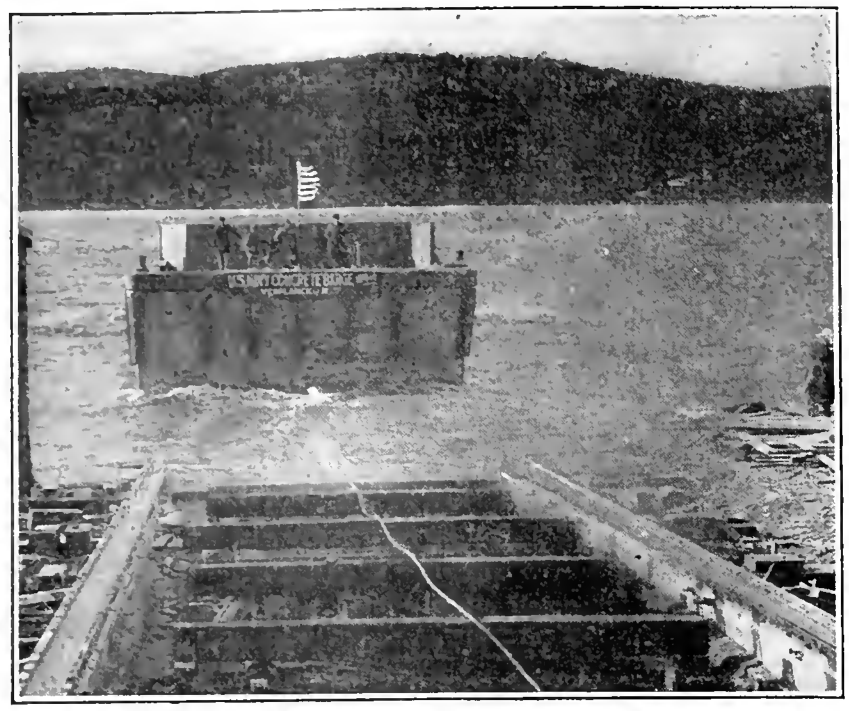
LOOKING DOWN ON OIL BARGE DURING CONSTRUCTION

tudinal rods. The mesh was placed transversely and was cut in lengths which extended above the joint in the sides of the hull. Posts were then erected and inverted trusses, framed of light lumber, were placed so that the upper chord spanned 40 ft. clear—that is, 2½ ft. each side of the outside skin of the boat. The lower chord was 30 ft. long and was included within the outside forms. This lower chord supported the reinforcement and the working platforms and runways. The chords were spliced, the framing was simple, and the erection by means of a gin-pole was easily effected. The lower chord was placed high enough to clear the intermediate deck by 2 ft. and the lower level of the gantry connected with the platform on the lower chord of the trusses.

The bottom of the barge was first concreted, the concrete being conveyed to the panels by buggies. Tied to the bottom reinforcement, stubs were placed to extend up into the bulkheads, longitudinal and transverse. The next step was the placing of reinforcement and forms for the longitudinal bulkheads and the intermediate deck. The forms were in 8-ft. lengths and in three parts forming the two sides and the top of the square, or, as it was called on the work, the tunnel. The stubs tied to the bottom reinforcement were hooked into the strands of the reinforcement of the bulkheads, such engagement giving a positive connection of the reinforcement of the two parts. This scheme of bonding was followed throughout the construction.

INTERMEDIATE DECK OF NAVY OIL BARGE CONCRETED FROM SUSPENDED RUNWAY

The bulkheads and the hull were poured to the level of the intermediate deck, and the intermediate deck was then poured. The webbing and the lower chord of the trusses were then removed, and the platform was shifted to the upper chord. This chord was posted in the center. The forms for the bulkheads above the intermediate deck were then set, the panel forms on the sides on which there were no beams being placed first. Against this the mesh was placed and then the 4-ft. panels forming the slabs and beams were set. These bulkheads and the hull were concreted to the deck level in two lifts. With these forms removed, supports were provided and the panels of the deck forms were placed. In concreting the deck the methods used in pouring were similar to those used in pouring floors.



BARGE LAUNCHED ENDWISE FROM CONCRETE WAYS

Additional reinforcement was provided where the deck fittings were placed, and holes were left in the deck for the fitting bolts. The fittings placed were standard Navy fittings. Under each was placed an oak seating 3 in. thick to protect the concrete deck. A 2-in. oak washer was provided below deck for each of these bolts, and the bolts were grommeted to make them water-tight. A waist for the deck cargo consists of brackets of structural steel bolted to the deck on 8-ft. centers and supporting 5 ft. of 3-in. pine plank. The fenders are 6 x 12-in. oak cut from local timber, bolted to the sides of the vessel by ¾-in. bolts 2 ft. on centers. Inside, a 2-in. plank was framed between the vertical beams to act as a washer for two bolts.

One of the essential features in the construction was the curing of the concrete. Concreting in extremely hot weather was avoided, and at all times the concrete was shaded from the sun for at least two weeks after placing. The surface of the concrete during this time was constantly kept wet, being sprinkled as often as was necessary. After the removal of the forms the exterior skin of the barge was carefully gone over, and all projections were rubbed down by a carborundum brick. The surface of the concrete was then rubbed with a cement brick, directly following a brush of thin mortar. Consideration was given to the painting of this hull with a paint other than a cement product, but the Navy gave instructions that this be omitted, in order to test the water-tightness of the slab. The barges proved to be dry—dusty dry. However, it is probable that an application of some waterproof coating on the skin of barges would be desirable in that it would assist in preventing water from attacking the steel reinforcement of the barge.

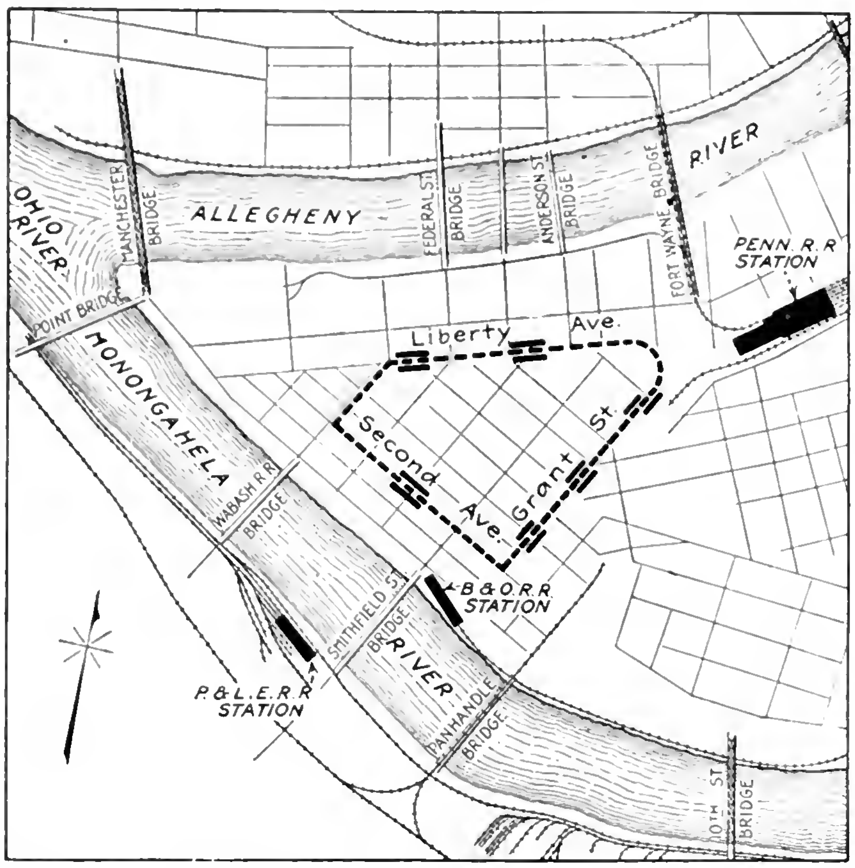
England Has Built Twenty-Two Concrete Barges

Up to Mar. 25 Great Britain had launched 22 concrete barges, according to a statement recently made in the House of Commons. Of these, nine had been completed and five actually delivered. Twenty-two more barges are under construction, as well as six concrete tugs. It is stated that as the Government does not require such vessels now, it is not the intention to build more, because in the opinion of the Admiralty there has not yet been sufficient experience to justify opinion concerning their success.

Street-Car Loop Subway Proposed by Pittsburgh

Six-Million-Dollar Municipal Project, to Relieve Downtown Traffic Congestion, Advocated by City Authorities

ISSUE of city bonds for $6,000,000 to build a street-car subway loop in downtown Pittsburgh has been proposed by the mayor and public works department to the voters of the city. Following several prior studies for transit improvement in the city, a report recommending two rapid-transit lines from the heart of the city to the eastern suburbs was rendered a year ago by E. K. Morse, appointed as city transit commissioner to investigate the situation and work out a solution. This



PROPOSED STREET-CAR LOOP SUBWAY IN PITTSBURGH

recommendation, which contemplated an expenditure of something over $12,000,000 for the two lines, did not meet with the favor of the city officials, however, partly for the reason that it would not relieve the downtown congestion of traffic. On account of the topographical limitations to the development of the Pittsburgh business district, the narrowness of the downtown streets, and the very great density of street-car traffic morning and evening, it has been concluded that relief of the surface-car congestion must be the first line of attack on the transit problem. The present project has been developed from this point of view.

In the accompanying sketch map of the "Point" district of Pittsburgh, taken from a recent pamphlet by N. S. Sprague, chief engineer of the city's department of public works, the proposed loop subway is indicated by a broken line. The route extends through Liberty Ave., Ferry St., Second Ave. and Grant St., passing the Pennsylvania Railroad station at the turn from Grant St. into Liberty Ave. The structure i. to be 8400 ft. long and is to be a two-track subway in which all cars will operate in the same direction around the circuit. Passengers will enter and leave by way of six stations, three of them being located on Grant St. (at Fourth Ave., Fifth Ave and Seventh Ave.), two on Liberty Ave. (at Wood St. and at Fifth Ave.), and one on Second Ave. (at Wood St.), the station intervals ranging from 760 to 1860 ft. Cars will enter and leave the subway by way of portals located above high-water level.

It is intended that all surface cars in the city shall loop through the subway except the North Side, West End, and Lincoln Ave. cars, which will extend only to the outer edge of the business district and will turn back by way of surface loops on Liberty Ave. (between Federal and Stanwix Sts.) and around the court house at Grant and Diamond Streets.

Referring to present traffic conditions and the proposed subway service, Mr. Sprague reports that at present 573 cars per hour enter the downtown district during the rush hours. Of these about 60%, or 335 cars per hour, would use the subway loop, the others using the two surface loops mentioned.

No definite plans for operation have been formulated, but the city officials believe that the subway can be leased to the street-railway company for operation. Inasmuch as the use of the subway would probably not increase the revenues of the street-car system very greatly, it is anticipated that part of the cost of the subway will have to be borne by the city. This is regarded as a proper offset against the cost of street widenings and other improvements which would have to be made for relief of street traffic if the subway were not built and the street cars thus were not taken from the street surface.

Development of the loop into the downtown portion of a true rapid-transit system is thought to be quite practicable at a later time. No suggestions have been made for future provision for the surface cars when the loop is thus taken over for rapid-transit service.

Engine Terminals and Roundhouse Cost

AN engine terminal capable of handling 100 locomotives daily will cost about $660,000, at present prices, for construction and equipment, according to a paper on "Modern Tendencies in Roundhouse Design," read before the Western Society of Engineers by E. M. Haas, railway specialist of the Austin Co. This would give annual fixed charges of about $69,300 at 10½% for interest and depreciation, or about $2 per engine per day. About 33% of the total first cost would be represented by the roundhouse and its equipment, the building of reinforced concrete. The cost per roundhouse stall at 1918 prices has ranged from $6000 to $22,000 for the building, with light, heat and plumbing; while for the entire terminal it has ranged from $25,000 to $50,000 per stall. The higher costs imply permanent construction and ample labor-saving facilities. The distribution of cost of such a terminal is shown in the accompanying table.

Fire-resisting construction is highly desirable, for,

COST OF ENGINE TERMINAL TO HANDLE 100 LOCOMOTIVES DAILY

24-stall roundhouse	$220,000
Grading, drainage and tracks	70,000
Two inspection pits and service building	16,000
Coaling and sand station, water-supply	74,000
Two water-type ashpits with a gantry crane	36,000
100-ft. turntable and pit	20,000
Oil house and equipment	10,000
Machine shop and power house	64,000
Boiler-washing plant, 10-ton crane, electric hoist for engines, shop and power house equipment	120,000
Miscellaneous	30,000
	$660,000

although roundhouse fires are not frequent, they may cause great loss to expensive locomotives, besides putting engines out of commission. This may be the case even if only the roof is of wood. Timber frame and roof with brick walls has been a very general type, but involves high cost for depreciation and maintenance. Both steel and concrete construction were noted by Mr. Haas, but he favored the latter, and also preferred monolithic concrete construction to the unit system. He referred to the desirability of long span between the posts, in order to avoid interference with the work on the engines. For this reason a design used by the New York Cenetral R.R. has a 64-ft. truss span over the main space. Incidentally, these trusses were originally made of heavy timbers, but they are now built up of planks, in order to cheapen the construction.

Overhead cranes have been applied in a number of roundhouses and an investigation made on the Pennsylvania R. R. showed that the maximum load to be handled was about 8½ tons, so that a 10-ton crane would be adequate for this service. In Mr. Haas' opinion there is a tendency to substitute the engine hoist for the drop pit for handling wheels and axles, owing to the greater liability of danger in jacking up the engines on the pits, due to weight of modern engines and the use of inexperienced labor. For heating, the hot-blast system is considered preferable, as it costs little more than the direct system and has the advantage of providing forced ventilation.

Daily Code Letter Shows Status of All Highway Work

Texas State Highway Department Condenses All Daily Progress Reports Into One Page by Means of Alphabetical Symbols

By Julian Montgomery
Division Engineer, Texas State Highway Department

Using alphabetical symbols, the Texas State Highway Department, which has 189 state-aid projects and 190 Federal-aid projects, has found it possible to make on one sheet of letter paper a combined daily progress report of the status of all jobs. The key for the code letter, which is sent to each recipient of the report, makes it possible to tell at once the condition of each job in the state, while the job number and county indices give a complete description of the project. These reports have been found very useful in conveying accurate information to commissioners and engineers who are constantly being questioned as to the status of the various jobs.

Due to the recent war, most state-aid and Federal-aid projects have been inactive. The majority of the counties in which they are located have not finally completed their applications for aid, one of the main reasons being that they had no available funds at the time of making application. In order to complete their applications they must show the source from which the county's share of the cost of construction is to come —usually bond issues.

Whenever aid is allotted to a county on a state highway, this allotment is given a job number for filing reference, and when the job has reached the stage for the execution of the project agreement it is then given a project number. Work other than road construction, such as the preparation of county road maps (specified by law to be done by the highway department in certain instances), involving the expenditure of money by the department, also receives a job number. The projects are in various stages of progress, ranging from 195 which have not finally completed their applications for aid, to 81 which are now under construction.

The state highway engineer, the highway commissioners, and the division engineers, located in different parts of the state, every day receive numerous inquiries concerning the present status of these state- and Federal-aid projects. In order to be able to answer these numerous inquiries, and to have the present status of each job for available information, the state highway engineer found it necessary to have a comprehensive daily progress report of all jobs. To serve its intended purpose, it was necessary for this daily report to be very brief, easily digested and thorough.

To the writer was entrusted the task of designing such a report. It is easily seen that an ordinary written report covering about 400 jobs, if intelligently prepared, would cover 10 to 12 pages. To issue such a report daily would entail a great deal of printing and consume a large quantity of paper. It was found that a status key combined with a job number key enabled the daily status of every job to be given on one sheet of paper.

CODE LETTER, JOB AND COUNTY INDEXES AND CODE KEY USED BY TEXAS STATE HIGHWAY DEPARTMENT

Daily Report on Jobs, March 8, 1919

1	RARIHLRRALQ	RRQRRVLRYW	RRMNYNRYRY	BARAAAAEER	AHHYYRYBBR	50
51	AYYHVRNLHR	PGARALLAFY	YAABAGARLY	AYAARBIAEB	YNFAAABBBA	100
101	NAHLBAARAA	ARBAAAMAAR	LAAAAYYAAR	BAARBAAAAA	AHMBARARLO	150
151	QKGAAGARNB	BAAARRABAA	AHRABAAAAA	AAAARARAAA	AAAAAAAHBG	200
201	AGQAAABPZR	RNBAACAABA	BAZZBAAHWO	ZAACRNAAAA	AAAAZZZZAA	250
251	NAAAAALNHZ	YBAAABAADB	ABANANAAAA	ZAAAAAAARA	AARNRAAAAA	300
301	AAAABABAAA	AAAAEHAARG	BAAAACACAB	AAAAAAAAAM	BRNCABAAGA	350
351	AAAAAALDAA	NAAAAAYAAA	AAAAAAAAAA	BBAAAAAAA		400

"Present-Status" Key

A Application incomplete
B Application complete
C Plans received, application incomplete
D Plans received, application complete
E Plans returned for correction
F Revised plans received
G Plans approved
H Federal-aid plans forwarded
I Federal-aid plans returned for revision
J Revised Federal-aid plans forwarded
K Federal-aid plans approved
L Letting advertised
M Bids rejected
N Contract awarded
O Contract executed
P State Project Agreement executed
Q Federal Project Agreement executed
R Work started
S Work suspended
T Work renewed
U Work complete
V Work accepted
W Final estimate paid
X Final reimbursement received by Federal Government
Y Project suspended or dead
Z Spacer or filler or County Road Map

Job Number Index (Sample)

Job No.	County	Estimated Cost	State Aid	Federal Aid
150	Travis	$100,436 00	$25,109 00	
151	Guadalupe	12,316 25		$5,000 00
152	Camp	65,644 52		17,454 00

County Index (Sample)

County	Local Name of Road	Job No.	Highway No.	—Project No.— State Aid	Federal Aid
Taylor	Texarkana-El Paso	297	1	61	..
Titus	Texarkana-El Paso	54	1	13	26
Travis	Austin-Lockhart	150	29	33	..

A reproduction of the code portion of one of these sheets, together with the key, is given in the table. The code in this case covered only about one-third of a sheet and the remainder was used for a summary of the various information and an announcement of coming lettings and jobs under construction.

It will be noticed that the code letters in the daily report are arranged in groups of 10. This is for convenience in locating the job numbers. Beginning in the upper left-hand corner, the first capital letter denotes the present status of Job No. 1, the second capital letter that of Job No. 2, etc. Fifty jobs are on each line, arranged in groups of ten. To expedite the location of job numbers on the report, the numbers of the first and last job on each line are placed at the beginning and end.

The "present-status" key is self-explanatory. Each capital letter represents a step in the process of the completion of the project, from the time when aid is granted to the acceptance of the completed work and payment of the final estimate. Some of the job numbers refer to other things besides state- and Federal-aid projects, such as the preparation of country road maps. The letter "Z" is supplied for such jobs.

Each person to whom the daily report is sent is supplied with a job number index showing the job number, county, estimated cost, state aid and Federal aid. In addition, an alphabetical index by counties is furnished showing county, local name of road, job number, highway number, state project number and Federal project number. Samples of these indexes are also given in the table.

Example

It is seen that the last letter in the third line of the daily report is "O." This is the 150th letter and therefore gives the present status of Job 150. Referring to the "present-status" key, the letter "O" shows that the project has reached the stage where the contract for Job No. 150 has been let and executed between the contractor and the department. Knowing that the project has reached this stage, it is known also that all the stages preliminary to this have been completed.

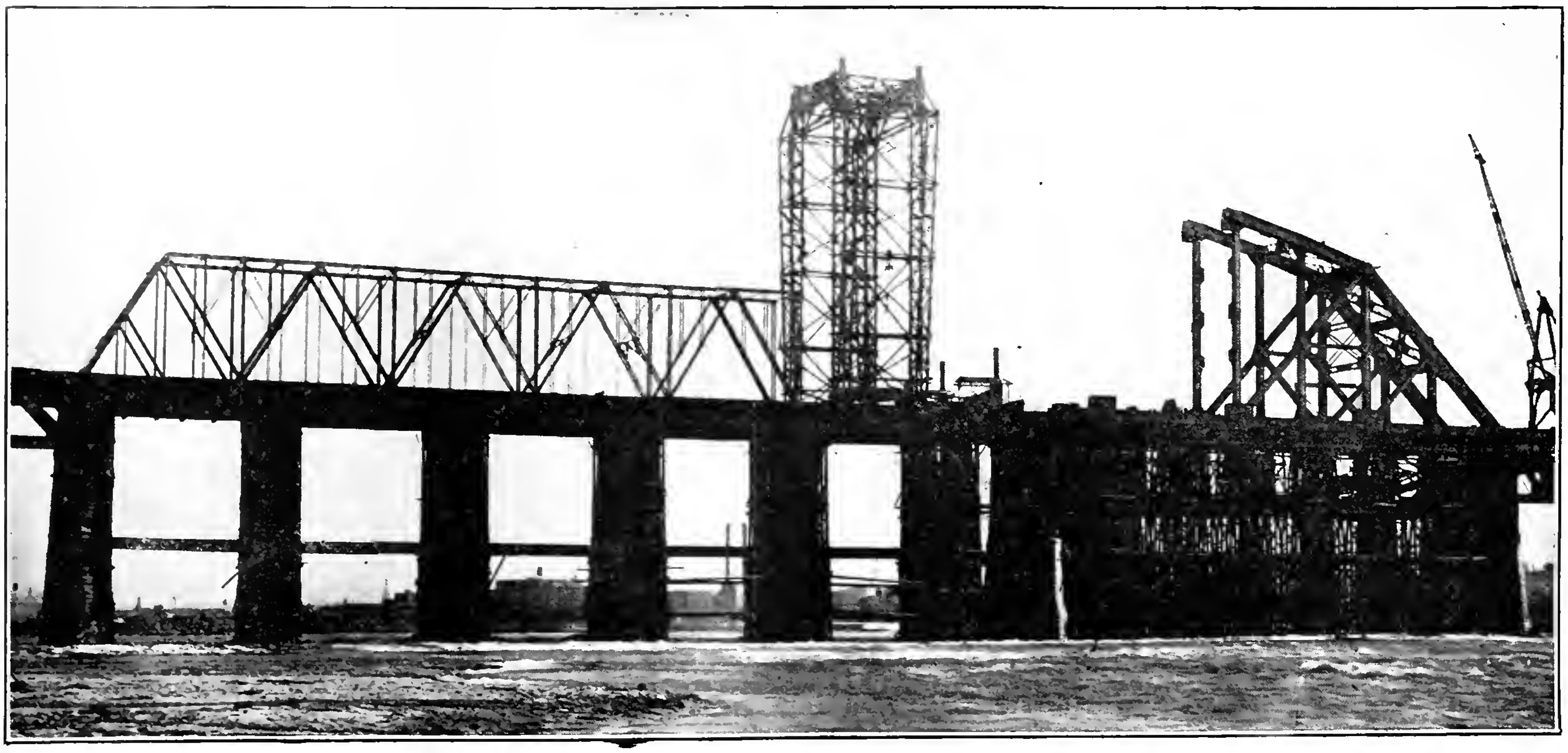
Referring to the job number and county indexes, it is noticed that Job No. 150 is a state-aid project, No. 33, on the Austin-Lockhart section of state highway number 29, Travis County, and that $25,109, state aid, has been allotted to this road.

This daily report is printed by multigraph which is kept set all the time. Only such daily changes are made in the capital letters as are dictated by the changes in the present-day status of each job.

Maintaining Traffic During Erection of Louisville Bridge

Floods and Washouts Caused by Swift Current of Ohio River Force Revision of Methods—Timber Towers Support Longitudinal Steel Girders

The erection of the new double-track riveted-truss spans outside of the historic Fink trusses of the Louisville bridge practically without interruption of traffic was completed last year in spite of many difficulties caused by the swift current of the Ohio River and unusual flood conditions which at one time resulted in the loss of some steel lower chords and floor material by the washing out of the falsework. By bunching the trains to pass over the bridge at the noon hour or about 4 p. m., and diverting some trains to other bridges at the critical stages in the work, operation was maintained throughout the two years from June, 1916, to October, 1918, during which time about one mile of steel superstructure was erected, including the long 644-ft. riveted span and a 260-ft. lift span. The old masonry piers were built by removing the upper courses and capping with steel grillages surrounded by concrete. The principal design features of this bridge were de-



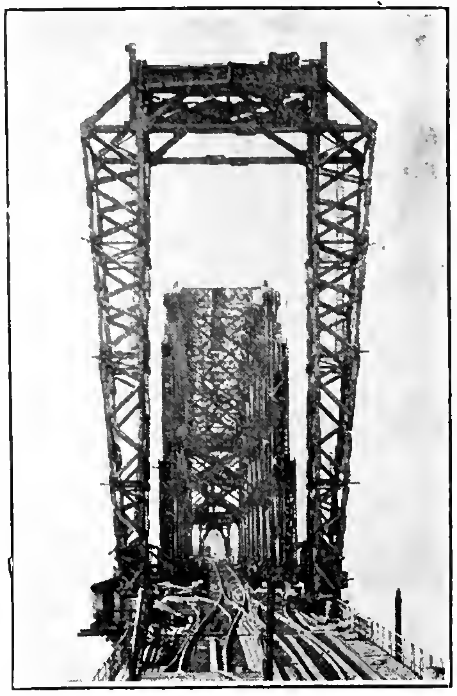
GANTRY TRAVELER DISMANTLING OLD 400-FOOT SPAN AND ERECTING NEW 644-FOOT TRUSSES

scribed in *Engineering News-Record* of May 22, 1919, p. 1007.

Erection of the 644-ft. span was carried out by the use of timber bents built in groups of four and supporting longitudinal steel girders for the tracks of a gantry traveler. Many difficulties had to be overcome in placing these bents on the rough rock bottom of the river. In general, the principle adopted to avoid flood danger was the use of longitudinal steel girders on timber towers spaced to conform to the lengths of the available girders. This resulted in greater clear waterway for the swift current, which averaged about 10 miles per hour, and a less number of bents to be set on the river bottom.

Erection Progress—Erection work started in June, 1916, on the deck spans at the north end, working from the abutment to the Indiana channel span. By Oct. 1, 823 ft. had been erected, consisting of three 180-ft. deck spans, one 150-ft. deck span, and two small girder spans. Between Sept. 1 and Sept. 15 of the same year, five 245-ft. deck spans, connecting the two through-truss spans, were completed. The next year the 370-ft. through span was constructed between Apr. 25 and July 10, followed by the remaining nine deck trusses on the Louisville side, which were completed by Jan. 20, 1918. The lift span, with its approach girder spans, was erected in the spring of 1918. Work began on the 644-ft. through span on Apr. 20, 1918, and it was swung on Oct. 15, 1918, about six months later.

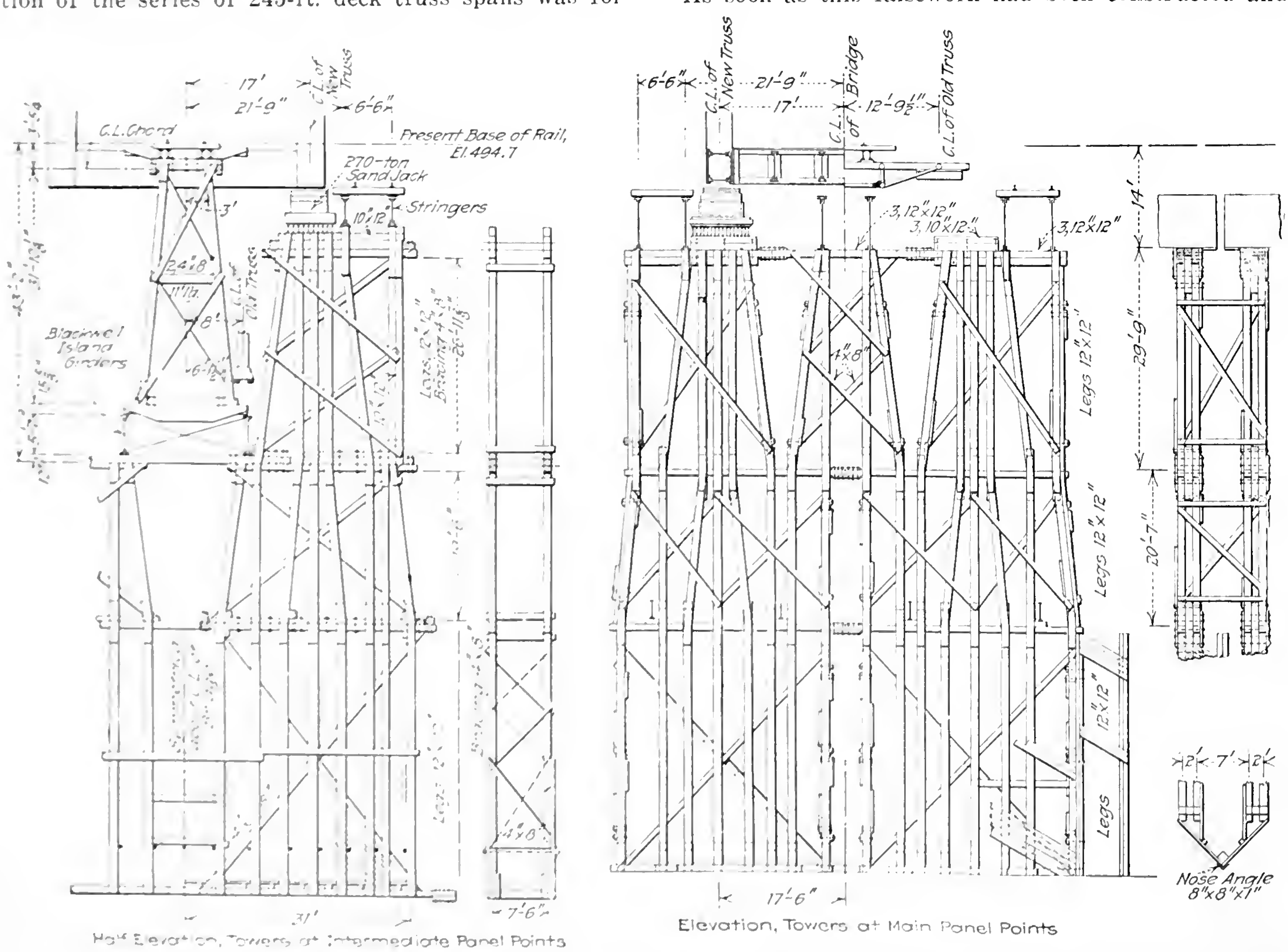
Deck Span Erection—A regular sequence in the erection of the series of 245-ft. deck truss spans was followed. In each case the first operation was the construction of the double-bent timber towers. These were placed on concrete pedestals anchored to rock by 1½-in. gaspipe set in cement grout, similar concrete foundations also being used for the pedestals of the 370-ft. Kentucky channel span.



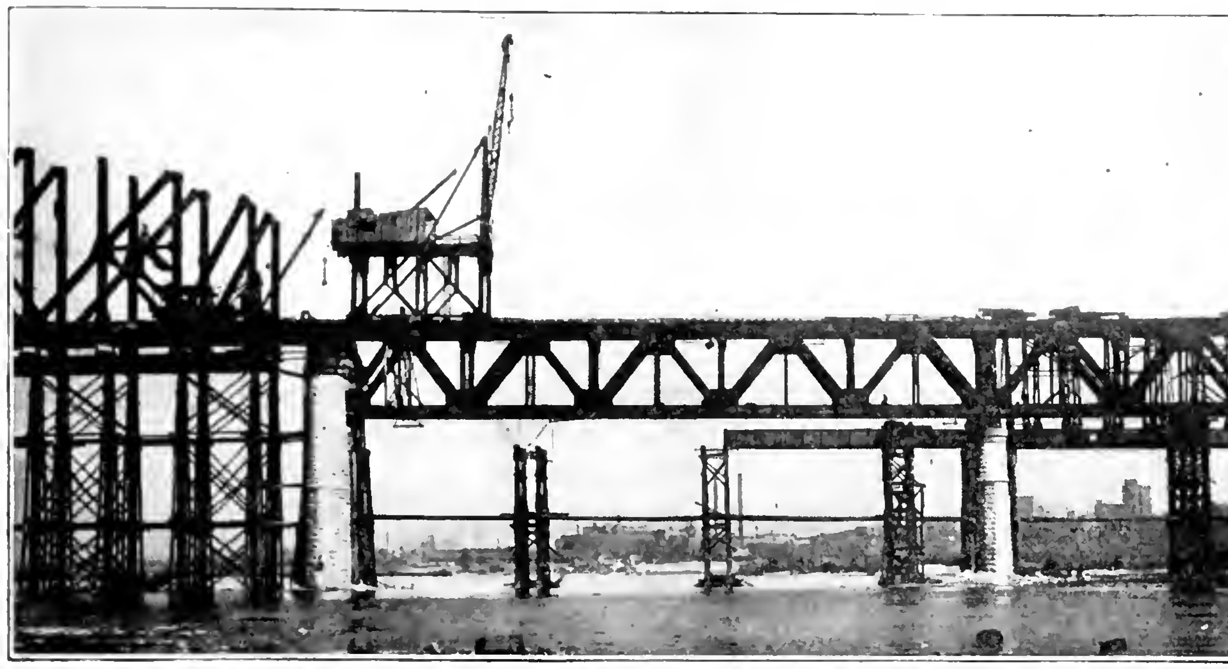
GANTRY ERECTION OF 644-FOOT SPAN

The timber towers, which supported steel girders at a level just below the lower chords of the old trusses, were spaced according to the length of the girders available—in the case of the deck spans these girders were 70 ft. long and were obtained from the contractor. They were placed by a derrick car from the old Fink-truss spans. Timber pony bents were then erected on these girders, one on each side of the panel points of the old truss, blocking up under the old stringers to support the floor. Except for the first group of spans erected, these pony bents, as shown in one of the drawings, were supported by floor-beams removed from the old trusses.

As soon as this falsework had been constructed and



TYPICAL FALSEWORK BENTS FOR ERECTION OF 644-FOOT SPAN—OUTSIDE TRACKS FOR GANTRY AND MATERIAL CARS



THROUGH MULE TRAVELER AND DERRICK CAR WHICH ERECTED DECK TRUSS SPANS OF LOUISVILLE BRIDGE

the floor supported in two adjacent spans, the old intermediate masonry pier was cut down by carefully removing the stones to a level far enough below the desired pedestal support of the new deck girders to allow the steel grillages to be placed on top of the pier, and concreted.

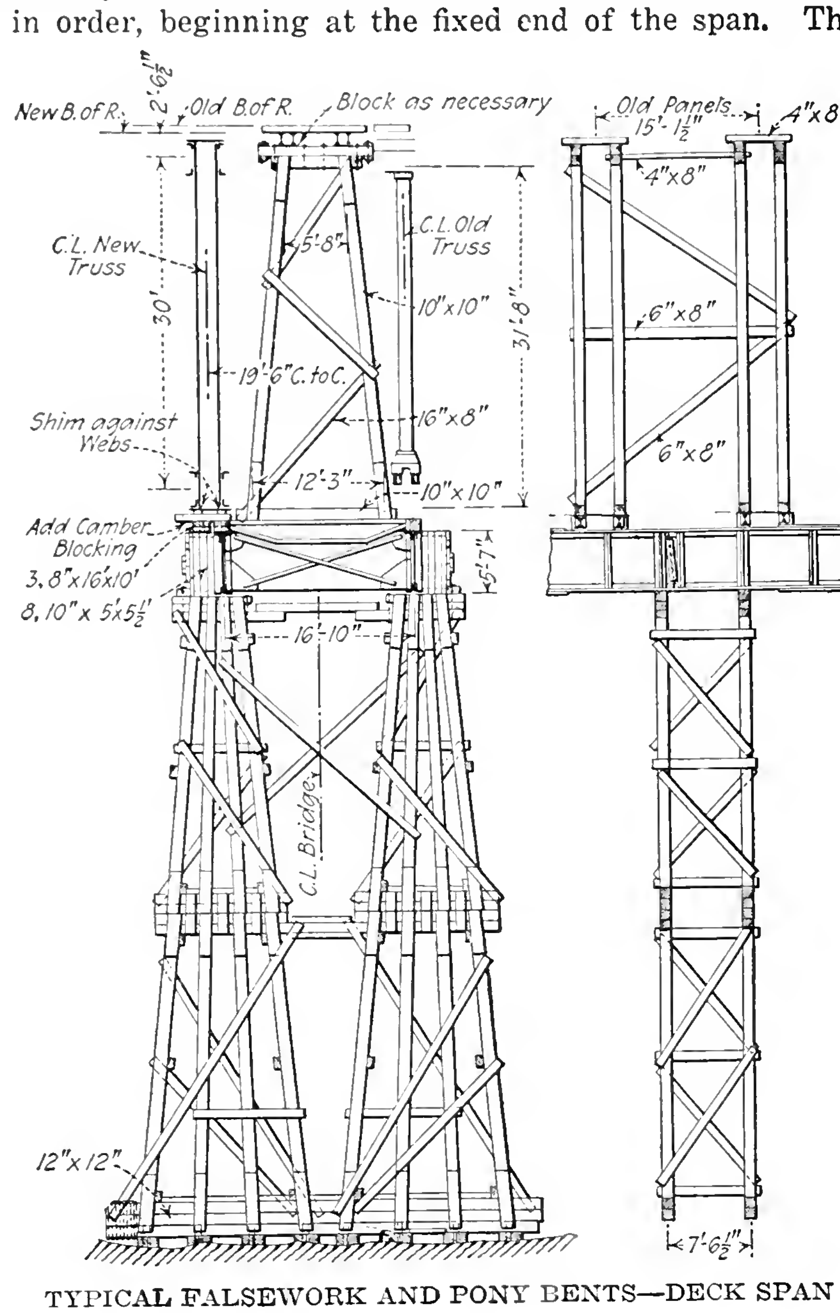
Regular Sequence Followed—Three spans at a time were thus carried on falsework, many of the bents of which were used over and over in successive spans, and a regular procedure was adopted, as follows: In the first span, the old wrought-iron members of the trusses were being burned through by acetylene torches and the cast-iron chord splice bolts burnt out, allowing the removal of the old trusses; in the next span the steel of the new trusses was in process of erection by a through mule traveler built up of steel and timber, as seen in one of the photographs; in the third span the new truss members were being riveted, and the falsework bents then removed for use in the next span.

Since the old trusses were so light, it was necessary to use care not to overload them in the erection operations carried out by derrick cars on the old tracks. In changing floor, two or three panel units were handled by these cars, the old stringer connections being cut through at the floor-beams. Special blocking on the pony bents supported the old stringers in adjacent panels.

Under the lift span, where the rock bottom of the canal is covered by several feet of soft mud, the bottom story of the falsework was set one leg at a time between guide timbers, and driven to bearing on rock by two or three blows of a light pile-hammer. This method was also used under the 644-ft. span, although the rock bottom was clear of mud. However, the depth of water, 10 or 12 ft., and the velocity of the current, about 10 miles per hour, would have made it very difficult to place concrete footings on the river bottom. Under the large span the legs were shod with cast-steel shoes, but no shoes were used in the canal. Before this scheme was adopted it was planned to use rock-filled cribs under the long span, but the attempt was abandoned.

Erecting 644-Foot Span—The general procedure in the erection of the 644-ft. span which replaced the old 400-ft. through span and one of the 245-ft. deck spans and involved, therefore, the removal of the intermediate pier, was as follows: A creeper traveler on the top chord of the through span was used in placing the timber bents below that span, and derrick cars placed the bents under the deck span. The spacing of these timber bents in the longer span was equal to the double-panel length of the big truss, while in the shorter span bents were placed under each panel point. Longitudinal steel girders were placed on top of these bents just below the lower chords of the main span in the longer opening, and below the lower chords of the deck span in the shorter opening. As illustrated in the cross-section here reproduced, these falsework bents supported the floor of the old bridge, two outside tracks upon which the material was transported and also the large gantry traveler which spanned the new trusses, the latter being spaced 34 ft. center to center. After supporting the old floor system, the old trusses were removed.

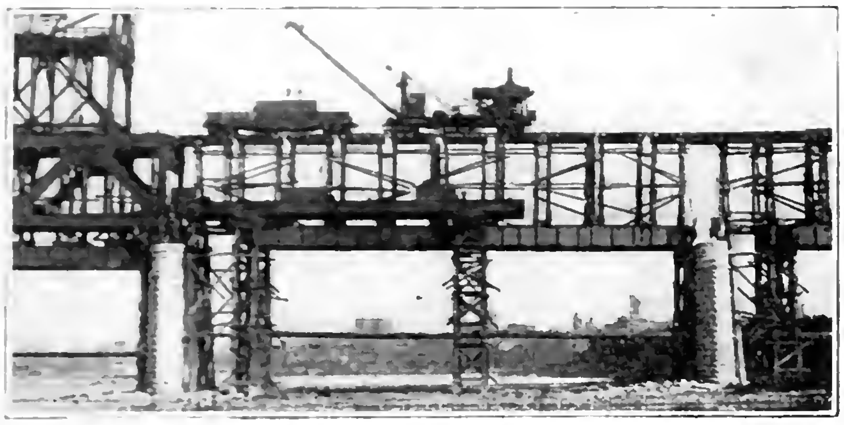
The gantry traveler which erected the heavy truss members was 145 ft. high overall, 124 ft. high inside and 46 ft. wide. This gantry traveler weighed 280 tons, with 100 tons extra weight for two engines. The lower chords of the trusses were placed first, then the floor system was changed, and the web members erected in order, beginning at the fixed end of the span. The



TYPICAL FALSEWORK AND PONY BENTS—DECK SPAN

heaviest members handled were the end posts and bottom chord sections, each of which weighs about 130 tons. The heaviest top chord weighs 95 tons and the heaviest diagonal 42 tons, the latter being about 95 ft. long.

Replacing the Top of Pier 19—At the Louisville end of the new long-channel span, it was necessary to increase the size of the supporting pier to carry the heavier load, and also to rebuild the top of the pier to provide a recess for the new deck truss span on the Louisville side, and at the same time secure adequate support for the heavy span. Futhermore, as the new span was erected before the adjacent 245-ft. old span had been supported by falsework, it was necessary to provide a special braced cross-girder to allow removal of the top of the pier and support the old span. The pier was enlarged by placing about 3 ft. of masonry around the old masonry, using stones removed from the top of the other piers, well anchored into the piers.



TRACK CARRIED BY PONY BENTS ON GIRDERS SUPPORTED BY TIMBER TOWERS

The top of this pier was first cut down to an elevation about 6 ft. below the bottom of the old truss pedestals, except that supporting stones immediately below the bearings were allowed to remain in place. The stones on the nose of the pier were then removed to about 39 ft. below the top of the pier, leveled off with 1 in. of cement grout to support the shoes of the temporary bent consisting of steel columns built up outside of the pier to carry the heavy temporary cross-girder already mentioned. Between trains, using old floor-beams for jacking beams, the end of the old span was jacked up, the stone pedestals below the bearings were removed, and the cross-girder was swung over to support the old span temporarily. The pier was then cut down to its final level, and steel grillages and new concrete coping were placed. In rebuilding the pier, old masonry was used as the outside facing, and concrete was placed for backing. For the support of the new deck truss span, it was necessary in the rebuilding of the pier to leave a recess carried back to the center line to allow for the end vertical posts and floor-beam of the 245-ft. deck span.

The grillages at the ends of the 644-ft. span were quite heavy; that for Pier 19 weighed 57 tons, being notched for the deck span, while that for Pier 21 weighed 73 tons, covering the full top of the pier. Grillages at the ends of the 370-ft. span weighed 50 tons.

Lift Span—The lift span replaces the old swing truss span and had to be placed with as little interruption as possible to either railroad or canal traffic. This was accomplished by first closing the old span, removing three panels at one end, and providing a temporary lift girder span in one channel. An 83-ft. clear opening between the timber bents was provided, these bents supporting the 90-ft. temporary girders. The operation of lifting the temporary girders to allow a boat to pass required about 20 min. and was carried out by the use of hand winches with wire lines to gallows frames at each end. The weight of this temporary span was 82 tons.

The steel-frame towers for the permanent lift span were erected and the old span was removed over both channels. Using a derrick car and locomotive crane the new floor and truss members were placed on falsework in the channel on the Louisville side of the canal. The floor and bottom chord were extended one panel, and the top chord two panels, north of the center of the span. This permitted the erection of the machinery house, situated on the top chord at the middle of the bridge, and the installation of practically all machinery, without the canal being closed. At the same time, the two north end posts were erected and the concrete counterweights poured and connected to the lift span. At this stage the canal traffic was of course closed while trusses were erected. Railroad traffic also had to be interrupted about eight hours while the temporary lift span was removed and the permanent floor placed. This operation was carried out by two derrick cars.

The plans for erection were developed under the general supervision of J. F. Ritter, superintendent of erection of the Bethlehem Steel Bridge Corporation, Steelton, Penn., with O. J. Marsten as assistant engineer in charge of drafting the plans, and J. L. Poffenburg as engineer in the field. J. J. Kelley was general foreman on the work. The plans for the erection were approved by J. C. Bland, engineer of bridges, Pennsylvania Lines West of Pittsburgh.

TEMPORARY LIFT GIRDER IN USE—HALF OF LIFT SPAN ON FALSEWORK

Power Flushers Economical at Ottawa, Ontario

Two power flushers mounted on motor trucks have satisfactorily flushed 18 miles of streets of various widths each day at Ottawa, Ont., according to the annual report of Andrew F. Macallum, commisioner of public works. The cost per mile averaged \$1.72. These trucks operated for 106 days at a cost of \$4650. They replaced 20 of the old horse-drawn sprinkling wagons at an operation cost of \$16,800. Thus a direct saving of \$12,150 is shown.

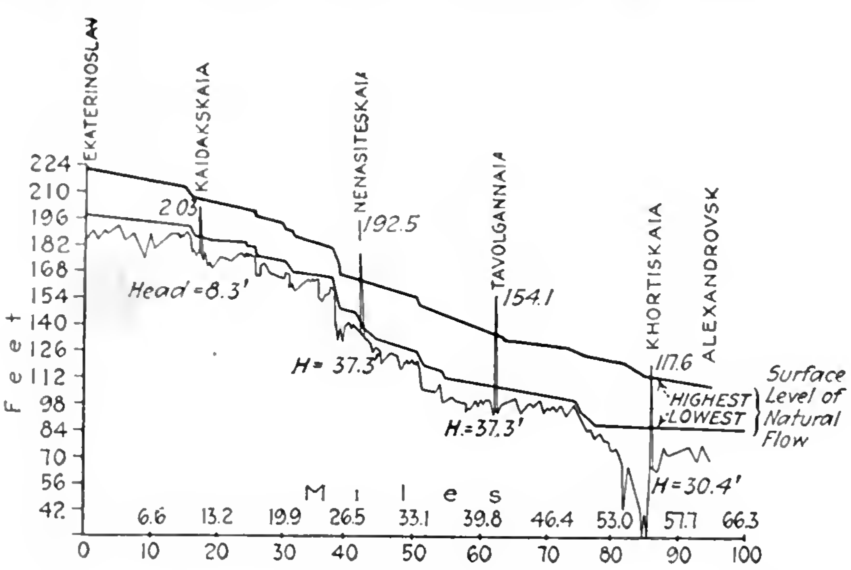
Russian Water-Power Possibilities at Dnieper River Rapids

Hydraulic and Canalization Project Interrupted by War — Four Dams and Power Plants Would Give About 600,000 Horsepower Nominal

By V. V. Tchikoff
Consulting Civil Engineer, Berkeley, Calif.

Water power is an important item in the vast natural resources of Russia. It will undoubtedly play a great part in the development of the country, because coal and other fuels are not distributed uniformly over Russia, and there is a lack of fuel in some very important industrial regions. The total potential water power of European Russia alone is estimated at 20,000,000 hp. or more. This is mostly concentrated in the border regions of Russia. The Caucasus has about 10,000,000 hp., and there are about 2,000,000 hp. in the north lake region. All the hydro-electric stations of European Russia have only some 250,000 hp., and most of them are small.

The rapids of the Dnieper River present one of the more interesting possibilities for early utilization. They are located between Ekaterinoslav and Alexandrovsk, within the navigable portion of the Dnieper River. They constitute one of the greatest obstacles to navigation on the canal system connecting the Baltic and the Black Seas. Beginning at Riga and ending at Kherson, this waterway will have a total length of about 1600 miles, utilizing the Rivers West Dvina and Dnieper.



PROFILE OF DNIEPER RIVER RAPIDS POWER SITES

The problem of utilizing the Dnieper River rapids has been worked out by many Russian and foreign engineers. The project of the Ministry of Way of Communication, in 1914, provided for the construction of four dams as follows (see profile): Kaidakskaia, with a fall of 8.3 ft.; Nenasiteskaia, 37.3 ft.; Tavolgannaia, 37.3 ft.; and Khortiskaia, 30.4 ft. The peculiarity of this project is the impounding of the night flow for use during the working hours of the day. Solid gravity dams were designed to be built on the granite foundation, and were to be provided with Thomas and Stoney gates. A canal with locks for boats of 7-ft. draft was proposed, with possibilities for 14-ft. draft.

The project was divided into two phases. The first phase was based upon the 37-year midsummer minimum discharge of 11,000 sec.-ft., corresponding to a turbine capacity of 238,600 hp. nominal, with a maximum of 316,800 hp. during the flood months of spring. The minimum discharge for a 15-day period is 15,100 second-feet.

For the second phase of the project there would be utilized about 22,000 sec.-ft., corresponding to a turbine capacity of 350,000 hp. nominal, and 465,000 maximum and a total of 588,600 hp. nominal. For this there would be necessary auxiliary steam plants of half the turbine capacity, working 90 days per year. The maximum capacity of the turbines was assumed as 1.33 times the nominal capacity. The construction cost of the dams, locks, etc., was estimated at about $25,000,000, and of the turbines, generators, etc., $16,500,000 for the first and $21,000,000 for the second phase, including the auxiliary steam plants, but not the transmission lines to Ekaterinoslav and Alexandrovsk, which are counted at $4,400,000.

For computation of the operation and maintenance costs per kilowatt, a working time of 3000 hours per year was assumed, and interest at 8% on construction capital. The resulting charges are shown in the accompanying table.

In computing the profit of all the stations for the first phase there was used an average operation and maintenance charge of 1.8 kopecks (0.9c.) per kilowatt-hour, well under the cost of power at which the steam plant can successfully compete. On this basis the profit for the first phase is estimated at $1,480,000, and for the second phase $1,700,000.

ESTIMATED CAPACITY AND COST OF DNIEPER RIVER WATER POWER PLANTS AND OPERATION AND MAINTENANCE COST PER KILOWATT-YEAR AND KILOWATT-HOUR

Name of Plant	Phases	Capacities of Turbines Hp. Nominal	Cost of Plants in Rubles, 1 Ruble = $0 515	Operation and Maintenance Cost Per Kilowatt-Year, Dollars	Operation and Maintenance Cost Per Kilowatt-Hour, Cents
Nenasiteskaia..	First	98,000	10,458,000	13.4	0.45
	Second	140,000	13,187,000	12.1	0.40
Tavolgannaia....	First	98,000	11,404,000	14.4	0.48
	Second	140,000	14,142,000	12.8	0.43
Khortiskaia	First	30,000	5,869,000	24.2	0.80
	Second	50,000	7,322,000	18.5	0.62
Kaidakskaia	First	12,600	4,087,000	38.2	1.27
	Second	20,000		--	....

A syndicate of French and Russian capitalists was ready to carry out the whole scheme of the Baltic-Black Seas waterway, but the old Russian Government was not willing to grant the concession and the Russian Duma was about to make an appropriation for the construction of the project when the great European war broke out.

Vandyke, Photostat and Blueprinting Costs

Production costs of vandykes, photostats and blueprints by the engineering division of the United States Ordnance Department, which during September, 1918, made 370,614, show a large reduction below commercial practice, according to the *American Machinist*. While the cost of vandykes and photostats varies with their size, an approximate cost per square foot can be given on vandykes 18 x 24 in., which cost 11½c. each and photostats 14 x 18 in., which cost 7½c. each. Upon this basis the costs per square foot were, vandykes 3.8c., photostats 4.3c. and blueprints 2 cents.

Excessive Storms Observed by the United States Weather Bureau

By Charles W. Sherman
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

THE accompanying table shows the rates of precipitation of the most noteworthy storms which have been observed at Weather Bureau stations during 1901 to 1918, inclusive, as reported in the annual reports of the Chief of the Weather Bureau and in the *Monthly Weather Review*.

The data presented show the most intense storms anywhere in the United States at Weather Bureau stations,

Locality	Date	Maximum Average Rate in Inches per Hour for Duration in Minutes																
	1901	5	10	15	20	25	30	35	40	45	50	60	80	100	120	150	180	
Galveston, Tex	Oct 7-8	5.52					4.12					3.13	2.74	2.58	2.40	2.41	2.40	
Jacksonville, Fla	June 14	7.20	6.30	5.68	4.77	4.18	4.00	4.15	3.94	3.73	3.55	3.11	....	....	....	....	....	
Topeka, Kan	Sept 13	5.76	3.96	4.08	3.60	3.84	3.56	3.67	3.48	3.16	3.04	2.81	2.19	....	....	....	....	
	1902																	
	1903																	
Baltimore, Md	July 12	8.88	8.34	7.60	6.69	6.05	5.38	4.91					....	....	....	....	....	
New Orleans, La	Mar 14	4.20										2.75		2.43	2.35	2.35	2.12	
Pensacola, Fla	Nov. 2	6.12	5.28	5.12	4.89	4.35	4.08					3.15	3.20	2.95	....	....	....	
	1904																	
Galveston, Tex	Apr 22	6.12	5.64	5.52	5.64	5.47	5.34	5.02	4.90	4.72	4.65	4.41	4.18	4.03	3.78	3.42	3.29	
Oklahoma, Okla	June 4							....	....			2.66	2.25	1.94	....	....	....	
Taylor, Tex	May 3	6.60	6.00				....	....	....	....	..	2.82	2.45	...	....	....	....	
	1905																	
Cairo, Ill	June 28											3.15	2.51	2.17	....	....	....	
Montgomery, Ala	May 30	6.48	6.24	5.64	5.31	5.15	4.98	4.60	4.29	4.13	3.95	3.46	...	....	....	....	....	
New York, N. Y	July 10	8.16	7.20	6.52	5.64	4.78	4.16	3.62		..	....							
Shreveport, La	July 23									..	...	2.99	2.63	2.60	2.60	2.43	2.16	
Taylor, Tex	Apr. 29	10.80	10.80	9.20	8.25	6.80	5.78	....	...			..	...	....	....	....	....	
	1906																	
Anniston, Ala	Sept. 5	7.80	7.44	7.24	7.08	6.43	5.94	5.58	5.15	4.67	4.27	3.60		...	....	....	....	
Baltimore, Md	Oct 20	13.20	7.26	5.84	4.68	4.03	3.56	3.15	2.91	2.76	2.79	2.61	2.08	1.73	....	....	....	
Kansas City, Mo	Aug. 23	6.84	6.72	6.60	6.45	6.35	6.14	5.91	5.69	5.46	5.19	4.74	4.09	3.44	....	....	....	
Madison, Wis	Aug. 8	6.60	6.48	5.48	4.83	4.51	4.18	3.92	3.96	3.98	3.83	3.61	3.40	2.90	....	....	....	
Meridian, Miss	Aug. 13	6.72	6.30	6.08	5.70	5.15	4.72	4.39	4.10	3.85	3.90	3.63	2.81	...	....	....	....	
Pensacola, Fla	Sept. 29	5.88	5.22	5.08	4.95	4.68	4.40	4.19	4.10	4.00	3.90	3.72	3.24	3.13	3.00	2.61	2.48	for 2 hr. 45 min.
Taylor, Tex	June 25	5.28	5.16	4.64	4.26	3.96	3.86	3.93	3.95	3.85	3.78	3.40	2.85	2.42	....	....	....	
	1907																	
Baltimore, Md	July 18	6.48	5.94	5.72	5.19	4.87	4.40	4.09	3.92	3.62				...	....	....	....	
Concord, N. H	July 7	6.60	6.36	6.20	5.64	5.23	4.78	4.46	4.04					....	....	....	....	
Jacksonville, Fla	Aug 4	7.92	6.72	6.04	5.49	4.75	4.10							..	....	....	....	
Lynchburg, Va	Sept. 3			...					3.82	3.91	3.78	3.49		..	....	....	....	
	1908																	
Abilene, Tex	May 22								3.62	3.41	3.12	2.70	2.38	2.50	2.21	....	....	
Jupiter, Fla	Oct 27-28	6.48	6.42	6.16	5.46	5.50	5.10	4.90	4.75	4.53	4.39	3.83	3.11	2.65	2.30	....	....	
Mobile, Ala	Apr 29	7.56	6.90	6.16	5.64	5.23	4.62	4.05				....	....	..	....	....	....	
Richmond, Va	Aug 19	8.40	6.78	5.84	5.61	5.45	5.20	4.61	4.13	3.80	3.49		....	....	....	....	....	
	1909																	
Key West, Fla	Oct 9-11								3.59	3.44	3.34	3.20	3.04	2.86	2.62	2.25	2.09	for 2 hr. 55 min.
Pensacola, Fla	Oct 20	9.60	9.18	9.16	8.64	8.09	7.30	6.38	5.91	5.35	4.98	4.27	3.37	2.84	2.41	....	....	
Vicksburg, Miss	Apr 12	8.88	6.60	5.00										....	....	....	....	
Thomasville, Ga	June 27	8.52	7.56	7.32	6.81	6.39	5.98	5.37	4.87	4.75	4.53	4.14	3.20	....	....	....	....	
Thomasville, Ga	Sept 17	6.96	6.60	6.16	5.70	5.04	4.68	4.25	3.82	3.45	3.30	2.86	2.24	....	....	....	....	
	1910																	
Davenport, Iowa	July 14	6.48	6.00	5.12												....	....	
Galveston, Texas	Oct 5-6	5.76†	5.76†	5.76†	5.76†	5.69	5.64	5.61	5.58	5.39	5.23	4.01	3.34	3.21	3.14	....	....	†Averaged from rainfall 20 min. period.
	1911																	
Abilene, Tex	July 31									4.01	3.77	3.46	2.74		...	....	....	
Augusta, Ga	June 18	14.89	10.80	8.44	6.78	5.91	5.30	4.75	4.32				....	..	....	....	....	
	1912																	
Springfield, Ill	July 6	5.04	4.92	4.80	4.29		4.20					2.75		.	....	....	....	
	1913																	
Galveston, Tex	Oct 22	7.80	7.14	6.32	6.06	5.88	5.42	5.60	5.53	5.65	5.55	5.31	4.51	3.91	....	....	....	
	1914																	
Raleigh, N. C	July 14	8.75	8.10	6.84	6.03	5.30	5.14	4.73	4.30	3.92	3.59							
Miami, Fla	Nov. 8												2.61	2.34	2.30	....	....	
Atlanta, Ga	Aug 20								4.33	4.04	3.83				....	....	....	
Kansas City, Mo	Sept 15	6.60	6.54	6.28	5.55	4.99	4.58	4.17	3.82	3.61	3.48	2.93	2.56	2.11	....	....	....	
Lincoln, Neb	July 25	7.44	6.95	6.36	5.67	5.37	5.06	4.76	4.35	3.99	3.67				....	....	....	
	1915																	
Concordia, Kan	June 17								4.91	4.38	3.94	3.52	2.72		....	....	....	
Corpus Christi, Tex	Oct 4							4.46	4.12	3.77					....	....	....	
Iola, Kan	Sept 6								3.94	3.51	3.17	2.73	2.41		....	....	....	
Oswego, N. Y	July 8	8.88	7.25	5.12											....	....	....	
San Antonio, Tex	Apr 18	8.40	6.71	5.44	4.56	4.51	4.20	4.06	3.72	3.45	3.22	2.83	2.33	1.97	2.32	2.14	2.05	for 2 hr. 40 min.
Terre Haute, Ind	July 7	12.60	7.92	5.52	4.68	4.08	3.60	3.40	3.27	3.17	2.95	2.57	2.20		....	....	....	
Valentine, Neb	July 6	9.60	8.21	7.48	6.42	5.61	5.04	4.53	4.04	3.72					....	....	....	
	1916																	
Macon, Ga	July 1[illegible]	7.44									3.46	3.11	2.49					
Miami, Fla	Aug 25												2.63	2.50	2.35	2.07	1.92	for 2 hr. 50 min.
Reading, Penn	July 21												2.69	2.61	2.44	....	....	
San Antonio, Tex	Aug 2[illegible]		6.60	5.68											....	....	....	
Wytheville, Ga	Aug 22		6.60		5.22	4.73	4.36								....	....	....	
	1917																	
Birmingham, Ala	[illegible] 2[illegible]	7.[illegible]																
Jacksonville, Fla	July 27	[illegible].04	6.96	6.52	5.85	5.44	4.92	4.46	4.06	3.73					....	....	....	
Louisville, Ky	Aug 2[illegible]			5.76											....	....	....	
Mobile, Ala	[illegible]	[illegible].76	7.98	5.92											....	....	....	
Savannah, Ga	Aug 3											3.40			....	....	....	
Springfield, Ill	[illegible] 23			5.64						...					....	....	....	
	1918																	
Cleveland, Ohio	[illegible] 2															1.47	1.46	1.38 for 4 h 5 min.
Houston, Tex	July 2												2.28	2.19	2.00	..	....	1.91 for 2 h. 10 min.
Houston, Tex	Oct 4		[illegible]	5.36	4.95		4.16		3.65			3.13	2.61					
La Crosse, Wis	Aug 7	7.[illegible]													....	....	....	
Meridian, Miss	July 2			5.52	5.22	4.74	4.36								....	....	....	
New Orleans, La	Oct 2[illegible]											2.68	2.52	2.23	....	....	....	
Red Bluff, Calif	Sept 3-4													....	1.86	1.66	1.59	1.35 for 4 hours
Vicksburg, Miss	Aug [illegible]		6.[illegible]	5.48	5.19	4.85	4.60	4.39	4.01	3.76	3.53	3.11	2.45	....	..	..	....	

and have been compiled with the idea of including, as a rule, not more than six storms in any one year. As is well known, the records of excessive storms, as published, are in the form of cumulative amounts for 5-min. intervals from the beginning of the intense precipitation. It has been necessary, therefore, to pick out a large number of storms which appeared on inspection to be most likely to include excessive rates of precipitation, and then compute the rates of precipitation corresponding to the reported amounts. The resulting figures for a large percentage of the storms were then rejected so as to leave only the most important of those in which the rate at some part of the storm was notably excessive. No storm was reported in 1902 which comes within the classification adopted for this tabulation.

With comparatively few exceptions, storms have not been included unless they showed rates of precipitation approximately as large as the following:

For 5 minutes	6.5 in. per hour
For 15 minutes	5 in. per hour
For 30 minutes	4 in. per hour
For 45 minutes	3.50 in. per hour
For 60 minutes	2.75 in. per hour
For 120 minutes	2 in. per hour

These data were worked up in the office of Metcalf & Eddy and are submitted for publication that they may be available for general use.

FIG. 2. ARMORY AS RECONSTRUCTED; BASE OF OLD FRONT WALL IN FOREGROUND SHOWS EXTENT OF SETTLEMENT AT RIGHT END

Faulty Foundation Causes Serious Damage to Armory

Settlement of Piles in Soft Subsoil—Attempts To Arrest Subsidence Fail—Part of Building Taken Down

INSUFFICIENT study of underground conditions resulted in so seriously defective foundation construction in the case of a Minneapolis armory that progressive settlement practically wrecked the building, and the only recourse was to take down part of it. The foundation piles under the building rested in a bed of soft mud instead of going down to a firm bearing stratum, and under the load of the building they went down, at some points as much as 2½ ft. In the course of some years much repairing was done and some attempts were made to remedy the defects. No method of underpinning the structure at reasonable cost was found, however, and finally the armory was condemned; as a temporary expedient, for war service, its heaviest portion was torn down and the drill hall kept in use.

The original structure (Fig. 1) was erected in 1905; its main part is sketched in the plan, Fig. 3. At the east end (left-hand of the view, Fig. 1) there was a rifle range about 20 ft. wide, while at the west end there was a driveway which was later replaced by a riding hall (at right in Fig. 2). The rear portion consisted of a drill hall, 120 x 174 ft., with a reinforced-concrete floor supported on concrete columns, and a steel arch-truss roof. The front part of the building was three stories high, and the floors were of reinforced concrete. The third floor, forming a 70 x 109-ft. dance hall, was roofed by 70-ft. steel arch trusses extending from the front wall to the forward truss of the drill hall. In 1912 a one-story riding hall, having a frontage of 163 feet and extending the full depth of the old building, was built on the west side of the armory. All contracts were let and the structure was supervised by the Board of Armory Commissioners, while the city building-inspection department had no connection with it.

Although the location was formerly swampy ground, and subsequent exploration showed that soft ground below a surface fill extended to a depth of over 40 ft., there seems to have been little or no study of foundation conditions before construction. Piling was provided, but it turned out to be entirely inadequate. Some years previously, in connection with the development of the surrounding high ground as a residence district, a fill of sand and gravel had been deposited over the soft ground, and this superficial condition may have misled the designers of the building. The original piles were 30 to 40 ft. long, as nearly as could be ascertained subsequently. One member of the piledriver crew is reported as saying that some of the piles went down

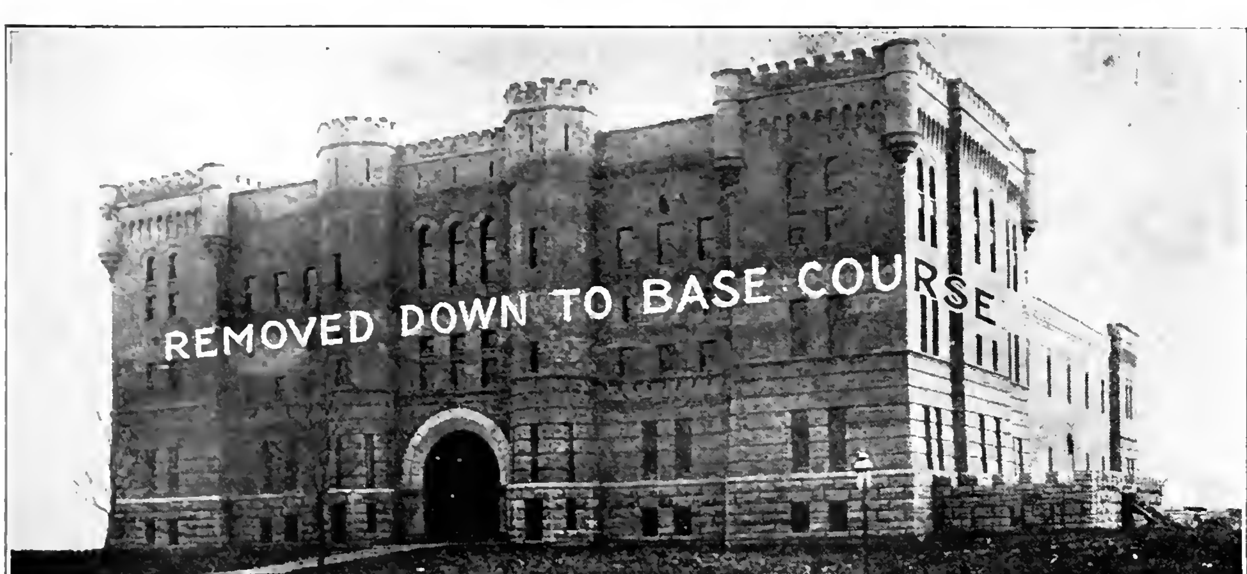


FIG. 1. THE ORIGINAL ARMORY; CONTINUED SETTLEMENT LED TO TAKING DOWN ENTIRE FRONT SECTION

12 to 24 in. under the last blow of the hammer.

Settlement developed even during construction. An attempt was made to level the floors by pouring on concrete, as noted in an account of the wrecking operations printed in *Engineering News-Record* of April 3, 1919, p. 687. Subsequent settlement was of such character that in 1913 the west wall of the main three-story building was condemned, torn down and rebuilt. An attempt to raise the building by jacks, to allow of constructing proper foundations, was made in the winter of 1916-17 by a house-moving company, but the jacks merely pressed their supports into the ground. The plan is reported as having been decided upon by the armory commissioners, without engineering advice. This work was abandoned, the blocking and jacks being left in place, as it was considered dangerous to remove them.

As long as the building continued in use it was necessary to screw up the interior jacks at intervals, in order to keep the floors level. After the building was closed by order of the building inspector, this work was not necessary, which tends to show that occupancy caused the local settlement.

The same contractor undertook to locate firm ground by sinking a well or open caisson about 8 ft. square, but at a depth of about 42 ft. the water rushed in to such an extent that this work was abandoned. Early in 1917 the city building inspector condemned the building as unsafe for occupancy, and it was closed.

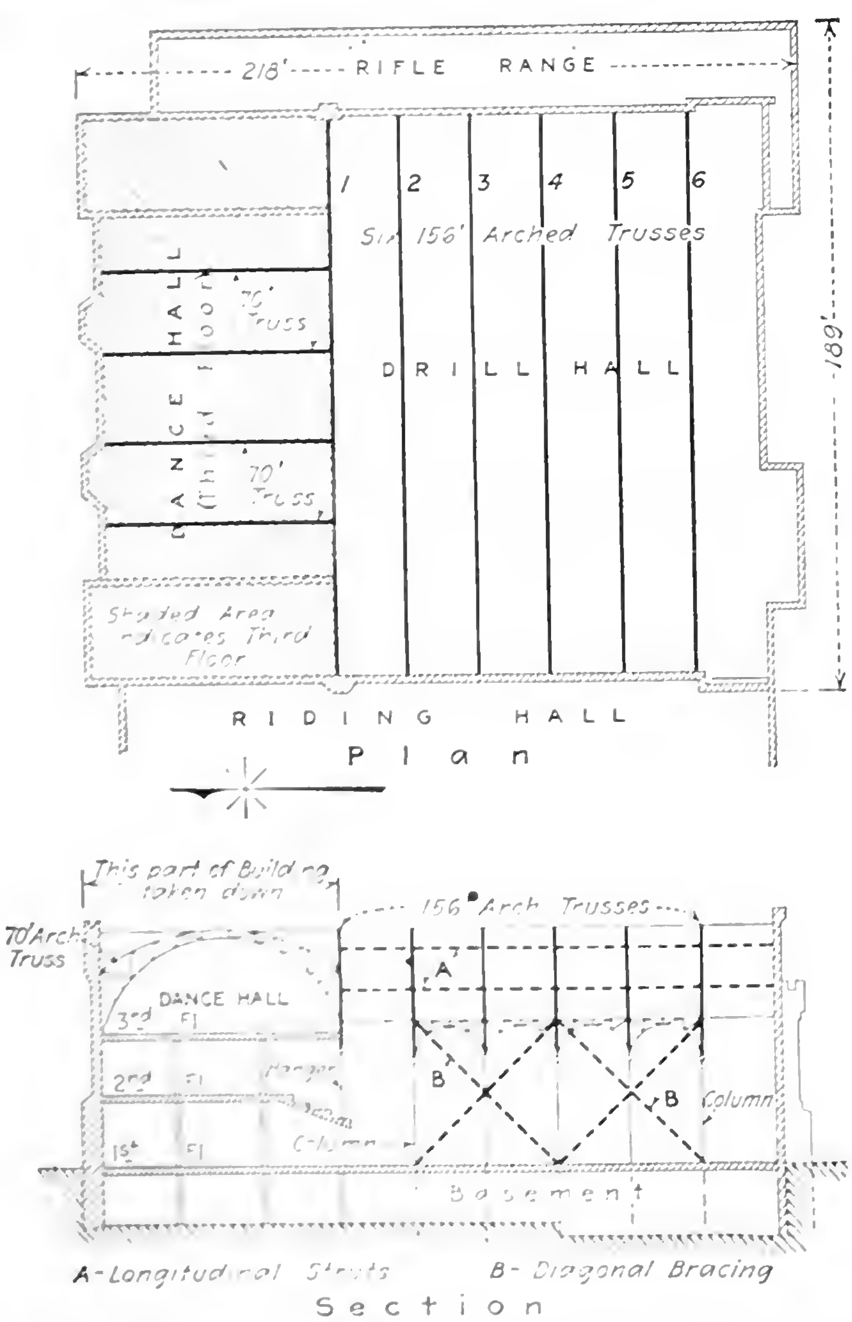


FIG. 3. ARMORY DAMAGED AND PARTLY TORN DOWN AS RESULT OF FOUNDATION FAILURE

In the summer of 1917, the city council requested F. W. Cappelen, city engineer, to make a thorough investigation of the matter and report to the Board of Armory Commissioners. Mr. Cappelen put down eight test holes from 70 ft. to 90 ft. in depth around the outside of the building, and one test hole inside of the building very close to the foundation for the west end of the main truss which carries a part of the roof as well as the third floor of the main building. He found that generally there was from 15 ft. to 20 ft. of surface fill, below which was a stratum of mud varying in thickness from a few inches to 41 ft. Underlying the mud were sand and gravel strata. Ground-water was about 1½ ft. below the footings, or below the cut-off level of the piles.

As to settlement, he found this to be 37½ in. at the northwest corner, 3 in. at the southwest, ½ in. at the northeast and zero at the southeast corner. The west ends of the roof trusses of the drill hall had settled 5 in. for the south truss and 9, 12½, 18, 21½ and 26 in. for the others, in succession. Their east ends had settled from zero to 2 in. Mr. Cappelen's report stated the conditions as follows: "Most of the inside columns and practically all the walls have settled. In fact, the whole building is wrecked, and the only reason that it does not fall down is that the concrete floors are reinforced and tie the whole thing together like a box."

Additional piles would have had to be 70 ft. or 80 ft. long and it would have been extremely difficult to put them down under the interior, while they would not be assured of proper lateral support owing to the great depth of the mud bed. The pneumatic system was considered to be out of the question. Adequate foundations would be prohibitive in cost, and even if they were built the structure itself would still be in a wrecked and unsatisfactory condition. For this reason Mr. Cappelen advised the Board of Armory Commissioners to remove the building, salvaging the trusses and material and perhaps leaving the riding hall, as the settlement here was light.

Owing to urgent need for the building for war services, however, the Board of Armory Commissioners felt justified in going to considerable expense to make it fit for temporary use, and a committee of engineers, architects and builders was appointed to investigate the matter further. This committee reported in March, 1918, that in the foundations of some of the walls and interior footings the piles were not only inadequate in number but did not reach the underlying stratum of sand. At other places the piles did penetrate the stratum sufficiently to make it certain that further settlement would be slow and might decrease. The committee recommended the removal of the three-story portion of the main building, and also of the adjacent main steel truss of the drill hall, as this latter would be left without lateral support, and had settled over 2 ft. at the west end. This was concurred in by Mr. Cappelen, in a report to the city council.

Alterations carried out to reinforce the high, arched roof of the drill hall included placing four lines of longitudinal struts connecting the trusses, and longitudinal diagonal bracing between the steel columns supporting these trusses, as shown on the drawing. The first-floor slab was left intact, as it ties the whole structure together. The floor was leveled from the old slab. Temporary walls of frame and stucco were built to inclose

the parts left open and to give a reasonably good appearance. The building as thus altered has been in use since October, 1918.

When this work was practically completed Mr. Cappelen found that the wrecking had not been done as suggested by the committee and concurred in by him, but that the heavy main truss had been left in place. Having no connection with the work, he simply reported the fact to the city council, so as to be on record in case anything should develop in the future. The steel trusses are said to show no signs of distress, in spite of the settlement of their supports.

Brick Chimney Carried On Platform At Roof Of Building

Concrete Slab Footing Is Supported From Ground By Separate Columns—Chimney Has Unusual High Taper

By J. G. Mingle

The Rust Engineering Company, Cleveland, Ohio

TWO features distinguish the brick chimney, illustrated herewith, recently completed for the power house of the Cleveland Electric Illuminating Co.; one is the large bottom diameter and consequent taper, the other is the method of support at the roof of the building.

The chimney, which is of the perforated radial brick type, is built on top of the power house and is supported by a reinforced-concrete and steel platform on top of 12 fabricated steel columns extending down through the building and resting on separate grillages. The top of the platform is approximately 105 ft. above the basement-floor level. The peculiar shape and great taper of the structure are due to the flue opening in the concrete platform which is 10 ft. wide and 37 ft. long, around and over which the chimney is built.

The height of the chimbney is 163 ft. above the top of the platform; the inside diameter at the top is 20 ft. and the outside diameter at the base is 43 ft. The radial brick wall is 20 in. thick at the bottom and decreases by sections, with an average decrement of 1 in. per 16 ft., to 10 in. at the top. The taper of the chimney varies from 0.016 ft. per foot for the top section to 0.240 ft. per foot for the bottom section.

Reinforcement is provided both vertically and circumferentially, to resist any tensile stresses which may occur. The circumferential reinforcement consists of 4 x $\frac{5}{16}$-in. bands of strap steel bolted together in sections and embedded in the brickwork at vertical intervals of from 20 ft. at the top to 5 ft. at the bottom.

The vertical reinforcement consists of $\frac{3}{4}$-in. twisted square rods spaced on approximately 5-ft. centers and also embedded in the brickwork. The chimney is lined on the inside with perforated radial brick to a height of 26 ft. The lining is so arranged that it serves the double purpose of protecting the outside wall and preventing the soot from collecting on top of the platform. The brickwork is laid up in 2 cement, 3 lime and 5 sand mortar. It was necessary to make the mortar fairly stiff to keep the brick from slipping when they were being laid up. The brick are red in color. The chimney is designed to withstand a wind of 100 miles per hour with no tension at the windward side and a maximum compression of 15 tons per square foot at the leeward side. The weight of the entire chimney, including the lining, is approximately 1200 tons. It was designed and built by the Rust Engineering Co., of Pittsburgh, Penn.

HIGH AND WIDE BRICK CHIMNEY CARRIED ON STEEL COLUMNS REACHING CLEAR TO GROUND

Effect of War on Manganese Ore Industry

Prior to the European war the United States produced less than 1 per cent of its manganese requirements. The remainder was imported mainly from India, Russia and Brazil in the form of ore, and from Great Britian in the form of ferromanganese. It is noted that the countries possessing the largest and richest deposits have an abundant and cheap labor supply. Under war conditions India and Russia were practically eliminated as sources of supply. The productive capacity of the world's major deposits is much greater than the total demand for ore for steel making. The industry considerably expanded in Brazil and in Cuba during the war period. The large supplies from these nearer countries, together with the increased domestic output, proved greater than even the enormously expanded needs of this country. The United States became independent of British ferromanganese and of Indian and Russian ore. Domestic production of high-grade (i.e., 35% or more manganese) ore, used largely for making ferromanganese, increased from 4063 tons in 1913 to about 294,000 tons in 1918. Production of low-grade (less than 35% manganese) ore, used partly for making spiegel and partly smelted direct in iron furnaces, increased from 85,588 tons in 1913 to over 1,079,000 tons in 1918.

General Solution of Problems in Railway Compound Curves

Fundamental Equations Are Derived and Applied to Several Usual Cases Encountered in Railway Practice—Shifting and Revolving of Tangents Considered

BY ANTONIO LLANO
Montclair, N. J.

General Equations and Problems

FOR THE solution of problems in compound circular curves connecting two tangents, previous writers have failed to use the valuable principle of generality and have sometimes complicated the subject by a false appearance of simplicity. Some general equations are here derived and discussed. These equations are applied to several of the common problems in railroad curves, arising especially in street-railway work. The problems of shifting a tangent parallel to itself and of turning a tangent about its tangent point are solved by shorter methods than those usually given in textbooks on the subject.

Referring to Fig. 1, let $t_1 = T_1C$ and $t_2 = CT_2$ be two tangents to be joined by a compound curve. The exterior angle of intersection is denoted by Δ, the chord

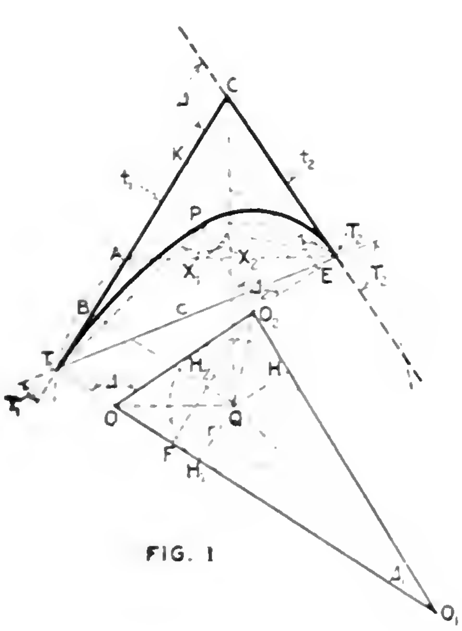


FIG. 1

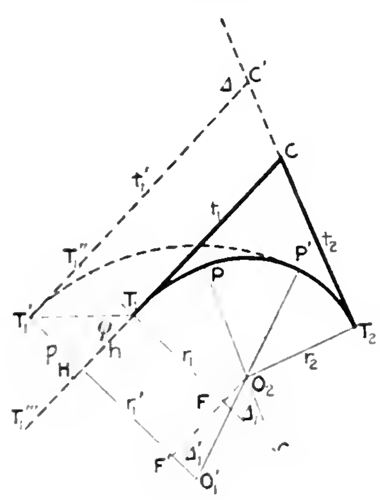


FIG. 2

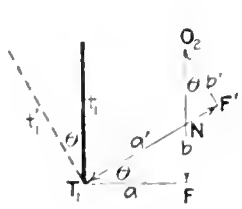


FIG. 3

FIG. 1. DIAGRAM SHOWING FUNDAMENTAL PROPERTIES OF COMPOUND CURVES. FIG. 2. SHIFTING A TANGENT TO A PARALLEL POSITION. FIG. 3. TURNING A TANGENT ABOUT ITS TANGENT POINT

T_1T_2 by c, and the angles between the chord and the tangents by T_1 and T_2, as shown. The heavy curve T_1PT_2 is one of the possible compound curves, P being the point of tangency of the two branches. The centers O_1 and O_2 of the branches T_1P and PT_2 lie in the normals T_1O and T_2O to t_1 and t_2, respectively, which meet at O. Since the angle T_1OT_2 is the supplement of the interior angle C, it is equal to Δ. The radii T_1O_1 and T_2O_2 will be denoted by r_1 and r_2, respectively, and the central angles by Δ_1 and Δ_2.

The determination of the locus of the variable point P is convenient both for the derivation of the general formulas and for the graphic solution and discussion of problems. Take $CA = CT_2$, and draw AT_2, PT_1 and PT_2. In the triangle OO_1O_2,

$$\Delta_1 + \Delta_2 = \Delta$$

Since the two triangles PO_1T_1 and PO_2T_2 are isosceles, $x_1 = 90° - \Delta_1/2$ and $x_2 = 90° - \Delta_2/2$, and therefore $T_1PT_2 = x_1 + x_2 = 180° - (\Delta_1 + \Delta_2)/2 = 180° - \Delta/2$. It follows that the locus of P is an arc described on c such that all angles inscribed in it shall be equal to $180° - \Delta/2$. The following is the simplest way of determining the center of that arc. In the triangle CAT_2, angle $CAT_2 = \Delta/2$, and also

$$T_1AT_2 = 180° - CAT_2 = 180° - \Delta/2.$$

Therefore, the required arc must pass through A; hence its center Q is the center of the circle circumscribed about the triangle AT_1T_2, and is at the intersection of the perpendicular bisectors BQ and CQ of AT_1 and AT_2, the perpendicular CQ being also the bisector of the interior angle at C. The arc is shown in dotted lines.

Although the arc just determined is the locus of *P*, not every line drawn from it cutting the two normals determines the centers of two circles fulfilling the conditions; for the line PO_2O_1 must fulfill another condition not involved in the mere fact that it cuts the normals and the arc. The line QO_2, being the line of centers of two circles meeting at P and T_2, bisects the angle Δ_2 made by the radii drawn from O_2 to the points of intersection. For a like reason, QO_1 bisects Δ_1. Therefore, Q is the point of intersection of the bisectors of the triangle OO_1O_2, and hence also the center of the circle inscribed in that triangle. The points of tangency of this circle with the three sides are denoted by H_1, H_2 and H, and the radius by r. From the figure,

$$r = QH_1 = BT_1 = AT_1/2 = (t_1 - t_2)/2$$

Any line tangent to the arc H_1HH_2 and bounded by the arc T_1AT_2 and the normal T_1O produced determines one value for each of the quantities r_1, r_2, Δ_1, Δ_2. It will be observed that only one of these quantities can be assumed at pleasure when t_1, t_2 and Δ are given.

Derivation of the Fundamental General Equations—As it is convenient sometimes to use the half angles, and sometimes the whole angles, two systems of equations will be derived.

Fig. 1 gives

$$T_1H_1 = BQ = BC \tan C/2 = \frac{t_1 + t_2}{2} \cot \Delta/2$$

Also,

$$T_1H_1 = r_1 - O_1H_1 = r_1 - \frac{t_1 - t_2}{2} \cot \Delta_1/2$$

Therefore

$$\frac{t_1 + t_2}{2} \cot \Delta/2 = r_1 - \frac{t_1 - t_2}{2} \cot \Delta_1/2 \qquad \text{(a)}$$

Interchanging t_1 and t_2, r_1 and r_2, Δ_1 and Δ_2:

$$\frac{t_1 + t_2}{2} \cot \Delta/2 = r_2 - \frac{t_2 - t_1}{2} \cot \Delta_2/2 \qquad \text{(b)}$$

Equations (a) and (b) can be transformed thus:

$$(t_1 + t_2) \cot \Delta/2 + (t_1 - t_2) \cot \Delta_1/2 = 2r_1 \qquad (A_1)$$

$$(t_1 + t_2) \cot \Delta/2 + (t_2 - t_1) \cot \Delta_2/2 = 2r_2 \qquad (A_2)$$

These are the fundamental half-angle equations. Together with the equation $\Delta_1 + \Delta_2 = \Delta$, they form a system of three independent equations by which any three of the quantities involved can be computed when

the others are known. As there are seven quantities, any four of them can be assumed at random, with the only limitation that Δ, Δ_1 and Δ_2 cannot all three be assumed, since they are connected by the relation just mentioned. This does not mean that any assumed values will lead to practical solutions; but the cases of impossibility will be indicated by the resulting equations themselves, as when a negative value is found for one of the radii or angles. Equations (A_1) and (A_2), when taken together, will be called system (A).

Whole-Angle Equations—The whole-angle equations can be derived by successive transformations of equations (A), but it is simpler to derive them directly from Fig. 1. Draw T_2K perpendicular to t_1 and EO_2F perpendicular to T_1O_1, and therefore parallel to t_1. The angle ET_2O_2 is equal to 180° — Δ (quadrilateral OK). Now

$$\begin{aligned} t_2 \sin \Delta &= KT_2 = KE + ET_2 \\ &= T_1F + r_2 \cos (180^\circ - \Delta) \\ &= r_1 - FO_1 - r_2 \cos \Delta \\ &= r_1 - (r_1 - r_2) \cos \Delta_1 - r_2 \cos \Delta \qquad \text{(c)} \end{aligned}$$

Interchanging subscripts:

$$t_1 \sin \Delta = r_2 - (r_2 - r_1) \cos \Delta_2 - r_1 \cos \Delta \qquad \text{(d)}$$

Writing (1 — vers) instead of cos, (d) and (c) take the following forms:

$$t_1 \sin \Delta = r_1 \text{ vers } \Delta + (r_2 - r_1) \text{ vers } \Delta_2 \qquad (B_1)$$
$$t_2 \sin \Delta = r_2 \text{ vers } \Delta + (r_1 - r_2) \text{ vers } \Delta_1 \qquad (B_2)$$

Sometimes the chord c and the angles T_1 and T_2 are given instead of t_1 and t_2. In that case equations (A) and (B) are transformed thus: From trigonometry,

$$t_1 - t_2 = \frac{c \sin(T_1 - T_2)/2}{\sin \Delta/2}$$

$$t_1 + t_2 = \frac{c \cos(T_1 - T_2)/2}{\cos \Delta/2}$$

Substituting in (A) and transforming:

$$c \sin \frac{T_1 - T_2}{2} [(\cot \Delta_1/2 + \cot(T_1 - T_2)/2] = 2r_1 \sin \Delta/2 \qquad (A'_1)$$

$$c \sin \frac{T_2 - T_1}{2} [(\cot \Delta_2/2 + \cot(T_2 - T_1)/2] = 2r_2 \sin \Delta/2 \qquad (A'_2)$$

The equations of system (B) are transformed by writing

$c \sin T_2/ \sin \Delta$ for t_1 and $c \sin T_1/ \sin \Delta$ for t_2,

which gives

$$c \sin T_2 = r_1 \text{ vers } \Delta + (r_2 - r_1) \text{ vers } \Delta_2 \qquad (B'_1)$$
$$c \sin T_1 = r_2 \text{ vers } \Delta + (r_1 - r_2) \text{ vers } \Delta_1 \qquad (B'_2)$$

The equations will now be applied to the solution of some of the usual problems.

(a) *Given the two tangents and their angle of intersection, and one of the radii (or the corresponding degree of curve), to compute the other radius and the central angles.*

Suppose r_1 to be given, to determine Δ_1, Δ_2 and r_2. Equation (A_1) at once gives

$$\cot \Delta_1/2 = \frac{2r_1 - (t_1 + t_2) \cot \Delta/2}{t_1 - t_2} \qquad (1)$$

Then, $\Delta_2 = \Delta - \Delta_1$, and r_2 is found from (A_2).

If c, T_1 and T_2 are given instead of t_1 and t_2, use the system (A′).

(b) *Given the lengths and degrees of curve of the two branches of a compound curve; or, what is the same thing, given r_1 and r_2, and the angles Δ_1 and Δ_2 ($= \Delta - \Delta_1$), to find the tangent points; that is, the tangent distances t_1 and t_2.*

As already stated, this problem is perhaps the most common. At first sight it may seem that equations (B), which at once give t_1 and t_2, are the better to use in this case. They are preferable for rough work, using natural functions; but for accurate work the equations (A) lead to simpler results, involving easier computation. The process consists in calculating $(t_1 + t_2)/2$ and $(t_1 - t_2)/2$ and then t_1 and t_2 by the equations

$$t_1 = (t_1 + t_2)/2 + (t_1 - t_2)/2 \qquad (2)$$
$$t_2 = (t_1 + t_2)/2 - (t_1 - t_2)/2 \qquad (3)$$

Subtracting (A_2) from (A_1):

$$(t_1 - t_2) (\cot \Delta_1/2 + \cot \Delta_2/2) = 2(r_1 - r_2)$$

whence, solving for $(t_1 - t_2)/2$ and replacing cot by cos/sin,

$$(t_1 - t_2)/2 = \frac{(r_1 - r_2) \sin \Delta_1/2 \sin \Delta_2/2}{\sin \Delta/2} \qquad (4)$$

Having computed $(t_1 - t_2)/2$, equation (A_1) gives

$$(t_1 + t_2)/2 = [r_1 - \frac{t_1 - t_2}{2} \cot \Delta_1/2] \tan \Delta/2 \qquad (5)$$

and t_1 and t_2 are found by equations (2) and (3).

(c) *Given one of the tangent points, the two radii and the angle Δ, to find the other tangent point and the central angles.*

Suppose t_1, Δ, r_1 and r_2 to be given, to find Δ_1, Δ_2, and t_2.

In this case the equations (A) are not convenient, and the equations (B) are used.

From (B_1):

$$\text{vers } \Delta_2 = \frac{r_1 \text{ vers } \Delta - t_1 \sin \Delta}{r_1 - r_2} \qquad (6)$$

Then, $\Delta_1 = \Delta - \Delta_2$, and ($B_2$) gives

$$t_2 = \frac{r_2 \text{ vers } \Delta + (r_1 - r_2) \text{ vers } \Delta_1}{\sin \Delta} \qquad (7)$$

For logarithmic work it is better to compute $t_1 - t_2$ by equation (4), after Δ_1 and Δ_2 have been found, and then t_2. One should not be deceived by the apparent simplicity of such expressions as the second member of (7). The arithmetical work involved is very laborious. The logarithmic work in (4), being more uniform and in a certain sense more mechanical, is much easier and safer.

It should be understood that the preceding formulas are entirely general. It is immaterial whether in them t_1 is greater or less than t_2, or which of the two tangents is called t_1 and which t_2. Furthermore, from every equation another similar equation can be obtained by interchanging the subscripts. It is thus that (A_2) is obtained from (A_1), and (B_2) from (B_1). The same remark applies to all the problems that follow. This fact is here emphasized because writers complicate the subject by making separate problems of special cases which, being included in the general equations, do not require independent treatment.

Shifting One Tangent Parallel to Itself

It is often necessary or convenient, after the elements of a compound curve have been calculated, to shift one of the tangents parallel to itself a given distance, leaving the position of the other tangent and the corresponding radius and point of tangency unaltered. Referring to Fig. 2, let T_1PT_2 be a given compound curve, the notation being as in Fig. 1. Let the tangent t_1 be shifted to the position t'_1, parallel to and distant p from t_1. Let $T'_1P'T_2$ be a new compound curve connecting t'_1 and t_2, the point T_2 and the radius r_2 remaining unchanged; O'_1 the center of the branch T'_1P', r'_1 the radius, and Δ'_1 the central angle.

Geometrically, the problem is to determine a circle that shall be tangent to the given circle O_2 and the given line t'_1. The problem would be indeterminate if t'_1 were not located with reference to O_2, and it is for this purpose that r and Δ_1 are utilized; that is, they determine the position of t'_1 with respect to O_2. For, drawing O_2FF' perpendicular to the normals T_1O_1 and $T'_1O'_1$ and producing O_1T_1 to T''_1 on t'_1, we have

$$FT_1'' = FT_1 + p$$
$$= r_1 - (r_1 - r_2)\cos\Delta_1 + p$$
$$= r_2 + (r_1 - r_2)\text{vers}\,\Delta_1 + p \qquad \text{(a)}$$

In order to locate T'_1 from T_1, it is necessary to know the distance $h = T_1H_1$. The variable elements to be introduced are therefore r'_1, Δ'_1 and h. There is a system of two independent equations by means of which any two of them can be determined when the other is known. Those equations will now be derived.

The figure gives

$$FT''_2 = F'T'_1 = r' - F'O'_1 = r'_1 - (r'_1 - r_2)\cos\Delta'_1$$
$$= r_2 + (r'_1 - r_2)\text{ vers }\Delta'_1$$

From this and (a) follows

$$(r'_1 - r_2)\text{ vers }\Delta'_1 = (r_1 - r_2)\text{ vers }\Delta_1 + p$$

We have also

$$h = FF' = O_2F' - O_2F$$
$$= (r'_1 - r_2)\sin\Delta'_1 - (r_1 - r_2)\sin\Delta_1$$

The fundamental system of equations is therefore

$$(r'_1 - r_2)\text{ vers }\Delta'_1 = (r_1 - r_2)\text{ vers }\Delta_1 + p \qquad (C_1)$$
$$(r'_1 - r_2)\sin\Delta'_1 = (r_1 - r_2)\sin\Delta_1 + h \qquad (C_2)$$

If the tangent to be shifted is t_2, interchange the subscripts. If the tangent is to be shifted inwards, make p negative. A negative value of h indicates that H_1 lies between T_1 and C. Conversely, if, when H_1 is given, it lies between T_1 and C, make h negative. It is unnecessary to treat all these cases independently. To locate T'_1 directly from T_1:

$$\tan\phi = p/h \text{ and } T_1T'_1 = p/\sin\phi$$

The three problems that may arise will be briefly considered, mainly to call attention to some special cases. In order to avoid confusion, the formulas applying to such cases will be numbered with prime numbers, lest they should be taken for general formulas.

(d) *Given Δ'_1, to find r'_1 and h. Solve* (C_1) for r_1', and then (C_2) for h.

If $\Delta'_1 = \Delta_1$, (C_1) gives

$$r'_1 = r_1 + p/\text{vers }\Delta_1 \qquad (1')$$

Substituting in (C_2), solving for h and transforming:

$$h = p\cot\Delta_1/2 \qquad (2')$$

It follows that

$$\phi = \Delta_1/2 \text{ and } T_1T' = p\,(\sin\Delta_1/2) \qquad (3')$$

(e) *Given r_1, to find Δ'_1 and h.* Solve (C_1) for Δ'_1, and then (C_2) for h

If $r'_1 = r_1$, (C_1) gives

$$\text{vers }\Delta' = \text{vers }\Delta_1 + \frac{h}{r_1 - r_2} \qquad (4')$$

From (C_1) and (C_2)

$$\frac{h}{p} = \frac{\sin\Delta'_1 - \sin\Delta_1}{\text{vers }\Delta'_1 - \text{vers }\Delta_1} = \frac{\sin\Delta'_1 - \sin\Delta_1}{\cos\Delta_1 - \cos\Delta'_1}$$
$$= \cot(\Delta_1 + \Delta'_1)/2$$

whence

$$h = p\cot(\Delta_1 + \Delta'_1)/2 \qquad (5')$$
$$\phi = (\Delta_1 + \Delta'_1)/2 \qquad (6')$$

(f) *Given h, to find Δ'_1 and r'_1.* Dividing equation (C_1) by (C_2),

$$\tan\Delta'_1/2 = \frac{(r_1 - r_2)\text{ vers }\Delta_1 + p}{(r_1 - r_2)\sin\Delta_1 + h} \qquad (8)$$

Now r'_1 is found by either (C_1) or (C_2).

If it is desired that the new tangent point should be on the same normal or radial line as before (at T_1''), $h = 0$, and (8) becomes

$$\tan\Delta'_1/2 = \tan\Delta_1/2 + \frac{p}{(r_1 - r_2)\sin\Delta_1} \qquad (7')$$

Also, from (C_2),

$$r'_1 = r_2 + \frac{(r_1 - r_2)\sin\Delta_1}{\sin\Delta'_1} \qquad (8')$$

(g) *Given a compound curve, to shift one of the tangent points along the same tangent, without changing the other tangent nor tangent point, nor the other radius.* Referring to Fig. 2, the problem is to shift T_1 to another point, as T'''_1 on the tangent CT_1, without changing t_2 nor r_2.

This problem, which occurs mainly in street railroad construction, is but a special case of that of shifting a tangent parallel to itself. The three cases that may occur are solved by making $p = 0$ in equations (C). The distance h is the distance $T_1T'''_1$ that the tangent point is shifted. System (C) can easily be reduced, in this case, to the following form, which expedites the solutions:

$$(r'_1 - r_2)\text{ vers }\Delta'_1 = (r_1 - r_2)\text{ vers }\Delta_1 \qquad (C'_1)$$
$$(r_1 - r_2)\text{ vers }\Delta_1\,(\cot\Delta'_1/2 - \cot\Delta_1/2) = h \qquad (C'_2)$$

Turning a Tangent About Its Tangent Point

Given a compound curve, to change it so that one of the tangents may be turned about its tangent point through a given angle without changing the other tangent nor the radius corresponding to the other tangent, nor either tangent point.

Referring to Fig. 3, where t_1 is the original tangent, O_2 the center of the r_2 curve, as in Fig. 2, and O_2F is perpendicular to the normal to t_1 at T_1, the problem is to turn t_1 through an angle θ to the position t'_1, and determine the elements r'_1 and Δ'_1 (not shown) so that the curve shall still begin (or end) at T_1, with O_2 and r_2 remaining unchanged. This problem occurs in connection with changes of alignment. Some writers solve it by the analytic geometry of conic sections. The following solution is simpler:

From Fig. 2 the following values are obtained for the distances denoted in Fig. 3 by a and b:

$$a = T_1F = r_1 - (r_1 - r_2)\cos\Delta_1$$
$$= r_2 + (r_1 - r_2)\text{ vers }\Delta_1 \qquad (9)$$
$$b = FO_2 = (r_1 - r_2)\sin\Delta_1 \qquad (10)$$

Fig. 3 gives

$$a' = b\sin\theta + a\cos\theta = (r_1 - r_2)\sin\theta\sin\Delta_1$$
$$+ r_1\cos\theta - (r_1 - r_2)\cos\theta\cos\Delta_1$$

that is

$$a' = r_1\cos\theta - (r_1 - r_2)\cos(\Delta_1 + \theta) \qquad (11)$$

Likewise

$$b' = b\cos\theta - a\sin\theta = (r_1 - r_2)\sin(\Delta_1 + \theta) - r_1\sin\theta \qquad (12)$$

Applying (9) and (10)) to the r'_1 curve, we have

$$(r'_1 - r_2)\text{ vers }\Delta'_1 = a' - r_2 \qquad (13)$$
$$(r'_1 - r_2)\sin\Delta'_1 = b' \qquad (14)$$

whence, by division

$$\tan\Delta'_1/2 = \frac{a' - r_2}{b'} = \frac{r_1\cos\theta - (r_1 - r_2)\cos(\Delta_1 + \theta) - r_2}{(r_1 - r_2)\sin(\Delta_1 + \theta) - r_1\sin\theta}$$

or, transforming,

$$\tan\Delta'_1/2 = \frac{(r_1 - r_2)\text{ vers }(\Delta_1 + \theta) - r_1\text{ vers }\theta}{(r_1 - r_2)\sin(\Delta_1 + \theta) - r_1\sin\theta} \qquad (15)$$

Now r'_1 can be found from (14) and (12).

If t_2 is the tangent to be turned, interchange the subscripts. If the tangent is turned inward, change the sign of θ.

How the Engineers of Iowa Got a Registration Law

Personal Study on the Ground, Backed by Coöperating Organizations and Individuals, Is Accountable for Success

By J. H. Dunlap

Secretary, Iowa Engineering Society; Associate Professor of Hydraulics and Sanitary Engineering, State University of Iowa

ORGANIZATION, analysis of past failures, a continuous, scientific study, by engineers on the ground, of each legislative delay, personal contact with the legislators, and coöperation by all engineering organizations and all engineers in the state, are responsible, in a prominent degree, for the success attained recently in Iowa in making the proposed registration bill a law. The favorable action of the General Assembly was based on the conviction impressed upon it that the time had now come when the public should be protected, so far as law may protect it, from incompetent and reckless engineers, as had already been done in the cases of physicians and lawyers. To show just how the work was done is the purpose of this article.

An analysis of past failures showed that there had been, first, a lack of general coöperation among the engineers of the state both in preparing the bill for presentation to the legislature and in backing the bill before the legislature, and, second, a lack of scientific management of the bill after it had been introduced in the legislature. This lack of scientific management was usually confined to the public hearing before the committee to which the bill had been referred. The chairmen of the committees on legislation have found it a task to bring despair, to get together three or four engineers who could talk intelligently and persuasively before a committee of legislators in regard to the benefits of an engineers' license bill.

Sample of Engineering Oratory

The customary speech of an engineer when called to his feet by the committee was very much as follows: "Gentlemen, I believe this bill is a good one. I am sorry to say that I have not had time to think up any speech and I don't think it is necessary." And then our engineering orator would resume his seat in much confusion of mind and body, and proceed to mop the perspiration from his brow. The result of such tactics was, justly, that the committee would almost invariably slate the bill for indefinite postponement. In other words, no scientific study was made of just how to create the right attitude toward the bill by each member of the committee, before the bill was voted on in the committee.

Having learned something from our habitual failures, we tried the following procedure—this time with success. In order to secure the widest coöperation among the engineers of the state, irrespective of their membership in the Iowa Engineering Society, it was decided to hold at Des Moines, June 8, 1918, a joint conference of all the engineers and engineering and architectural organizations of the state. As a result of this joint conference, a committee representing each one of these organizations was appointed, with C. H. Young, president of the Iowa Engineering Society, as chairman and the writer as secretary. This committee was instructed to draft an engineers' registration bill, to submit it to all the engineers and to all organizations that would be affected by the law, and then to call a second joint conference to discuss the proposed bill.

After a study of the bills which had been enacted or proposed recently, a bill was drafted which was modeled closely on the Florida law and on the law suggested by the Joint Committee of the national engineering societies Feb. 4, 1915. This first draft of the bill was submitted to an informal group of interested engineers, was criticized and then was rewritten. Copies of the bill were then sent to a mailing list, reaching, it was hoped, every engineer in the state. Accompanying the bill was a call to a second joint conference Jan. 25, 1919.

At this conference each section of the bill was thoroughly discussed, and in many cases amendments were made. After a session nearly six hours long the final draft of the bill was approved as amended. The motion then prevailed that a committee be appointed to prepare copies of the bill as amended, to have the bill examined from a legal point of view by the attorney provided by the office of the Attorney General for such purpose, and then to submit the bill in its final form to the legislature which was soon to assemble. The chairman of the conference, Mr. Young, appointed an executive committee of five members, an advisory committee of eight members, and a promotion committee of 31 members.

Senator Takes Charge of Bill

Senator J. D. Buser, becoming convinced of the good points of the bill, consented to take charge of it in the Senate. He introduced it Feb. 11, 1919. It was referred to the committee on roads and highways. It was later thought best to have the bill transferred to the committee on cities and towns, which was easily arranged. At the public hearing before this committee, a few interested engineers appeared and tried to enlighten the members of the committee in regard to the good points of the bill. As usual, however, the same result came to pass—namely, the bill was slated for indefinite postponement.

At this juncture it was decided to make a scientific study to decide exactly what was the trouble. Accordingly, two engineers were dispatched to Des Moines, Mar. 20, to study this problem with the same thoroughness that engineers are accustomed to give to problems of other kinds. From this point on, the most careful personal attention was given to each problem as it presented itself, with the result that the bill came out of the committee promptly and was passed by the Senate Mar. 26, with a few amendments, by a vote of 28 ayes, 16 nays, with six absent or not voting. Since the constitutional majority was 26, there were two votes to spare. Great credit for this successful result is due the engineers of the state who responded quickly to telegrams sent them two days before, asking them to get into personal touch with the senators from their districts.

Before the adjournment of the Senate for the day, it was learned that one of the senators had moved to reconsider the vote by which the bill had passed the Senate. By conference with him, it was learned that he wished to amend the bill so that private systems could be extended and constructed without the necessity of employing registered engineers, and also to amend the bill so that surveys, in all cases except where contests were involved, could be made by unregistered surveyors. Believing that it would be dangerous to have

the bill reconsidered on the floor of the Senate because of the small margin of safety in the vote, every effort was made to persuade the senator to withdraw his motion to reconsider. He finally consented to do so, when given a gentlemen's agreement that his desired amendments would be offered in the House.

In the House the bill was referred to the committee on municipal corporations. The progress of the bill in the committee was carefully watched by two engineers, assisted by such others as were available from time to time. The bill was reported out favorably by the committee just in time to be placed in the hands of the sifting committee, which had been appointed that very day to decide which bills, of the large number remaining to be acted upon, should be brought before the House. The problem presented by the sifting committee was carefully studied, since to lose at this point would have been to lose all. As a result, the bill was promptly reported out to the House, with the amendments proposed which had been agreed upon with the senator.

On Apr. 14 the bill was passed by the House by a vote of 81 ayes, 10 noes, and 17 absent or not voting. As the constitutional majority in the House was 55, the bill was declared to have passed the House.

The heavy vote in favor of the bill is a testimonial to the personal efforts of engineers in every county of the state in bringing the bill to the intelligent consideration of the representatives from their districts. It is impossible to place too much emphasis upon careful organization work of this kind. All such work should be reported back to those in personal charge of the work for the bill in the state house, in order that proper records and information may be instantly at hand when needed.

On Apr. 15 the Senate concurred in the House amendments with a vote of 35 ayes, no noes, and 15 absent or not voting. On Apr. 25 the bill was signed by the Governor.

Generous use of the telegraph and of the long-distance telephone, continuous scientific study, with characteristic engineering thoroughness, of each problem presented, and coöperation by all engineering organizations and all engineers in the state are responsible for the success of the bill. In personal conference with individual representatives it proved very helpful to have on hand a supply of brief abstracts of the bill, together with a brief list or arguments against the bill. The use of specific instances in which the bill, if it became law, would operate to prevent existing difficulties proved very effective. Many of the legislators seemed surprised when told that there was yet no law to prevent any one of them from hanging out his shingle and selling his services as an engineer anywhere in Iowa. When told, however, that he could not do this in Illinois, he usually concluded that Iowa should emulate her sister state.

Pennsylvania's Record Week in Road Letting

Reports from the Bureau of Public Roads, United States Department of Agriculture, indicate that Pennsylvania holds the record for amount of road work let in any one week. During the week ending Apr. 12 contracts were awarded for $2,034,378. This is considered an indication of the resources that will be enlisted in highway construction in this country in the near future. Of the contracts mentioned, the Federal Government will pay $911,407, under the Federal-aid act.

Cost of Operating Trucks on Highway Maintenance in Illinois

By B. H. Piepmeier

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Details of the cost of operating five light trucks in maintenance work on Illinois highways are shown in the accompanying table giving figures for 1917 and 1918. The higher costs for the latter year are accounted for by the higher price of supplies and the greater age of the cars, two of which were new at the beginning of 1917. Trucks numbered 1, 3 and 5 are Ford cars converted into trucks; those numbered 2 and 4 are Ford-Smith Form-a-Trucks. All the trucks are subjected to very severe usage on account of the bad roads between jobs and the excessive loads they are compelled to carry at times. Annual depreciation on the cars is usually computed at about one-third their value, this figure being varied slightly each year to fit the general condition of the car upon completion of the season's work.

COST OF OPERATING ROAD-MAINTENANCE TRUCKS IN ILLINOIS

Truck No.	1	2	3	4	5
Type	Ford	Ford-Smith	Ford	Ford-Smith	Ford
Investment	$602.40	$795.53	$419.80	$784.54	$383.55
Figures for 1917					
Fixed charges per year:					
Interest	$20.33	$26.85	$14.17	$26.48	$12.94
License	4.00	4.00	4.00	4.00	4.00
Storage	38.20	124.73	20.00	25.60	67.55
*Total fixed charges	$62.53	$155.58	$38.17	$56.08	$84.49
Charges based on total mileage for year:					
Fuel and lubricants	$125.81	$210.39	$119.68	$182.92	$141.34
Mechanical repairs	72.01	73.40	76.91	148.08	76.25
Tires	82.45	12.75	75.45	28.00	119.53
Depreciation (computed)	279.63	325.72	152.63	399.31	220.16
Total mileage charges	$559.90	$622.26	$424.67	$758.31	$557.28
Ttoal maintenance cost	$622.43	$777.84	$462.84	$814.39	$641.77
Miles traveled	6,963	6,141	5,453	7,635	8,610
Cost, cents per mile	8.94	12.67	8.12	10.67	7.45
Figures for 1918					
Fixed charges per year:					
Interest	$20.33	$26.85	$14.17	$26.48	$12.94
License	6.00	6.00	6.00	6.00	6.00
Storage	76.50	108.53	36.30	65.55	41.25
*Total fixed charges	$102.83	$141.38	$56.47	$98.03	$60.19
Charges based on total mileage per year:					
Fuel	$109.76	$143.78	$60.06	$184.01	$94.76
Lubricants	23.60	49.00	8.50	41.02	17.68
Mechanical repairs	250.75	231.35	242.42	525.86	94.82
Tires	127.82	52.06	96.56	139.83	114.59
Depreciation (estimated)	165.99	300.00	139.84	350.00	150.00
Total mileage charges	$677.92	$776.19	$547.38	$1240.72	$471.85
Total maintenance cost	$780.75	$917.57	$603.85	$1338.75	$532.04
Miles traveled	5,460	6,276	4,300	7,900	5,200
Cost, cents per mile	14.30	14.62	14.04	16.95	10.23

* Wages of chauffeur and insurance omitted.

British Concrete Colliers Have Precast Sides

Concrete colliers of a capacity of 1000 tons are being built for the British Admiralty by the firm of Christiani & Nielsen, of London. These boats are 185 ft. long, of 35-ft. beam and 18 ft. deep, and are novel on account of the method of casting the straight sides. The ships have a minimum of molded lines, a large proportion of the section being vertical straight sides with a flat bottom. The sides, which are composed of heavy vertical stringers and intermediate horizontal cross-beams, are cast horizontally on a flat platform, and after having attained their set are raised to the vertical position. Protruding rods are left for the bottom and deck. The curved bow and stern, being cast in place, have a shell 5 in. thick, as against the 3½-in. thickness for the precast sides.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Engineers' Versus Laborers' Compensation

Sir—There is a curious letter in your issue of May 8, 1919, p. 931, from a young man, apparently 18 years of age, who received about $160 a month, including overtime, as a day laborer on an aviation field last summer, during the war, and whose spirit, in consequence, moves him to make invidious remarks about the opportunities for money-making offered by the engineering trade. He feels that it would be at least three years after graduation before a young engineer would receive a salary of $2000 a year. I feel that he is correct in feeling thus. He is rather dubious about the advisability of spending $1500 a year for four years in order to obtain an engineering education. I am rather dubious about the average young man obtaining the education if he spends the $1500. Most engineering students who spend this much become educated in matters quite interesting, perhaps, but not found in the school curriculums.

I would not have written this letter, however, were it not that the boy says he is dubious not only on account of the great wage he received as a laborer but on account of "similar conditions described by your readers." I have noticed these descriptions made quite frequently lately in letters to *Engineering News-Record*, and have wondered whether some of them might not have a serious effect upon some of your young readers who were thinking of becoming engineers. They evidently have had such effect upon, at least, one.

It is well, therefore, to iterate and reiterate the fact that an engineering education pays in money if in no other way. The laborer generally has to remain a laborer. The young graduate generally earns a fair salary at first—all he is worth, at first—and if he is able and continues to work very hard is sure to rise in his profession and be well paid. You will note I write only of payment in money, because the letters to your paper on this subject refer only to money—to the difference between the wages of laborers and the salaries of young engineers.

I certainly should be one of the last, for more than one reason, to criticize those who are trying to obtain better salaries for young engineers; but the cold fact remains that services, in the long run, receive the payment they are worth. The complaining letters are most frequently written by surveyors and draftsmen. The difficulty is that common surveying and ordinary drafting are not difficult to learn, and the law of supply and demand takes care of the pay for this kind of work. It is also a fact that a good carpenter is often worth more to a community than a good leveller or a good draftsman; but the opportunity of the leveller or draftsman to rise, if he has had a good education and works hard, is far better than that of the carpenter. It may be truly said of a young graduate of a good engineering school that he is self-supporting as soon as he begins his professional career and that, if he has average capacity and works hard, he need not let a laborer pass him in the running. Many presidents, managers and chief engineers of corporations, who have not written to *Engineering News-Record*, could substantiate this statement.

These remarks apply to other professions also, but the advantage in ours is that it costs less to obtain the necessary education and that young graduates become self-supporting much sooner than graduates of other professional schools; for instance, lawyers and physicians. And, in this age, it would be difficult to prove that even the later money rewards of lawyers and physicians average more than those of graduate engineers, so many of whom, as part owners or employees, have highly remunerative connections with large corporations.

PALMER C. RICKETTS,
President, Rensselaer Polytechnic Institute.
Troy, N. Y.

Sir—Reading the discussions in your journal about the compensation received by engineers never fails to interest me to a high degree. In your issue of May 8, 1919, p. 931, you print a letter by Lucien Alter, who apparently is very dubious about investing the necessary time and money to study engineering after comparing his earning capacity as a laborer with the earning capacity of his brother, a graduate of an engineering school.

Putting aside the fact that the high wages received by him are directly traceable to the urgency of war, I beg leave to ask Mr. Alter if his choice of a profession is solely guided by the expectation of making money.

If this is his predominant idea, I, as a graduate engineer who started work 25 years ago with the royal salary of $50 per month, would tell him very earnestly to divert his activities and energies into other channels. Such a frame of mind will surely prevent him becoming a real engineer—that is, a man who devotes his professional life to the creation of things useful to his fellow citizens and to mankind, and whose joy of life is derived from such work well done, irrespective of the size of the estate he may leave behind when he is called to the great beyond.

GUSTAV A. STIERLIN.
Pittsburgh, Penn.

Accidents and Expert Checking of Engineering Plans

Sir—Burtis S. Brown's interesting article, "Details of the Failure of a 90-Ft. Molasses Tank," and the editorial comment thereon, in your issue of May 15, have induced me to send you these few lines calling attention to a paper which I wrote for you nearly two years ago, and which was published in your issue of Nov. 22, 1917, p. 979, under the title "Why Not Have All Designs Checked by Outside Experts?" In that paper I advocated the checking of plans for all important engineering constructions, more especially those in which failure would jeopardize human life, and having such checking done by expert engineers who had not been concerned in the designing. Had such a precaution been taken in the case of the molasses tank no failure would have occurred, and 12 human lives would have been spared, to say nothing of the great damages to property which would have been avoided. The most simple calculations would have located the weakness; and it could have been corrected at comparatively small expense.

Another late example of fruitlessly expended money

through failure to check the working plans is that of the foundations on the Rondout Creek bridge, constructed under a former Commissioner of Highways for the State of New York. The amount of money there wasted was $48,000.

It would not be difficult to resurrect a long list of serious failures in engineering work which could readily have been avoided by proper checking of plans; but, as I stated in my original communication, "so doing would raise animosities and cause hard feelings, which is something to be avoided whenever possible."

Cannot you use the powerful influence of your paper to materialize this much-needed innovation in engineering practice? By doing so you would confer a lasting benefit upon both the engineering profession and the general public.

J. A. L. WADDELL,
Consulting Engineer.
New York City.

Military Training and the Army's Construction Work

Sir—Capt. R. K. Tomlin, Jr., has shown me an extract from his letter to you in regard to your editorial in the issue of Feb. 27, 1919, p. 408, entitled "Civilians Did Army's Construction Work in the United States." His purpose in writing you, and mine in the interview to which he refers, should be made clearer.

Without wishing in the slightest degree to detract from the credit due for the work of the Construction Division, I deprecate any tendency on your part to create, even indirectly, the impression that a knowledge of military procedure and familiarity with the essentials of military organization are not of great value in connection with such operations as were performed by the Construction Division, and of still greater value when the construction operations take place, as they did in France, in the actual theater of war, where the main and only satisfactory labor was that of soldiers.

As you doubtless know, construction work for the Army in the United States in peace is assigned to the Quartermaster Corps, while similar work in war in the theater of operations is assigned to the Corps of Engineers. Realizing the fact that war upon a modern scale would employ men, munitions, supplies and materials to an extent hitherto unknown, either in war or peace, and call for an enormous expansion of all our military facilities and personnel, with a correspondingly large program of construction operations, some time before our entrance into the war the Chief of Engineers in the United States, taking advantage of a newly made provision of law, sought to interest the engineers of our country in the Engineer Reserve Corps. His efforts met with a gratifyingly large response on the part of the profession, so that even before we entered into the war the Reserve Corps had a large personnel, including many of the leading engineers of the United States.

When our entry into the war became imminent, accelerated efforts were made to enlarge the Engineer Reserve Corps, and the ultimate result was that the number of engineer officers in our Army, which in the peace establishment amounted to something over 200, grew during the war to over 8000, most of whom were employed in France, although many were necessarily retained in the United States on work of supply, administration and organization. As many as possible of these engineer officers, so drawn from civil life, were sent to officers' training camps to become familiar with the fundamentals of Army discipline, organization and procedure, and everything possible was done to impart to the remaining officers who could not go to these training camps a similar knowledge.

These are the engineers who have officered our engineer combat organizations and who have executed the great work of construction in France, which in mere magnitude is at least equal to that done at home by the Construction Division, and which, in addition, has been executed under circumstances of far greater difficulty. To do this work in France it has been necessary to employ almost exclusively military organizations under the supervision of these engineer officers, so that practically the entire work has been that of men in uniform—soldiers, under close military control and discipline, whose operations were facilitated by the fact that those in authority over them were also soldiers, familiar with the necessity of military discipline and routine of administration.

This, then, is a point that I wish to emphasize—that certainly in the theater of war, where operations of construction must be performed by soldiers, it is of the highest importance that the engineers in charge shall be familiar with military procedure. In this manner alone can the work be conducted without undue friction and difficulty.

As the head of the engineer service of the American Expeditionary Forces, I have had a unique opportunity to come into contact with the leaders of our profession. Nothing that I can say would be adequate to express my admiration of the magnificent work that these men have done here in France, both in the combat organizations and in those more specially devoted to construction of various kinds. My experience with them has confirmed me in the belief that, professionally speaking, there is no real difference in training and attitude between the officers of the permanent Corps of Engineers and those of their professional brothers from the country at large who offered their services to the United States for the duration of the recent emergency. The education of officers of the permanent Corps of Engineers is conducted along sound engineering lines, and their normal experience in times of peace—namely, in the construction of works of seacoast fortification and of river and harbor improvement—involves the assembly, organization and use of the same instrumentalities as are employed by all engineers. Much of their work is done by force account, thereby adding breadth and value to their construction experience.

Feeling this to be true, it has been my deliberate policy here in France to make no distinction between those officers more recently drawn from civil life and the permanent engineer officers of the Army. I have endeavored to employ each man to the best national advantage, regardless of whether he came from civil life or from the Army. The results have proved that the country can, as it must, hereafter confidently rely upon the engineers of the United States, civilians, to furnish the large increase needed in time of war for the engineer work needed in the front line as well as along the line of communication; but, I am also convinced, it is a decided advantage to have these engineers enrolled in an Engineer Reserve Corps, the members of which are put in the closest possible touch with such details of military organization and administration as must exist in a well ordered Army. There must, of course, always be a corps of regular engineers, trained

and educated as indicated above, sufficiently large to take care of the necessary expansion, and to take charge of and prosecute all Government engineering and construction work in times of peace that may be confided to it.

In this way alone can proper coördination of effort and ultimate efficiency be secured, and it is to emphasize this important point that this letter is written. It would be, I think, extremely damaging to our country to permit the dissemination of a definite and widespread impression that for military purposes a civilian personnel, unfamiliar with and untrained in Army organization, administration and methods generally, is as serviceable as a force of corresponding productive capacity which has the added advantage of familiarity with necessary Army procedure.

W. C. LANGFITT,
Major General, U. S. A., Chief Engineer, A. E. F.
France.

Latin and Greek for Engineers

Sir—The article by Dean Cooley quoted in your issue of May 8, 1919, p. 930, touches a very live subject. There is no doubt that engineering graduates are narrow in their viewpoint. But are they the only ones? If my observation is to be trusted, the same criticism can be made of almost all men taking technical and even purely scientific courses. In other words, it applies to men whose work deals with *things* rather than with *persons*. Perhaps there is a tendency for this aloofness of attitude to be more pronounced with engineers, since so much of their work involves moving about, and hence they do not feel the same interest in their neighbors that a man would who felt more securely settled in his community.

If my idea is correct, the remedy is to turn more attention to subjects dealing with persons—history, sociology, economics, literature, English, modern languages. So far I go with Dean Cooley. But as for Greek and Latin—I doubt the benefit.

I am inclined to think there are few engineering schools where the other subjects mentioned above are not taught and some of them, at least, required. But the engineering students do not get the benefit that arts students do. And this is the crucial point, in my opinion. There is a constant effort on the part of engineering students to get out of the little that is required. The universal term for all such studies seems to be "junk," and if they cannot be escaped as little is absorbed as it is possible to do and get by. The arts student recognizes that this work is an essential part of his training and studies accordingly.

To remedy the situation we must make the student of engineering take the same attitude. It is extremely difficult for the college tc do it. The student regards the college authorities as prejudiced and as the victims of tradition. His home influences are very likely in the same direction; and I am of the opinion that the influence of many engineers is also. It will take many articles like that of Dean Cooley to counterbalance the remarks of Dr. Waddell on the study of Latin in the preface to "De Pontibus."

I hope it can be done. It will ease the path of the student adviser on the faculty. As it is, the man taking engineering wants engineering and nothing else, and the school must to a large extent meet his demand or lose the student. The acceptance of the obligation to train for good citizenship is connected with the acceptance of other obligations which are at variance with the popular philosophy that a man's prime duty is to get the most for himself and to ignore his duties to others.

I await with great interest further discussion of the article.

FRANK H. CLUTZ, PH. D.,
Department of Civil Engineering, Pennsylvania College.
Gettysburg, Penn.

Credit for Original Design of the New Orleans Army Base

Sir—A protest is in order on a matter of professional etiquette regarding the article on the New Orleans Army base in *Engineering News-Record* of Apr. 24, 1919, p. 823. This group of buildings was originally laid out, with no reference to its use as an Army base, by the engineers of the Board of Commissioners of the Port of New Orleans, and the layout was used almost without modification. The original reinforced-concrete design was made by C. A. P. Turner, of Minneapolis, and was in accord with the Chicago building code; this design was used with only minor changes involving additions to the cost of the structure. Two of these warehouses will be given back to the supervision of the Board of Port Commissioners, and payment of the cost of construction required. It is of course right and proper that the State of Louisiana should bear a part of the increased cost of construction made necessary by the assumption of this work by Army engineers with their appropriate demand for speed above all other considerations; but credit for the whole should not have been assumed without stating the above mentioned facts.

MARSHALL G. FINDLEY,
Designing Engineer, Board of Commissioners of the Port of New Orleans.
New Orleans, La.

[An inquiry regarding the facts recorded in the above letter addressed to George H. Davis, the author of the article in question, has been acknowledged by him as follows: EDITOR.]

Sir—I would acknowledge receipt of your letter, and note the communication which you have received from M. G. Findley making the point that the group of buildings was originally laid out, with no reference to its use as an Army base, by the engineers of the Board of Commissioners of the Port of New Orleans, and that the layout was used almost without modification. In reply I would say that on Aug. 15, 1918, you published an article on this development which included a perspective drawing showing the group of buildings in question and the New Orleans ship canal and terminal, as indicated, with accompanying maps and sketches. In this article it is mentioned on p. 306 that at the Mississippi River entrance of the canal commodity warehouses shown in perspective have just been started and have been taken over by the United States Government for use as quartermaster's stores. It is also mentioned at this point that the construction is being carried on under force account by the Board of Commissioners of the Port of New Orleans, of which W. B. Thompson is president and J. Devereux O'Reilly is chief engineer. On July 26, 1918, the firm of Ford, Bacon & Davis was appointed supervising engineers by the construction division of the Quartermaster Corps of the United States Army, and since that time the design and construction of the plant have been in charge of the

organization, as indicated by me in the article of Apr. 24, 1919, p. 826, to the exclusion of the Board of Commissioners of the Port of New Orleans or the engineers or other officers of the board. As to their previous connection, I am of the opinion that the article of Aug. 15, 1918, gave the Board of Commissioners of the Port of New Orleans and its engineers full publicity.

New Orleans, La. GEORGE H. DAVIS.

Definite Specification for Overhaul

Sir—The definition of "overhaul" and specification for payment are not easily made. The attempt described in your issue of Apr. 24, 1919, p. 835, is evidence sufficient.

The writer several years ago prepared the following definition and specification covering overhaul on canal earthwork. He believes it is readily understood by anyone familiar with this class of construction, and leaves no opportunity for misinterpretation.

"*Haul*—For all haul beyond the length of free haul overhaul shall be paid. The measure of overhaul shall be the 'station yard,' which shall be the hauling of one cubic yard one engineer's station, or 100 lin.ft. The amount of overhaul in any case shall be computed by determining the number of engineer's stations intervening between the center of mass of overhaul yardage as it lies in excavation and as it lies in embankment, deducting therefrom the length of free haul, in engineer's stations, and multiplying the remainder by the yardage of overhaul." EVERETT N. BRYAN.

Waterford, Calif.

Capital, Labor and the Engineer

Sir—In your issue of Apr. 24, 1919, p. 834, you print a letter from Thomas P. Morrissey in which he calls attention to the lack of understanding between labor and the professional engineer. He says the engineer "has seen fit to act as go-between" for capital and labor, and has "considered capital as his client."

In the first two ideas Mr. Morrissey is wrong. In the third he is right. At the beginning of work requiring engineering assistance the owner, generally the capitalist, starts an engineer on the work of preparing the plans. Thus, at the outset the engineer reaches an understanding with the capitalist. The engineer looks to the capitalist for employment, and not to labor. If the work requires execution the engineer is placed in charge and may then have some dealings with labor.

The engineer has never seen fit to act as go-between, and would not relish such a position, though he is sometimes half-way between. Capital and labor reach their agreements without the assistance of engineers. But the engineer often finds himself acting as buffer between two opposing forces. Sometimes these forces are a contractor and an owner, and sometimes they are a capitalist and a laboring class. From the nature of the engineering business this buffer position cannot be avoided.

On contract work which is done under the supervision of engineers, the engineers make the mistake of accepting employment direct from the owner. If the engineers would insist that the contractor have equal voice with the owner in the selection and payment of the engineer, there would be a certainty that the engineer would hold himself as much responsible to the one as to the other, and place himself above the suspicion of favoring any side of a transaction of which he is supposed to be an impartial judge. F. T. HOWES.

Member, American Association of Engineers.

Emigrant, Mont.

Build the Road to Fit the Traffic

Sir—Economy in highway transportation is far-reaching in its results, benefiting not only the users of the highway but the producers and the final recipients of the goods transported. For this basic reason, everything which, directly or indirectly, tends to lower the cost of highway transportation is of immediate interest to the public, which in the end pays the bills. The greatest economy in transportation can only be attained from a general application of systematic, continuous, organized effort directed along practical lines.

Such practical lines can only be determined by a complete recognition of all the factors involved in highway transportation and by a thorough study of their relations to one another and to the end sought. For such a study, much data must yet be secured and correlated.

One line of information needed for all the main traveled roads of this country is that of the kind, weight and amount of daily traffic passing over them. This traffic factor bears upon the selection of routes, establishment of grades, width of roadways, strength of bridges and culverts, type of pavement and cost of maintenance. A traffic census is needed *now*, before extensive and costly improvements are undertaken, in order that a more rational development may follow and the greatest economy be secured. The various highway commissions in this country could well devote some attention and funds to this important basic work and thereby lay the foundation for securing roads designed and built to fit the traffic. Every highway engineer, every highway commissioner, every good-roads advocate, every automobile and motor-truck association, every good-roads organization could well afford to adopt the slogan, "*Build the road to fit the traffic.*"

Kansas City, Mo. ROBERT C. BARNETT.

Wireless Telephone Outfits for Surveying and Construction Operations

Sir—The war witnessed the development of the wireless telephone from the experimental stage to that of a practical and usable field outfit. It has occurred to the writer that the portable wireless outfit, as used by the Signal Corps Field Service, U. S. A., will be a very useful adjunct to the equipment in many engineering operations.

The portable equipment consists only of two cases, containing the batteries and transmitting and receiving apparatus. The antennæ may be mounted on natural objects, or on two light 15-ft. poles included with the outfit, which serve as supports. These outfits usually have a range of from 5 to 20 miles. This equipment should prove useful to a water-works department, the engineer engaged in surveying, or to the construction engineer in conjunction with work covering considerable territory, such as construction of canals, pipe lines and railroads.

The writer once used six of these outfits in a survey

of base lines for triangulation in the Army meteorological and aërological work. Six different parties were distributed on this survey, and throughout the entire work were in constant communication with one another, although miles apart in rough and rugged country. The use of the wireless outfit so expedited the work in hand by permitting the six different parties to work in harmony with one another, when other means of visual signalling or wireless communication was impossible, that the survey, which otherwise would have taken a week or ten days, was finished in a single day.

Now that the war is over, these outfits will soon be on the market and engineers should not be slow in adapting them to civilian enterprises.

Albany, N. Y. FLOYD A. NAGLER.

Distortional Rotation and the Principle of Virtual Work

Sir—Referring to the article on finding the rotation of a member in a truss or at any point of a beam under stress, given in your issue of May 1, 1919, p. 864, it does not seem quite right to say that there is a new principle underlying the method presented. It was taught to the writer and its results pointed out, about 25 years ago, and in the last edition of "Modern Framed Structures" the problem is taken up and solved.

Aside from this, it seems to me that all similar questions about linear or angular elastic changes, as well as indeterminate stresses, are much more comprehensively treated by using the law of virtual work. Take for instance the bent beam, mentioned in the article:

If certain loads P and external moments M are applied to it and if, furthermore, any arbitrary deflections d are assumed to take place at the loads P and in the direction of the same, and any arbitrary rotations v at the external moments M, then the external virtual work done is:

$$\Sigma\, Pd + \Sigma\, Mv$$

This work shall now balance the work of the internal stresses. If the moment in any section caused by the loads P and the external moments M is called M_t and the moment in the same section corresponding to d and v is called M_s, the internal virtual work is

$$\int \frac{M_t\, M_s\, dx}{E\,I}$$

The equation

$$\Sigma\, Pd + \Sigma\, Mv = \int \frac{M_t\, M_s\, dx}{E\,I}$$

gives us immediately a means of finding either any rotation v or any deflection d. As P and M can be given any values we see fit to select, we may put every $P = O$, also every $M = O$ except at the point whose rotation is wanted, where we put $M = 1$ and get:

$$v = \int \frac{M_t'\, M_s\, dx}{E\,I}$$

By analogous assumptions we also get:

$$d = \int \frac{M_t''\, M_s\, dx}{E\,I}$$

The only difference is that M'_t in the first case represents the internal moment due to a unit external moment applied where v is wanted, and in the second case M''_t represents the internal moment due to a unit load where d is wanted. In either case M_s may represent the actual moment corresponding to v or d, as in your article.

It is apparent that if either M_t or M_s is equal to zero for any particular portion of the beam, the summation need not be extended over that portion, as it evidently does not have any effect on the elastic change.

Chicago, Ill. GEORGE N. LINDAY.

A Definition of Professional Engineering

Sir—The license committee of Engineering Council, in its study of laws adopted, or proposed, for licensing engineers in various states and in Canada, is considering one of the most puzzling details—to evolve a definition of professional engineering practice. The following definition has been arrived at after very careful study:

> The practice of professional engineering embraces designing and responsible supervision of the construction, operation or maintenance of private or public utilities or works, and designing or responsible supervision of processes of production, means of transportation and methods for the disposal of waste, when such designs or supervision involve and require the intelligent application of the principles of physics, mechanics, hydraulics or thermodynamics in the determination of the proper selection, use, removal or disposition of material for the attainment of a definite purpose.

The writer would be glad to have you print this definition and equally glad to receive from any of your readers comments or suggestions for its improvement, bearing in mind that brevity and clearness are all-important. Many of the definitions in the laws examined are very lengthy in detail, but, nevertheless, fail to define professional engineering adequately.

T. L. CONDRON,
Chairman License Committee, Engineering Council.
Chicago, Ill.

A Resource That Every Engineer Should Know

Sir—Let me recommend to all your readers that the headquarters of the American Library Association should be appealed to generally as a clearing house of information. If an engineer has a question that puzzles him and he does not live in a large city, with access to a good technical reference library, he should send his question to the American Library Association, 78 E. Washington St., Chicago.

Whether or not such appeal meets with due response, I should be glad to know the result, as I have long been working for a closer connection between the library industry and other industries. Experience with information bureaus has convinced me that there is great need to establish a public demand for information, for already there exist great facilities of which the public has hardly begun to avail itself. Moreover, my familiarity with the American Library Association enables me to say with confidence: Here is an organization having enormous research possibilities, which need only to be used in order to develop a large service that has long been latent.

I made the foregoing suggestion in a paper that was sent to a convention of chemists in Buffalo this spring, and so far three or four have acted upon it. The *Library Journal* for May published for me an article entitled "The Library Phalanx, a Presidential Address at a Phantom Convention." I believe this article would appeal to many who are interested in the general subject

of getting at information and to many who have been bewildered by the difficulties of getting as much out of a convention as they had hoped for. I shall be glad to send reprints of this article, upon request.

G. W. LEE,
Librarian, Stone & Webster.

147 Milk St., Boston, Mass.

Subdrainage for Country Highways

Sir—Referring to W. P. Blair's article in *Engineering News-Record* of May 8, 1919, p. 914, and your editorial calling attention to some objections to subdrainage for highways: The writer has had many years' experience in planning and superintending drainage for highway, municipal and agricultural purposes, and has observed carefully the effect of subdrainage upon highways.

Many times, in constructing underdrains for agricultural purposes, farmers will take advantage of the highway side ditch in order to save depth in placing their outlets, often running some distance along the side of the highway. My observation has been, and the testimony of road superintendents is, that roadbeds where drains have been so placed settle much earlier in the spring and cost much less for maintenance.

A number of years ago, in constructing a gravel road, the writer placed a line of farm tile on each side, 8 ft. from the center line. In this case the outlets were not as good as they should have been, but the reports of the superintendent of roads show a much lower cost of maintenance than for similarly constructed roads without the drains. Residents along the line also state that this road settles and is ready for heavy traffic much earlier than the others.

The action of subdrainage is twofold: Removing excess water, and aëration of the soil.

This brings us to some objections mentioned in your editorial on the question of how to arrange for drainage of subsoils which are practically waterproof, such as clay. Where or when in the springtime did any contractor or engineer outside of arid regions find any clay that was not saturated with water? If it is waterlogged it must be porous; if there are pores the air can enter when the water is withdrawn. And therein lies the advantage of subdrainage. The removal of water from the subsoil permits the entrance of the air, and in flowing out, the water makes way for the small current of air which must flow in to take its place. This action places the soil in such condition that the moment excess moisture appears it begins to sink toward the tile instead of lying in the ground, which becomes saturated until the water is removed by evaporation. Subdrainage allows the grade to solidify much earlier and more quickly than when water stands in level side ditches and soaks into the grade. In cuts, subdrainage is especially advantageous, as it prevents ground water from the banks from reaching the subgrade.

Except in extreme cases, the writer would not regard the laterals shown in Mr. Blair's plan as necessary. In most soils the action of the subdrain will have its effect much farther than half the distance shown in his plan, and, when the subgrade is once drained and the hard surface road constructed, but little, if any, water will reach it.

Where highways are being reconstructed—that is, being changed from gravel or macadam to hard surface—through a well underdrained farming country, subdrains along the highway would be required in but few places.

As to the tile filling with roots, in the case of country highways this likelihood would be negligible, the occasional shade tree not being likely to have roots of the water-seeking variety, and, should such trees exist, the removal of the cause is a small matter.

The matter of subdrainage as an aid to maintenance is also neglected by the railroads, by which large sums could be saved by a small expenditure for such work. My experience has been that subdrainage is a benefit to any roadbed, making even the dirt road easier to maintain and better for travel.

M. H. DOWNEY.

Anderson, Ind.

[It should be noted that Mr. Downey has treated the problem largely from the standpoint of the rapidity with which saturated roadbeds dry out in the spring, rather than from the standpoint of maintaining dryness, which we understand to be the end sought by Mr. Blair. It is admitted that dry clay soil is hard to find in the spring. This is not only the case under earth and gravel roads, but also under hard surface roads. How to keep capillary water from collecting under the road surfacing and causing frost heavage in the winter is the problem to be met by the engineer. When the roadbed is saturated the damage is done. That roots are a problem in some sections, at least, is shown by inquiries that we receive as to how to prevent such clogging of the tile.—EDITOR.]

Suggestion for Geological Survey Maps

Sir—I learn from your editorial in the issue of Apr. 17 that an effort is being made to popularize the Geological Survey maps by making the contours more understandable to the general public through the use of colors.

I made an experiment of this kind a few months ago that may be of interest. I had a comparatively large map of a rough region in which a drainage project, a highway and a number of bridges were planned, which improvements it is proposed to finance by a municipal bond issue. For explaining the project to the public I desired to put the map in such form as would make the contours understandable to those unfamilar with such maps.

As the portion of the map desired to be brought out had a range of grades of 105 ft., represented by contours at 5 ft. intervals, 21 in all, I selected a complete spectrum chart of 21 shades of colors and had each of the contour lines colored to match one of the colors of the spectrum chart. I had the lowest grade colored a deep violet and each of the succeeding contours colored the successive spectrum shades, the highest contour line being red.

The resulting map brought out the differences in elevation in a remarkable way, except that the blue colors were largely lost, owing to the fact that the lines of the print itself were blue. If the colors had been put on a perfectly white paper and a slide of it made by the Lumière, or other color-photography process, it would probably have produced the effect desired.

The Geological Survey bureau probably has considered such a method, but if not may find it worth trying. Only when the maps are to be engraved, however, would it be possible to reproduce them without very great expense.

L. R. BOWEN,
Engineer of Bridges and Buildings, City of St. Louis.

St. Louis, Mo.

Hints for the Contractor

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Push Plow Unloads Flat-Cars

FOR unloading dirt from flat-cars a mechanical pusher or plow has been devised and built by the Denver Tramway Co. On a four-wheel truck is mounted the heel of a 55-ft. horizontal pole which carries a rectangular steel plate on the projecting end and is made rigid by means of three truss rods. On the rear end of the truck are piled old car wheels to form a counterweight.

This pusher stands on a siding at the dump. When a loaded car has been placed for unloading, the brakes are set and the side boards are lowered. The motor car then runs back and is coupled to the rear of the pusher car, which it drives forward until the plate on the pole has pushed the load off the floor of the flat-car. The brakeman stands behind the plate and guides it so that the entire floor of the car will be cleared.

In the description of this device by W. L. Whitlock in the *Electric Railway Journal* of May 10, 1919, p. 924,

PUSHER REMOVING SNOW FROM FLAT-CARS

it is stated that two men—conductor and brakeman—can unload a dirt car in about 15 min. In unloading snow, three men with the pusher were able to do the work of 15 shovelers, with an average of 6 min. per carload of 12 to 14 cu.yd. of snow.

Other Articles in This Issue of Interest to Contractors:

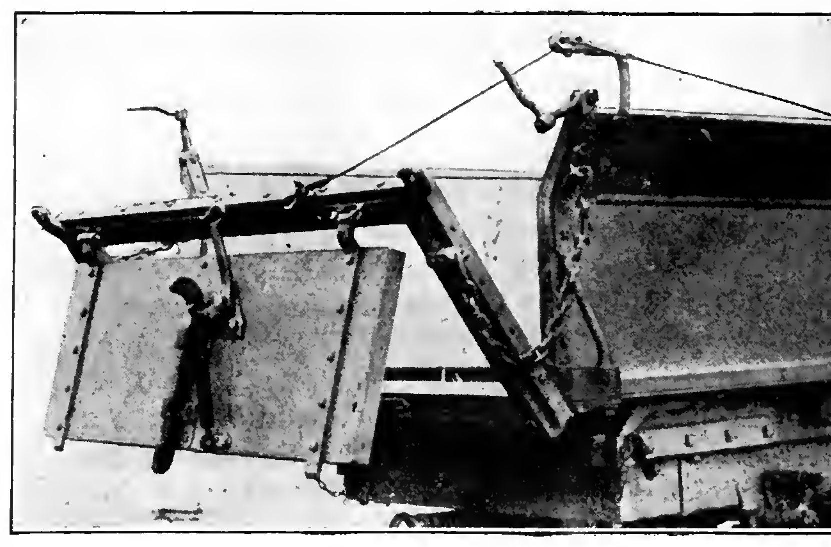
Gin-Pole Removes Train-Shed Trusses

REMOVAL of a steel train-shed roof without interference with traffic was carried out successfully by the Indianapolis Union Ry. in connection with the reconstruction of the union station. The framing consisted of trusses of 102-ft. and 68-ft. span, spaced 26 ft. to 45 ft. on centers and supported on steel columns. After the roofing had been stripped, each truss in turn was cut away near the ends by means of oxyhydrogen torches, the middle portion being handled by a gin-pole derrick having a 60-ft. pole guyed by cables and having its rope led to a hoisting engine placed on one of the platforms. As soon as the truss was cut and swung clear it was turned parallel with the tracks and lowered to the ground. This work had to be done in intervals between trains, and the method adopted eliminated the necessity of occupying the tracks by cranes or other machinery. The portable derrick could be quickly set up and guyed and as promptly removed to clear the tracks. The steel columns with the ends of the trusses attached were released from the footings and pulled over in a direction parallel with the tracks by men hauling on tackle hitched to the top of the column. The lowered trusses and columns were then loaded onto flat-cars by a railway wrecking crane and transported to their destination. By these methods interference with trains was entirely avoided.

Combination Detachable Truck-Body Serves Several Purposes

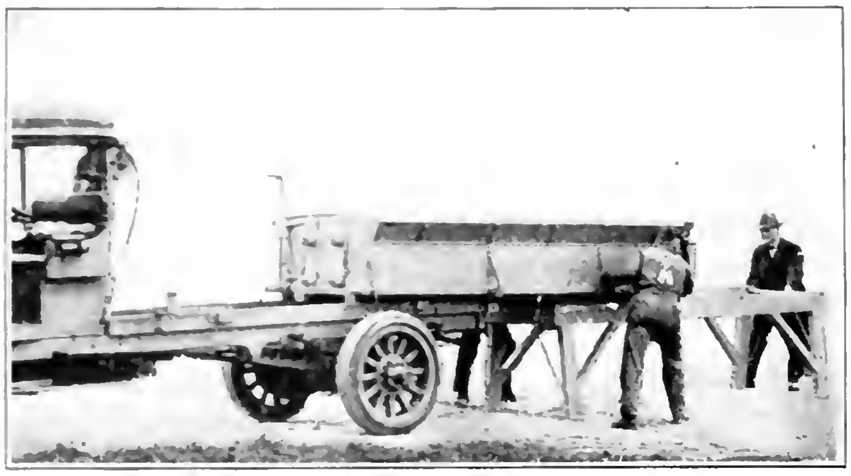
A MOTOR truck with a removable combination express and dump-delivery body has recently been delivered to Charles S. Wheeler of McCloud, Calif., by the Federal Motor-Truck Co. Express and other commodities can be hauled in the box, or sand, gravel, etc., can be hauled and dumped. The box being removed, heavy and cumbersome material such as logs, etc., can be hauled about Mr. Wheeler's estate.

The construction of the truck and the manner of manipulation are shown in the photographs. The tailboard is arranged with hinges at both top and bottom so that it will lie flat for loading merchandise, or open at the bottom for dumping sand and gravel. By releasing the hoist cables which are bolted to the front of the truck and removing the swivel bolts from the



DOUBLE-HINGED END BOARD LIES FLAT OR DUMPS

box hinges at the back, two men can roll the body from the truck frame, which is equipped with rollers, to the roller platform, as shown. This operation takes less than 4 min. The rollers on the frame are also advantageous for loading heavy material when the truck is used without the box. The hoist cables are arranged for drawing heavy materials upon the frame. The truck was especially designed to meet the requirements of Mr. Wheeler.



REMOVING BOX FROM ROLLER FRAME TO PLATFORM

Subaqueous Tunnel Heading Under Eight Inches of Rock Cover

By Alexander Lyle
Field Engineer, Booth & Flinn, Ltd., New York City

BY CAREFUL judgment in blasting, an interesting and difficult piece of tunneling was recently carried out successfully in one of the west headings of the new 14th St. rapid-transit tunnel under the East River, New York City. When the heading, which was advancing in full-rock face, without compressed air, approached a depression in the surface of the rock, the test holes that are drilled before each shot indicated that the rock cover was becoming exceedingly thin. Ultimately the rock proved to be only 8 in. thick over the top of the arch, at the lowest point of the depression. The question was how to proceed with the rock work under these conditions.

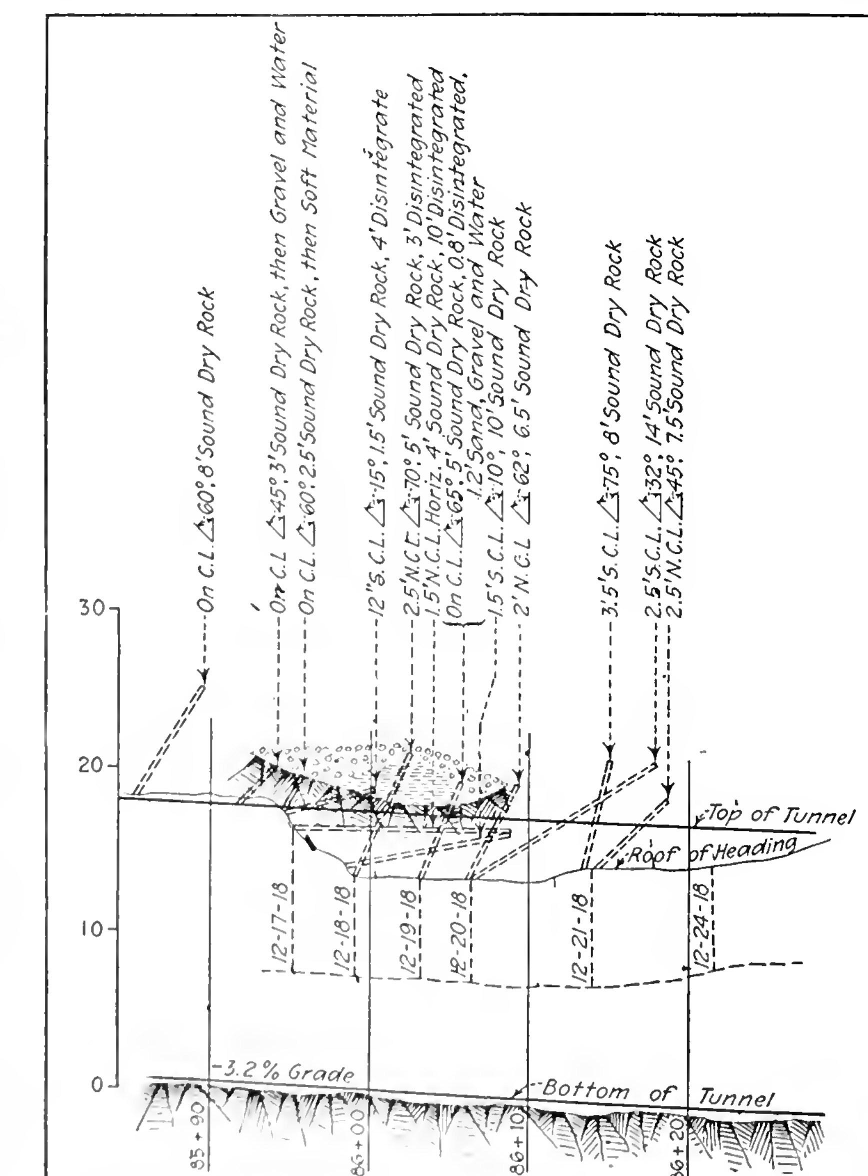
Here was a free-air rock tunnel 17 ft. 2 in. in diameter, with the roof to be trimmed to within 8 in. of the rock surface. The risk involved was that the river bottom might be brought in if the thin shell of rock were broken through. The material at this point was a good, homogeneous gneiss, overlaid by about 56 ft. of soft river-bottom material. The roof of the tunnel was 83 ft. below mean high-water level

In order that work should not be delayed by this thin spot, the top heading was dropped about 4 ft. and driven ahead until the test holes showed that the proper level could be resumed. This bypassing allowed progress to be maintained. After the heading and bench had passed out of shooting distance it was decided to carry the cast iron tunnel lining beyond the thin point of the roof, in order to insure the safety of the heading.

As the first step in preparation, the concrete cradle and the bottom segments of iron lining were placed in proper position, up to the bottom of the section of roof that required trimming; this work involved no particular difficulty. The flanges of the lining were then well protected with timber, to avoid breakage when it was hit by falling pieces of rock.

At first the plug-and-feather method was considered for trimming the depressed section of roof to the neat line. This method was rejected as too slow, however, and it was decided to try very careful blasting. The results showed the blasting method to be entirely safe and successful. Short trim holes were drilled, loaded and shot, to take out the rock to within a foot of the desired excavation line, for a length of tunnel just sufficient to clear the ring of lining next to be erected. Additional trim holes were then drilled just on the neat line. These holes were spaced about 6 in. apart, and were loaded with about one-eighth stick of dynamite, sometimes every hole but usually only every other hole. Shooting these holes, one by one, took out the arch excavation very close to the neat line, and only rarely required a little hand-trimming in order to allow the iron lining to be placed. The blasting being very light, and the rock weakened by the closely spaced holes, no damage was done to the remaining cover.

As soon as space was cleared for the erection of one plate of lining, the plate was erected and all spaces back of it were filled by driving in rock packing. Operations were then transferred to the opposite side of the tunnel, and clearance was made for another plate. The work thus continued one plate at a time until the entire ring had been completed, and then shifted ahead to the next ring. Booth & Flinn, Ltd., are contractors for this tunnel. M. L. Quinn is their general superintendent, and Sam Allen is shaft superintendent. M. H. Freeman supervises the work for the Public Service Commission.



SECTION WITH HEADING DROPPED TO PROVIDE SUFFICIENT ROOF THICKNESS FOR SAFETY

NEWS OF THE WEEK

New York, May 29, 1919

Sees No Price Reduction in Building Material

Report of Illinois Joint Legislative Commission Recommends State Operation of Plants

Acting under a joint resolution of the legislature of Illinois, a legislative committee has just completed an investigation into the cost of building materials. The commission held a number of public hearings, but confined its attention to the price conditions in brick, cement and lumber. It reported that the costs of brick do not seem to be unduly high, and that there is no evidence of illegal combinations to regulate the price of common building brick. The committee's report on lumber is quite ambiguous. The intimation is that it does not consider the price too high, but no definite statement is made.

In its study of cement it seems to feel that the prices are too high. The committee states, for instance, that a Government expert asserts that the manufacturing cost of portland cement in a 3000-barrel mill should be \$1.25 a barrel, as against an actual cost figure submitted by a cement company of \$1.67 per barrel. It says that it could find no positive evidence of combination of cement manufacturers to establish prices, but that the "circumstances indicate that cement prices are fixed by agreement." The committee also states that the La Salle Portland Cement Co. had net earnings from operations of over 77⅓% on its capital stock, but gives no figures as to the relation of the capital stock to the net investment.

The committee recommends that the interests of the state are so great that it believes the state should engage in the manufacture of cement for public works, as this would have a tendency not only to create competition but would serve to keep the public constantly advised as to the cost of production of the product. As a final conclusion, the committee thinks that prices are at a new level, and quotes approvingly the widespread statement of Prof. Irving Fisher. As a result of the investigation, it is recommended that the state, as trustee for the people, should protect the public from extortionate charges for roadbuilding material, and should be authorized to manufacture products entering into the public improvements of the state. The committee therefore recommends the passage of an act enabling the state to acquire land, mines, quarries, mineral deposits, etc., necessary for raw material, and to lease them, to sell and dispose of products, to enter into contracts with producers for the supply to the state of the raw materials, to extend loans to the manufacturers of such materials, and to permit competition in patented roadbuilding products.

Employment Bureaus

Engineering Societies' Employment Bureau, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Transit Construction Commissionership Declined by Engineers

With the appointment of John H. Delaney as Rapid Transit Construction Commissioner for New York City, Governor Smith of New York State announces that the position had been declined by Col. William Barclay Parsons, consulting engineer, and by J. Waldo Smith, chief engineer of the Board of Water Supply. Mr. Delaney has until now been the city's Commissioner of Plant and Structures, having charge of bridges and ferries.

Government To Build River Boats

Contracts for boats to be used in the freight traffic on the Warrior River under Federal direction have been let by the United States Railroad Administration, Inland Waterways Division. The St. Louis Boat & Engineering Co., of St. Louis, Mo., is to build four steel, self-propelled tunnel-type boats, for \$244,400 each; the Howard Shipyard & Dock Co., of Jeffersonville, Ind., has the contract for three steel towboats of the twin-screw tunnel type for \$137,000 each, and the Murnan Shipbuilding Corporation, of Mobile, Ala., will build the 20 wooden barges for \$5985 each. Delivery of the steel boats is to be commenced next August.

Federal Highway Commission Opposed by Houston

Secretary of Agriculture Defends Present System—Explains Objection to New Plan

In response to a communication from a city chamber of commerce requesting the views of Secretary of Agriculture Houston regarding the creation of a Federal highway commission and the wisdom of taking the Federal supervision of roads from the Department of Agriculture, Mr. Houston has made a detailed reply. He opposes the commission idea which has been indorsed by chambers of commerce and other organizations throughout the country, and defends the present system. The arguments which are advanced by Secretary Houston are as follows:

Before the advisability of changing the present methods of administering the national highway funds are considered, there are certain facts that it is well to have in mind. First, the importance of roads and the traffic conditions vary throughout the country; second, the state highway departments, being in immediate touch with the situations in their respective localities, are best able to classify and judge which roads will serve the greatest economic needs, and, thirdly, the Federal Government is now aiding the states in considering their technical problems in the selection and improvement of the most important roads, and, when the state department has properly selected a state highway, it generally meets a state highway in an adjoining state and the two become an interstate highway of nation-wide utility.

Furthermore, there is already in existence an excellent organization, the Bureau of Public Roads, which works in a coöperative manner through the 48 state highway departments, under the provisions of the Bankhead Federal-aid road act.

Ample funds have been provided by Congress, the law has been amended to made it work more smoothly, and provision has been made by increasing the Federal allowance per mile, so that roads of substantial character can be built. Altogether, there seems no obstacle in the way, now that the war is over, of the building of those roads which will serve the greatest economic needs.

With the above conditions in mind, the secretary finds it difficult to see what need there is for additional machinery, such as would be required by a Federal highway commission, or, as suggested in a bill introduced in the

last Congress [the Townsend bill, described in *Engineering News-Record* of Feb. 7, 1919, p. 446], which would commit or limit the Federal Government to the construction of two Federally owned and maintained trunk lines in each state.

After calling attention to the fact that there is now in the Federal treasury about $300,000,000 available for roadbuilding, Secretary Houston suggested that it is unlikely that Congress will appropriate additional funds for this purpose, under present financial conditions. He also pointed out the difficulty in diverting the money pledged, from the present appropriations, from the projects for which it has been laid aside, as would be necessary to put the commission plan into effect without further appropriations.

Another problem would be the necessity of changing all the state highway laws, some of which were passed with difficult to meet the new plan. It is doubtful that the states would be willing to change from the present plan of developing the roads serving the greatest economic need to a plan for building two main trunk lines in each state.

Conference on Federal Road Laws Held in Washington

Federal highway legislation was discussed at a conference in Washington on May 20 called by Senator Townsend, author of the Townsend highway bill, for officials of various states and members of the Highway Industries Association. The meeting was attended by representatives from all parts of the country and it is reported that sentiment was very strong for a comprehensive national highway policy along the lines suggested in the Townsend bill. [See *Engineering News-Record* of Feb. 27, 1919, p. 446.]

Among those present were A. R. Hirst, state highway engineer of Wisconsin and president of the American Association of State Highway Officials; G. P. Coleman, state highway commissioner of Virginia and chairman of the executive committee of the organization; Paul D. Sargent, chief engineer of the Maine State Highway Commission; Col. W. D. Uhler, chief engineer of the Pennsylvania State Highway Department; M. L. Cunningham, state highway engineer of Oklahoma; W. S. Keller, state highway engineer of Alabama; Ira R. Browning, state road engineer of Utah; S. M. Williams, president, and H. G. Shirley, secretary, of the Highways Industries Association.

State Buys Two Toll Bridges

State purchase of the Greenbush bridge at Albany and the Congress St. bridge at Troy is provided for by two bills of the legislature recently signed by Governor Smith of New York. Sums amounting to $1,700,000 are made available for the purpose. Tolls collection on the bridges will be abolished.

Sixth Canadian Good Roads Congress and Exhibit

Good Attendance Reported—Resolutions Favoring Federal Aid and Lower Freight Rates Passed

The Sixth Canadian Good Roads Congress and Exhibition, held at the Parliament Buildings, Quebec City, May 20-22, is reported to have been the most successful in the annals of the Canadian Good Roads Association. It started with a motor ride over 180 miles of improved road from Montreal to Quebec. More than 200 delegates were present, and the meetings were well attended.

Keen interest was shown in both the practical and theoretical addresses and papers. The program included addresses on many types of pavement, their construction and maintenance, and on road machinery. The only criticism made of the program was that it was rather overbalanced, the length of the papers curtailing too much the time for discussion. The most interesting exhibit was that made by the Ontario Highway Department, showing models of roads from Roman times down to the present.

The general tenor of the congress is indicated by the resolutions passed at the business meeting: The first petitions the Government, the Board of Railway Commissioners and the railways of Canada for a decrease of 10c. per ton on roadbuilding materials immediately, with an investigation to determine the possibility of a further reduction to a pre-war basis.

The resolution further points out that these rates in Canada have always been higher than in the United States.

Another resolution, dealing with Federal aid, was next passed, as follows:

"Whereas, the Canadian Good Roads Association has heard with the greatest satisfaction that the Dominion Government is contemplating the introduction of legislation with a view of granting financial aid to the provinces toward road improvements;

"And whereas, this association considers that such action would be a highly deserved appreciation of the efforts already put forward by the provinces in this connection and a much needed encouragement to their desire to endow the country with a first-class system of good roads;

"Therefore, be it resolved, that the Canadian Good Roads Association heartily endorses the principle, and strongly urges that it be carried through with the least delay possible."

A general resolution was passed urging the Dominion Government to proceed with any projected bridges affecting international or interprovincial traffic.

The following officers were elected: Honorary president, W. A. Campbell, Dominion Commissioner of Roads; president, S. L. Squire, honorary president of the Ontario Good Roads Association, Toronto, Ont.; first vice president, A. F. MacCallum, commissioner of works, Ottawa, Ont.; second vice president, Dr. E. M. Desaulniers, M.L.A., deputy speaker of the provincial legislature, St. Lambert, P. Q.; secretary-treasurer, George A. McNamee, of Montreal.

New York Governor Signs Bills Affecting Road Contracts

Two bills affecting road contractors have been signed by Governor Smith of New York. One deals with the cancellation of highway contracts made before the war, while the other pertains to the amounts of certified checks to be deposited with bids, and provides conditions whereby bonds for the completion of contracts may be omitted.

The first bill authorizes the termination of highway contracts entered into prior to Apr. 6, 1917, confers jurisdiction upon the Court of Claims to hear claims, determine the extra cost of work due to war conditions, and make awards for increased cost incurred.

The second law provides that all bids on highway contracts shall be accompanied by a draft or certified check for 3% of the amount of the gross bid. This check will be returned when the contract is executed and bonds are provided. The commissioner may, on request of the contractor, dispense with the giving of his bond, in which case 20% of the contract price will be retained until the work is completed.

Septic Tank Patent Claims May Be Settled for Nominal Sum

Settlement of any and all claims of the Cameron Septic Tank Co., Chicago, for alleged infringements of the patents held by the company is provided for in a contract made between the company and the National Septic Process Protective League, Frank G. Pierce, secretary, Marshalltown, Iowa. The company agrees, for the sum of $5000, paid by Sept. 1, 1919, to release from all claims all who may be members of the league on the date named. The agreement also provides for dismissal of the suit brought by the company against Shelbyville, Ky., without cost to either party. The league, through its executive committee, has adopted a schedule of payments to be made by present members of the league or any who may join between now and Sept. 1, 1919, in order to obtain releases under the contract.

Detailed information may be obtained by addressing Mr. Pierce. The attorney for the league has advised that, although he is confident of winning the Shelbyville suit through a decision, and that the American patent expired with the British patent on Nov. 8, 1909, yet that since the cost of the settlement will be so much less than the cost of the litigation, it is advisable to accept the terms of the agreement. The league needs about $10,000 to meet the $5000 payment and all expenses. Any user of a septic tank is eligible to membership in the league and to release from royalty claims.

Third American Concrete Ship Launched

On May 22 the third American concrete ship, and the second to be built by the United States Government, was launched at the yard of the Fougner Concrete Shipbuilding Co., on Flushing Bay, Long Island. The ship, which was christened the "Polias," was described in *Engineering News-Record* of Dec. 12, 1918, p. 1058. It is a 3500-ton vessel, 281 ft. 9 in. long, of 46 ft. beam, and 26½ ft. molded depth. It was designed by the Fougner company and the construction was superintended by the concrete ship section of the Emergency Fleet Corporation. The vessel was stern-launched from the concrete ways and slid off into the water easily and successfully. Four days after launching it was reported to be bone-dry inside, there not being any evidence whatever of leaks or porous percolation. It has been ready for launching for some months, but it has not been possible to put it into the water on account of lack of depth of the offshore basin.

"POLIAS," 3500-TON CONCRETE SHIP, JUST AFTER BEING LAUNCHED

Choose Site for Pittsburgh South Hills Tunnel

A decision reached May 23 by the Allegheny County commissioners, jointly with the county planning committee, fixes the location of the South Hills tunnel, Pittsburgh, soon to be built. A high-level route has been selected, in contrast with the low-level locations of some earlier projects utilizing the Smithfield St. bridge as an approach. The new project provides for a tunnel extending from the Bell House on West Liberty Ave. to the Knox School on Brownsville Ave., and for a bridge over the Monongahela River to Sixth and Forbes Sts. The name "Liberty Tunnel" has been adopted for the entire improvement.

E. K. Morse, consulting engineer to the county, and W. M. Donley, engineer for the planning commission, directed the studies which resulted in the decision that this location will give best service to both the city and the South Hills district. On the question of ventilation, Maj. Gen. George W. Goethals, who was called in consultation, advised that no difficulty would be encountered in keeping the tunnel atmosphere in good condition.

The tunnel will be 5500 ft. long, and will have a single opening 44 ft. wide. Its grade will be 2%. It will serve pedestrian as well as street-car and roadway traffic. A branch tunnel 1000 ft. long to reach Hagerman Ave. is also being considered.

Colorado Engineers Form Engineering Council

At a meeting in Denver, May 16, representatives of eight organizations of the state met and formally launched the Colorado Engineering Council in order, according to its constitution, "to coördinate the work of various technical, scientific, and engineering organizations, promote the welfare and professional standing of their members and foster a more general recognition of the engineer in civil matters." Among the associations represented were the Colorado Scientific Society, the Teknik, the Colorado Society of Engineers and the local associations of the four national engineering societies. The following officers were elected: Arthur Ridgway, president; E. G. Carpenter, vice-president, and Robert J. Grant, secretary and treasurer. Meetings of the council are to be held at least once a month.

Committee to Report on Site of Newark Bay Bridge

A joint committee of the county engineers of Essex and Hudson Counties and the bridge engineer of the New Jersey State Highway Commission has begun the study of the best site and design for a bridge crossing Newark Bay to connect Jersey City and Newark. The bridge would be about two miles long. An appropriation of $15,000 provided by the counties and the State Highway Commission is available for the study. F. A. Reimer of Essex, C. J. Wasser of Hudson, C. A. Mead of the State Highway Commission, and H. W. Hodge, consulting engineer, constitute the committee. Surveys are to be started at once, and meetings will be arranged to determine the wishes and needs of the public in respect to the location of the bridge.

John Fritz Medal Conferred on General Goethals

The formal ceremony of conferring the John Fritz Medal on Maj. Gen. George W. Goethals for his achievements in building the Panama Canal was observed in the auditorium of the Engineering Societies' Building, New York City, on the evening of May 22. Charles F. Rand presided, and addresses were made by William L. Saunders and the Hon. Henry L. Stimson. The latter was Secretary of War during the period when construction work on the canal was most active, and he described his observation at that time of the methods by which General Goethals maintained the *esprit de corps* and the discipline among the army of workers on the canal.

The formal presentation of the medal was made by Ambrose Swasey. In accepting the medal, General Goethals emphasized the credit due many others whose work contributed to the success of the enterprise, mentioning especially President Roosevelt as the one above all others who made the canal possible. Mr. Roosevelt's keen judgment in rejecting the majority report of the International Commission, which he had himself appointed, and adopting instead the minority report which favored the lock canal, saved the enterprise from disaster at a crucial time, he said.

Major General Goethals is the fifteenth engineer to receive the John Fritz Medal, and the third to receive it on account of work in the civil engineering field. The two other civil engineers who have been thus honored are J. Waldo Smith and the late Alfred Noble.

Cedar Lake Sealing Operations To Be Resumed

Sealing the Cedar Lake reservoir of the Seattle municipal water-works, officials of the water department announce, will be resumed as soon as the water goes down enough to leave a dry basin. The work done in 1918 had hardly progressed beyond the preliminary stages when the autumn rains made it necessary to close down work for the winter. The city retained J. D. Blackwell, consulting engineer, of Seattle, to make a further study of the plans for sealing the basin by sluicing methods, and his work has been carried on actively during the rainy season of the year.

Civil Service Examinations

New York.—Heating and ventilating engineer, office of state architect, $1500 to $2500 per year, June 28, apply to State Civil Service Commission at Albany for application forms before June 16.

United States

For United States civil service examinations, listed on the following page, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File application before June 10

Assistant designing engineer, Naval Ordnance Plant, South Charleston, W. Va., $9.20 per diem. July 8. File applications before July 8.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

The American Society of Marine Draftsmen will hold its eighth annual meeting at the Hotel Brunswick, Boston, June 20-21. The officers of the society are: President, Alfred H. Haag, chief naval architect, United States Shipping Board; vice-president, W. A. Leavitt, Jr., New York Shipbuilding Corporation; secretary, B. G. Barnes, Lake Torpedo Boat Co.; treasurer, J. Binford Sadler, industrial department, United States Navy Yard, Norfolk.

The Montreal Branch of the Engineering Institute of Canada will tender a banquet to Brig. Gen. Charles Hamilton Mitchell, C.B., C.M.G., D.S.O., in the first part of June. General Mitchell is returning to Canada to reënter civil life after nearly five years in overseas service He has been decorated by the Governments of France, Belgium and Italy, as well as by Great Britain.

The Society of Terminal Engineers held its annual meeting in New York City May 20. Francis Lee Stuart, chairman of the engineering committee, United States Railroad Administration, previously chief engineer of the Erie and Baltimore & Ohio R.Rs., was elected president. Other officers elected for the coming year are: Vice-presidents, John Meigs, E. H. Lee, Calvin Tomkins, Charles Whiting Baker and Maurice W. Williams; treasurer, W. Joshua Barney; secretary, J. H. Leonard.

The Engineers' Club of Philadelphia elected the following officers at the annual meeting May 20: President, Joseph A. Steinmetz; vice-president, Paul Spencer; secretary and treasurer, Lewis H. Kenney. The club's last weekly luncheon of the season will take place June 3 and will be addressed by Dr. Samuel C. Sadler, on "American Potash and Its Sources."

The St. Louis Chapter of the American Association of Engineers has been elected a member of the Associated Engineering Societies of St. Louis, which body has unanimously approved the schedule of wages for city employees adopted by the St. Louis Chapter and its municipal section.

The New York Chapter of the American Association of Engineers has elected the following officers: President, Alexander Potter; vice-presidents, J. C. Patterson and Maurice Griest; treasurer, Hugh C. Jackson, and secretary, E. B. Miller, 294 Henry St., Brooklyn, N. Y.

The Chattanooga Chapter of the American Association of Engineers held a regular meeting May 21 at which the following temporary officers were elected: Chairman, J. L. Earles; vice chairman, R. E. Elgen: secretary-treasurer, Ray Dunlap.

The Pacific Coast Good Roads Association will hold its annual meeting in San Francisco June 25-26. The association is working in coöperation with the Pacific Coast Defense League, Inc., to provide a system of military highways on the Pacific Coast.

The Oregon Society of Engineers was addressed May 23 by Capt. J. W. Morris, Engineers, U. S. A., former city engineer of Portland, who spoke on his experiences as an Army engineer with combatant troops.

The Cincinnati Chapter of the American Association of Engineers was formally installed May 24 and was addressed by W. H. Finley, president of the national organization.

The Albany Society of Civil Engineers held a meeting May 27 at which S. T. Dodd spoke on the "Electrification of the Chicago, Milwaukee & St. Paul Ry.," the paper being illustrated by motion pictures.

The Rochester, N. Y., Engineering Society made a trip of inspection May 24 to the mines and plant of the Empire Gypsum Co., at Garbutt, N. Y.

Personal Notes

PROF. FRANK P. MCKIBBEN, head of the department of civil engineering at Lehigh University since 1907, has accepted an appointment, effective on Sept. 1, as professor of civil engineering at Union College, Schenectady, N. Y. Professor McKibben was graduated in 1894 from the Massachusetts Institute of Technology, and until 1907 served successively as instructor, assistant professor and associate professor in the department of civil engineering. During this time he was engaged also in work as assistant engineer for the Boston Elevated Railway Co., and the Massachusetts Railroad Commission. In 1907 he was appointed professor of civil engineering at Lehigh University, succeeding Dr. Mansfield Merriman. In 1918 he inaugurated a course in shipbuilding.

MAJ. EUGENE W. STERN, Engineers, U. S. A., who recently returned to this country and received his discharge from the service, has opened an office for the practice of engineering at 56 W. 45th St., New York City. Mr. Stern resigned as chief engineer of highways, Borough of Manhattan, New York City, to enter the Army.

MAJ. CLARENCE GOLDSMITH, Construction Division, U. S. A., who recently received his discharge from the service, has resumed his work as engineer for the Committee on Fire Prevention and Engineering Standards, National Board of Fire Underwriters, with office at 76 William St., New York City.

CAPT. PAUL HANSEN, Sanitary Corps, U. S. A., has returned to this country and has received his discharge from the service. He has resumed his position as chief sanitary engineer, Illinois State Department of Public Health, with headquarters at Springfield.

LIEUT. C. C. SADLER, U. S. A., who was assistant to the utilities officer at Camp Jackson, Michigan, has received his discharge from the service and has resumed his position as field engineer, coke plant, American Steel & Wire Co., Cleveland.

J. M. DUGAN and R. E. CHRISMAN, formerly with the Sound Construction & Engineering Co., Seattle, recently returned to Seattle from California and have become associated in partnership to engage in engineering and construction work, with offices at 312 Boston Block, Seattle.

R. J. WINDROW, of Waco, Texas, has been elected state highway engineer of Texas by the State Highway Commission, succeeding GEORGE A. BUREN, who has retired to private practice. Mr. Windrow is a graduate in civil engineering from the Agricultural College of

Texas, and has had extensive experience in roadbuilding in McLennan County, Texas. He recently resigned as city engineer of Waco to engage in contracting.

HENRY OAKES, Engineers, U. S. A., who recently received his discharge from the service, has been appointed city engineer of Muskegon Heights, Mich., in place of VICTOR BURTON of Lansing, to whom the office was offered but who was unable to accept the appointment, made several weeks ago.

CAPT. HENRY E. ROBERTSON, 344th Machine Gun Battalion, U. S. A., has received his discharge from the service and has resumed his work with the El Paso Bridge & Iron Co., El Paso, Texas.

MAJ. ROBERT I. RANDOLPH, 535th Engineers, U. S. A., has received his discharge from the service and has resumed his work as a member of the firm of Isham Randolph & Co., consulting engineers, Chicago.

L. A. WEATHERWAX, Hendrickson Construction Co., Seattle, and former secretary of the Seattle Master Builders' Association, has become associated with Stone & Webster on hydro-electric work at Fresno, Calif.

COL. H. M. WAITE, Engineers, U. S. A., has received his discharge from the service and has become associated with the Lord Construction Co., New York City, as vice-president and chief engineer.

C. A. DUNN, division engineer, State Highway Department of Oregon, with headquarters in Salem, has resigned to become general superintendent for Oscar Huber, contractor, Portland.

H. C. HEDDINGER, who for some time has been associated with the Aberthaw Construction Co., Boston, has been placed in charge of the new permanent office of that company in Buffalo, at 918 Ellicott Square.

DALTON MOOMAW, formerly road engineer of Cuyahoga County, Ohio, with headquarters in Cleveland, has been appointed county road engineer of St. Joseph County, Indiana, with office in South Bend.

HARRY BOLLINGER has been appointed city engineer of Columbia City, Ind., succeeding CLAUDE ANSPAUGH, who has resigned to devote his entire time to the duties of county surveyor.

LIEUT. CLARENCE A. LIVINGSTON, Signal Corps, U. S. A., has received his discharge from the service and has become associated with D. H. Burnham & Co., architects, Chicago.

GEORGE O. WITH, assistant manager, Consolidated Expanded Metal Co., Chicago, has been appointed city engineer of Joliet, Ill. He was previously assistant city engineer of Chicago Heights, Ill., for two years. During the war he served as chief carpenter's mate, Great Lakes Naval Training Station, in charge of sewer construction and water-supply. Previous to this service he was in the field service department of *Engineering News-Record*.

CAPT. E. P. RANKIN, JR., 110th Engineers, U. S. A., has received his discharge from the service and has returned to his work with the El Paso Bridge & Iron Co., El Paso, Tex.

PERRY FILKIN, division engineer, New York State Highway Department, has been transferred from Rochester to Hornell, succeeding S. E. FITCH, transferred to Utica.

ARTHUR A. SMALLEY, assistant city engineer of Pleasant Lake, Ind., has resigned to become assistant city engineer of Hamilton, Ohio.

ERNEST BRUCE, civil engineer, Charleston, W. Va., has been appointed chief of the engineering department of that city, succeeding HARRY WILEY, resigned.

E. R. KENNER has been placed in charge of the new permanent office of the Wellman-Seaver-Morgan Co. at Atlanta, which is located at 318 Hurt Building.

O. E. ECKERT, formerly with the engineering division, Michigan State Board of Health, has been appointed city engineer of Lansing, Mich.

WILLIAM S. MURRAY, consulting engineer, New Haven, Conn., has removed to 165 Broadway, New York City.

WALTER BOWMAN has been appointed city engineer of Harvard, Ill.

STEPHEN PALMER, of Clarksburg, W. Va., has been appointed county road engineer of Wetzel County, West Virginia.

BLAINE H. MILLER has resigned as building commissioner of Indianapolis, Ind., to devote his entire time to private business.

HARRY B. COOK, of Atlantic City, has been appointed a member of the State Board of Commerce and Navigation of New Jersey to fill the vacancy created by the resignation of Allen K. White.

OBITUARY

ALLEN E. NICHOLS, consulting engineer, Chicago, died in that city, May 8, at the age of 31. He was graduated from Purdue University in 1910, and for two years following was engaged in railroad work with the Baltimore & Ohio R.R. and the Chicago & Western Indiana R.R. He then became associated with Alvord & Burdick, consulting engineers, Chicago, engaged in sanitary engineering work. He served for two years as assistant engineer in charge of contracts and design of the municipal reduction plant and incinerator under Col. Henry A. Allen, for the Bureau of Waste Disposal. During the war he was employed by the du Pont Engineering Co. as assistant engineer of construction on the 70,000,000-gal. filtration plant for a powder plant at Old Hickory, Tenn. He had recently opened a consulting office in Chicago, in connection with his father, specializing in garbage and waste disposal.

CAPT. HENRY B. SAUERMAN, Engineers, U. S. A., who was one of the organizers of the first company of Army engineers in the State of Illinois, died in Chicago, May 20, at the age of 40. He was a member of the firm of Sauerman Bros., engineers and manufacturers of construction equipment, Chicago. He entered business in the employ of Fairbanks-Morse & Co., where he remained for 11 years, first as chief draftsman and later as contracting engineer. In 1911 Mr. Sauerman joined his brother, John A. Sauerman, in organizing the firm of Sauerman Bros., succeeding the H. N. Elmer Co. When the original Co. A, Engineers, Illinois National Guard, was formed in 1911, Captain Sauerman enlisted for three years as a private, but was elected captain a year later. In 1918 he received the Octave Chanute medal from the Western Society of Engineers for his paper "Fortification," which was prepared for a meeting of the society in 1916 and was later published as a handbook for Army engineers. Later his booklet, "Highways and Railways for the Defense of Our Nation," attracted considerable attention.

WILLIAM TRUTCH PRESTON, principal assistant engineer, United States Engineer District, Seattle, died in that city May 14. He was born in 1859 and went to the Canadian Northwest as a civil engineer in 1880. He had charge of construction work on the Canadian Pacific Ry., including that in Frazier River cañon. Later, for two years, Mr. Preston was engaged in construction work for the Seattle, Lake Shore & Eastern R.R. Since 1896 he had been continuously in the service of the United States Government. He was connected with fortification work in the Boston district for five years, and with river and harbor fortification work in the Seattle district during the remainder of his service. The major portion of the fortification works of the coast defenses of Puget Sound was constructed under Mr. Preston's supervision. He was also connected with the construction of the Lake Washington ship canal. During 1918 he was in charge of the Seattle district as district engineer.

LOUIS ARTHUR KINNEAR, of the engineering staff of the Ontario Hydro-electric Commission, died at Nipigon, Ont., May 12. He was graduated from Queen's University, Kingston, in 1912, and acted as engineer for several municipalities.

New Semi-Trailer Has Collapsible Auxiliary Wheels

A new tractor and semi-trailer designed to facilitate coupling and uncoupling, and to allow for turning in the shortest possible radius, is shown in the accompanying illustration. This trailer, having four wheels when uncoupled, may be shifted around for loading without the use of the tractor. The outfit shown is the regular four-ton unit, being manufactured by the Fulton Motor-Truck Co., of Farmingdale, N. Y.

TRACTOR AND SEMI-TRAILER MAKING A SHORT TURN

The main features of this transportation unit are the method of coupling and the collapsible wheels on the front of the trailer which rest on the ground while it is being loaded, and allow for shifting.

To facilitate coupling, the tractor has two flared runways at the rear, one on each side, which pass under two small wheels on the bottom of the trailer body. As the tractor backs up to the trailer, these small wheels run up the inclined runways, lifting the front of the trailer from the ground. As the wheels pass up the runways, they are controlled by guides on each side, which bring the coupling device into position. The coupling is completed automatically. By means of a hand lever, the front supporting wheels of the trailer may now be lifted and clamped free of the ground, as shown in the view.

The two small forward wheels which guide the coupling device up the runways rest and roll upon a circular wheel similar to a turntable, thus steadying the trailer. When it is desired to uncouple the trailer, the operation is controlled entirely from the driver's seat. By pulling a lever he releases the front supporting wheels of the trailer, which are thrown into a vertical position. At the same time the brakes on the rear wheels of the trailer are set, and the tractor can be freed and attached to another trailer.

National Association of Manufacturers Elects Officers

At a meeting of the board of directors of the National Association of Manufacturers, held in the Waldorf-Astoria Hotel, New York City, following the 24th annual convention of the association, the following officers were elected: President, Stephen C. Mason; treasurer, Henry Abbott; general manager and assistant treasurer, J. Philip Bird; secretary, George S. Boudinot.

Very Little War Motor Equipment to Be Sold

A comparatively small amount of used passenger and commercial cars, not adapted to Governmental use, will be sold at public auctions to be held at various military posts and camps beginning June 1, according to C. W. Hare, director of sales. The major portion of all present surplus motor equipment is now being transferred to Governmental departments. Over 10,000 motor trucks, passenger cars, ambulances and motorcycles have already been transferred, deliveries having been made to the Postoffice Department, the Public Health Service and the Department of Agriculture, the latter having received about 5000 trucks to date. As fast as the several states place in operation the consignments made through the Department of Agriculture, the director of sales will transfer additional trucks and roadbuilding machinery. The needs of the departments mentioned are expected to absorb practically the entire surplus of motor vehicles acquired for military purposes.

BUSINESS NOTES

THE ALLIED MACHINERY CO. OF AMERICA announces that it has increased its capital stock to $5,000,000. This was made necessary by the decision of the American International Corporation to group all of its machinery export selling subsidiaries under one head, completely absorbing the Allied Construction Machinery Corporation. The Allied Machinery Co. de France, the Allied Machinery Co. d'Italia and the Horne Co., Ltd., of Japan, while retaining their corporate entities, will also be directly connected with the Allied Machinery Co. of America, rather than the American International Corporation, as before. The Allied Machinery Co. of America is at present operating in 14 countries. J. W. Hook will continue as president. F. A. Monroe, in charge of administrative affairs, S. T. Henry, in charge of sales and advertising, and T. G. Nee, devoting his attention to the affairs of the Horne Co., Ltd., have been elected vice-presidents. R. P. Redier is general sales manager of the company, with headquarters in Paris.

THE STANDARD ELECTRIC AND ELEVATOR CO., of Baltimore, has opened a New York office at 280 Broadway, in charge of C. A. Yarrington, formerly sales manager of the company. M. H. Jones, with the Westinghouse Electric Mfg. Co. for 15 years, has resigned to succeed Mr. Yarrington as sales manager of the Standard company.

THE MASSEY CONCRETE PRODUCTS CORPORATION announces the opening on June 1, of a Pittsburgh office at 1405 Oliver Bldg., with A. F. Humphrey as resident manager. It also announces the appointment of J. A. Higgs, Jr., as resident manager of the Southeastern district, with headquarters in the Candler Annex, Atlanta, Ga.

THE CENTRAL FOUNDRY CO., New York City, announces that George A. Harder has been elected president and director of the corporation and its subsidiaries. Mr. Harder is also president of the Essex Foundry Co., Newark, N. J.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE JAEGER MACHINE CO, Columbus, Ohio; two catalogs, 7¾ x 10¾ in., 32 pages, and 6¾ x 10 in., 16 pages, illustrated; describe concrete mixers and the layout for their use.

THE LOCOMOTIVE SUPERHEATER CO., 30 Church St., New York City; Bulletin T-2, 8 x 10½ in., 8 pages, illustrated; describes the use of "Elesco" superheater to secure the advantages of the use of superheated steam in stationary boilers.

THE BUFFALO FORGE CO., Buffalo, N. Y.; section 400 of the catalog, 5 x 7½ in., pp. 403-436, illustrated; pertains to fans, blowers and exhausters.

THE WHITING FOUNDRY CO, Harvey, Ill.; folder, 8½ x 11 in., 4 pages, illustrated; gives names of users and describes Whiting bucket cranes.

WILLIAM H. WOOD, hydraulic engineer, Media, Delaware County, Penn.; catalog, 63 pages, illustrated; embraces all kinds of hydraulic machinery and improved locomotive boilers.

THE T. L. SMITH CO., Milwaukee, Wis.; two pamphlets, 7½ x 10¾ in., 16 pages each, illustrated; concrete mixers for paving work and pumps for construction and industrial work are the respective subjects.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor — CHARLES WHITING BAKER, Consulting Editor

Volume 82 — NEW YORK, THURSDAY, JUNE 5, 1919 — Number 23

Chicago Leads in Centrifugal Pumping

BY FAR the largest aggregation of centrifugal pumping machinery for water-works purposes is that of Chicago, which includes 16 plants having a combined capacity of about 400,000,000 gal. per day, with over 60% of the volume lifted electrically. The record of the growth of the Chicago installation, given on p. 1114, is a chapter in the development of large centrifugal pumping units for water-works plants that is well worth reading.

Water-Works Association Growth

GROWTH has been shown by the American Water-works Association for several years. This applies both to numbers and efficiency, but perhaps more notably to membership and to sectional organization than to the volume and character of work done. In fact, even before we got into the war there appeared to be a decline in accomplishments, at least as regards committee work. Naturally, the war checked committee work still further. It should now be resumed along well considered lines and with vigor. In particular, the committee on cast-iron pipe specifications should complete its work of revision and of unification of the American and New England specifications. There might well be a committee on methods of paying for water-main extensions, directed to gather extensive data on methods in use, to compare the merits and demerits of the several plans and to draw conclusions as to the best plan, or the most desirable plans from which to choose, to meet prevalent types of local conditions. In such a study particular attention should be given to assessments for benefits. These are only two of many kinds of committee work that might be mentioned as possibilities.

Public Service Through Technical Discussion

NOT often does an engineering society give such direct service to the community through technical discussion as did the American Society of Civil Engineers with its recent symposium on the Hudson River highway tunnel, recorded in the May *Proceedings* of the society. By taking up an urgent problem, one of exceptionally formidable engineering aspect, and giving opportunity for the free expression and clarification of opinion on its solution, the society afforded important help to the community in its largest present enterprise. Coming at the time when the technical organization of the Hudson tunnel work is being perfected, the discussion will almost at once produce a tangible gain to the community. It marks out the field within which must develop the final solution of the tunnel-construction problem on which New York and New Jersey have just agreed, and thereby it gives to the public the advantage of surer engineering decision, which will mean more efficient performance. Furthermore, the facts and views brought out in the symposium establish, if one will read between the lines, the urgent need for better intercommunication between New York City and its New Jersey outliers more convincingly than has yet been done. They tend to define the land-traffic problem of this terminal as a unit problem—one of great magnitude—and raise the question whether the trans-Hudson traffic situation is not more serious than even the most ardent advocates of bridge and tunnel projects have yet ventured to claim. The issues here, involving additional crossings of the river and elaborate connections for these crossings, are so weighty that only by focusing the full power of engineering thought upon the subject can a sound program of action be constructed. The society's discussion was the first step toward creating this condition.

Engineers for Hudson Tunnel

ANNOUNCEMENT has been made that six consulting engineers will be appointed to advise on the vehicular tunnel to be built under the Hudson between New York and Jersey City. Time was when it appeared that one plan—that for the 42-ft. single tube—had the clear right of way. Though proposed by an able tunnel builder and approved by an able engineer, obviously a project departing so far from standard practice requires not only close scrutiny in itself but detailed comparison with tried methods of construction. There are no less than four plans proposed, two concerned chiefly with type and two with construction methods—the large tube, a pair of tubes of customary size and two variants of the trench method of construction. Presumably, the engineers will be selected for their familiarity with the types of construction proposed; this, of course, does not apply to the large single tube, for that is unprecedented. The principle of the procedure is correct, that of a broad study of the question. If the appointments agree with the principle the commissioners will have competent data to guide their decision.

Municipal Rain-Gages

"THERE are far too few rainfall stations," said Robert E. Horton a few months ago (*Engineering News-Record* of Mar. 27, 1919, p. 614), in pointing out the inadequacy of our hydrological data. His statement has just had renewed illustration. During the heavy rainfalls of the past month many towns and cities reported short-time storms of unusual intensity. Rainfall rates exceeding any previously known are said to have occurred in some cities; tangible evidence such as the amount of water caught in vessels standing in the open confirms mere impression in this matter. Were local drainage works to be built in those cities, a definite measurement of the new maximum rainfall rate reached would be important, but for lack of a rain-gage no

measurement was obtained. A few cities maintain gages; most do not. May it not fairly be considered a proper municipal engineering function to provide rain gages and to keep exact records?

Flying the Atlantic

IN THE broad annals of engineering last week will mark an epoch. For the first time the Atlantic Ocean was crossed by man in the air. Those of us who have not followed closely the development of flying little appreciate the amount of painstaking engineering study and investigation that has gone into making that flight possible. We speak not of the details of Commander Read's crossing of the ocean, nor of the design of his plane and its accessories. We are thinking of all that has gone before in the way of study and experimentation, of the thousands of planes built only to be scrapped, of the thousands of lives that have been risked and lost in order that we might come to the NC-4 and her triumph. We are thinking, too, of our own Chanute and of Langley, of happy memory. Much as the thoroughness of the preparations, the weather reports and the bridge of ships extending from Newfoundland to the Azores, to Portugal and to England may detract from the possible romance of an Atlantic flight, the accomplishment is a tremendous one. It has furnished, so aëronautical experts tell us, many valuable data on which to base further oversea flying feats, and it will act as a stimulus for others to do their utmost, not merely to duplicate the feat, but to surpass it by a nonstop flight from land to land. From the historical standpoint, the outstanding fact is that the first successful flight from the Western to the Eastern continent—a distance by the Azores of 2150 nautical miles—was accomplished in 26 hours and 47 min. of actual flying time. Therein lies the compelling motive in the development of the method of flying—that it will bring the two continents much closer than they are today. Imaginations stirred by such an event can rove wildly, but he would be dull indeed who did not live in the expectation of mail transmission between Europe and America consummated in the space of a single day. As a regular method of postal conveyance, such a feat may be a few years off, but it has plainly been brought within the realm of probability.

City Planning Progress

TWENTY years ago city planning was a term rarely used in America, and then only by a few men who were almost universally held up to amusement or contempt as idle dreamers. Ten years ago the need for city planning had obtained sufficient recognition on this side of the Atlantic to warrant the holding of a conference on the subject. Similar conferences have been held year after year ever since. These have shown growth in numbers and in concreteness of discussion. At the start few engineers were in attendance. Year by year the number has increased, until, at the conference held May 26-29, 1919, at Niagara Falls, perhaps a fourth of the members were engineers. The proceedings of all the city planning conferences have dealt almost exclusively with severely practical matters, nearly all of which are within the engineering field as commonly understood and practically all of which are included within any broad view of municipal engineering. Of this no better evidence could be offered than the abstracts of conference papers and the report of the meeting given on pp. 1079 and 1133 of this issue. Many of the more progessive municipal engineers of the country are already members of the conference. The number should increase.

The Development Committee

AT MINNEAPOLIS there should be opportunity for crystallization of views with reference to the development committee of the American Society of Civil Engineers. The question should come up at the business session of the convention; it surely will in the corridor talk. In New York in January the preliminary report of the committee was passed without comment. No food for thought had been offered by the committee. The time available had been too short. The situation as far as it concerns measures proposed for discussion has not improved. But there is the difference that six months have gone by, six months that have multiplied questions as to what the development committee was doing and what good would come of it. In those six months, too, has come the demand that the executive power of the committee be changed at intervals. It will be singular indeed if after six months of silence the Minneapolis-St. Paul convention should pass without the taking of bearings on this important question.

Service Rather Than Honor

THE coming meeting of the nominating committee of the American Society of Civil Engineers makes apropos the repetition of a thought expressed at a meeting in New York in March. J. E. Johnson, Jr., since deceased, described many of the men elected to office in our national societies as men who had won reputations and who were afraid of damaging them by starting something new. While the particular turn he gave his thought renders it liable to dispute, it is true, as was expressed in these columns in the issue of Apr. 3, 1919, that in seeking to honor men by electing them to office we have at times sacrificed the interests of the societies. The older men have come to the time of life when they take up new problems with less energy, when the inclination is strong to be content with that which is. Age, however, is not essentially a disqualifier; rather, mental alertness and freshness of view are to be looked to. There are men who are old at 45 and others young at 70. The late Dr. Corthell, notably, belonged to the latter group. In these days, when new conditions are pressing upon us, the standard for selection, we should think, would be ability *and inclination* to serve the society.

Simpler Geometry of Compound Curves

ALTHOUGH the formulas for the treatment of the geometry of compound curves developed by Mr. Llano on page 1070 of last week's issue are not all new, they are apparently simpler theoretically and more convenient practically than any others heretofore developed. Being derived in a systematic way from a few sets of fundamental equations without the necessity of drawing special figures or going through any special investigations for every particular case, they make unnecessary the introduction of auxiliary quantities. They are an improvement over the methods adopted by other writers because they reduce to a minimum both the work itself and the probabilities of error. The apparent simplicity sometimes indicated in textbooks is often misleading, because when application is made it is found that the actual arithmetical work is exceedingly laborious and often involves much unnecessary duplication. While

compound curves are not now so frequently used in steam railroads, the spiral being generally resorted to as more efficient and economical, in minor roads and especially in street railways the compound circular curve is much used. Furthermore, in the original location of steam railroads running through open country, compound curves are usually determined by assuming the two radii and central angles and computing the tangent distances. Certain auxiliary circles given in the article will be found most helpful in the solution of such problems. In street railways, on account of limited space, many of the problems solved in this article are likely to arise. For example, in the construction of the Lexington Ave. cable road in New York City, the assumed directions of the tangents to connect with the Broadway line at 23d St. were found to interfere with the intricate system of water, gas, and electric pipes, making it necessary to change the alignment by swinging a tangent about one of the tangent points. This led to the solution of one of the problems given in the article.

Engineers Decline Executive Post

MUCH comment has been occasioned at New York by the reported refusal of certain New York engineers of the post of transit construction commissioner. They were good engineers, able executives, the comment runs—why, then, did they decline a post concerned exclusively with the execution of engineering work? We are not in a position to answer for the engineers in question, but we do know that the post is not an enviable one. All our readers will remember the hamstringing of the commission by the Board of Estimate and Apportionment when some 300 engineers were dropped last winter. It is a position of apparently large responsibility, with the incumbent's hands effectively tied, if the board wishes to tie them. The case, then, is not typical. It is likely to be a position beset with much grief.

Executive Versus Technical Ability

THE declination by engineers of the post of transit construction commissioner at New York, discussed in the preceding note, brings up the old question of engineer executives. Fortunately, we are class-conscious. We like to see one of our own number succeed, not merely for his own sake, but because of the luster he sheds on the profession. We believe, too, not without reason, that, given two executives of equal executive ability, the one with engineering training, if the position is one in charge of engineering work, will give the better account of himself. He will grasp the problems more quickly; his analytical ability, developed by his scientific training, will enable him more certainly to get at the essentials. But in the enthusiasm for our fellows and our profession we ought not to lose sight of the fact that executive work is distinct from technical work, and that success in it springs from qualities not necessarily developed in an engineering course. In fact, the qualities are but little developed in any college course. They depend more upon inherent qualities and on those developed outside of college—or at least outside the classroom—than upon book-training. The appointing officer, looking for a capable executive, must seek executive qualities first. If for a job much concerned with engineering he finds an executive who is also an engineer, so much the better—but his first responsibility is to find the executive. When we come to the appointment of an engineer as a member of a commission charged with an engineering project the situation is somewhat different. The transit construction commissioner at New York is a sole commissioner. As a rule, the qualifications needed on a board are judicial, rather than executive, and here the engineer will be invaluable, even though he does not possess executive ability. Of one thing though, there must be warning—of the temptation of an engineer-commissioner, or of an engineer-executive, to become the chief engineer as well. Confusion of judicial or purely executive work with technical detail is likely to lead to disaster.

Water-Supply and "Mobexpertocracy"

THE delay in obtaining a pure and adequate water-supply for Sacramento, Calif., has continued so long that, according to an editorial in the Sacramento *Union*, "gray-haired men are numerous in this city who remember the eternal discussion over a municipal water-supply that went on when they were boys. From that day to this not an advance has been made." The course of events shows how a city should not go about securing a water-supply. "Mobexpertocracy" was a word used editorially in *Engineering News-Record* of June 14, 1917, to denote the chief obstacle to progress. In the main the conditions deplored then still obtain.

The unusually comprehensive report covering well, river and mountain sources that was prepared three years ago by Messrs. Hyde, Wilhelm and Miller has not been acted upon. It seems rather to have added fuel to the fire of debate and discussion, despite the fact that there is no question about the capability or the unbiased judgment of the engineers who made the report. Since the first of this year a citizens' committee, unable to reach a conclusion, has called in C. E. Grunsky to add to the engineering reports on the subject. After a careful study Mr. Grunsky recommended the immediate construction of a filtration plant for purifying river water. The committee was wise enough to indorse the recommendation. An election has been called for June 26 to vote on a bond issue of $1,800,000 for carrying out the project recommended—a slight modification of the Hyde plan.

The use of wells as a source of supply, so strongly urged by one faction in the controversy, has not been recommended in either of the two reports mentioned because of the uncertainty of their yield, the litigation that would probably result from lowering the water table, and the question as to whether unsafe surface waters could be excluded. To avoid affecting the water table, wells would have to be near the Sacramento or American River, in which case a purification plant would be needed. A mountain supply, desirable though it may be, is not now feasible, it has been agreed, because of its high cost, but should the time come when it is feasible the proposed river filtration plant would become a standby or safety feature.

Engineering News-Record has no brief for any of the sources, but when experts agree, as they have in this case, and when exhaustive studies indicate some safe and sure means of relief, then it is not only unwise and unprogressive, but it is unlike our American spirit, to heed the lay "experts" who have nothing constructive but only pet theories to offer.

The issue seems to be clear. It will be interesting to see what the voters of Sacramento decide on June 26.

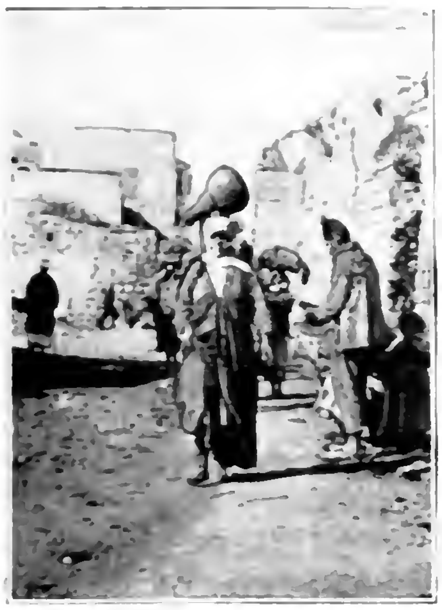
Ancient, War-Time and Present Water-Supply in Jerusalem

How General Allenby's Engineers Brought Water from Nile Across Desert—Ancient and New Permanent Water-Supplies of Jerusalem—Important Part Played by Caterpillar Tractors and Modern Pipe

By H. Y. Carson

Lately Captain and Sanitary Engineer, American Red Cross Commission; now With the Central Foundry Company, New York City

IN CARRYING the work of the American Red Cross into Palestine, following the reclamation of the Holy Land by the British troops, one of the first duties undertaken by the commission was that of surmounting the troubles occasioned by lack of proper housing and sanitation. Many of the troubles were due, primarily, to the difficulty of obtaining pure water.



IN THE VILLAGE OF RAMLEH

Carrying water jars on the head is still common in all Palestine.

The introduction of water into Palestine from the Nile is said to have been predicted thousands of years ago. It is no longer a prophet's dream, as the Nile water was brought to Palestine by General Allenby's able engineers when they fought successfully over the desert more than a year ago. American pipe and American equipment, joined with British ingenuity, accomplished the thing which had been foretold so many years ago. Caterpillar tractors hauled the pipe from Egypt over the sand of lower Palestine. The pipe and tools were the property of the Standard Oil Co., and were stored in Egypt just prior to the war. They were to have been used for piping oil from the recently developed oil fields there.

The water brought into Palestine at the rate of several million gallons per day was pumped from the so-called "sweet-water canal" near Kantara which has its source in the Nile. The British Royal Engineers erected at Kantara rapid sand filters very much like those on the Mississippi and Ohio Rivers. The plant at Kantara had a capacity of 5,000,000 to 10,000,000 gal. of water daily. Pumps sent by rail from Cairo impelled the purified Nile water through a 12-in. pipe across the Suez Canal and about 50 miles beyond the desert. At this point the water not actually used along the line was "picked up" from a newly constructed reservoir and delivered into a 10-in. pipe through which it was carried northward about 40 miles. Originally it was again pumped through an 8-in. pipe line some 50 miles to Gaza, but this force main has since been discontinued.

The pipes were laid directly in the sands of the desert and followed for the most part a parallel with the newly constructed railway. All of the piping, except for expansion joints, was covered with the soil or sand to a depth of 18 in. or more, thus protecting both the pipe and the water from the intense heat of the Palestinian sun. These waters of the Nile served only the lower portion of Palestine, the supply for such cities as Jerusalem, Gaza, Beersheba and Jericho being obtained from local sources, springs, wells, etc., some of which yield an abundance of pure water, others a scanty supply.

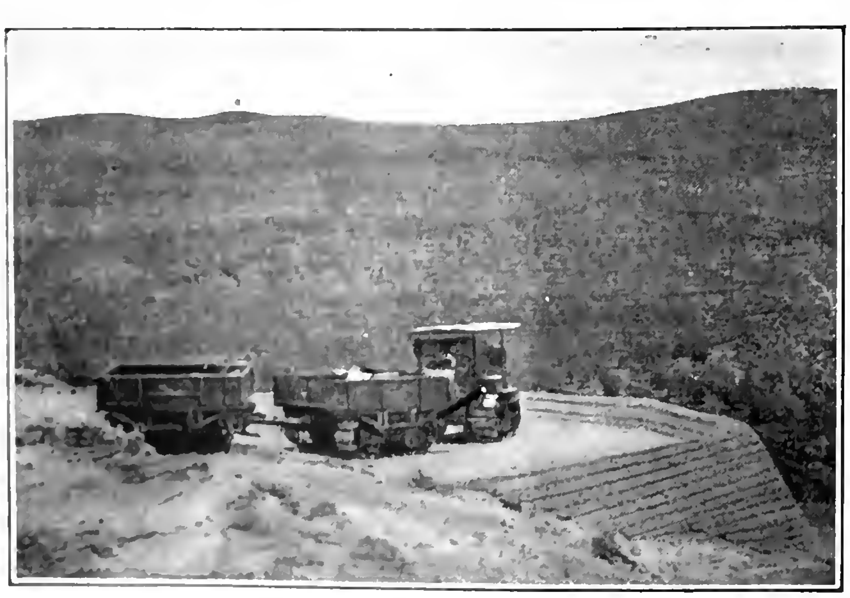
Under the surface, however, can be found plenty of water in all of the regions north of Beersheba. The geological formation and the meteorological conditions of Palestine account for the fact that very little water is retained on the surface of the ground. The surfaces are stony, the stone is mainly dolomite limestone (there is also some flint), so that the rain that comes during the winter soon percolates into fissures or crevices in the stone. Very little of the total rainfall runs directly to the sea; actually no rivers exist in Palestine except the Jordan, which, as is well known, is located in a huge "fault" far below the sea level.

On the western slopes of Palestine it will be a quite easy task to impound water, as the valleys or "wadys" are very steep, forming excellent reservoir sites for collecting the winter rains. The sites must be selected on flintstone formation, or else must be carefully treated so that the water will not escape by percolation into the crevices. One way of treating the slopes of the reservoirs would be to bare the stone surfaces and go over the crevices with a cement gun, thus stopping all the openings through which water can escape.

The climate of Palestine is subtropical, but it seldom rains during seven out of 12 months of the year. Although Palestine during its early history was a prosperous agricultural state, the Turks have simply stripped it of its trees, leaving the whole country a barren waste, as compared with its early reputation of the "Promised Land."

From the very earliest times, the inhabitants of Palestine have been hard pushed to obtain a supply of wholesome water, and possibly no other one physical attribute has so affected the political and religious history of Palestine. History relates how Hezekiah stopped up the outer entrance to the spring, "the Virgin's Font," in order to cut off the water-supply of those besieging Jerusalem, and brought it straight down to the south side of the city of David. The Bible further relates how "Hezekiah prospered in all his works."

Hezekiah carried out what is, to me, one of the most wonderful engineering tasks in history. The tunnel which he constructed stands almost unexplainable today.

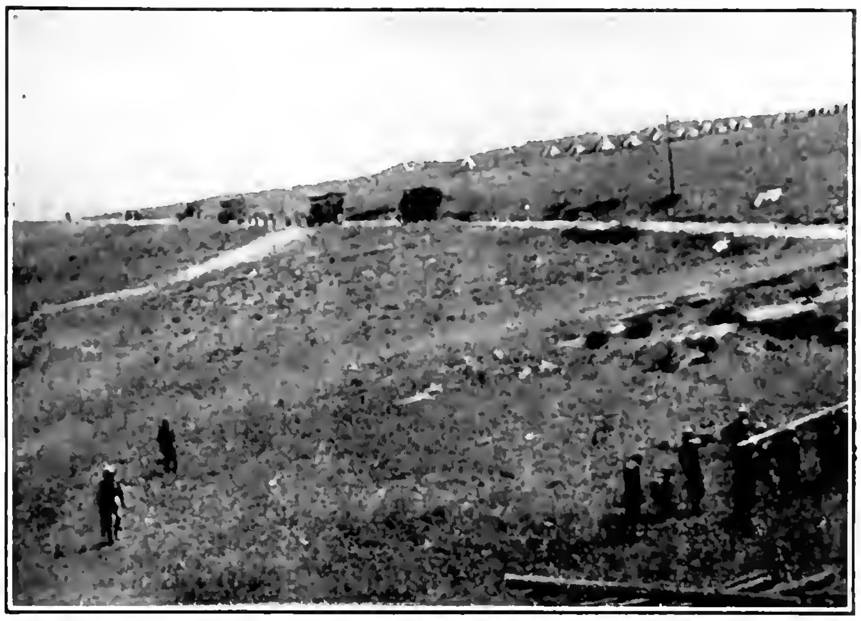


HAIRPIN BEND ON JERUSALEM-RAMLEH ROAD

Illustrating difficulty of transporting materials in Palestine. Caterpillar tractor and two trailers in foreground. Beyond is steep slope of one of the "wadys" which afford possible reservoir sites.

Hezekiah's engineers conducted the water through the limestone hill from the east to the south side by a marvelously built conduit 1750 ft. long. An ancient Hebrew inscription on the west entrance of the tunnel has been translated to read: "The boring. And this was the manner of the boring . . . the pick each toward his fellow . . . boring the hewers struck each to meet his fellow, pick against pick, then went the waters from the issue to the pool for two hundred and a thousand [1200] cubits. . . ." The water flowing in this ancient aqueduct is still used from the Pool of Siloam, which is the terminal point of the tunnel. History seems to indicate that the water was conducted through the hill so that the intermittent spring on the east side of the village could be closed up and all of the water diverted into the Pool of Siloam.

One might easily go on describing the interesting part which water-supply has played in Palestine's history, but suffice it to say that today the land of Canaan needs the modern engineering skill of the West as it needs nothing else, for the development of its water-supply.



PIPE TRANSPORTATION AND LAYING IN PALESTINE
Tractors on Jerusalem-Hebron road hauling pipe for Jerusalem water-supply. Laying 6-inch pipe, in right foreground

its agriculture, its industry and its very place among the modern nations of the world.

Besides Hezekiah other noted men—Solomon, Pontius Pilate and Herod—attempted to get a supply of pure water into Jerusalem, but it remained for the British to do the job in little less than 70 working days. Water is now flowing by gravity through a 6-in. line from the springs at Wady-el-Arub, south of the city, at the rate of over 200,000 gal. per day. The total capacity of the line, which has a delivery head of 200 ft., is 300,000 gal. per day, but the springs have twice this capacity.

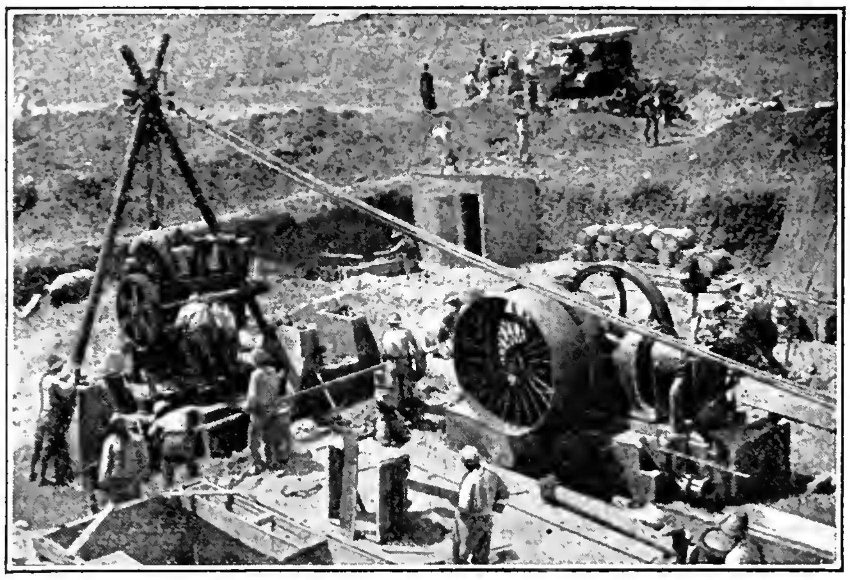
The springs at Arub are located about 16 miles south of Jerusalem, on the Bethlehem road beyond Bethlehem. It was probably Pontius Pilate who carried out with Roman engineers a wonderful piece of work there by developing the spring in the form of a gallery, collecting and conducting the water by aqueduct into a stone reservoir of 5,000,000-gal. capacity located about 2000 ft. from the main spring. Thence Pontius Pilate conducted the water to the center of Jerusalem, probably the temple site, by an aqueduct so marvelously constructed that it stands almost intact to this day. Moreover, the British Royal Engineers found little difficulty

THE LOWER OF THE POOLS OF SOLOMON
The pools have a total impounding capacity of 80,000,000 gallons

in putting the spring and reservoir into service. The water is now elevated by a pump and a 66-hp. gasoline engine into a newly constructed reservoir on the top of a nearby hill. This new reservoir has a position over 500 ft. above the temple site in Jerusalem.

Practically every house has its own rainwater cistern, and it has been estimated that if all these cisterns in Jerusalem were full they would contain 360,000,000 gal. But most of them are usually found to be filthy. One recently inspected by the Sanitary Department had not been emptied for 19 years. Before a cistern is filled with pure water, however, the owner must obtain a certificate from the newly organized health department to prove that his reservoir has been rendered sanitary and mosquito-proof. He is then provided with enough water, through a temporary pipe line, to fill his cistern entirely, regardless of its size. The organized effort to supply pure, sparkling water to the 50,000 residents of Jerusalem has enabled them to have ten times more water than formerly. The picturesque water vendor, with his pigskin pack on his back, likewise the water fantanzies aboard the camel and the donkey, as well as the more charming picture of the native virgin carrying a sheriby (a thin, porous, earthenware jar) on her head, will soon be but a memory of Jerusalem. It is more to be hoped that the terrible water-borne diseases so common when Palestine was under Turkish rule will likewise pass quickly into the forgotten past.

The speed with which British sanitary engineers put



ERECTING PUMPING PLANT FOR JERUSALEM
At Berket-el-Arub, Kilo 23, Hebron road. Two 66-horsepower Hornby engines to lift 300,000 gallons of water under 500-foot head. Caterpillar tractor at work, in background.

into operation this new supply of clear spring water from the vale of Arub will ever stand in engineering annals. A preliminary investigation and survey of the ground was made Feb. 14, 1918, and a scheme was submitted four days later. Owing to the shortage in transport and unusually bad weather, it was not possible to begin work until Apr. 12. Even then the mud interfered with the huge tractors which hauled the many miles of pipe. The pump, which has a working capacity of 300,000 gal. per day under a head of 500 ft., the two 66-hp. gasoline engines brought from Cairo, and the pipe, were in shape for delivering water into Jerusalem by June 18—just 67 days after work commenced.

Jerusalem the Golden could be furnished with an ample supply of pure, sparkling water at a lower cost than it could be done in most American cities. It is possible to supply more than 20,000,000 gal. per day, and this will be sufficient in this country for a population of 1,000,000. In addition to the development of springs at Arub, a similar supply can be had at Wady Kelb, 12 miles distant. At Ain Fowar the winter rains can be impounded and the pools of Solomon can be put into service again with comparative ease.

Water-Waste Education by Bulletins

COINCIDENT with a comprehensive water-waste survey and intensive inspection methods in Buffalo is a campaign of education by bulletins issued periodically by the water department and circulated particularly among the less well informed consumers. The water-saving procedure was described in *Engineering News-Record* of Dec. 5, 1918, p. 1033. The material for the bulletins is taken largely from official records, which are put into easily understood language, with diagrammatic views of such things as the distribution by classes, coal consumed in pumping, water used and wasted, water consumption in other cities—showing Buffalo at the head of the list with its 339 gal. per capita.

One bulletin contains a succinct seven-paragraph description of the water-works system. Another contains instructions for repairing leaky faucets and closets of various types, and presents a table of waste for openings of various sizes. An explanation is made that coal saving during the war became much more than a question of thrift, since the bureau of water, which buys for pumping twice as much coal as either Cleveland or Detroit use, was notified by the Fuel Administration that its coal allotment had been cut from 65,000 tons to 50,000 tons per year. Waste prevention only could effect this saving. This statement was followed with results from eight test meters placed on services with antifreezing toilets, the estimated annual consumption averaging 2,300,000 gal. per year, ranging from 69,000 gal. (one toilet) to 9,580,000 gal. (two toilets). If billed at meter rates the owner of the latter service would have had to pay nearly $400 for his neglect. The regular rate is $1.50 per toilet, although a recent ordinance has raised it to $10 unless an inspection is made and an affidavit filed that the service has been kept in repair. Other points covered are the harm of sprinkling a lawn more than the three hours allotted, and the enormous waste caused by letting water run for cooling purposes.

One incentive to save that is set out is that plans for filters will be started only when the average daily consumption reaches 100,000,000 gal. It is now 124,000,000 gal. and was 163,000,000 gal. in 1917. Bills would be increased by filtration 62% if waste were not stopped, while the people can have filtered water for a 22% increase if the 322-gal. rate is reduced to 175 gal. As the rates decrease that fact is noted and the coöperation of the people is duly recognized.

Just how effective the bulletins are George C. Andrews, commissioner of water, by whom they are issued, is unable to say, but he is sure they give the consumer some understanding of a complicated public utility.

Niagara Falls to Be 100 Per Cent. Metered

FACED with the alternative of spending $500,000 for more filters and additional mains or of placing meters on every service, the Niagara Falls water department has recently decided to become 100% metered. The 3000 meters necessary are now being installed, and would all have been in place June 1 except for a plumbers' strike which threw the work upon the city's own force of two gangs. The installation will be completed this season, but Charles T. Shepard, superintendent, is of the opinion it will take three months before the majority of the consumers realize that they have leaks which must be stopped.

In a report dated Mar. 7, 1918, Mr. Shepard stated that the 16,000,000-gal. normal capacity of the filtration plant had been exceeded on cold winter days of 1917 and that the year's consumption was 26% more than that of 1916. A water-waste examination indicated that the 4000 flat-rate consumers were using 350 gal. per capita daily at a rate about seven times as much as the 3750 metered-service consumers. Manufacturing plants and large buildings consumed 32.9%; domestic services, metered, 6.6%; the city, 10.7%; flat-rate consumers, practically all domestic, plus all other unaccounted for consumption, 49.8 per cent.

Financially considered, 39.4% of the total metered pumpage paid 48.5% of the revenue obtained. This included 6.6% of the domestic metered pumpage, which paid 16.2% of the revenue. The flat-rate consumption and that used by the city produced 51.5% of the revenue. The flat-rate consumers are getting water for the lowest rate, 2.23c. per 1000 gal., which is not profitable, while the total water pumped was sold for 3.657c. The industries pay 3.44c., and metered customers 4.49 cents.

It is estimated that the installation will reduce the annual gross revenue more than $20,000, but the rate of return will be materially increased, and the cost of chemicals and power will be reduced by $4700 per year. The principal saving, however, will be in the 5,250,000 gal. of water, thus putting off for at least five years the time when the works must be enlarged.

Meters are installed by the city at nominal cost to the consumer, a flat charge of $10 being made for each ⅝-in. service. All except about 100 meters will be placed inside the houses. Those in pits, which are being left to the last, will be set at the bottom of an 18-in. tile, 3 ft. long, bell end down, the service pipe being brought up from the usual 5- to 6-ft. depth. A cast-iron cover will be set on the top of the tile and a wooden disk placed on top of the meter, thus creating an air space to prevent freezing. A full-time meter superintendent will be employed, but the number of meter readers will not be increased, the city being redistricted so that the reading will be continuous throughout the year.

New Coal-Handling Plants for Philadelphia Water-Works

General and Detail Design of Three Systems Supplying a Total of 16 Boilers With a Total Boiler Capacity of 7400 Horsepower—Costs Reduced as Compared With Old Methods

By Harrison R. Cady
Bureau of Water, Philadelphia, Penn.

THE Philadelphia water-supply system was completed, in so far as new plants and major projects are concerned, in 1911, when the Queen Lane filtration plant was put in operation. The system now takes an average of 325,000,000 gal. daily from the Delaware and Schuylkill Rivers, filters it, and distributes it over an area of 129 square miles. While the filtration plants are all of comparatively recent construction, some of the pumping stations have been in operation for many years. Consequently, the increase in water consumption, together with deterioration and obsolescence of plant equipment and methods, has necessitated considerable work in the nature of reconstruction and the installation of new equipment. Much work of this kind was done in the four years previous to 1917, but in that year war conditions caused the abandonment of all new work which could be deferred. The more important undertakings include the installation of three complete coal-handling systems, 5400 hp. of boilers, mechanical stokers for 9400 hp. of boilers, 16 pumping units having an aggregate capacity of 195,000,000 gal. per day, and a complete high-tension generating and transmission system furnishing current for lighting and power at five small stations. This article will describe the new coal-handling systems. The general equipment of all five pumping plants is given in the accompanying table.

Belmont—The principal features of the coal-handling system at this station are shown in Fig. 1. About 115 tons of anthracite barley coal are used per day. All shipments are received by rail. Cars are dumped into the storage bins, beneath the tracks, where about 3000 tons can be stored without trimming. The bins have hopper-shaped bottoms leading to gates which feed the cross conveyor, a flight-type apparatus extending through a tunnel under the bins and discharging into a bucket conveyor. This conveyor carries the coal through a branch tunnel to the boiler house, elevates it

EQUIPMENT OF PUMPING STATIONS, PHILADELPHIA

Station	Boilers Number	Boilers Horsepower	Pumps Number	Pumps Horsepower
Belmont	6	3,000	6	6,300
Queen Lane	8	2,400	5	5,600
Shawmont	4	2,000	6	4,500
Torresdale	9	2,950	8	4,000
Lardners Point	14	7,000	13	16,000
Total	41	17,350	38	36,400

and discharges it into the suspended steel bunker in front of the two boilers at the north end. From this bunker, having a capacity of 200 tons, the coal runs down into a 2000-lb. electrically operated weigh larry which distributes it to the stoker hoppers.

In this plant, as well as at the Queen Lane and Shawmont stations, the installation of the conveyor system was coincident with the change from hand-firing to mechanical stokers. Consequently, there is some difference in the point of delivery, a difference which would have worked to the disadvantage of the old system. In the comparative analysis of costs this difference will not be considered.

Under the old system, at Belmont coal was dumped into the same storage bins that are now used, and was trimmed to push cars which were moved on tracks, located substantially as shown in Fig. 1, to firing position in front of the boilers.

The cost of dumping cars and delivering coal to stoker hoppers under the new system is 24c. per long ton. This includes labor, interest, depreciation, maintenance, and power costs. Under the old system, the cost was 29c. per ton under pre-war labor prices, which would mean about 40c. per ton at present labor prices.

Queen Lane — The general location of this station, as related to streets and railroad line, is shown in the sketch plan forming a part of Fig. 2. The other portions of Fig. 2 show the principal features of the coal-handling apparatus and the storage bunker which constitute the new system. This station uses about 100 tons of anthracite barley coal per day, and receives all shipments by rail. The storage bunker, over which cars are placed for dumping, has a capacity of 3200 tons, without

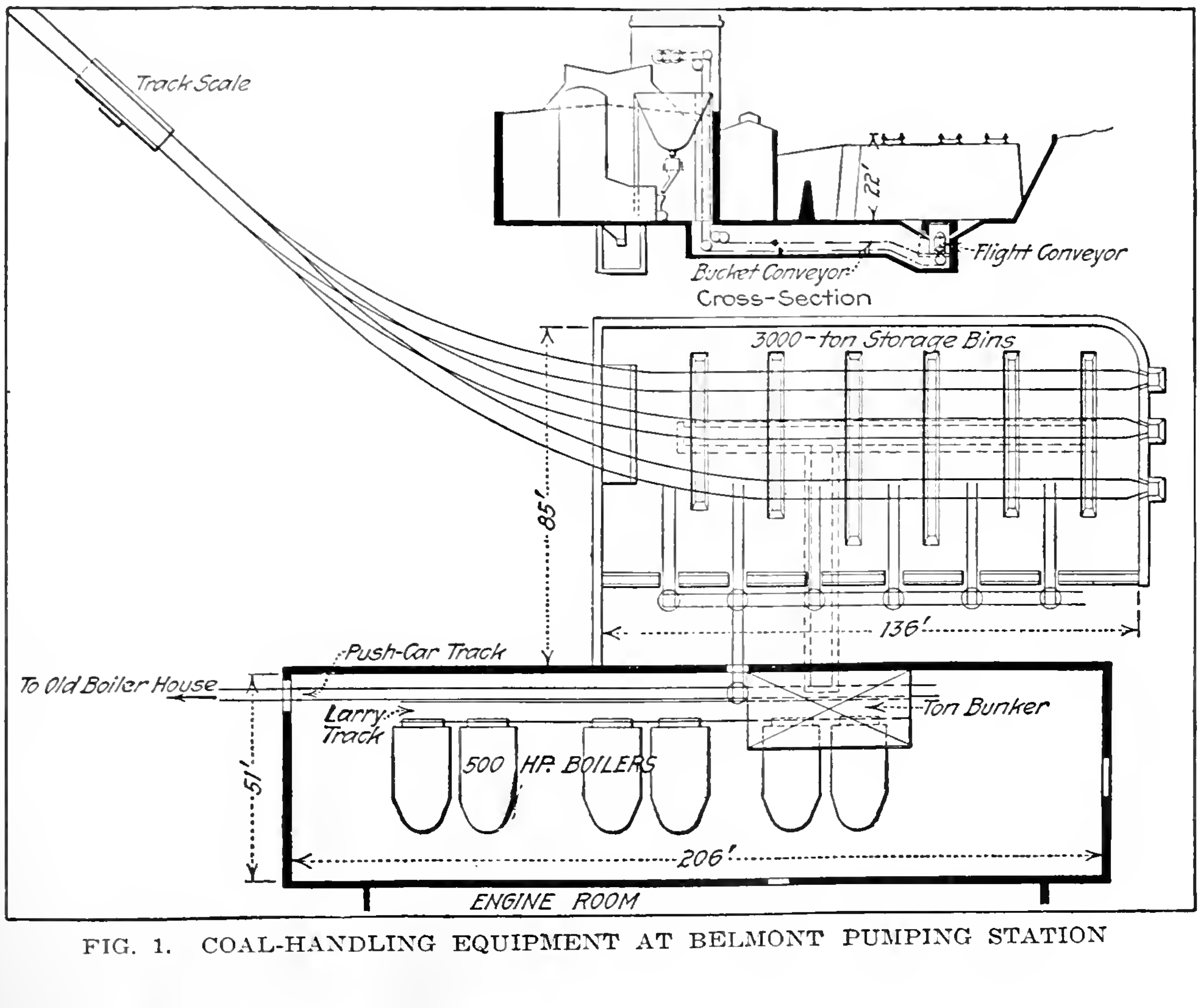


FIG. 1. COAL-HANDLING EQUIPMENT AT BELMONT PUMPING STATION

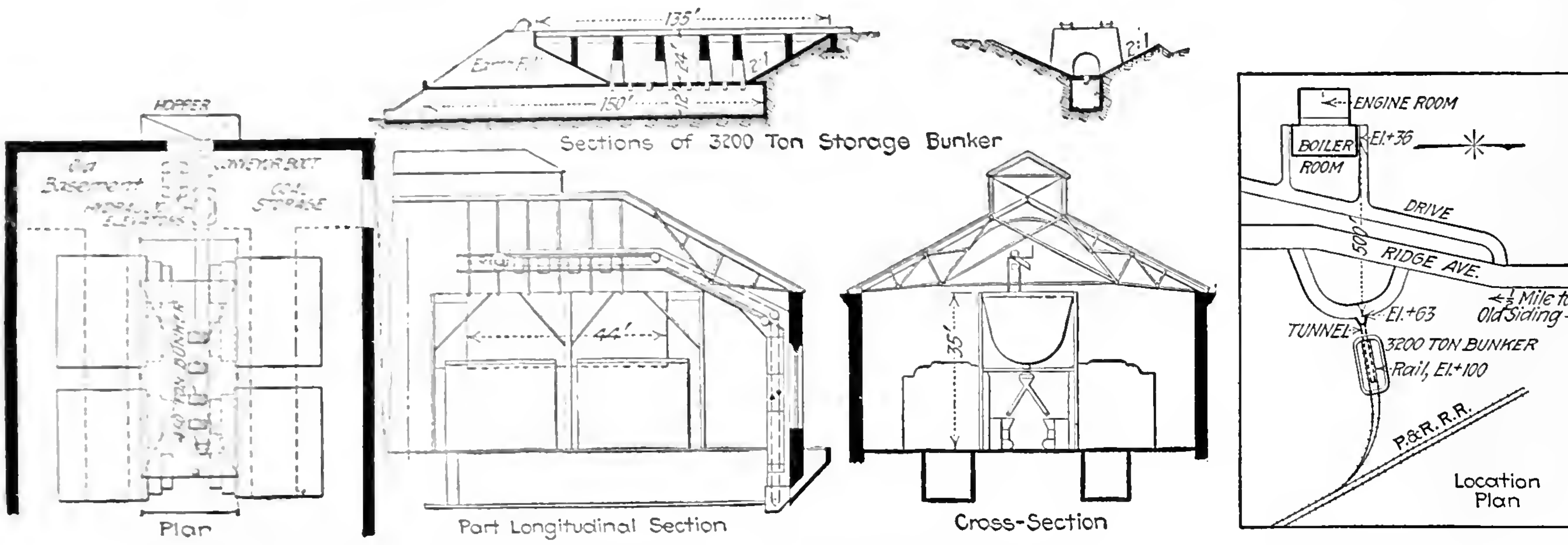


FIG. 2. GENERAL LAYOUT AND DETAILS OF QUEEN LANE STATION COAL-HANDLING PLANT

trimming. From gates at the bottom of this bunker the coal is discharged into motor trucks which haul it to the north end of the station, there dumping into a small hopper feeding a bucket conveyor. This conveyor, which has a capacity of 20 tons per hour, elevates the coal and distributes it along a suspended-type steel bunker of 450-ton capacity. Distribution to stoker hoppers is effected by means of a 1000-lb. hand-operated weigh larry. This larry is found uneconomical here and will be replaced by downspouts in the near future.

Under the old system the coal was hauled from a siding, more than one-half mile distant, where no dumping facilities were available, and it was necessary to shovel from the cars to wagons. The coal was dumped from wagons to bins in the basement at the north end of the boiler room and trimmed to push cars which were brought to the floor level by hydraulic elevators and then moved to firing position in front of the boilers.

At this station the cost of handling from the receiving hopper to stoker hoppers, with the new system, is 23c. per long ton, while the cost of unloading cars, storing and hauling is 24c. per ton, making a total cost of 47c. per ton. Under the old system the cost of handling was about 43c. per ton except when it became necessary to store coal in outside piles, when the cost of recovering was considerably increased. With the old apparatus and present labor prices, the cost per ton would be about 75 cents.

Shawmont — The general layout and details of this station system are shown by Fig. 3. About 70 tons of bituminous coal per day are used here, and all shipments are received by rail. The present coal-handling system was completed in 1916. Cars are dumped into a track hopper, with a capacity of 50 tons, which feeds a double-roll crusher. From the crusher a bucket elevator lifts the crushed coal to the conveyor gallery, where a flight-type conveyor carries it to the boiler room and distributes it in the bunker. This bunker is of the suspended-steel type and has a capacity of 275 tons. Distribution to stoker hoppers is accomplished by means of a 1½-ton motor-operated weigh larry. To provide for cases of delayed or irregular shipments a small storage pile is kept in the old storage shed; the coal from this is brought in push cars to the crusher.

Before the installation of the new system coal was received in the old storage shed which had a capacity of

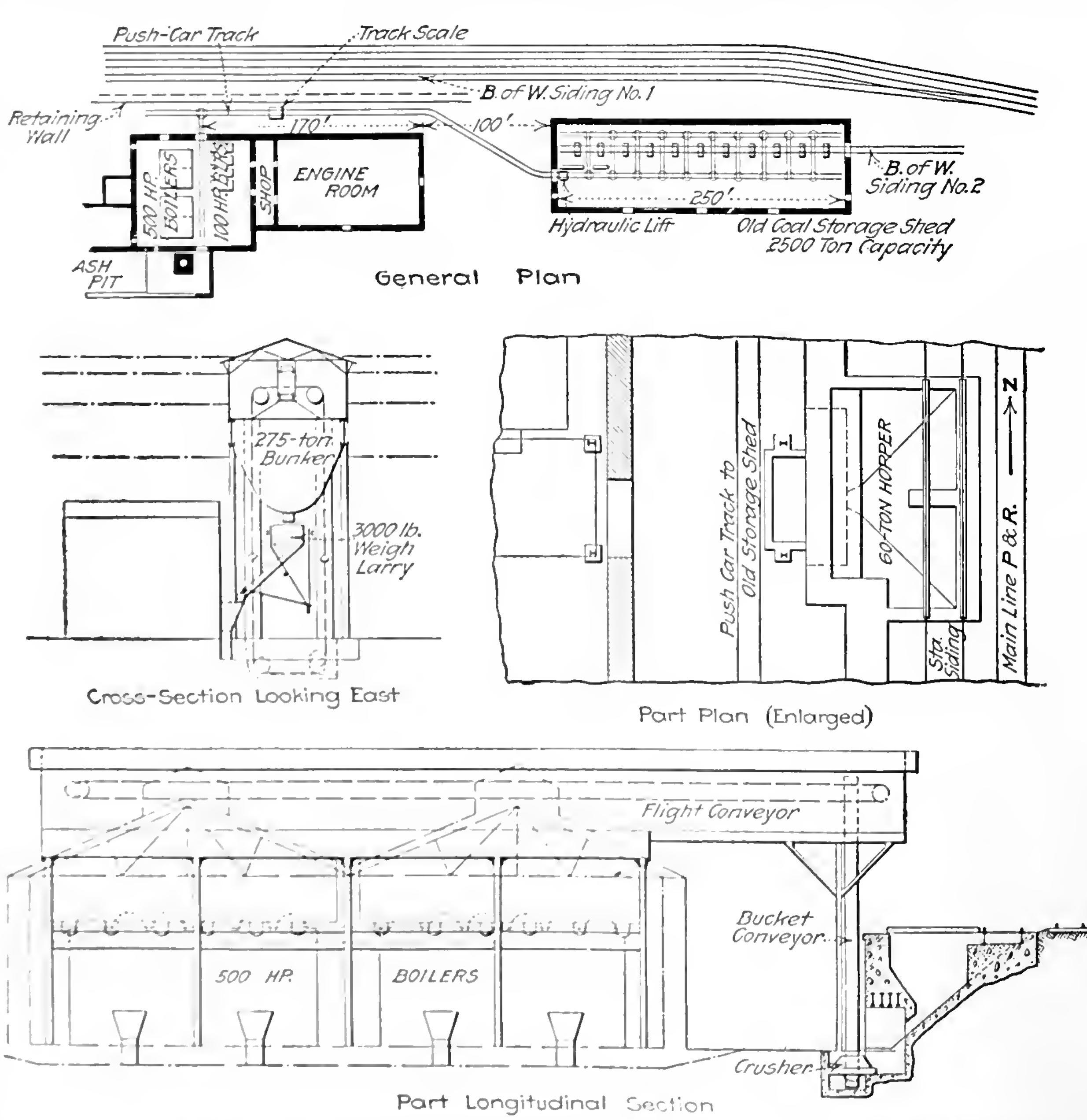


FIG. 3. PLAN AND DETAIL OF COAL-HANDLING PLANT AT SHAWMONT STATION

2500 tons, and was dumped from cars without trimming. The coal was then trimmed to push cars and moved by hand, on tracks shown in the general plan (part of Fig. 3), to the firing aisle in front of the boilers.

The total cost of handling the coal from cars to stoker hoppers and crushing is 24½c. per ton, not including the cost of dumping cars. Adding the latter cost, which amounts to about 8½c. per ton, we have a total cost of 33c. per ton. Under the old system it cost 34c. per ton to handle the coal from the cars to push cars in front of boilers, and increasing this cost to meet present labor prices would make the cost of handling coal now, with the old system, about 44½c. per ton.

To summarize the work of the three systems: In handling a total of 103,300 tons in the past year a saving of $19,150 was effected on the cost of operating the old systems. While this figure may be somewhat reduced in the future, due to lowering of wage scales, it will still remain high, for labor is by far the largest item of cost; and to offset any such reduction there will be certain improvements in operation and apparatus. In addition to the saving in handling costs, to the Queen Lane station has been afforded an easily recoverable reserve storage of 3200 tons, and the Shawmont station has crushing apparatus. The total cost of the three systems was about $54,000, of which the cost of the Queen Lane station's storage and hauling equipment amounted to about $27,000.

Some Engineering Problems of City Planning

Abstracts of papers before the National Conference on City Planning, held at Niagara Falls and Buffalo last week—Regional planning, industrial cities, the steam railroad and the city plan, the common sense of civic centers

Regional and Town Planning

By Thomas Adams

Housing and Town-Planning Adviser of the Canadian Government, Ottawa

TO PLAN our cities and towns properly we must investigate and analyze many problems which have a bearing on life and growth within and surrounding them. Recent tendencies in industrial decentralization have shown the importance of one of the modern aspects of town planning, namely, the direction and control of the growth taking place within the rural and semi-rural districts where new industries are being established. The artificial boundaries of cities are becoming more and more meaningless. The real controlling factors which determine and encourage industrial growth are physical and natural to a greater extent than they are administrative and artificial.

One of the difficulties in dealing with this subject is that we have not yet adopted a clear and unambiguous terminology. Some definitions are in order:

1. *The regional survey* has to do with the investigation and mapping of the existing physical, industrial and residential features of a region that has interests and problems in common, which needs comprehensive and coördinated treatment without regard to arbitrary administrative boundaries.

2. *The regional plan* is concerned with the general planning of the area included in a regional survey. It is a skeleton and tentative plan of a region within which there is comprised a series of municipal units in juxtaposition with one another, and having overlapping and interrelated problems. The width, direction and classification of our main and secondary highways should be governed by the needs of such a region and not by the needs of one municipality within it. This principle is fully recognized in Ontario highway legislation, in regard to the principle on which the cost of construction is apportioned.

The planning of our system of communications in the regional plan should also have regard to the classification of land for different purposes of industry or residence. Land should be classified in a general way for industries, for residences and perhaps for agriculture, for park areas or for special reserves, or as unsuitable for building purposes. We would also consider within the region how far it is desirable to prescribe a code of housing and town-planning regulations to deal with building conditions that need to be dealt with in common over large areas of different character. Sewerage and water-supply may have to be dealt with in large regions to obtain efficient and economical schemes, in cases where it is not practical to get an efficient system of either in separate units of administration. These and other problems that can be dealt with in a preliminary and general way need regional rather than municipal treatments.

3. *The town plan* is the definite plan, accompanying a definite piece of legislation, for fixing within the city or the country areas, first, those parts of a regional plan which are locally approved, and, second, the civic design and regulation dealing more intimately and precisely with the problems connected with the growth of the town, its means of communication, its industrial development, its residential areas, its character and density of building, etc.

We thus have three distinct processes, connected with one another and logically leading up to one another, which are the regional survey, the regional plan and the civic plan. It is unnecessary for me to argue with town planners how hopeless the task is to attempt to prepare a plan without having obtained accurate data regarding existing physical and industrial conditions.

We hear much of reconstruction. One of our greatest needs is to know what and how to reconstruct. In parts of Europe the work of reconstruction is simple and clear. It is a matter of rebuilding what has been destroyed by war. Here, reconstruction has to deal with involved human and economic problems, with transition from disorder to order, with remedies for traffic confusion, and with bad housing and wastefulness of resources. As an English writer recently said, "the monument which this war demands is the reconstruction of the material fabric of civilized life, its reconstruction upon a survey and a plan," and, as Carlyle said long ago, the most effectual of all work of man is wise planning.

It is impossible in this brief paper to analyze the complex problems that need consideration in the regional survey and the regional plan. All that I can

attempt to do is to present some of the reasons why they are necessary and to indicate some of the problems with which they have to deal. I claim that the nature of modern growth of communities, of the relation which exists between different elements in our community life, and the changes which are ever taking place in methods and conditions, impose upon us the obligation to deal with the regulation of growth on elastic principles over wide areas, and at greater expense of time and money than we have hitherto given to it. We must not only prepare our schemes by gradual steps, but prepare them in such a way that gradual fulfilment will be obtained. While our ultimate objective must be clear in our minds, we must be content to work toward it by successive steps instead of jumping to the concluding stages without adequate measures of preparation.

The Niagara district seems to me to be one which needs the making of a regional survey and a regional plan as a preliminary to a series of civic plans for its city, town and county areas. Neither Buffalo nor the Tonawandas nor Niagara Falls is a strategic conter. They are parts of a strategic center of 1000 square miles in extent on both sides of the Niagara River. The problems of this region are international, and give us proof that the power of natural conditions is so great that even the boundaries of nations do not form intelligent and appropriate boundaries to regional and town-planning schemes. Indeed, may we not hope that in the process of planning them we will help to knit these two nations, their industries and people, closer together; and also that the bridge which we propose to erect as a symbol of peace will be more than that, will be a symbol of coöperation and mutual respect? Personally, I should like to see something more than a physical bond; such a bond as could be provided by a regional planning commission representative of the State of New York and the Province of Ontario, to deal with the planning problems of the Niagara district. That need not be an idle dream, any more than the creation of an international waterways commission.

Planning Problems of Industrial Cities

By John Nolen
City Planner, Cambridge, Mass.

The modern city is the industrial city. Most of the planning problems and most of the evils of the modern city are due to manufacturing.

What do we mean by an industrial city? Not a city that is exclusively industrial—few cities are that—but a city that is primarily industrial, a city whose existence and growth depend mainly upon manufacturing. In this sense Bridgeport, Akron, Niagara Falls and many other American cities which are now beginning to grapple seriously with their planning problems are industrial cities.

What are the planning problems of industrial cities? There are two broad divisions, not mutually exclusive by any means, but they can with advantage be considered separately: Those that have to do directly with the economy or efficiency of manufacturing; those that have to do directly with the contentment and welfare of the wage earner, and indirectly (some would say directly) with the economy and efficiency of manufacturing.

The requirements of manufacturing cities are level land, cheap land, few streets (large blocks), room for extension; railroad or water facilities; proper zones; main thoroughfares for hauling (no grade crossings); proximity of factory sites to good housing; trolley or motor-bus transportation for employees if homes are not within walking distance; location of factories with due consideration to prevailing winds; public utilities. Equally important are homes for workmen. Consideration must be given to the house itself; the garden; the protected residential zone; local streets; recreation areas; schools and part-time schools; churches, and main streets to the factory, the low-cost housing and the downtown districts. Consideration must also be given to costs in relation to wages—cost of the home, of living and taxes.

Among the city-planning features of industrial cities may be mentioned especially main thoroughfares, problems in regard to which are connections for goods (factory to freight stations, water terminals, etc.), grade, width, alignment, and freedom from railroad crossings.

What is the difference in the planning of an industrial city and other cities? It is mainly a difference of emphasis of those things which have to do with economy and efficiency in manufacturing, and with the contentment and stability of wage earners. Some of the economic effects of planning upon costs of production are: Proximity to raw material; the elimination of unnecessary cost of hauling and shipping, reduction in labor turnover; and decent living and working conditions both in homes and in factories.

A study of industrial cities discloses the fact that the power, growth and progress of a city are limited only by the initiative of its leaders and the united civic interest of its people.

The challenge to the members of the National Conference on City Planning is, "Do you know of a single industrial city that can claim a reasonable mastery of its planning problems, if tested by the topics here enumerated?" If such cities cannot be named, what are the reasons?

City Planning Handicaps at Niagara Falls

The City of Niagara Falls is at present greatly handicapped in its efforts to obtain an orderly and attractive development by the unfavorable existing conditions, which interfere seriously with its success as a resort, its efficiency as an industrial city, the stability of its property values, and with the growth and increase in wealth of its population.

The removal of these handicaps involves the relocation of the railroad rights-of-way and of the union station, also the elimination of grade crossings (all of which are definitely contemplated), the planning and construction of an appropriate and adequate major street system, the selection and development of a system of parks and parkways, the acquisition of sites suitable for public buildings, schools, etc., and the adoption of an ordinance providing for the separation of city areas for various city needs.

In connection with the rail and water transportation problem, new locations are proposed for the railroad right-of-way, the elimination of grade crossings, the site for a new union station, other railroad development, and the barge-canal terminal and pleasure-boat landing.

The consideration of main thoroughfares includes the selection of existing streets best located for traffic, the extension of existing streets, the locations for new streets, and widenings.

The Steam Railroad in Its Relation to the City Plan

BY EDWIN J. FORT
City Manager, Niagara Falls, N. Y.

TO A very great extent the presence of the railroad determines the character of improvements in its immediate neighborhood, the location of manufacturing industries, development by certain classes of business enterprises, or the poorest class of residences or tenements. The slums and undesirable resorts and the nuisance-producing enterprises are usually not far from the railroad.

When the topographical features of the surrounding territory are such that expansion in every direction is unrestricted, the evils of undesirable railroad location are not so serious, because the city can grow away from them and business can adjust itself, but when, as is the case in Niagara Falls, the site is inclosed upon two sides by an international boundary line and a stream, which so far as the growth of the city is concerned, are impassable, it is most essential to orderly growth and development that the problem of railroad location be given the most careful study and be so worked out that all industries shall be adequately served, that shipping facilities shall be convenient and stations shall be located with due regard for the comparatively large passenger traffic.

We have here [Niagara Falls] no more serious or difficult problem to deal with, in carrying out an acceptable city plan, than that of the treatment of railroads.

Within its comparatively limited area of less than nine square miles, Niagara Falls is crossed from north to south by three surface-railroad lines and from east to west by two such lines. It also has within its corporate limits four separate and distinct extensive railroad yards. The Erie R.R. cuts through what might have been a most desirable residence district, and has its yard at the highest point, almost exactly at the place where the new civic center of the greater municipality is designed to be placed. Obviously, the ideal in the way of a city plan cannot be attained unless some changes are made in those conditions.

There are several alternatives. Lines may be relocated so as entirely to eliminate some of the most objectionable ones. They may be elevated or depressed so as to allow streets to cross at grade, or they may all be allowed to remain as they are, depressing or elevating street crossings where, from time to time, it becomes necessary to do so.

Regardless of what the final plan may be, great relief to every one concerned and considerable advantages to the railroads themselves would come from the electrification of all lines within the limits of the cities located along the Niagara frontier. The abundance of cheap electrical power and the rapid increase in business and population which is taking place should make such a change practicable in the near future.

Such changes as have already been made have consisted in elevating street crossings entirely above the tracks or depressing them below them in such a way as not to disturb the tracks either as to line or grade. These changes add nothing to the embellishment of the city. They are not convenient for street traffic and they are expensive. An indefinite continuation of this method of grade-crossing elimination would result in much haphazard building and in waste of public funds.

If the city is to continue to grow through the development of its enormous resources in power and a corresponding increase in manufacturing industry, the time cannot be far distant when some of the handicaps caused by indiscriminate railroad location must be removed and the districts blighted by them reclaimed.

The Common Sense of Civic Centers

BY NELSON P. LEWIS
Chief Engineer, Board of Estimate and Apportionment, New York City.

AMBITION to create civic centers has become quite general and is laudable. Many projects of this kind have been proposed, some prompted by a desire for the spectacular; others by the hope of realizing some ill defined ideal; some, perhaps, by the prospect of personal gain; and still others through an appreciation of the value of order and economy in public business.

In a study of the civic-center problem the following fundamental principles should control: (1) The centralization of all city business in one locality, while it may result in economy and convenience in the case of a small city, may prove costly and inconvenient in a large city; (2) civic centers should be planned so that only related public business and activities need be concentrated in them, subordinate or secondary centers being established when overcentralization becomes apparent; (3) secondary centers should be so located as to be easily accessible through direct traffic routes from the principal center and from one another, and readily found by those desiring to reach them; (4) the possible need of principal and secondary centers should be kept in mind when developing the plan of any city and its successive additions, so that a rearrangement of the streets about or leading from them may not be necessary; (5) it should be assumed that the buildings comprising the civic group or groups will be worth seeing, and the chief buildings should, therefore, be on the axis of one or more of the streets leading to them; (6) some competent and continuing authority should be required to approve plans for all civic centers and designs for all public buildings or other structures located in or about them, and such plans, once approved, should not be changed without the concurrence and approval of the same authority.

American Engineer to Build Water-Works at Lima, Peru

W. W. Handley, American consul at Lima, Peru, reports that a new water-supply is being designed for the City of Lima by F. W. Spalding, an American engineer now resident in Miraflores, Peru. It is stated the work includes the construction of infiltration galleries for the collection of the water, the necessary aqueducts and distribution reservoirs, and an entirely new cast-iron pipe distribution system, at a total cost of approximately $2,000,000. Work has already been started on the construction of the infiltration galleries and on the reinforced-concrete pressure main. Plans and estimates have also been prepared for a new sewer system and sewage-disposal plant to cost approximately $1,500,000, and a garbage-disposal plant to cost about $150,000. Mr. Spalding was especially engaged by the municipal gov- of Lima to go there and make a report on the various engineering undertakings contemplated.

Highway Design and Construction Papers Read Before Canadian Road Congress

While there were some papers dealing with after-war and the more general roadbuilding conditions, the great majority of the subjects on the program of the sixth Canadian Good Roads Congress dealt with practical problems in the design, construction and maintenance of the various type of country and city highways. The following are abstracts of three of the papers read at the meeting—EDITOR.

Design and Construction of Hot-Mix Asphalt Pavements

BY FRANCIS P. SMITH
Dow & Smith, Consulting Engineers, New York City

HOT-MIX asphaltic pavements, which are distinguished from those of the so-called penetration type by having both the mineral aggregate and the bituminous cement heated and mixed hot, differ from one another chiefly in size and kind of mineral aggregate used, the bituminous cement or binder being substantially the same in each case. The function of the mineral aggregate is to give the requisite amount of stability, while the bituminous cement binds the aggregate and gives pliability to the pavement. It is generally conceded that the ideal surface for mixed traffic is one which is slightly malleable (approaching sheet lead in this respect) as this will minimize wear and noise. This malleability precludes extreme rigidity, hence the malleable pavement will be low in bridging strength and will require a rigid foundation. The ideal pavement, therefore, would appear to be one in which the foundations and wearing surface were separate and composed of materials differing very widely in their properties. All bituminous pavements are, to a certain extent, malleable and yielding; thus the wear of the mineral particles are minimized, and the pavements are made more acceptable for horse-drawn traffic. To obtain the best results, great care should be taken in mixing the surfacing, to get the proper pliability.

FOUNDATIONS

Several different types of foundations have been successfully employed, such as old macadam or telford; broken stone rolled dry or cemented together with some form of bituminous cement; old cobblestones, Belgian blocks or granite pavements; old brick or asphalt-block pavements; bituminous concrete, and natural and portland-cement concrete.

In all of these, stability is the important characteristic. If the foundation is unstable it will sink after the pavement has been put down, and thus will be formed a depression in which water will collect and eventually destroy the pavement. Wheels of vehicles passing over such depressions will drop into them, and the force of the blow will further exaggerate the depression by forcing up a portion of the surfacing. Vibrations in the springs will also be set up, which will cause successive blows to be dealt to the pavement until the springs return to normal. This action, particularly in commercial vehicles, will sooner or later form waves which will be unpleasant to ride over, and which will finally require the resurfacing of the street or road.

The character of the foundation required will depend upon the traffic, the climate, the character of the subsoil, and drainage conditions. The heavier the traffic the stronger must be the foundation. Where traffic is light, the first two types of foundation, named above, may be used. In the opinion of the speaker, telford is preferable to macadam, on account of the larger stones composing its base, which give a partial slab effect. A well drained subgrade is of first importance with this type. In resurfacing, the old macadam surface should be disturbed no more than is necessary to obtain a bond, and the new surface should be reconstructed exactly as if a new macadam road is to be built. Many so-called macadam roads are little more than dirt roads covered with stone and have never been properly drained. In all cases a complete investigation of the history of the road by taking borings and inspections, particularly in the spring, should be made, and provision should be made for draining and rebuilding.

STABILITY IMPORTANT IN BLOCK PAVEMENTS

Old pavements of brick, granite, etc., should not be used as a base if it is first necessary to reset them. In their original condition they are satisfactory, if the traffic is not too heavy. Relaid blocks, until bedded by traffic, are not rigid, and have a tendency to rock, and asphalt pavements laid on such foundations in New York City have rapidly disintegrated wherever they were exposed to heavy traffic.

Bituminous concrete is sometimes employed as a foundation. One of the best types is made of crusher-run stone, from 2-in. down to dust, so graded and mixed with sufficient sand as to make a fairly dense and rigid mixture carrying about 6% of asphalt cement. When it is kept clean after laying and the wearing surface is laid upon it at once, no binder course is necessary. It has less bridging strength than portland-cement concrete, should only be laid on firm, well drained subgrades, and is not suitable for very heavy traffic. It is usually laid from 4 to 6 in. thick. This type has a number of advantages over portland-cement concrete: It is subject only very slightly to expansion and contraction cracks; it binds more strongly with the surfacing, and is also water-repellent, so that underlying moisture will not be drawn up through its pores and attack the bottom of the wearing surface—a frequent cause of disintegration of bituminous pavements laid on cement-concrete foundations.

Portland-cement concrete foundations vary, according to conditions, from 4 to 9 in. in depth, and before they are laid the subsoil should be thoroughly drained and compacted. On certain very heavy clay coils, such as are found in the Northwestern sections of the United States and Canada, which crack and heave very badly in winter, transverse trenches should be dug every 25 or 30 ft. and filled with coarse broken stone. These should be connected and drained to longitudinal trenches at the side of the street, which in turn drain into catch basins. Sand or gravel should then be spread upon the subgrade and compacted to a depth of from 3 to 4 in., and the concrete should be laid upon this instead of the natural soil. Under rapid temperature changes cement-concrete foundations are liable to crack. When the cracks are large the overlying bituminous wearing

surface frequently cracks in or near the same place. Rich, dense concretes are more liable to crack than leaner mixtures, and the speaker advocates a monolithic structure composed of a rather lean mixture, not richer than 1:3:5. Transverse expansion joints in the concrete base to overcome cracking are not altogether satisfactory, as cracks in the surfacing are liable to occur directly over them.

Preparation and Laying of the Wearing Surface

Upon the foundation is placed a wearing surface composed of mineral aggregate and bituminous binder mixed hot. The mineral aggregate constitutes from 80 to 90% of the pavement, and takes practically all the wear resulting from traffic. It must, therefore, be selected with great care. It must be hard enough to carry the traffic; it must have clean grains of particles to insure the adherence of the bitumen to them, and these grains or particles must be graded from coarse to fine, so as to make a pavement of maximum density and with sufficient inherent stability to resist displacement under the shoving action of traffic. Earth, sand, gravel, broken stone or slag, and finely ground limestone or portland cement or combinations of them, are the materials used in hot-mix pavements.

With all these aggregates (with the exception of the earth), the particles should be prefectly clean and free from clay. Material of a flinty nature should be avoided, as the bitumen will not adhere to it. Broken stone is superior to gravel, which should only be used for light traffic and should preferably be crushed. Dense, hard limestone will carry medium and light traffic satisfactorily. Where the traffic, even though comparatively light in volume, is composed of heavy, iron-tired vehicles, a dense hard trap is required. Where slag is used, a dense basic slag is to be preferred. It should be stable when exposed to the weather, and should show no tendency to slack or disintegrate. It is only suitable for light traffic, and should preferably be coated with a very fluid bitumen.

For filler, portland cement is to be preferred for heavy traffic, while ground limestone is preferred by the speaker for light traffic, as it does not have so markedly drying an effect. Whichever is used, it should be ground so that at least 65% of it will pass a 200-mesh sieve. Pulverized clay has also been used with excellent results, but is difficult to handle.

Great care should be taken in mixing the bituminous cement (which should conform to the best standard specifications) with the aggregate. A uniformly good mixture cannot be turned out by an imperfect plant. The best type of plant is that in which the sand or stone, or both, are heated in revolving driers, and fed by means of elevators into a storage bin. Bituminous sand is heated in properly designed melting kettles. The ingredients should be measured or weighed (preferably the latter) and mixed in a twin-shaft mixer of the pug-mill type, which should have a speed of from 65 to 80 r.p.m. For ordinary work each batch should receive a full minute of mixing. It is important to insure a thorough coating of tne surface of all particles with a firmly adherent film of bituminous cement. Great care must always be taken not to overheat either the mineral aggregate or the bituminous cement, as this will injure and harden the latter.

In plants used for constructing pavements made of pulverized earth, the grains after heating are subjected to pulverization, which breaks up any clay balls which may have formed and cleans the sand grains. Owing to the large percentage of water which clay earths are liable to contain, these plants must have a much larger drier than ordinary sheet-asphalt plants. Extreme fineness of the mineral matter necessitates a completely inclosed mixer and measuring box and special dust-collecting devices.

Of the raw materials which have been mentioned, four distinct types of hot-mix pavements are made. They are as follows: Sheet asphalt, Topeka pavement, bituminous-concrete pavement, and pulverized-earth pavements, commonly known as National pavement. The table shows a typical analysis of the types:

TYPICAL ANALYSIS OF VARIOUS TYPES OF HOT-MIX PAVEMENTS

	—Sheet Asphalt— Light Traffic Per Cent.	Heavy Traffic Per Cent.	Topeka Mixture Per Cent.	Bituminous Concrete Per Cent.	Pulverized Earth Pavement Per Cent.
Bitumen	11.0	10.5	8.5	7.0	17.5
Aggregate:					
Passing 200 mesh	14.0	10.5	8.5	5.0	55.5
Passing 100 mesh	14.0	10.0	6.0	4.0	12.0
Passing 80 mesh	13.0	10.0	6.0	2.0	6.0
Passing 50 mesh	19.0	14.0	6.0	5.0	5.0
Passing 40 mesh	11.0	14.0	10.0	4.0	3.0
Passing 30 mesh	10.0	13.0	10.0	4.0	1.0
Passing 20 mesh	5.0	10.0	9.0	3.0	....
Passing 10 mesh	3.0	8.0	6.0	5.0	....
Passing 8 mesh	....	....	6.0	3.0	....
Passing 4 mesh	....	....	14.0	7.0	....
Passing 2 mesh	....	....	10.0	20.0	....
Passing ¾-inch mesh	....	....	....	14.0	....
Passing 1-inch mesh	....	....	....	12.0	....
Passing 1½-inch mesh	....	....	....	5.0	....
	100.0	100.0	100.0	100.0	100.0

Sheet asphalt will sustain a very heavy traffic. This statement applies more especially to a traffic largely composed of quick-moving, light, medium-loaded vehicles, such, for instance, as prevails on Fifth Ave., New York City. It is not the most suitable type of pavement for very dense, slow-moving, heavily loaded, iron-tired traffic. Nor will it give satisfaction where there is practically a total absence of traffic, as it then is liable to develop cracks, apparently requiring the kneading action of traffic to equalize the stresses set up by contraction and expansion and to keep it in proper condition. On account of its smoothness, where the traffic is heavy, a 3 to 4% grade is usually considered as the limit for this type, although traffic grades as high as 9 to 12% have been used.

Generally speaking, the heavier the traffic, especially iron-tired traffic, the finer should be the mineral aggregate used. This is because the coarse particles are more liable to fracture than the smaller particles. Where fracture takes place to any considerable extent, rapid deterioration of the pavement will ensue, as the bituminous cement ordinarily used is not sufficiently fluid at atmospheric temperature to rebond and recoat the fractured particles. These will quickly be pulverized and washed out, leaving depressions where water will accumulate and eventually rot the pavement. Where traffic is largely or wholly composed of rubber-tired vehicles, a greater proportion of coarse particles is permissible and is desirable, as it gives greater stability.

Standard sheet-asphalt construction at the present day is 1½ in. of binder and 1½ in. of wearing surface. The binder should be of the "close" type; that is, it should contain approximately 20% of material passing an 8-mesh sieve, and approximately 15% each of ¼-in. and ½-in. stone. A "close" binder properly made and laid will be superior in many respects to the mixtures

that have been laid on a large number of country highways, and will carry a fair amount of traffic for a considerable time without suffering any serious damage. A poor binder will cause serious damage to the pavement. In all hot-mix asphaltic pavements great care should be taken to compress the binder thoroughly, if one is used, with a steam roller, before laying the wearing surface, and, in turn, the wearing surface should be thoroughly compressed.

When the surface mixture is delivered upon the street it should be of such a temperature that it can be properly compressed and should be evenly spread by means of hot iron rakes. In many cases the loads of hot surface-mixture are dumped directly upon the spot where they are to be spread. This is a bad practice, as the men trample upon it while shoveling and raking it, and rakes do not thoroughly loosen up this trampled material when passing over and through it. Although the mixture is raked to a uniform surface of apparently even thickness before it is rolled, those portions which have been trampled on before and during raking are really covered with a greater quantity of surface mixture than those which have not been trampled on. When these spots are rolled there will be a slight unevenness in the finished surface.

Extreme care should be taken to insure a proper union between the work laid on successive days. The first load laid in the morning should be a little hotter than normal, so that the hot mixture may soften the cold edge of the joint. The practice of painting the edge with hot asphaltic cement is not to be recommended, as there is danger of making that portion of the pavement too rich in bitumen and softer.

Topeka Pavement Better with Binder Course

Topeka-mixture pavements are laid from 2 to 3 in. thick, and are frequently placed directly on the foundation. Much better results are obtained by using a binder course 1½ in. thick, with a 1½- or 2-in. wearing surface. This greatly reduces the tendency of finished pavements to shove. With a well graded mixture a squeegee coat is unnecessary, although it is frequently employed. Great care should be taken in mixing these surfacings, and the amount of asphalt must be watched much more closely than is necessary with sheet-asphalt mixtures. One-half of 1% above or below normal is about the permissible variation.

Bituminous-concrete pavements, as previously noted, have a mineral aggregate consisting wholly or largely of stones of varying sizes from 1½ in. down. Some of them are made of crusher-run stone, and some of them (bitulithic, etc.) are made of carefully graded aggregate. Where the aggregates are graded, it is customary to separate the particles of different sizes in from three to five bins, and weigh out definite amounts from each bin for every batch. From 2 to 3 in. of surface mixtures are usually laid directly on the foundation. Pavements of this type will not carry as heavy an iron-tired traffic as will sheet asphalt or Topeka. Both Topeka and bituminous-concrete pavements can be laid upon somewhat steeper grades than sheet asphalt.

Pulverized-earth pavements are usually laid without any binder course, and from 1½ to 2½ in. in thickness. They are very rich in bitumen (15 to 20%), but are extremely stable, and so malleable that at temperatures of 60 to 75° F., a piece may be cut out of them and hammered back with a hammer, and a perfect cold weld obtained. Their stability is due to the extreme fineness and absorbent properties of the mineral aggregate. On account of this fineness it is impossible to wear away the surface by any fracturing or grinding of the individual particles, as they have been reduced to practically their ultimate state of fineness before they are incorporated in the pavement.

The clayey material of which the pavements are composed has a much greater affinity for bitumen than any other known paving material, which still further adds to their permanence. With the exceptions noted under the discussion of plants, their manufacture and laying are very similar to those of sheet asphalt. The cost is somewhat higher than sheet asphalt, owing to the large amount of water frequently obtained in the mineral aggregate which must be dried out, and the high percentage of bitumen used in them. They are capable of carrying the heaviest kind of traffic, and when properly constructed mark less in summer than do sheet-asphalt pavements and are much less susceptible to shoving and displacement. They are equally suitable for very light traffic. The bituminous cement used is about 90 penetration at 77° F., which is much softer than is used in other types of mixed pavement. For this reason they do not become hard, and crack when not subjected to traffic for a considerable time.

Testing Aggregates for Concrete Roads

By H. Eltinge Breed
Consulting Engineer, New York City

Good concrete depends on the quality of the materials—cleanness, hardness, toughness, gradation and proportioning—combined with placing and curing. Methods of testing concrete for road use, chief among which are those for abrasion and impact, are important. Impact tests are by far the most valuable in determining wear-resisting value. Results obtained from a large number of tests made by the New York State Highway Department, with a special machine, seems to justify several conclusions, as follows: (1) Crushed-stone concrete resists impact better than gravel concrete; (2) large-sized materials are more durable than those of small size; (3) toughness is a very important factor in aggregate; (4) the fine and coarse aggregate must both be good, and (5) coarse-grained sand mortar resists impact better than mortar made from fine sand.

First in importance are the materials used; they determine the quality of the pavement. The fine aggregate should be tested for: (1) organic impurities, by the colorimetric test; (2) gradation (sieve analysis); (3) mortar strength, by testing briquettes; (4) volume of silt or loam by measurement. These are all field tests, except the third, and are very valuable.

The coarse aggregate cannot be tested in the field. Field determination of these materials can be made only for voids. Visual inspection should, of course, detect soft material and dirty aggregates. Such inspection should be made constantly, to know that the material is running uniform and of quality equal to the original sample.

For laboratory test of coarse aggregates, the most valuable is the Deval abrasion test. It is in general use and has been standardized. How accurate it is in determining the suitability of coarse aggregate for con-

crete remains to be seen. It is certain, however, that this test indicates the difference between poor and good stone; and, taken in conjunction with the impact test, described later, it is the best means we yet have of determining the suitability of stone for concrete roads.

Tests for pebbles (called gravel by some) with the Deval machine have been unsatisfactory, because certain pebbles much inferior in service to trap and syenite rock show less loss when tested than do these standard materials. In 1915 the New York State Highway Department laboratory modified the Deval stone-abrasion machine by substituting a slotted cylinder for the closed cylinder. The slots allow the fines to escape, so there is no protective cushion of dust to keep the pebbles from wear. For four years we found that this machine has given slag and pebbles a truer rating in accordance with the service test, though often at variance with the showing of the standard cylinder.

After testing the aggregates, we made tests of the resulting concrete, for two purposes: (1) To determine its wear; (2) to determine its strength.

By far the most valuable test to determine the wear-resisting values is a machine which generates impact stresses, closely paralleling those imposed by traffic. This machine was described in *Engineering News-Record*, of May 2, 1918, p. 861, by H. S. Mattimore, engineer in charge of physical testing, New York State Commission of Highways. In general, the machine consists of an arm which is raised by a cam and falls freely, striking a 6-in. concrete cube or cylinder upon a table which is revolved by a dog attachment. At the head of the arm are placed nine hitting points, armored with nonslip horse calks, each point and its shaft being held in place by a spring giving a play of ½ in. to compensate for any irregularity or unequal wear. The effective weight of the head is 29 lb., and the blows are delivered at the rate of 100 per minute. The blows of the calks strike in nine concentric circles ¼ in. apart. To date, several hundred tests have been made with this machine. The reports in the table are representative.

PARTIAL RECORD OF IMPACT TESTS MADE BY THE NEW YORK STATE COMMISSION OF HIGHWAYS

Coarse Aggregate	Fine Aggregate	Mix	No.	Grams Lost per Test	Average Loss	Remarks
Trap	Sand, Niagara	1 : 1½ : 3	3	150-110 105-95	103	Small stone area omitted
Trap	Sand, Cowbay	1 : 1½ : 3	4	110-120 110-100	110	
Trap	Sand, Albany	1 : 1½ : 3	4	140-100 125-125	122	
Trap	Sand, Long Island	1 : 1½ : 3	2	120-135	127	
Trap	Sand, Marlboro	1 : 1½ : 3	2	130-135	132	
Trap	Tailings, graphite	1 : 1½ : 3	2	155-135	145	
Trap	Sand, Booneville	1 : 1½ : 3	4	165-130 165-135	149	Group (1) 103-165
Trap	Tailings, iron ore	1 : 1½ : 3	5	200-155 165-155 165-180	164	Excess grout omitted
Trap	Sand, Cowbay	1 : 2 : 4	2	150-150	150	Group (2) 150-175
Trap	Sand, Albany	1 : 2 : 4	3	180-160 185-225	175	Small stone area—excess grout omitted
Trap	Sand, Marlboro	1 : 2 : 4	2	180-170	175	
Syenite	Sand, Booneville	1 : 1½ : 3	8	150-145 150-140 145-125 185-130	141	Group (3) small stone area omitted 141-186
Syenite	Sand, Booneville	1 : 2 : 4	4	180-205 180-180	186	
Buffalo Limestone	Sand, Niagara	1 : 1½ : 3	5	150-120 155-125 135	137	Group (4) 137-170
Buffalo Limestone	Sand, Cattaraugus	1 : 1½ : 3	5	155-160 140-125 160-200	148	Excess grout omitted
Buffalo Limestone	Sand, Booneville	0 : 1½ : 3	4	180-160 185-160	171	

The results indicate that generally the average loss increases as the mortar strength of the sand decreases. An average loss for each test shows that there is greater strength in the 1 : 1½ : 3 mix than in the 1 : 2 : 4 mix. It is interesting to note that syenite, with a French coefficient of 12.5, shows, approximately, an equal loss under this test with Buffalo limestone with a French coefficient of 7.9. On the basis of the Deval test, the limestone is inferior for road purposes to the syenite, but service conditions indicate that the Buffalo limestone and many other limestones, with a French coefficient of 7 and better, are very satisfactory in service.

In the test to indicate strength, concrete from a batch is made up on the road into 6-in. cubes or 6 x 12-in. cylinders from every 500 cu.yd. or less of material. They are cured for 21 days in moist sand and then shipped into the laboratory and tested at 28 days. The following is a record of four years' work:

Years	Mix	Coarse aggregate	No. of cubes	Average compression per square inch
1915-16	1 : 1½ : 3	Stone	1684	3590
1917-18		Gravel	221	2950

It may be noted that a total of 1905 tests were made and that, with the exception of the gravel, they are well over 3000 lb. per square inch. When any individual test shows below 3000 lb., a thorough investigation was immediately made to determine the cause. While this occurred too late to correct the given piece of work, it had a good moral effect on the contractor, and a wholesome rivalry was inspired among the engineers to have a high test value for their work. The figures given above represent actual tests from the laying of something over 400 miles of 16-ft. concrete pavements of 6-in. average thickness.

Factors Influencing the Selection of Road Plant

By Arthur H. Blanchard
Consulting Highway Engineer, New York City

HIGH wages for unskilled labor in 1917, 1918 and 1919, and the uncertain status of the labor supply of the future, have resulted in a thorough analysis of highway-construction data to determine economical methods of using road machinery. In the opinion of the writer, American highway officials must face high wages for unskilled labor for several years. It is not logical to expect that unskilled labor which entered the service will rush back to the pick and shovel after demobilization. Emigration records show that thousands of laborers are leaving America every month. Immigration, the usual source of supply of unskilled labor, is an unknown quantity. It is not surprising, therefore, that the reconstruction period finds highway officials, engineers and contractors investigating all types of labor-saving machinery.

Selection of Equipment

The selection of equipment for the construction and maintenance of highways should be based upon a consideration of the following factors: (1) Character of work; (2) specification requirements covering equipment; (3) amount of work; (4) portability of plant; (5) large and small units; (6) ease of manipulation; (7) adaptability to different classes of work; (8) funds available; (9) depreciation of plant; (10) transporta-

tion facilities. The practical necessity for the consideration of many of the above factors is self-evident.

Character of Work—In the case of contractors whose work is confined to the construction of sheet-asphalt pavements, and in the case of a department such as, for instance, that of Wayne County, Michigan, where the highway work consists primarily of grading operations and the construction of cement-concrete pavements, the problem is materially simplified. On the other hand, where a contractor's work covers the construction of the various types of roads and pavements used in a municipality, county or state, the selection of the several units of plant equipment should be based upon their adaptability to different classes of work.

Specification Requirements Covering Equipment—In the modern practice of highway engineering, many specifications include stipulations which must be met by the machines and accessories employed. Illustrations might be cited such as the weight of rollers, pressure limitations in distributors, grouting apparatus, and detals of mixers for the manufacture of bituminous concrete.

Amount of Work, Portability of Plant, Large and Small Units—It is evident that a contractor for a department will be justified in the purchase of an ideal equipment if the work is to be extensive in character. If the work is centralized and large in amount, as in the case of sheet-asphalt work in many municipalities, a large, well equipped, permanent plant will prove economical. If, on the other hand, the work is large in amount but distributed over considerable area, small, portable units will prove more satisfactory, as in the case of mixing plants for the manufacture of bituminous concrete to be laid on country highways.

Ease of Manipulation—In cases where contractors are engaged in general highway work and their organization does not include foremen who are specialists in the manipulation of various types of complicated machinery, it is of the utmost importance that simplicity of machines and ease of manipulation should receive great weight, in the selection of equipment. This is particularly true in connection with various types of machines used in the construction of bituminous surfaces, bituminous-macadam and bituminous-concrete pavements.

Adaptability to Different Classes of Work—It is well known that specifications for different classes of work, requiring the same type of machine, call for differences in detail. For grading work, specifications might require rollers weighing from 12 to 15 tons, while in the construction of wearing courses of some types of pavements a 10- to 12-ton roller is stipulated. A contractor who is handling a small amount of general highway work would find it advantageous, therefore, to purchase a 12-ton roller suitable for both classes of work.

Funds Available—Departments and contractors are necessarily forced to consider first cost of equipment, as the funds available may not permit the installation of the most economical and efficient machines. In many cases where such conditions are encountered it is obvious that it will not be practicable to anticipate that the work can be accomplished with the same degree of rapidity and at the same cost as if more efficient machinery were available.

Depreciation of Plant—Depreciation charges on plant should receive careful consideration, prior to the purchase of machines and accessories, as well as in the consideration of the cost of highway work.

Transportation Facilities—Facilities for the transportation of machinery and materials affect materially the efficiency of the several units of plant. For example, in municipalities, states and provinces where materials may be transported over highways in good condition, the use of the motor truck will usually be found desirable.

Filter Operations at Niagara Falls

OPERATING costs of the Niagara Falls municipal filter plant for the year 1918, taken from the annual report of B. T. Dignan, chemist in charge, indicate low unit costs. This rapid filter plant, which has a nominal capacity of 16,000,000 gal. daily, was described on p. 601 of *Engineering Record*, of June 1, 1912, the year of its completion.

For 1918 the bacterial count by months averaged 14, with high and low figures of 33 and 6. The removal ranged from 99.47% in December to 99.90% in January.

SEVEN YEARS' MECHANICAL FILTER OPERATING DATA AT NIAGARA FALLS, N. Y.

Year	Hypochlorite	Cost per 1,000,000 Gallons Alum	Power	Labor	Total
1912	$0.00	$1.79	$1.82	$2.12	$5.73
1913	.04	1.25	1.97	2.46	5.72
1914	.10	1.00	2.16	2.99	6.25
1915	.08	1.10	2.38	3.73	7.29
1916	.25	.75	2.37	3.62	6.99
1917	.21	.75	2.14	3.16	6.26
1918	.14	.86	2.13	3.05	6.18
Average	$0.12	$1.07	$2.14	$3.02	$6.35

Bacterial Results, Alum Dose, Hypochlorite Rates and Typhoid Figures

Year	Bacteria per cc. on Gelatine	Per Cent. Bacteria Removed	Alum, Grains per Gal.	Price of Hypo. per lb. in. N. Y.	Total Cases	Typhoid Deaths
1912	34	98.41	1.25	0.00	66	23
1913	32	98.71	0.87	2.67	26	10
1914	25	99.27	0.70	6.61	17	6
1915	12	99.62	0.77	5.02	10	0
1916	26	99.49	0.52	4.18	16	5
1917	15	99.69	0.41	4.35	13	3
1918	14	99.76	0.40	4.00	15	2
Average,	22.5	99.28	0.70	4.30		

Likewise, the variation in chemical-treatment cost varied only from $0.88 in October to $1.06 in February. Wash-water percentages varied from 1.16% in August to 2.74% in June, the higher figure being due to algæ growths in the lake shortening the runs. The average for the year was 2.05 per cent.

The typhoid situation has not changed from the enviable position held by the city, as noted by Charles B. Burdick in *Engineering News-Record* of Sept. 6, 1917, p. 440. It is pertinent to add that the Niagara River is continuously polluted by the raw sewage of 500,000 persons in Buffalo, 20 miles distant; also, that the municipal plant does not furnish all of the water to the city, but that the Western New York Water Co. supplies about 7,000,000 gal. daily of filtered and disinfected water to manufacturers and to 700 domestic consumers.

Kansas Water-Supplies To Be Studied

Research work planned by the Kansas State Board of Health includes water-works operation—particularly as to plants treating surface waters, swimming pools, sewage-disposal and the control of pollution of water-supplies by oil wells. F. M. Veatch is acting engineer of the division of water and sewage.

Women Water-Waste Inspectors at Baltimore, Maryland

Men Replaced With Satisfactory Results—Women Under Direction of Pitometer Engineer Paid $2.76 a Day

By Walter E. Lee
Water Engineer, Baltimore, Md.

WOMEN inspectors have taken the place of house-to-house men inspectors, for a year past, in the water-conservation campaign which is a part of the daily operation of the Baltimore Water Department.

The main campaign is based on pitometer surveys of consumption and leakage occurring on underground mains and services. Preceding the pitometer measurements, all leaks on plumbing in buildings are eliminated or repaired and stop-cocks on house service pipes are made tight, to cut off all demands effectively. This includes the overhauling of house service pipes, stop-cocks and boxes by construction gangs and house-to-house inspection of plumbing and sanitary fixtures in the district under investigation, by women inspectors working under the direction of a pitometer engineer. From the time water conservation was started in 1914 until Apr. 1, 1918, male inspectors were employed, averaging 50 to 100 inspections each per day, depending upon the character of the leakage found. The results obtained through the male inspectors were not altogether satisfactory, and, due to the effectiveness of women inspectors on mosquito-prevention work, it was decided to employ the same women permanently the year round, on house-to-house inspection.

INSPECTRESS LISTENING FOR WATER WASTE

The women inspectors are selected and employed on the basis of fitness, preferably between the ages of 30 and 45, and they must have good hearing to enable them to use the aquaphone in detecting wasting water on house-service pipes and plumbing. They must be neat in dress, quiet, mannerly and able to make direct replies to interrogations.

Each inspectress is equipped with an aquaphone for detecting water flow in the plumbing, a flashlight for use in cellars and basements, a street directory for the location of her daily assignment, and a stiff-back book holding her daily report sheets. The entire equipment is contained in a stiff leather case.

The hours of employment are from 8:30 a.m. to 5 p.m. five days in the week and to 3 p.m. on Saturdays, with one-half hour for lunch. The wage is $2.76 a day, or $16.56 a week. Twenty inspectresses are to be ultimately employed.

WATER DEPARTMENT CITY OF BALTIMORE
ENGINEERING AND CONSTRUCTION DIVISION.
S. W. Cor Oliver and Wolfe Sts

Date March 27 1919

To the occupant and to the owner of 600 E 42nd St

Notice is given that there is waste of water in the above premises due to leaking spigot in kitchen

If not repaired as required by law (City Code 1906, Art. 40) in 7 days, the water will be turned off.

Served by Mrs C.B. Stewart Inspector. WALTER E. LEE, Water Engineer.

Received by Mrs. E. M. Brown on premises.

1086-1-18-19-A Co.-100 B-200 L.

WATER WASTE NOTICE SERVED ON CONSUMERS
Original slip 4⅜ by 3⅜ inches, thin paper

A year's experience demonstrates that results are better than with men inspectors, for in such house-to-house inspection a municipality must always deal with the housewife or maid servant, and women inspectors can better educate them as to the object of the survey.

When water waste is found on any premises inspected, either through a split service pipe or a leaking plumbing fixture, a notice is served on the occupant of the premises and a reinspection is made one week from the serving of the notice, to see whether repairs have been made.

NOTE:—WHEN TRANSFERRING SHEET FROM BOOK TO FILE CUT OFF MARGIN

CITY OF BALTIMORE WATER DEPT
HOUSE INSPECTION E. & C. DIVISION
Pitometer Dist. M Sec. 15 Service Middle
Location E 42nd St

H.O. No.	Date Insp.	Leaks: Inside Stop	Leaks: Outside Stop	Leaks: Gallons Per Day	No. of Persons	Turn-off	Turn-on	Remarks
600	8/2/18	S			6			In bath
	3/27/19	Sp			6			In kitchen
602	8/2/18	H			3			In cellar
	3/27/19	T			3			In bath
604	8/2/18				4			Noise on pipe
	3/27/19				4			OK
606	8/2/18	Sp			6			In kitchen
	3/27/19				6			OK

Mrs C.B. Stewart

4-10-18-J.T.S.-20,000

H.—Hopper SP.—Spigot ST.—Stop SU.—Supply SY.—Syphon T.—Toilet F.—Footway Y.—Yard

CONTINUOUS RECORD FOR WATER-WASTE INSPECTIONS
Original, 5 by 6 inches on thin paper, with duplicate on reverse side

A schedule of house-to-house inspection is arranged so that each property receives about three inspections a year, and provision for subsequent inspections is provided for on the report sheet showing the style of the fixture that is leaking and its location on the premises.

The Numerical Interpretation of Bacteriological Tests

Theory of Probabilities Applied to Sanitary Engineering, With Particular Reference to Results Obtained in Studies of Water and Sewage

By Milton F. Stein
Civil Engineer, Chicago, Ill.

IT IS a peculiarity of the human mind that in any comparison other than the most elemental there is always an urgent desire to resort to the use of numbers. This holds true in the case of bacterial work, as is evidenced by the various attempts to express the complex bacterial characteristics of a water or sewage by a single index number. It is highly desirable, for purposes of comparison and standardization, that such results be numerically expressed, and it is the purpose of this article to explain the proper methods of numerical interpretation and to point out certain conditions which must be met, and certain limitations which must be submitted to. The methods given are based on the theory of statistics and probabilities. It is not intended to explain the underlying theories, which have been fully developed elsewhere, as given in the references, but simply to state the principles involved and to show their practical application.

To avoid confusion it may be well to define the use which will be made, for the purpose of this article, of certain terms commonly used indiscriminately:

By a *sample* will be meant the quantity of liquor, removed from the main body thereof for testing purposes, and which may be of any size, from the usual bacterial sample to one or more gallons.

By a *test* will be meant the operations involved in developing and counting the colonies on a single plate, or in producing and recording a result in a single fermentation tube. Thus, a *sample* may be subjected to but one *test* or to a number of *tests*. The *quantity tested* will refer to the amount involved in each test—10 cc., 1 cc., 0.1 cc. or other fractional part, this quantity being often called the *size of sample.*

There are evidently two kinds of bacterial results to be considered: (a) Those based on a *single sample,* such as would be made on the same portion of a liquor at each of the several steps in a continuous process of purification, to determine the changes or improvement effected, or on a definite, limited quantity of liquor to determine its bacterial condition; (b) those based on *repeated samples,* such as routine results obtained from day to day in filtration plants and sewage-disposal works.

There are two types of tests usually made: (a) *Numerical tests,* such as the usual bacterial count; (b) *tests of attributes,* involving the presence or absence of some one attribute or characteristic, as the presence or absence of gas in the fermentation test used in the detection of the colon bacillus in water.

Arithmetic Mean the Best Average—In averaging a number of tests, either on a single sample or on repeated samples, the ordinary arithmetic mean gives the most logical result, being rigidly defined and based on all the tests made. Its significance is readily comprehensible and it lends itself to simple computations. The use of the median, or the middlemost value of a series when these are arranged in the order of their magnitude, has been proposed, because in it the effect of exceptionally large and small values upon the average are partially neutralized, but no reasons have been advanced why such divergent values are entitled to less consideration than the rest. The geometric mean has some advantages in special cases, but its nature is not generally understood, and its calculation is rather involved.

The Expected Error—The expected error is sufficiently defined by its name. The formulas for it are derived by means of the theory of probabilities, assuming certain ideal conditions to exist. As applied to bacteriological tests these conditions would be:

1. That all bacteria in the liquor sampled are identical in all characteristics affecting the results of the tests, such as rate of growth, vitality, effect of environment, etc.

2. That, in single samples, the distribution is essentially uniform, and, in repeated samples, the number in the liquor does not vary from sample to sample.

3. That all the bacteria are independent, in the sense that one does not hinder the development of another by overgrowths, toxic products, etc.

In the conventional interpretation of the bacterial count these conditions are assumed to obtain, in that no allowance is made for unequal distribution of bacteria in the liquor, and all the bacteria plated are supposed to produce visible colonies within a specified time and without mutual interference. We know that such an ideal state of affairs does not hold, and it is one of the tasks of the statistical method to devise a measure of departure therefrom.

The rules for finding the expected error are:

1. The expected error in the number of colonies on a single plate is equal to the square root of that number. If a dilution is used in the test, then the expected error in bacteria per cubic centimeter is obtained by multiplying the square root of the plate count by the dilution factor, just as the plate count must be multiplied by the dilution factor to give the bacteria per cubic centimeter.

2. The expected error in the number of colonies on any plate of a series made from the same sample is equal to the square root of the arithmetic mean number of colonies per plate in the series. Here, again, results must be multiplied by the dilution factor to apply to bacteria per cubic centimeter.

The general formula (See Stein, "A Critical Study of the Bacterial Count," in *American Public Health Journal* of November, 1918) for these rules is:

$$\varepsilon(\alpha) = \sqrt{\frac{\alpha}{n}}$$

$\varepsilon(\alpha)$ = The expected error in the number of bacteria per cubic centimeter in any one test.

α = The number of bacteria per cubic centimeter as determined by a single test, or, better, by the mean of a number of tests.

n = The dilution factor, 10, 100, 10,000, etc., as the case may be.

Theoretically, α should be the actual number of bacteria per cubic centimeter, but since this is not known exactly, the best value available should be used, which is the mean of the available tests.

The expected error of the mean of a series of tests is obtained by dividing the expected error for a single test by the square root of the number of tests in the series, or

$$\varepsilon\,(M) = \frac{\varepsilon\,(a)}{\sqrt{N}}$$

M = The mean number of bacteria per cubic centimeter.

N = The number of tests in the series.

THE STANDARD DEVIATION—If a number of tests are made on the same sample the results will in general differ among themselves and also from the arithmetic mean. Some measure of this deviation from the mean is necessary in order to establish the accuracy of the latter quantity. If, following a natural and logical impulse, we attempt to find the mean value of these deviations, with due regard to signs, we are baffled by the result, which is invariably zero. It is therefore customary first to square these deviations, which at once eliminates the difficulty of signs, then to find the mean, and extract the square root thereof.

The result is called the *standard deviation.*

It may be formulated as follows:

$$\delta = \sqrt{\frac{(a_1 - M)^2 + (a_2 - M)^2 + \ldots . (a_N - M)^2}{N}}$$

δ = The standard deviation.

$a_1\,a_2\,\ldots a_n$ = Bacteria per cubic centimeter as determined by the different tests.

M = Mean value of bacteria per cubic centimeter.

N = Number of tests made.

There are good theoretic reasons for the use of the standard deviation as a measure of dispersion, not the least of these being that, under the ideal conditions given previously, it is equal to the expected error.

The standard deviation or "mean error" of the mean is given by the formula,

$$\delta_M = \delta/\sqrt{N}$$

THE LEXIAN RATIO—Since, under the ideal conditions, tacitly assumed in the bacteria count, the standard deviation is equal to the expected error, the ratio of the former to the latter is a measure of the departure from these ideal conditions. This is known as the Lexian ratio, and is given by the formula $L = \delta/\varepsilon$.

If the conditions are "normal," as assumed, this ratio will be equal to 1. If the distribution of bacteria is irregular, and the usual small accidents and interferences in plating and counting occur, the Lexian ratio will be greater than 1.

APPLICATION TO THE BACTERIAL COUNT—*I. The Single Sample; a. Single Test*: In Fig. 1 the expected errors in a single test for various numbers of bacteria per cubic centimeter are shown for tests of 1-cc. quantities. For other dilutions multiply the expected error as shown on the diagram by the dilution factor. *Example:*

A single plating of a sewage sample at 10,000 dilution gives a count of 256 colonies. This is equivalent to 256 × 10,000, or 2,560,000 bacteria per cubic centimeter. From Fig. 1 the expected error for 256 is 16, which multiplied by 10,000 gives an expected error of 160,000 bacteria per cubic centimeter. The largest error which may be reasonably expected is three times the expected error, in this case 480,000 per cubic centimeter.

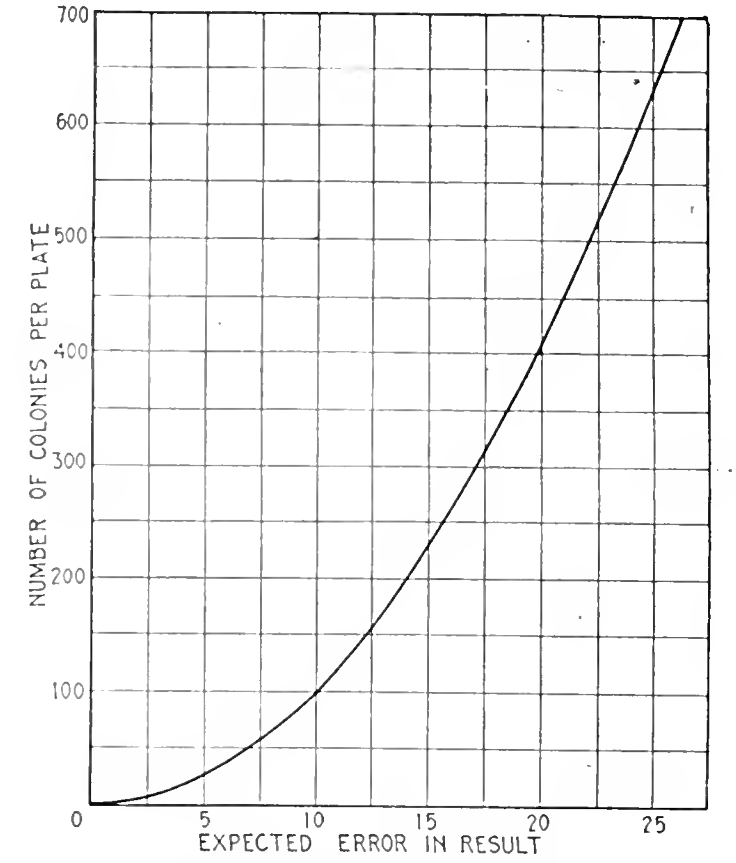


FIG. 1. CURVE SHOWING EXPECTED ERROR IN BACTERIAL COUNTS

Fig. 2 shows the expected error in per cent. for various numbers of colonies per plate, and may be called a *precision curve.* It shows very clearly that *to reduce errors in the bacterial count, dilutions should be used giving 200 or more colonies per plate.*

b. Series of Tests: The method of treatment is best shown by the example given in Table I. Two of the 15 tests made on the sample were discarded. The average of the remaining 13 was then found. The difference between each result and the mean is given in the second column, and the square of the difference in the third column. The square root of the sum of these squares divided by 13 gives the standard deviation.

In finding the expected error, Fig. 1 is entered, using the mean count, 398.4, the corresponding expected error, 20, being multiplied by 10,000, the dilution factor. This expected error, divided by $\sqrt{13}$ gives the expected error of the mean. The Lexian ratio is exceptionally low, showing as close an approach to the assumed conditions as is usually obtained. Values from 4 to 6 are more common for tests on single samples. The results are exceptionally accurate and show what can be hoped for with careful work.

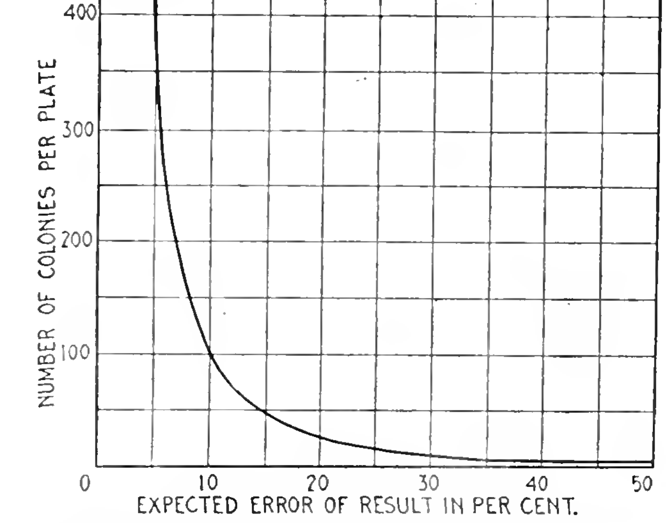


FIG. 2. THE PRECISION OF BACTERIAL COUNTS

TABLE I. TESTS ON A SINGLE SAMPLE OF RAW SEWAGE

Incubation, 24 hours at 37° C. Dilution, 1/100 x 1/100
Controls, 0-0-0. Special care used

	Count	Deviation	Deviation²
1	3,780,000	204,000	41,600,000,000
2	4,340,000	356,000	126,600,000,000
3	3,800,000	184,000	33,900,000,000
4	840,000 (omitted)		....
5	4,280,000	296,000	87,600,000,000
6	3,340,000	644,000	414,000,000,000
7	3,980,000	4,000	16,000,000,000
8	3,300,000	684,000	466,000,000,000
9	4,370,000	386,000	149,000,000,000
10	4,160,000	176,000	31,000,000,000
11	4,060,000	76,000	5,760,000,000
12	3,730,000	254,000	64,500,000,000
13	3,650,000	334,000	111,200,000,000
14	5,000,000	1,016,000	1,030,000,000,000
15	Overgrowths		....
Mean	3,984,000		2,577,160,000,000

$$\text{Standard Deviation } \sqrt{\frac{2,577,160,000}{13}} = \pm 445,000 = \pm 11.2\%$$

$$\text{Maximum Deviation } \begin{cases} = +\ 1,016,000 = +\ 25.5\% \\ = -\ 684,000 = -\ 17.1\% \end{cases}$$

$$\text{Expected Error} = \sqrt{398.4 \times 10,000} = \pm\ 200,000 = \pm\ 5.0\%$$

$$\text{Lexian Ratio} = \frac{445,000}{200,000} = 2.2$$

$$\text{Mean Error} = \frac{445,000}{\sqrt{13}} = \pm\ 123,000 = \pm\ 3.1\%$$

II. *Repeated Samples*—Repeated samples are to be considered the usual routine tests, one or more per day, made in water-works and sewage laboratories. The essential difference, as compared to the single sample, is the variation from sample to sample, in the bacterial content of the liquor being examined, due to river fluctuations, wind currents, seasonal changes, etc. Considerable importance is usually placed upon monthly and even yearly averages of daily tests. These, in themselves, while not to be ignored, should not be given undue weight, unless accompanied by the standard deviation and Lexian ratio, which will give an idea of the variation from ideal conditions. In sanitary work particular interest attaches to exceptionally large values, which calls attention to the individual samples tested. In order that the results of these may be reasonably reliable, the writer recommends that two conditions be observed: (1) Use such quantities in the tests as will give 200 or more colonies per plate, if possible; (2) make from three to 10 tests of each daily sample. Plotting the daily results graphically in the order of their magnitude gives a very clear picture of the type of distribution.

Repeated samples are computed exactly as are repeated tests on single samples, but generally the Lexian ratio will be much larger, from 5 to 15.

THE BACILLI COLI TEST—The presence of the colon bacillus in a water-supply is indicative of pollution, and a consideration of the factors governing its presence will show that the intensity of pollution must be proportional to the density, or number per unit volume of water, of this species present. Unless, therefore, we wish to restrict our classification of waters, according to this test, to polluted, if present, and unpolluted, if absent, it is necessary to have numerical results. The fermentation test used in the determination of coli indicates merely their presence or absence. A certain percentage of positive results gives no direct measure of the degree of pollution, nor does it allow of comparison between different waters, since the causative factors are not necessarily the same. The combination of the percentages of several series of tests, as in the coli index, while creating a false sense of security, through its apparent definiteness, only serves to obscure actual conditions the more. While some method of direct counting would be highly desirable, the best that can be done, in its absence, is to interpret the fermentation test by means of the laws of probability, under certain well defined restrictions, and with a full appreciation of the limits of accuracy involved.

Such a method was described by the writer in a previous article ("Making the B. Coli Test Tell More," Stein, *Engineering News-Record* of May 24, 1917, p. 391) and the theory and application were more fully discussed in a pamphlet privately circulated. For cases of a number of tests made upon a single sample this method gives the very simple formula, $x = -\log_e Q$, where x = the number of coli in the quantity tested, and Q = the proportion of negative tests in the series.

By using 1-cc. quantities x becomes the number of coli per cubic centimeter. The curve for 1-cc. tests is shown in Fig. 3. For other sizes of tests it is necessary to divide by the size of test to obtain the number of coli per cubic centimeter. By use of this curve it becomes a simple matter to find the most probable number of coli for any percentage of positive tests.

The corresponding formula for the expected error becomes rather involved, but the values for 10, 30 and 100 tests are shown graphically in Fig. 4, and the desired values can be picked therefrom. For sizes of tests other than 1-cc., division by the size of test is necessary to obtain results per cubic centimeter.

In Fig. 5, the expected errors have been plotted as percentages. This may be called the precision diagram and is of considerable interest. It brings out:

1. *Ten tests are the least that should be used in determining the percentage of positive tests in a single sample.* Ten tests give an error of from 45% to 50%, which is certainly quite large, but the burden of laboratory work involved in making a large number of tests upon each of a continuous series of routine samples evidently requires some consideration. The error can be reduced in proportion to the square root of the number of tests made. Thus, for 100 tests the error for 10 tests should be divided by $\sqrt{10}$, for 200 by $\sqrt{20}$, etc. To obtain results within $\pm$ 10% requires 200 tests, $\pm$ 5%, 800 tests! It is unfortunate that this test, of much greater sanitary significance than the bacterial count, should be so inexact.

2. *For reliable results, the percentage of positive tests should lie roughly between 35 and 85.* Closer limits can be obtained by inspection of the individual precision curves. Below 35% the error increases very rapidly and above 85 the curves abruptly change their slope and pass into a region of indetermination.

3. *Of three dilutions in the usual geometrical progression of 10, 1.0, 0.1, only one can be in the range of reliable results.* This follows directly from (2) and has been checked by the examination of a large number of actual results. A coli value by the method given above, based upon the combination of three dilutions, is less exact than would be obtained by selecting the one of the three which lies within the range of reliable results. This point applies with even greater force to the coli index, since therein the lower of the three values is given 10 times the weight of the middle (and usually the most accurate) one. Of course, dilutions closer together might be used, but then there is the possibility of all of them being outside of the limits, so that it is better to use the multiples of 10, and select that set which comes within the range.

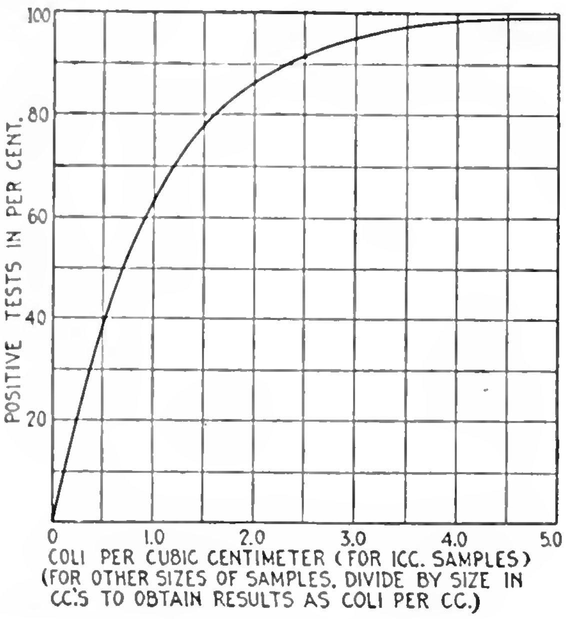


FIG. 3

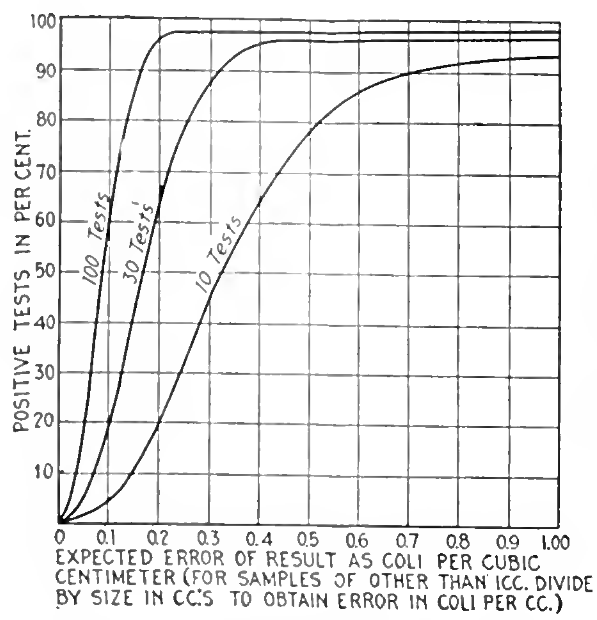


FIG. 4

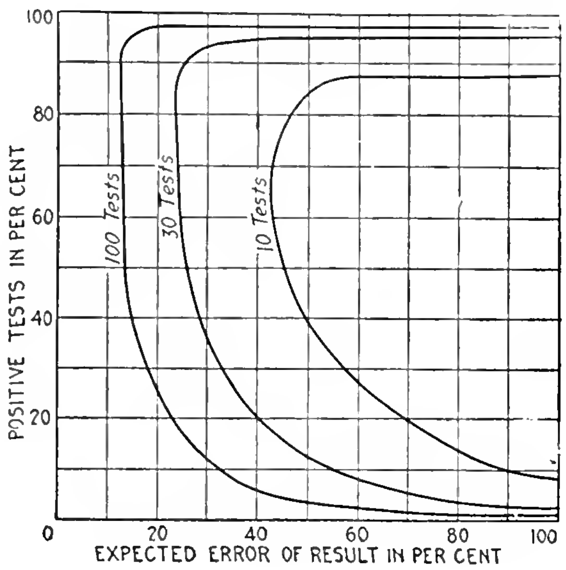


FIG. 5

FIG. 3. MOST PROBABLE NUMBER OF COLI CORRESPONDING TO ANY PERCENTAGE OF POSITIVE FERMENTATION TESTS. FIG. 4. THE EXPECTED ERROR IN COLI RESULTS. FIG. 5. THE PRECISION OF COLI RESULTS

THE BACILLI COLI TEST—REPEATED SAMPLES—If there is so much uncertainty in the results of fermentation tests on a single sample, how must matters stand in the case of repeated samples, such as the daily tests (usually one each of several dilutions) made at filtration plants? The density of coli in almost every water varies from day to day, so that the daily results are in fact only single tests taken haphazard from a number of series, each of which, if developed, would yield a different percentage of positive tests. Therefore, unless it is definitely known that the coli content of a water is practically constant from day to day, any percentage or other computation based on a series of single daily tests is of little value, and unless such a constancy has been experimentally verified it is necessary to make a series of tests, not less than 10, each day, if it is desired to avoid the danger of being entirely misled by the results.

TABLE II. RESULTS OF DAILY SERIES OF COLI TESTS FOR 10 DAYS
(1-cc. samples)

Column	1	2	3	4	5	6	7	8	9	10	P	Coli
Monday	+	—	+	—	+	—	—	+	+	+	0.6	0.9
Tuesday....	—	+	—	+	—	+	—	+	—	—	0.4	0.5
Wednesday	—	—	—	+	+	+	+	+	+	+	0.7	1.2
Thursday	—	+	—	—	—	+	—	—	—	+	0.3	0.35
Friday......	+	+	+	+	+	+	+	+	+	—	0.9	2.3
Saturday...	—	—	—	—	—	+	—	—	—	—	0.1	0.1
Sunday....	—	+	—	—	—	+	—	—	—	—	0.2	0.2
Monday.....	—	—	—	+	+	+	+	—	+	+	0.5	0.7
Tuesday....	+	+	+	+	—	+	+	+	+	—	0.8	1.6
Wednesday.	+	+	—	+	+	—	+	—	+	+	0.7	1.2
Mean												0.91

This may be shown by Table II, which represents the results of 10 tests on a single sample each day for 10 days. The mean number of coli was 0.91 per cubic centimeter. If only one test had been made each day, the results obtained might have been as in column 3, which gives 0.3 positive, or 0.35 coli per cubic centimeter, or they might have been as in column 6, —0.8 positive or 1.6 coli per cubic centimeter or any one of many other combinations.

TABLE III. THE STATISTICAL COMPILATION OF BACILLI COLI TESTS
1-cc. Samples

Date	P	Coli	Deviation	Deviation
1/11	0.6	0.9	0.0	0.00
1/12	0.4	0.5	0.4	0.16
1/13	0.7	1.2	0.3	0.09
1/14	0.3	0.35	0.00	0.30
1/15	0.9	2.3	1.4	1.96
1/16	0.1	0.1	0.8	0.64
1/17	0.2	0.2	0.7	0.49
1/18	0.5	0.7	0.2	0.04
1/19	0.8	1.6	0.7	0.49
1/20	0.7	1.2	0.3	0.09
Mean........................		0.9		4.26

Standard Deviation $= \sqrt{\frac{4.26}{10}} = \pm 0.65 = \pm 72\%$.

Expected Error = Value P corresponding to 0.9, from Fig. 3 = 0.6; from Fig. 4, the expected error for $P = 0.6$ and 10 tests is ± 0.38.
Lexian Ratio = 0.65/0.38 = 1.71.
Mean Error $= 0.65/\sqrt{10} = \pm 0.21 = \pm 32\%$. This value is included merely to show the method of computation. Where results are very irregular its use is not warranted.

Assuming that 10 or more tests are made per day, the summarizing of results for 10 days, 30 days or for a longer period is very similar to the method used for the bacterial count. Using the data in Table I, the procedure is shown in Table III, and calls for little comment. If 0.1-cc. samples had been used, it would have been necessary to multiply the values under "Coli" by 10; whereas if 10-cc. quantities had been used, the same values would have been divided by 10, as previously explained.

New Projection in Map of United States

Using a new system of projection, known as the Lambert conformal conic projection, the United States Coast and Geodetic Survey has just issued an outline map of the United States, scale 1: 5,000,000 and 25 x 39 in. in size. By this system of projection the average scale error is much reduced from that in other systems commonly used. For instance, between latitudes 30½° and 49°, the maximum scale error is only ½%. The Lambert projection is well adapted to large areas of predominating east and west dimensions as the United States, where the distance across from east to west is 1⅗ times that of the distance north and south. The strength of the polyconic projection, on the other hand, is along its central meridian. Special features of the Lambert projection that are not found in the polyconic are claimed as follows: (1) The Lambert projection is conformal; that is, all angles between intersecting lines or curves are preserved; and, for any given point (or restricted locality), the ratio of the length of a linear element on the earth's surface to the length of the corresponding map element is constant for all azimuths or directions in which the element may be taken; (2) the meridians are straight lines and the parallels are concentric circles; (3) it has two axes of strength instead of one, the standard parallels of the map of the United States being latitudes 33° and 45°, and upon these parallels the scale is absolutely true.

Water-Meter Practice and Testing at Buffalo, New York

Special Testing Bench for Large Meters, Cubic-Foot Pail for Skeptical Householders, and Non-Freeze Settings

By Carl L. Lund
Hydraulic Engineer in Charge of Buffalo Meter Shop

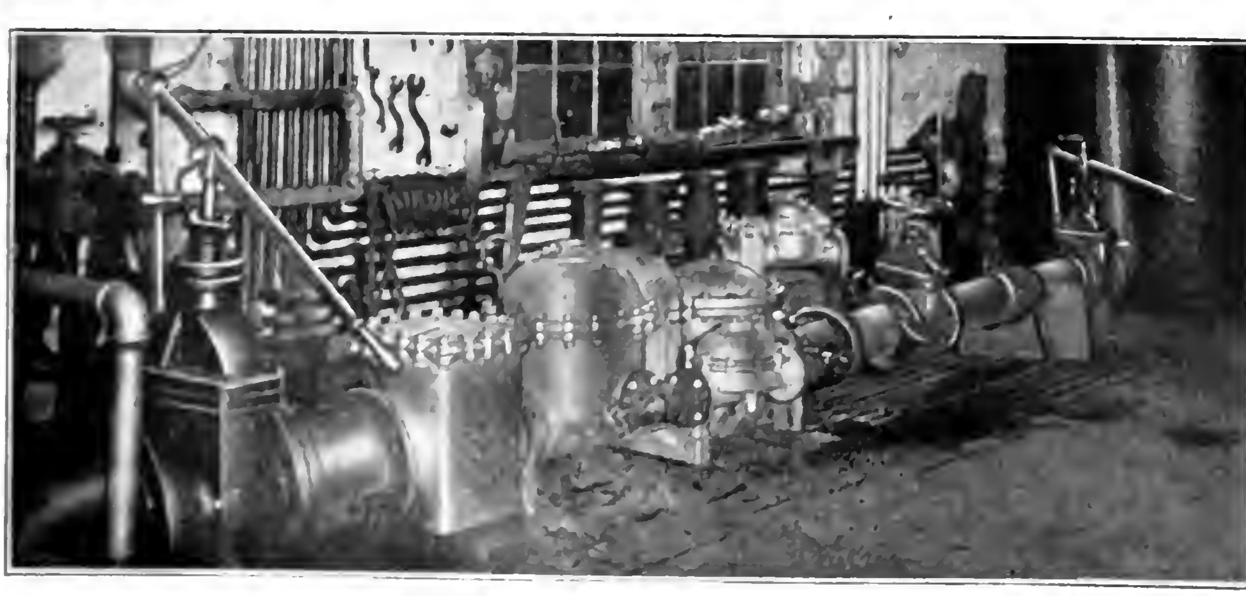
ALTHOUGH 7% only of the 75,325 water services in Buffalo, N. Y., are metered, 46% of the revenue is obtained for metered water. The meter division is, therefore, considered one of the most important branches of the water department. To show how it functions from initial installation to final replacement is the present object.

The city furnishes and installs all water meters, making a nominal charge for labor and fittings. All meters are maintained without expense to the consumer unless the meter should disappear; then he pays for it. If the meter should be ruined by hot water or be frozen, the consumer pays for the damage. A charge is made also for repairing or changing meters after the working hours of the water-department employees. It happens frequently, especially in the large office buildings or offices of corporations, that when we ask, "What is a convenient time to make the repairs?" the reply is, "After we have shut down for the day." In 90% of these cases, when the consumer is informed that he will have to pay for the overtime of the men he finds time to permit the making of the repairs in working hours. Furthermore, if this were not done it would be an inducement to the employees to put off the repairs for the overtime.

Meters are installed in the buildings as far as possible, but where the connections are such that this cannot be done the $\frac{5}{8}$-in. and $\frac{3}{4}$-in. meters are placed near the curb in an 18-in. tile with an iron cover and an 11-in. opening. The larger meters are installed in concrete vaults with a flat-iron frame and cover made by a local foundry. The small meters of the outside installation are brought up to within 15 in. of the surface, and the tile is filled to within 6 in. of the meter. During the severe winter of 1917-18 only half a dozen of the outside meters were frozen, and in each case the service froze in the building first. In the same winter there were over 100 meters frozen inside buildings. A yoke with a stop-cock at each end is used for the small outside installations, as it saves time in changing meters. In the installation of large meters the department requires a valve on both sides of the meter and a 2-in. tee between the outlet side of the meter and the valve. This is for use in making tests of the meter at frequent intervals. A siamese or battery connection is required so as to place two meters instead of one, as with this installation there is no need of the consumer being entirely without water while repairs are being made.

At the present time five meter readers do nothing but read the meters. The readings are taken monthly, and if the reader thinks there is something wrong, or if the meter is stopped, he has an order issued and the meter is sent to the meter shop for investigation. This order is given to the plumber who has charge of the district, and unless he is positive that there is nothing wrong he is supposed to change the meter. We have found that time is saved by taking the meter to the shop, as the disk may be broken, the spindle worn, the train-gear gone, the pinions stripped, or parts of the dial loose. Should the meter reader find a large discrepancy in the previous consumption, he has an order made to investigate for leaks, and the bill is not sent to the consumer until the investigation is made and we are positive that the reading is correct. No complaints are received of under-registering of the meters, but as soon as a bill rendered is larger than usual we are notified that the meter is wrong. For complaints of small meters we make a test on the property by using a 7½-gal. copper pail. For the large meters we use a 2-in. meter and test the two meters in tandem, through the 2-in. test tee. We find the cubic-foot pail more satisfactory to the water-rate payers, as they are always skeptical of a meter.

It is the intention to change meters every two years or oftener, according to consumption. The Lake Erie water is turbid at times, filling the meter with silt. This is bad for the rotary meter, which will under-register 12% in two years. According to the Buffalo rules, meters must register within 2%, plus or minus, and must register water through a $\frac{1}{8}$-in. opening before it can be reset. We find that it is impossible to get the meter to run on a smaller stream without spending a greater amount of time than is commensurate with the revenue we receive at 4c. per 1000 gal. At 40-lb. pressure (which is higher than the average) we find that a meter repaired in the shop and tested perfectly on all streams, including $\frac{1}{8}$-in., will, after a few days, be brought back to the shop, and the best we can get this meter to do is a $\frac{1}{4}$-in. stream.



TESTING OUTFIT FOR LARGE METERS HAS QUICK-OPENING INLET AND OUTLET VALVES

The meter-repair division is located in a one-and-a-half story brick building at Lake View Ave. and Jersey St., in conjunction with the general repair division. It is also near the Col. Francis G. Ward pumping station. The meter shop is 200 ft. x 50 ft., with a stock room 20 ft. x 40 ft. in the center and adjacent to the meter repairer's bench. In the stock room are 1300 compartments for fittings and repair parts. From a 48-in. main in Lake

View Ave. there is a 10-in. connection for the shop. A 2-in. line supplies the testing machine for small meters up to 2-in. A special testing bench, designed and constructed by the writer, is used for the larger meters. The layout is as follows: A 10-in. supply comes into the building and up to a 10-in. flanged quick-opening valve (there is a 10-in. air chamber just inside the building wall); then a 10 x 8-in. flanged reducer, followed by an 8 x 6-in. flanged reducer, then a reducer to fit any size of meter, and, finally, space for a meter. The line is then increased to a 6-in. screw gate valve, and a piece of 6-in. pipe is followed by a 6-in. quick-opening valve. On this piece of 6-in. pipe there is a special flanged joint for inserting bronze disks with openings of various sizes, from 4 to ⅛ in. The discharge is through a 7-ft. riser over the top of a 60-in. cast-iron pipe set on end on a concrete foundation, with a 6-in. outlet to the sewer. The outlet is controlled by a 6-in. quick-opening valve. This is a volume tank, and the amount of water that is registered shows through glass gages in three 4-ft. sections, with a wood board painted to show cubic feet. The bottom of the 60-in. pipe is 5 ft. below floor level, with the zero of the gage at floor level, so zero is always at water level. A third testing machine is used by the meter repairers to tell how small a stream the meter will register.

The present force and the salaries of the meter division are as follows: One general foreman, $1500 per year; one clerk, $1200 per year; two plumbers, $110 per month; three meter repairers (outside work), $4 per day; two meter repairers (shop work), $3.75 per day; one repairer and tester (large meters), $3.75 per day; four plumbers' helpers, $3.25 per day; one plumber's helper, $3 per day; one meter tester, $3 per day, and one laborer, $3 per day. The Bureau of Water is under the Department of Public Works, of which Arthur W. Kreinheder is commissioner and George C. Andrews is water commissioner. The writer is hydraulic engineer in charge of the meter shop.

Design and Tests of Highly Efficient Air-Lift Installation at Fort Bliss, Texas

Novel Foot Piece, Well Proportioned Eduction Pipe, and Special Head Tanks Give 51.9 Per Cent. Air-Lift Efficiency—Overall Efficiency 28.6 Per Cent.—Test Figures and Operating Costs Given

By Captain J. F. Brown
Quartermaster Corps., Engineering Branch, Construction Division of the Army, Kansas City, Mo.

In the light of experience, extending over several decades, in the use of compressed air for lifting water from wells, engineers are inclined to receive, not without a degree of skepticism, reports of actual installations which are operating at high efficiency. Careful analysis of conditions to be met and thorough study of plants of a similar character, on the part of the designing engineer, have, however, made possible the design and installation of such a plant at Fort Bliss, Texas, tests of which show operating efficiencies never before attained—51.9% as the average of the better of two sets of air-lift tests and 28.66% as the corresponding overall or wire-to-water efficiency. The foot piece, consisting of a double conical bronze casting (inverted cone at lower end), set within and at the foot of the eduction pipe, is the special feature of design. Particular attention was also given to the proportions of the eduction pipe and to the head tanks at the top of each eduction column. Small water-storage reservoirs, with sand-settling compartments and measuring weirs, are provided.

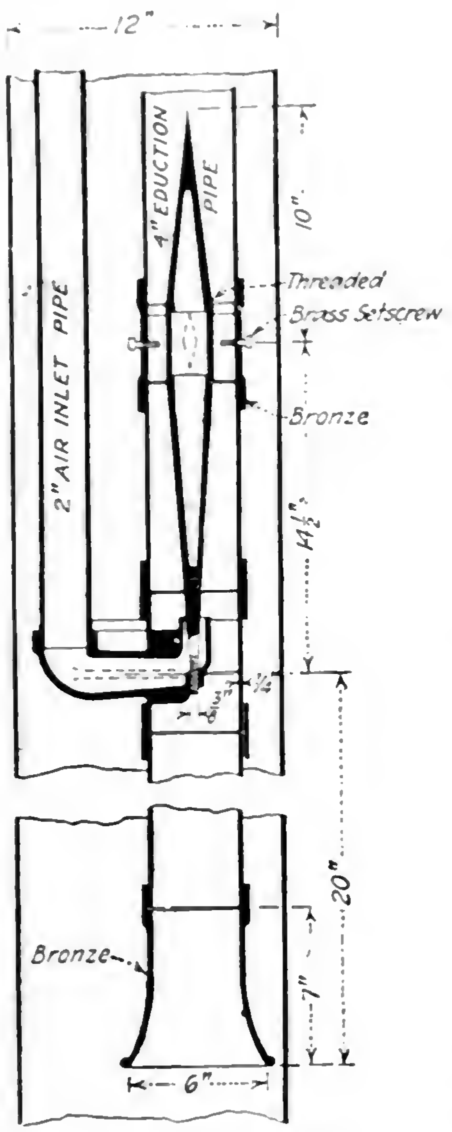
Water for all needs of the permanent military establishment, as well as for several bodies of troops encamped temporarily on the Fort Bliss military reservation, is supplied from four bored wells, each 600 ft. deep, and is pumped from these wells into surface reservoirs by means of compressed air. From the surface reservoirs the water is pumped directly into the distributing mains by means of centrifugal pumps. According to information obtained during the drilling of the wells, eight distinct water-bearing strata are penetrated, the first, or uppermost, being about 220 ft. below the surface, at which depth is the normal water plane.

These wells, two of which are 10 and the other two 12 in. in diameter, are cased to the full depth with standard threaded steel casing. From the normal water plane to the bottom the casings are perforated with ½ x 10-in. vertical slots, the area of opening being 10 sq.in. per foot of casing. In the 10-in. wells drilled in 1913 the slots were cut by means of air-operated hammers, while in the larger wells, drilled in 1917, they were cut by means of an oxyacetylene torch. The latter method proved to be much more rapid and less costly than the former.

Air for operating the four wells is supplied by four duplex, two-stage compressors, two of which are equipped with high- and low-pressure cylinders 7½ and 14 in. in diameter, respectively, the other two being equipped with cylinders of 7- and 12-in. diameters, respectively, and all having a 12-in. stroke. At the normal speed of 190 r.p.m., the two larger compressors deliver 320 cu.ft. of free air per minute each, and the smaller ones 260 cu.ft. each, when operating against a terminal gage pressure of 150 lb. The cylinders are equipped with Corliss-type intake and direct-lift-type discharge valves, and are water-jacketed. Each compressor is provided with a brass-tube intercooler having a cooling surface of 50-sq.ft. area.

All of the compressors discharge into a 6-in. header, at each end of which is an air receiver 3½ ft. in diameter and 10 ft. long. From each receiver compressed air is distributed to two wells, the air-supply line to each well being 3 in. in diameter. At the well head the air line is reduced to 2 in. and extends into the well between the casing and the eduction column to a depth of approximately 540 ft., at which point it connects into a specially designed cast bronze foot piece.

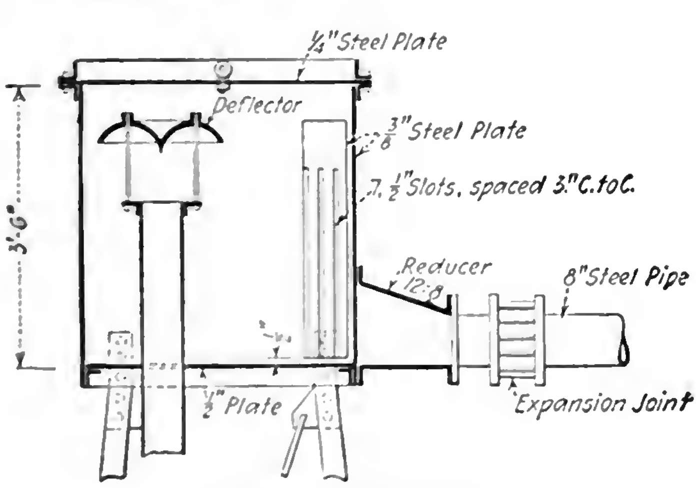
The function of the foot piece, shown (see next page) is to facilitate the thorough mixing of the current of air and the rising column of water. This highly important feature of the installation differs radically from the well-known commercial types of foot pieces. It consists



AIR LIFT FOOTPIECE

essentially of a double conical bronze casting supported concentrically within the eduction column, the apex of the lower cone extending just into the compressed air inlet. From this point the velocity of the rising column of water is increased, due to the decreased area of the section, until the throat section at the base of the cone is reached, at which point the velocities of the two currents are very nearly equal. In this portion of the foot piece there occurs the thorough mixing of air and water, the two fluids passing through the throat section in a thin sheet or film. The upper cone serves to provide a steadily increasing section, thus preventing a separation of air and water which would be caused by the shock due to a suddenly increasing section. The eduction column was designed of such proportions that the maximum velocity of the rising column of water and air should not exceed 25 ft. per second at any point when the well was delivering at the normal rate, and increases in diameter from 4 in. at the foot piece to 7 in. at the top.

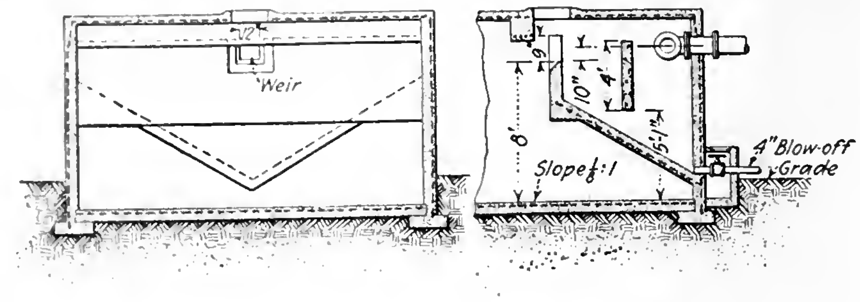
At the upper end of each eduction column is a cylindrical steel head tank (see below), 3½ ft. in diameter and 3½ ft. in depth, within which is supported, just above



AIR LIFT HEAD TANK

the end of the pipe, an umbrella-shaped cast-iron deflecting vane, whose function is to break the force of the rising column of water and air. The head tanks are closed at their tops by means of steel plates, bolted on over rubber gaskets to prevent the escape of air. From the head tanks water and air flow through 8-in. galvanized-steel pipe lines supported on angle-iron frames and concrete piers, to two covered rectangular reinforced-concrete reservoirs of 46,000 gal. capacity each. Each reservoir contains a small settling chamber, in which the sand coming from the wells subsides, and a rectangular weir for measuring the rate of discharge from the wells. (See illustration below.)

Horizontal, double-suction, single-stage, volute-type, centrifugal pumps are used for pumping the water



RESERVOIR WITH SAND-SETTLING COMPARTMENT AND WEIR

from the surface reservoirs into the distributing mains. There are four of these pumps, each rated to discharge 600 gal. per minute against a head of 135 ft. at a speed of 1760 r.p.m., although two of them have a discharging rate of about 1000 gal. per minute when operating against that head.

All of the compressors and centrifugal pumps are driven by constant-speed, induction-type motors. The motors for the two larger compressors are rated at 75 hp. each and operate at a speed of 580 r.p.m., while those for the two smaller compressors are rated at 61 hp. each and operate at a constant speed of 1150 r.p.m. Each centrifugal pump is direct-connected by means of a flexible coupling to a 40-hp. motor, which operates at a constant speed of 1760 r.p.m. Electric current for operating these motors is bought from the El Paso Electric Railway Company.

Upon completion of the original installation, consisting of the two larger compressors and two centrifugal pumps, a series of tests, or trial runs, was made to ascertain the efficiency of operation of the plant, particularly of that portion of the plant used for lifting water from the wells. During the past year the capacity of the plant has been practically doubled by the installation of additional compressors and pumps, and upon completion of this work a second and more comprehensive series of tests was made. No effort was made to ascertain the mechanical efficiency of the individual units, such as motors, pumps, compressors, etc., since each of these had been tested at the various factories under the supervision of Government engineers, and it is understood that they met fully the specifications and the manufacturers' guarantees.

In preparing the plans and specifications for the plant consideration was given to the desirability of making frequent operating tests of the different portions of the plant, with the result that it was determined to provide in the permanent installation such gages and meters as would be necessary in obtaining the desired data.

The series of tests, or trial runs, on the air-lift installations is divided into two sets. In the first set, the power input to the compressor motors was obtained from readings of the recording dials of the watt-hour meters on the switchboard; the speeds of the motors and compressors by means of revolution and stroke counters; the rate of delivery of compressed air to the wells from readings of the scale of the manometer of the air meter; the air pressure from gages on the air receivers and at each well head; and the rate of delivery of water from the wells from the weir gage. In the second set of tests the power input to the com-

SUMMARY OF AIR-LIFTS TEST AT FORT BLISS, TEXAS

Test No.	Actual Air Delivered Cu Ft per Minute	Water Delivered per Minute Gal.	Water Delivered per Minute Cu.Ft.	Air Pressure at Receiver, Lb.	Pumping Head, Ft	Water, Hp	Air Hp Iso-thermal	Input to Motors, Hp.	Efficiency, % Air-Lift	Efficiency, % Overall Wire-to-Water	Units Operating Compressors	Units Operating Wells
			I. Input to motors from readings of watt-hour meters. Output from wells from weirs									
2	468 5	554	74.1	133	239	33 6	68 9	130.1	48 7	25 8	3 and 4	2 and 3
3	473 9	566	75.7	133	239	34 3	69 7	127.4	49.2	26.9	3 and 4	2 and 3
6	521 4	614	82.1	132	239	35 6	76 6	153.0	46.4	23.2	2 and 4	2 and 3
7	616 5	663	88.6	130	239	40 2	90 6	159.0	44.4	25.3	1 and 2	1 and 4
8	617 6	668	89.4	131	239	40 5	90 8	157.0	44.6	25.8	1 and 2	1 and 4
9	602 5	680	91.0	132	239	41.2	88.6	161.0	46.5	25.6	1 and 2	1 and 4
11	553 5	622	83.2	132	239	37 6	81 3	145.0	46.2	25.9	2 and 3	1 and 4
12	311 3	412	55.1	132	239	24 9	45.7	75.2	54.5	33.1	2	4
25	776 1	889	118.8	135	239	53 8	114.3	204 0	47.1	26.4	2, 3 and 4	1, 2 and 3
26	582 4	705	94.3	135	239	42 7	85 6	163.7	49.8	26.1	1 and 2	3 and 4
27	470.8	546	73.0	132	239	33.1	69.2	128.7	47.7	25.7	3 and 4	2 and 3
			II. Input to motors from revolutions of disks of watt-hour meters. Output from wells measured volumetrically									
28	618 3	746	99.8	131	239	45 2	90.7	159.7	49.8	28.3	1 and 2	1 and 4
30	618.0	735	98.3	133	239	44 5	90.8	159.3	49.0	27.9	1 and 2	1 and 4
32	310.0	338	45.2	130	239	20 5	45.6	78.6	45.0	26.1	1	1
34	302.4	399	53.3	131	239	24.1	44.4	79.5	54.2	30.3	1	4
36	308.2	399	53.3	132	239	24 1	45.3	81.5	53.2	29.6	2	4
38	226.4	314	42.1	133	239	19 1	33 3	63.7	57.3	29.9	3	2
40	480.4	652	87.2	133	239	39.5	70 6	128.4	57.0	30.8	3 and 4	2 and 3
42	226.4	275	36.7	133	239	16.6	33.3	63.3	49.8	29.3	4	3

pressor motors was obtained by counting the number of revolutions of the rotating disks in the recording watt-hour meters, the rate of delivery of water from the wells from actual volumetric measurements by means of the surface reservoirs, and all other data as in the first set. The methods of obtaining the power input to the motors and the rate of delivery from the wells, as used in the second tests, are thought to be much more accurate than those used in previous tests, because unit rates are derived from totals for a given period of time rather than from direct observations.

The series of tests on the centrifugal pumping units is divided into three sets. In the first of these the power input to the motors driving the centrifugal pumps was obtained from readings of the dials of the recording watt-hour meters on the switchboard; the speed on the unit by means of a revolution counter; the rate of delivery of water and the total volume delivered during the test from the indicating and registering dials of the manometer of the venturi meter, and the head against which the pump was operating from the recording altitude gage. In the second set of tests, the power input to the motors was obtained as above described, and the total volume of water pumped during each test was measured volumetrically. In the third set, the power input to the motors was obtained by counting the revolutions of the rotating disks of the watt-hour meters, and all other required data were obtained as in the first set.

Results calculated from data obtained during the tests described are given in the accompanying table. The average efficiency of the air-lift for the first set of tests was 48.1 and for the second tests 51.9%. The average overall efficiency (wire to water) for the air-lift end of the plant for the first set of tests was 26.4% for the first and 28.66% for the second set of tests.

For the centrifugal pumping units the average overall efficiency (wire to water) for the first set is 43.6%, for the second 49.27% and for the third 55.93%. The results obtained in the first and second sets show overall efficiencies of the pumping units on the basis of useful work done. The power applied to the motors is consumed in actually pumping water against the pressure head in the distributing system. In the third set of tests, in which the pumps were throttled on the discharge side to give the desired rate of discharge, the statement of efficiencies is the relation between the power applied to the motors and the actual work done by the pump in forcing water through the partially closed gate valve in the discharge line and against the pressure head in the distributing system. The results in this set are interesting, therefore, only as indicating the actual overall efficiencies of the units.

The average power requirement for lifting water from the wells to the surface reservoirs is 2.77 kw.-hr. per 1000 gal. of water, and that for pumping the water from the surface reservoirs into the distributing system is 0.798 kw.-hr. per 1000 gal., under average working conditions of pressure and rate of delivery. At an average cost of 1.5c. per kilowatt-hour, the actual cost for power alone for delivering 1000 gal. of water into the distributing system is 5.34c. The cost for the pumping station crew, consisting of a chief engineer and one assistant engineer and one laborer on each of three daily shifts, and also including the cost of incidental supplies, such as lubricating oil and waste, is 1.66c. per 1000 gal., making the total actual cost 7c. per 1000 gal. The actual outlay of funds for this plant is $101,767, the original installation, including the two 10-in. wells, having cost $42,700 and the addition to the plant, including the two 12-in. wells, having cost $64,067. Interest at the rate of 4% upon the cost of the installation, and depreciation of equipment at the rate of 5%, are provided for by adding 2.63c. per 1000 gal., making the total cost for supplying water 9.63c. per 1000 gal., on the basis of a plant capacity of 1,000,000 gal. per day. Prior to the completion of the plant, water purchased from the El Paso Water Co. to supply the needs of Fort Bliss cost 20c. per 1000 gal. At an average daily demand of 1,000,000 gal., the annual saving to the Government effected by the operation of this plant is $37,850. If the plant capacity is taken as 1,500,000 gal. per day, which is its normal working capacity, providing for the shutting down of one compressor and one well, the total cost of supplying water is 8.21c. per 1000 gal., and the annual saving to the Government is $64,550. Taking the plant capacity as 2,000,000 gal. per day, which is the ultimate capacity of the present installation, the total cost per 1000 gal. is 6.74c., and the annual saving is $96,798

The original investigations and studies of the problem of providing an adequate water-supply for Fort Bliss, and all original designing in connection with the preparation of the plans for the project, were carried out during the years 1915-16 by Leonard S. Doten, who was at that time sanitary and hydraulic engineer in the

construction and repair division, Office of the Quartermaster General of the Army. The preparation of the plans for the addition to the plant in 1918 was also accomplished under his direction as advisory engineer on sanitation, Construction Division of the Army. The contractor for the original equipment installation was the Perry Electric Co., of Brooklyn, N. Y., and the general contractor for the addition to the plant was the Jennings Construction & Engineering Co., of El Paso, Tex., the drilling of the wells having been done by local contractors. The writer, at that time civil engineer for the construction and repair division, Office of the Quartermaster General of the Army, superintended the original installation and had charge of the preparation of plans for the addition to the plant, and conducted the tests described herein.

Centrifugal Pumps at the Chicago Water-Works Plants

Electric Power More Satisfactory Than Steam—Two 40,000,000-Gallon Pumps With 1100-Horsepower Motors Being Installed

EXTENSIVE use of centrifugal pumps for the Chicago water-works is due partly to the fact that the small floor area required enabled them to be placed in existing pumping stations which had no room for additional steam equipment, and partly to a movement for electrical operation of the pumping plants together with the low cost of an electrically operated centrifugal plant as compared with that of a steam-operated reciprocating plant. This movement has been backed by the Sanitary District of Chicago, in order to increase the city's consumption of current generated at the hydro-electric plant on the Drainage Canal. There are now 16 centrifugal pumps, with rated capacities ranging from 5,000,000 to 40,000,000 gal. daily, and six of these are electrically driven.

Steam-turbine centrifugal pumping units are reported to have given considerable trouble in operation, so that there is reluctance to install more machinery of this kind, at least where permanent service is required. The difficulties consist mainly in minor failures of turbine parts which necessitate shutting down the unit, but it has not been determined whether these are caused by unfamiliarity on the part of the operators or by defects in the machinery, or both combined. With motor-driven units there has not been much trouble. However, a flooding of the 22nd St station, which caused the putting of all electrical units out of service for a considerable time, has indicated certain difficulties against which provision must be made.

The first centrifugal pump installation was made in 1910 at the 22nd St. pumping station. Additional capacity was needed to serve the stockyards district, but there was neither floor space nor boiler capacity for new steam units. The city engineer decided, therefore, to adopt motor-driven centrifugal pumps, which could be placed in the existing pump pit. The two pumps are each of 25,000,000-gal. capacity against 130-ft. head, directly connected to induction-synchronous motors having a rated capacity of 1000 brake-horsepower, 800 kva. The speed of pumps and motors is 514 r.p.m. This type of motor has the advantage of greater starting torque than a synchronous motor, while retaining the simple starting method of an induction motor. Current was furnished by the Sanitary District of Chicago, and was stepped down from 12,000 to 440 volts. These units have been in continuous service since 1911, pumping for much of the time at the rate of 20,000,000 to 30,000,000 gal. daily, or about 25% above the rated capacity. Their satisfactory service led to further use of the system.

Two steam turbine driven, direct-connected pumps of 20,000,000-gal. capacity, operating at 1500 r.p.m. were installed for temporary service at the Lake View pumping station in 1912. Four similar units of 25,000,000-gal. capacity, operating at 1550 r.p.m. were installed in 1913, one each for reserve at the 14th St., Harrison St., Central Park Ave. and Springfield Ave. stations. In 1914, two similar units for booster service were installed at the Roseland station, being of 5,000,000 gal. capacity and operating at 2750 revolutions per minute.

New equipment for the 68th St. station was needed at about this time, but as there was a probability of this station being abandoned in favor of a new location, it was not considered advisable to incur the heavy expense of new reciprocating pumps. To meet these conditions, the two 20,000,000-gal. turbine-driven pumps at the Lake View station were moved to 68th St. in 1914. Two 30,000,000-gal. units were installed at the latter station in 1916, but in this case reduction gears of the herring-bone type were used, the speeds being 3740 r.p.m. for the turbines and 720 r.p.m. for the pumps. It is stated that these units have given more trouble than any of the others, and new gears are now being placed. This station, with its four steam-driven centrifugal pumps, is still in service.

Motor-driven units have been adopted for all other installations, following the general type of the second plant at 22nd St. At the Jefferson Park station a 3,000,000-gal booster pump was installed in 1913, and two of 2,000,000 gal. in 1915. All had slip-ring induction motors, with speeds of 1140 r.p.m. for the smaller and 865 r.p.m. for the larger machines. These three booster machines were dismantled in 1918. Two 25,000,000-gal. pumps directly connected to 875-hp. induction motors, operating at 440 volts and with a speed of 720 r.p.m. were installed in the 22nd St. station in 1918, replacing some of the old steam pumps and supplementing the original electrical installation of 1911.

The largest centrifugal pumping units (which are not yet in service) are two 40,000,000-gal. machines, having a maximum rating of 50,000,000 gal., to replace two old steam pumps of 25,000,000-gal. combined capacity at the Chicago Ave. station, where there still remain three modern steam reciprocating pumps of 25,000,000 gal. each. The new centrifugal pumps will be directly connected to slip-ring induction motors of 1100 hp., operating at 2300 volts and with a speed of 720 r.p.m. An overall efficiency of 72.3% for pump and motor is required for this plant, which, it is expected, will be put in service in 1919.

All these installations of centrifugal pumps for main and supplementary units have been planned by and made under the direction of John Ericson, city engineer
made under the direction of John Ericson, city engineer.

More Metering for Salt Lake City

Under an amendment to a city ordinance of Salt Lake City, Utah, dating from the beginning of 1919, all new services are to be metered. At present about 25% of the services are fitted with meters. A water-waste survey is contemplated but has not been undertaken.

Municipal Freight-Handling Dock and Cranes at St. Paul

City Now Prepared To Convey Freight From the Mississippi River to Storage Yards, Trucks or Railroad Cars

ST. PAUL, Minn., has just completed a municipal river freight-handling terminal on the Mississippi at a cost of $71,800, and the city is now equipped to transfer river and land freight, if river haulage becomes popular. The terminal comprises main-line railroad tracks on a timber trestle paralleling the river, an adjacent storage yard, a large tower crane mainly to handle coal, and a locomotive crane for smaller loads.

The trestle is 800 ft. long and has two standard-gage tracks connected to the main-line railways. Straddling

CRANE WILL HANDLE RIVER FREIGHT AT ST. PAUL

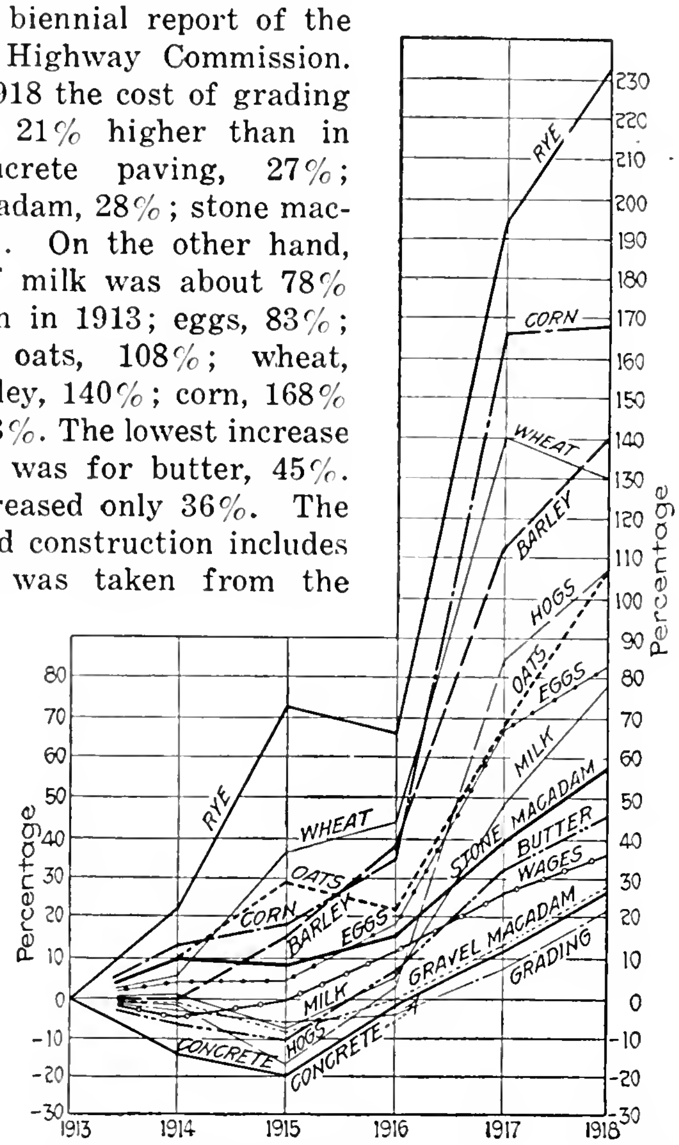
the tracks is the tower shown in the view, equipped with a 2-yd. clamshell bucket traveling on a boom which extends 70 ft. over the river and 85 ft. over the land. This tower is to be used exclusively for handling coal, sand, gravel, package freight, etc. The tower may load directly onto railway cars on the double tracks, to automobile trucks on the marginal way or dump on the storage platfrom. Parallel with the trestle the ground has been leveled off and filled in to provide storage for a width of 100 ft. Here 18,000 cu.yd. of earth fill was made, material being delivered free of charge from building excavations and other sources. The only expense connected with it is that of spreading and leveling.

The locomotive crane, which runs on the trestle tracks, has a 1½-yd. clamshell and a maximum working radius of 50 ft. The mean height of the river is only 10 ft. below the rail on the trestle, although in the view herewith the distance looks much greater.

The work was planned and built under the supervision of O. Claussen, chief engineer, and M. S. Grytbak, bridge engineer, of the city.

Comparatively Small Increase in Cost of Wisconsin Road Building

RELATIVELY low increase in cost of roads in Wisconsin during the war period, 1914-18, as compared with the increase in cost of farm produce, is shown by the accompanying diagram, which is taken from the fourth biennial report of the Wisconsin Highway Commission. Thus, in 1918 the cost of grading was about 21% higher than in 1913; concrete paving, 27%; gravel macadam, 28%; stone macadam, 58%. On the other hand, the cost of milk was about 78% higher than in 1913; eggs, 83%; hogs and oats, 108%; wheat, 130%; barley, 140%; corn, 168% and rye 233%. The lowest increase in produce was for butter, 45%. Wages increased only 36%. The cost of road construction includes labor and was taken from the



RELATION BETWEEN INCREASE IN COST OF WISCONSIN ROADS AND FARM PRODUCE

records of the commission. This chart shows that the farmer can build more road with a measure of produce than before the war.

100-Mile Motor-Truck Express Route

A 100-mile motor-truck express route is reported in operation between Portland and Salem, Ore., the round trip being 110 miles. Two 3½-ton trucks and one 2-ton truck are in use, the larger trucks making a round trip every day, while the two-ton truck is used on rush days and in picking up express packages in Portland. The freight rates range from 30 to 40c. per hundredweight, the trucks picking up and delivering all along the route. The line has had so much business that five tons have been carried every trip. Greater speed is expected when 20 miles of rather rough earth roads are improved. The express consists of taking milk, butter, eggs, veal, poultry, hogs, and vegetables to market, and merchandise on the return trip. E. B. Scott, whose father, Capt. Hugh B. Scott, ran the first light-draft steamer between Portland and Salem on the Willamette River, is behind the undertaking.

Study of Revenue From Sale of Water to Metered Domestic Consumer

New England Water-Works Association Form Based on Service and Output Charge Alone Rational and Equitable — Basing Revenue Estimates on Unregistered Water Leads to Error

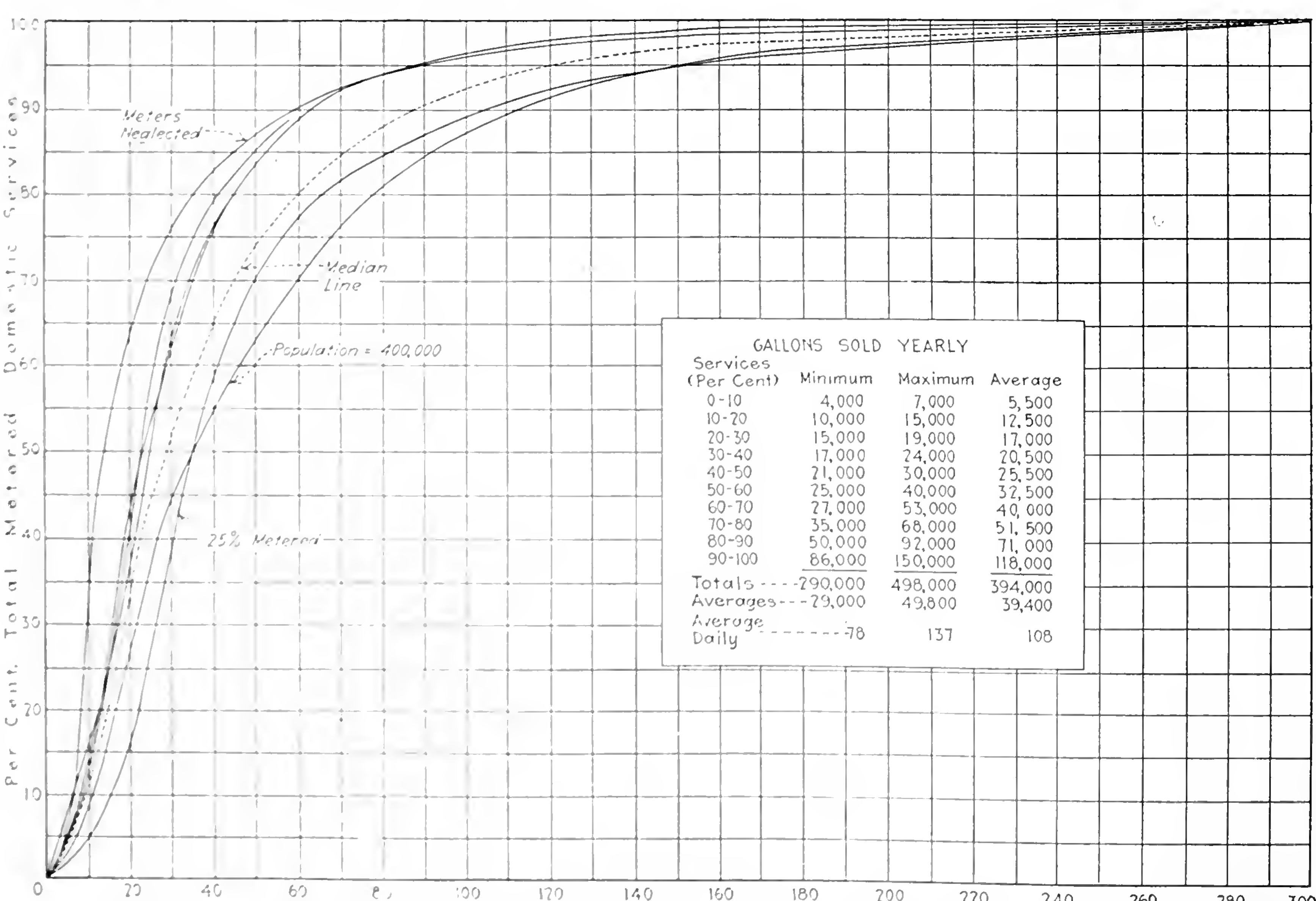
By Philip Burgess

Engineer, Columbus, Ohio, Before the Indiana Sanitary and Water-Supply Association

Control of water rates charged, especially by private companies, is now largely in the hands of state commissions. It is the usual procedure, in adjusting water rates before the commissions, to determine, first, the cost of service, based in part on the reasonable return on the fair present value of the properties and in part on the operating and maintenance cost of the plant; and when the total cost of service is thus determined the schedule of rates is established so that the property will earn an amount at least equal to the total cost of the service rendered. It has been the writer's experience that during such proceedings it is customary to spend much time and effort in determining the value of the property and the cost of service but that little attention is given to the form of the schedule and the individual rates properly chargeable for the service. For this reason it is generally found that, after all the effort, the schedule of rates finally set up does not earn the amount which it properly should earn. This is particularly true when the schedule is changed from flat rates to metered service rates, and is attributable principally to lack of information relative to the amount and distribution of the water sold.

It is the writer's opinion that the determination of a schedule of fair water rates chargeable for metered service requires the setting up of a reasonable service charge, payable whether or not any water is delivered, and, in addition, a reasonable output charge for water actually consumed or sold by the meter. The most interesting and instructive discussions of the service charge are found in the reports of the committee on meter rates of the New England Water-Works Association and in some of the earlier reports of the Wisconsin Railroad Commission. The New England Water-Works Association has adopted a standard form of meter rates. The schedule includes also a service charge for a $\frac{5}{8}$-in. meter. The output charge is divided under three classifications—domestic, intermediate and manufacturing—with limits of 75,000 and 750,000 gal. per quarter. Quoting from the *Journal* of this society (Vol. 30, No. 4, p. 469) the service charge for a $\frac{5}{8}$-in. meter would be made of three parts, namely:

"(1) Ten per cent. of the average investment of the works in service pipe and meter; (2) one dollar per annum for reading meters, billing and collecting; (3) two dollars per annum for the probable value of unregistered water; for a domestic service charge with a $\frac{5}{8}$-in. meter the ordinary service charge may properly



GALLONS SOLD YEARLY			
Services (Per Cent)	Minimum	Maximum	Average
0-10	4,000	7,000	5,500
10-20	10,000	15,000	12,500
20-30	15,000	19,000	17,000
30-40	17,000	24,000	20,500
40-50	21,000	30,000	25,500
50-60	25,000	40,000	32,500
60-70	27,000	53,000	40,000
70-80	35,000	68,000	51,500
80-90	50,000	92,000	71,000
90-100	86,000	150,000	118,000
Totals	290,000	498,000	394,000
Averages	29,000	49,800	39,400
Average Daily	78	137	108

FIG. 1. PERCENTAGES OF TOTAL METERED DOMESTIC SERVICES USING LESS THAN INDICATED QUANTITIES OF WATER

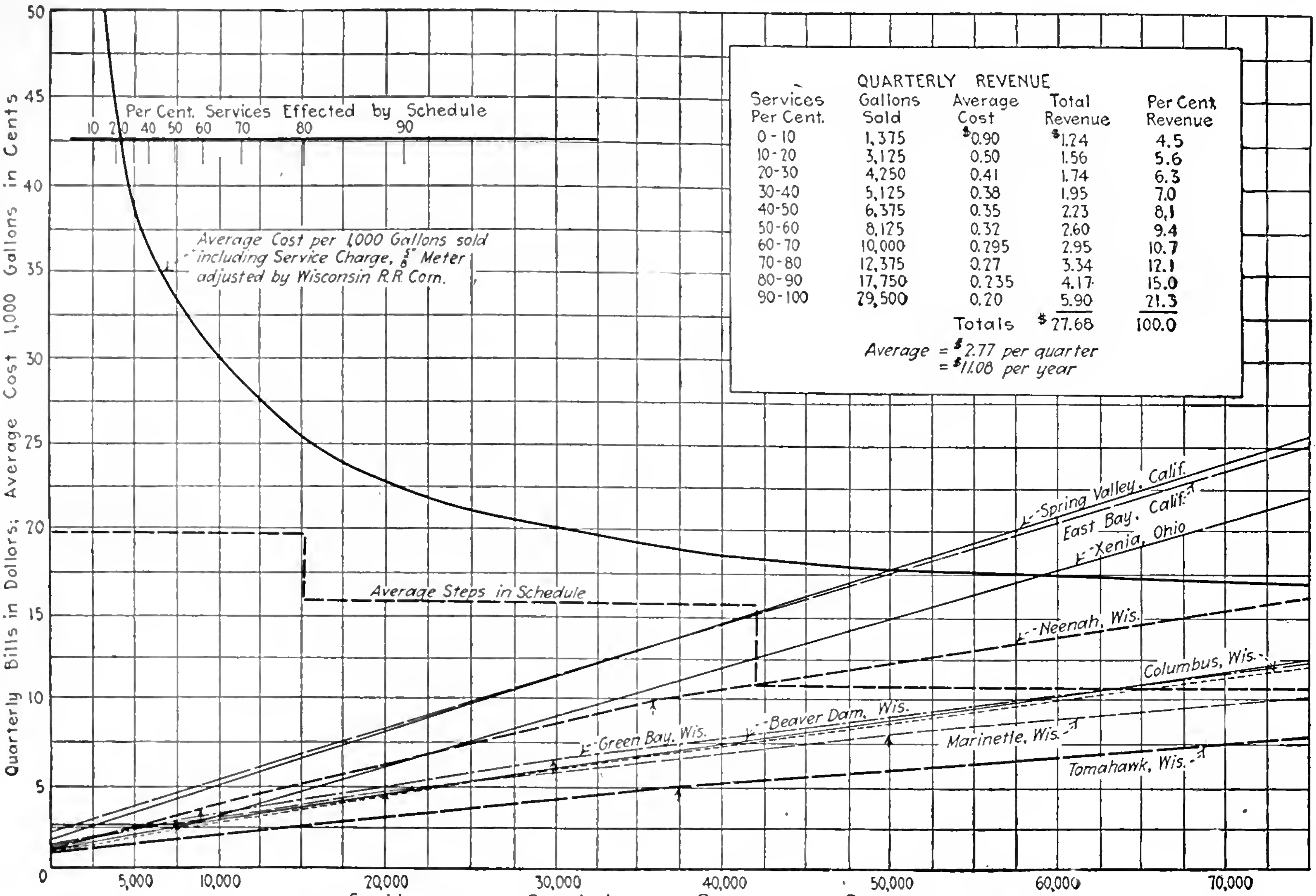


FIG. 2. DOMESTIC METERED WATER REVENUES PER QUARTER AND AVERAGE COST PER 100 GALLONS

be $3, when the service and meter are paid for by the taker; $4 when the meter is furnished by the works; and $5 or $6 where both meter and service pipe are paid for by the works; the lower figure being used where the average cost of the service pipe is under $15 and the higher where it is greater than $15."

It is somewhat remarkable that the service charges determined by the committee of the New England Association and by the Wisconsin Railroad Commission are practically identical, for the amounts are determined in an entirely different manner, especially in regard to the third element which goes to make up the service charge. The New England society's committee determined as this third element the probable value of unregistered water. The Wisconsin Railroad Commission used elements similar to the first two elements contained in the service charge as developed by the committee, but as the third element of the service charge the commission included the capacity expense of the service rendered.

The writer believes that it is immaterial which method may be adopted to compute the service charge, provided that the output charge is figured consistently.

Many errors have been made in estimating revenue receivable under a meter rate, principally because of the fact that reliable information was not available as to the quantity of water sold under the schedule. This quantity frequently is determined by taking from the total output of the plant a certain allowance for unregistered water. In the writer's opinion such a method of computation frequently is subject to error, because of the fact that local conditions which are not determinable affect materially the percentage of unregistered water, which commissions are prone to underestimate. This is one of the fundamental reasons why rate schedules frequently do not develop the amount of the income which they properly should develop.

The more logical method of determining the quantity of water to be sold is, in the writer's opinion, to determine the quantity of water actually sold in similar communities—provided, of course, that reliable information be not available in regard to the plant in question. Unfortunately, however, but little accurate information is available to show the quantity and distribution of the water sold, particularly to domestic consumers. In Fig. 1 I have endeavored to show on several curves the quantity and distribution of water sold to domestic consumers, using the limitation of 75,000 gal. of water per quarter, specified in the schedule of the New England Water-Works Association. This will generally include from 90% to 95% of all services.

The curve, "Meters Neglected," indicates the sale of water by a plant serving about 9000 persons where the meters have been neglected for about 10 years and where the quantity of water sold obviously is much less than the quantity which reasonably should be sold. The curve, "Population 400,000," on the other side of the diagram, represents the distribution of water sold to a large city. It is obvious that the average quantity per consumer in a large city frequently may be more than that sold in a small city, because the water is cheaper in a large city and there is less incentive to conserve the supply; because frequently several families are supplied by the one service; and because there is a class of wealthy people residing in the large city which is not found in the small city. The curve, "25%

metered," also is distinctive as illustrating the fact that the average sale is considerably larger when a comparatively small part of the total consumers are metered, because naturally meters are placed first upon the services supplying large consumers. The "median line" represents approximately an average between the large and small cities, of which three are shown on the diagram.

In the right-hand portion of the diagram are shown the distributions of the sale to the different percentages of services supplied; also the total yearly and average daily quantities of water actually sold. These quantities are significant in view of the fact that generally about five persons are served by each meter. It is obvious that the actual quantity of water sold per consumer is very much less than is generally appreciated.

In Fig. 2 (see preceding page) I have shown the quarterly bills in dollars and the average cost per 1000 gal. in cents, chargeable to domestic services using less than 75,000 gal. per quarter. The schedules adopted were those as indicated and adjusted by the Wisconsin Railroad Commission, two schedules adopted in California, (*Jour.* Am. Water-Works Assoc., March, 1919, p. 37), after adjudication and one schedule recently adopted at Xenia, Ohio, after adjustment by the Ohio Public Utilities Commission.

The diagram shows considerable divergence in the actual cost of water under the several schedules, but on the other hand there is a marked agreement in four of the schedules of the Wisconsin commission. On the diagram I have shown the average costs per 1000 gal. sold, including the service charge of a ⅝-in. meter as adjusted by this commission. This rate varies from the service charge to about 17c. per 1000 gal. It is obvious that in order to get a similar apportionment or distribution of the cost of water service under a schedule containing a minimum charge, it is important that the first unit charge be very much higher than that usually adopted. For instance, the schedule at Xenia contains a first unit cost of 29.2c. per 1000 gal. and a minimum charge of $9.90. This rate is too low, with the result that there is a marked discrimination in the schedule in the favor of about 20% of the consumers, using from 5000 to 10,000 gal. per quarter. The commission wished to establish a schedule which would earn an average of approximately $15 yearly per domestic service, and it is obvious that the schedule selected is unjust to the small consumer and is in favor of the middle-class consumer, whereas if the form of schedule adopted by the Wisconsin commission had been used these discriminations would not have occurred.

I have also shown on the diagram the percentage of services affected by the different portions of the schedule, and it is of interest to note that 50% use less than 30,000 gal. per year. In the same way, I have shown the per cent. of revenue derived from the services, and it is also of interest to note that 50% of the services provide only approximately 30% of the income derived from domestic consumers. In other words, the lower part of the schedule is important as affecting the majority of the customers, but the upper part of the schedule is important as affecting the revenue earned by the company.

I have also shown that, assuming a sale of water similar to that determined on the first diagram and assuming an average cost of 1000 gal., as determined by the second diagram, the average income per service is about $11 per year, based on the average schedule adopted by the Wisconsin commission. This figure is of considerable interest and value in determining what may be reasonably earned by a plant where conditions are similar to those of the average plant above discussed. It is obvious that the expense of service established in California is about double the average

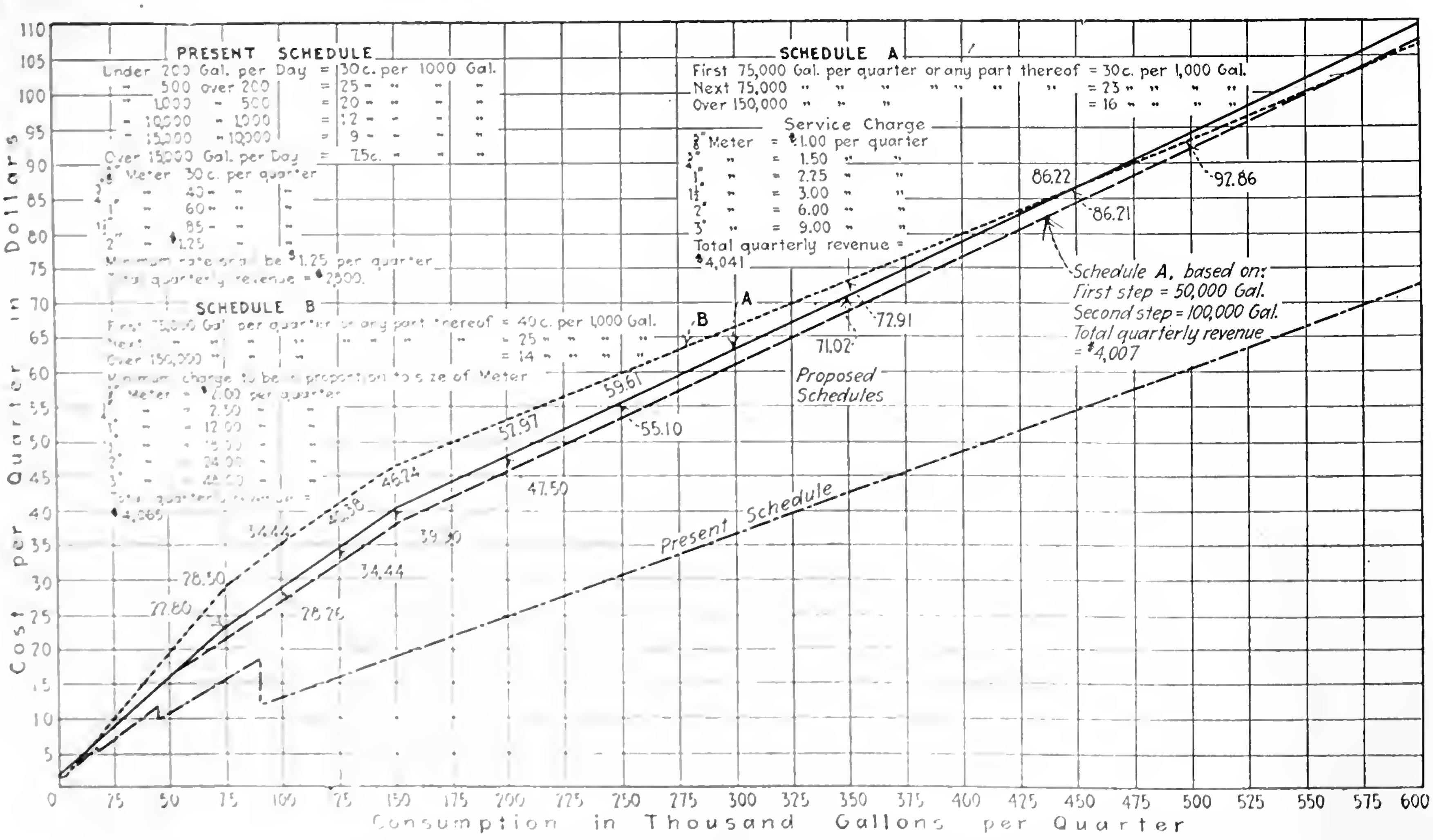


FIG. 3. QUARTERLY BILLS FOR METERED WATER AT GENEVA, OHIO, UNDER PRESENT AND PROPOSED SCHEDULES

expense determined above. The expense at Xenia is about 50% greater than the average, and the form of the schedule could much more properly follow that of the New England committee or that adopted by the Wisconsin commission.

Fig. 3 (see preceding page) shows three rate schedules for a town of about 5000 population. Schedules A and B each are set up to earn practically the same revenue, but schedule A contains service and output charges, while schedule B contains output and minimum charges. Schedule B, containing a minimum charge, is discriminatory, and, in fact, it is practically impossible to make a schedule of this form which is fair to all classes of domestic consumers.

Schedule A should be improved by increasing the service charge and decreasing the first output charge, but there was serious local objection to increasing the cost of service to the small consumer. Schedule B could be improved by increasing the first output charge and by decreasing the quantity of water sold under this charge. Both of these changes would give better balanced schedules and would eliminate obvious discrimination against the middle class of consumer. The present schedule shown on the diagram is similar to many old "sawtooth" schedules in force, and is obviously very unsatisfactory and unfair. It tends to promote waste rather than to conserve the supply.

Interesting Conditions at Plant

Conditions at this plant were especially interesting, because investigation showed that only one-third of the entire output of the station was actually sold. One-third of the output was utilized in sewer flush tanks which were leaking badly and which required a large daily supply in order to make them operate. If rates were determined for this property in the usual manner, by subtracting, say, one-third of the total output as water unaccounted for, and by figuring the rate on the basis of selling two-thirds of the entire output, the actual revenue obtained would be just one-half of the computed revenue. Conditions at this plant are unusual but illustrate the principle which it is desired to emphasize—namely, that rates can be determined only on the basis of the quantity of water actually sold, regardless of the quantity which may be delivered by the system.

In conclusion, the writer believes that the New England form of schedule, with its service charge and an output charge, alone permits an equitable and rational basis of charge for water service. Its general adoption would provide valuable information relative to the actual cost and value of the water service rendered by different properties. Until some standard form of schedule is adopted comparative statistics of water rates will continue to be of little if any value, because the schedules are generally unfair and discriminatory in respect to some of the consumers supplied.

Oil in Chlorinated Water Causes Trouble

Water-supplies in the oil-producing districts of West Virginia are giving trouble, due to the combination of oil wastes with the chlorine. An investigation is being made under Mayo Tolman, chief engineer of the State Department of Health, Charleston, W. Va., to see what can be done to obviate this trouble. Pollution of water-supplies by oil wells is also a matter of investigation by the Kansas State Board of Health.

Handling Iron Ore at the Head of the Great Lakes

How Ore, of Many Different Compositions, From Hundreds of Mines, Is Delivered Rapidly To Boats in Required Analyses

By George H. Herrold
City Engineer's Department, St. Paul, Minn.

On June 20 those members of the American Society of Civil Engineers who will be in attendance at the annual convention in St. Paul and Minneapolis will start on an excursion to Duluth and the Missabe Range. This trip is made the occasion for the description here of one of the little-known details of operation of the iron field.—Editor.

Ore-dock design has been often treated in technical journals, but the system whereby this ore is taken from many mines in variegated composition and delivered to ore docks as required is not so well known.

The iron-ore output of the Lake Superior district was 61,156,732 tons for the fiscal year which ended June 30, 1918, and for Minnesota was 44,537,061 tons, or almost 75% of the total output of the Lake Superior district. Minnesota's output for the year which ended

DIGGING IRON ORE IN A MINNESOTA RANGE

June 30, 1915, was 22,000,000 tons, against a total iron-ore output in Germany in 1915 of 21,000,000 tons. On account of the richness of Minnesota ores, averaging 55% pure iron, it requires only 1.9 tons to produce a ton of pig iron, while the ores of Germany require 2.4 tons of ore. Four million tons of the Minnesota ore in 1918 came from state-owned lands, for which the state received a royalty of over $1,000,000.

This ore lies largely in three districts, known as the Vermillion, the Missabe and the Cuyuna Ranges. The Vermillion ore is all handled by the Duluth & Iron Range R.R. to its docks at Two Harbors on Lake Superior. The Missabe, by far the largest district, is tapped by four railroads, with docks at Duluth and Superior. The Cuyuna Range, the smallest and least developed, furnished 2,588,000 tons for the fiscal year which ended June 30, or an increase of 658,000 tons over the year previous. The haul to the Head of the Lakes is from 70 to 100 miles. The haul to St. Paul on the Mississippi River is 110 miles.

A view herewith shows a typical ore dock, the design of which is fairly well standardized. One of the largest of such docks, for instance, is 2304 ft. long, with 384 pockets of 300 tons, or six cars, capacity each. Its height is 80 ft. above the water surface and on its top are four parallel delivery tracks from end to end. The dock is partitioned along its center line with the pockets opening on either side. The cars, pockets and boat hatches are standardized. The ore car, 24 ft. in length,

DUMPING ORE ACCORDING TO ANALYZED COMPOSITION INTO BOATS AT DULUTH

has an unloading mouth of 8 ft., the pockets are 12 ft. wide, the boat hatches are 24-ft. centers and the ore chutes are 12-ft. centers. A boat can take ore only from alternate pockets without shifting its positions; a cargo for any given boat is therefore placed in alternate pockets. There are over 400 boats in the ore-carrying trade, with capacities of from 5000 to 13,500 tons each.

The ores of the different mines are divided into groups having certain outstanding characteristics, each group having a guaranteed or set analysis, and contracts are made on the basis of these groups. A mine may take out ore belonging to one of these groups, or its ore may have to be mixed with the ore from other mines or an ore of different grade from the same mine, to maintain a group analysis. From the mines, where cars are loaded in open pits or at shafts and switched to the holding yards, samples, usually in units of five cars, are taken to the laboratory, where they are crushed and tested, and a record is made of this unit, giving the car numbers, the name of the mine, the sample number and the analysis. In addition to the iron content, a determination is made of the phosphorus, silica, manganese, alumina, lime, magnesia and sulphur.

A "block" is the name given to a cargo of ore in process of formation, and is built up in a certain number of odd- or even-numbered alternate pockets at the dock. A "hold" is ore which cannot be assigned to any group or "block" because of being off grade, and is held in cars assigned to certain tracks or sections of track, according to grade, to be held for further disposition. "Blocks" and "holds" are designated by number, and no two numbers may be mixed without instructions from the laboratory. As each unit of five cars is weighed at the yard, its waybill receives its "block" number or "hold" number. If the unit belongs to a "block" it is switched to its proper track, and a train is soon made up, sent on its way to the dock, and unloaded. Here the actual tonnage and analysis are carried forward cumulatively until the "block" contains a mixture of ore, built up mathematically, which will have the proper group analysis. By this method units of five cars have been combined one with another and built up until the group analysis is reached. A boat takes, if possible, an entire "block" or all of two or three "blocks," in filling out cargo, for the mixture is mathematical, and a part of a "block" might run short or exceed the average analysis of the whole "block," and, while mixed mathematically, rather than actually, in the dock, it becomes actual after running through the chutes, being spread from near to far side, back and forth, to trim the boat. "Holds" are later ordered to the dock to raise or lower the analysis of a "block" which is running off grade.

All vessels must be loaded in the order of their arrival, and the tonnage and grades for each vessel must be given to the mines before they can begin to figure the "block." There are as many as 40 vessels on the list at one time, and, as many of these carry coal, the time required to unload must be taken into consideration in figuring the time they will arrive at the dock. A thorough knowledge of all lake boats, their capacities and draft and the conditions under which they can unload and load, is a part of the education needed by a dock superintendent or agent. As a road can handle, for instance, up to 125,000 ton in 24 hours to the yard, and the storage is 250,000 tons, and ore boats can take from 5000 to 13,500 tons of ore of any one of a possible 25 standard groups of grades of ore, the mines laboratory must block out the ore 24 to 48 hours in advance of the arrival of a boat, to insure the ore being ready for loading when the boat docks. Not only must ore be ready for loading when the boat docks at its assigned position at a certain dock under certain numbered pockets, but to the master of the vessel must be given the time required to load so he may know his leaving time. The average time of a boat at dock per one thousand tons loaded is one hour and 12 minutes, the average actual time loading is 38 minutes.

At the laboratory the unit is the pennyweight or gram. At the switching yard it is a unit of five cars of approximately 50 tons each, or 250 tons, and at the dock it is a "block," averaging 175 cars, or 8750 tons. Here is a mixing process carried on, on a mammoth scale, done accurately and expeditiously without delay to train or boats. The ores are sold under a guarantee to maintain within a fraction of 1% the chemical analysis of any group or grade. The operation requires skill, assurance and quick action, by men trained to keep accurate figures and accounts, and it is very rare to have serious mistakes occur in the handling of these immense quantities of ore.

Cedar Lake Landslide Damage Suits

The large slide that occurred on the hillside below the Cedar Lake reservoir of the Seattle water-works on Dec. 22, 1918, has led to the bringing of suits against the city for property damages. It is expected that hearings will be held during the summer.

Underwater Construction of Outshore Launching Ways

Speed and Economy of Work at Bristol Justified Choice of Diver Method in Place of Cofferdam Construction—Special Rig for Use in Placing Pile Caps

By E. D. Buel
Engineer for John Monks & Sons, Contractors, New York City

REMARKABLY low costs were recorded in the construction of the underwater or outshore portion of the shipways at the Government fabricated-ship yard at Bristol, Penn., operated by the Merchant Shipbuilding Corporation. The method employed here differed from that used by the contractors at the two other Government yards, at Hog Island, Penn., and Newark Bay, New Jersey.

Five contractors built the 50 shipways at Hog Island, and one contractor built the 28 at Newark Bay. Thus, seven contractors were engaged practically at the same time in constructing 90 shipways. Six of them elected to construct the outboard portion by the cofferdam method, while the contractor for the Bristol work decided to use an underwater method, employing divers. The marked predominance in favor of the cofferdam method caused some anxiety on the part of the engineers of the Emergency Fleet Corporation as to the wisdom of the choice of the Bristol contractor, with respect to economy and time of completion. On discussion of reasons, however, they allowed the contractor to proceed on his own lines. The ultimate success of the method fully justified its adoption.

Capped pile bents covered with a plank deck and carrying the longitudinal launching-way timbers constituted the work which was to be built. It is shown clearly in the drawing, Fig. 1, in inspecting which it is to be understood that the concrete-slab construction continues to the right, up the slope of the building berths. The slab construction extends from Sta. 0 at the head of the way to Sta. 3 + 10, while the timber-bent work extends from 3 + 10 to 4 + 84. There are 26 bents of 17 piles with 70-ft. caps 12 x 14, and 11 six-pile bents with 7-ft. caps 12 x 16.

There is a tidal range of 5.9 ft. at Bristol. In the spring of 1918, when this work was carried out, however, the water seldom went below El. 1.5, mean low water being 0. By taking advantage of low-water stages it was possible to cut off and cap the first seven bents. There remained in the 12 ways 4668 piles to cut off below water, 228 long caps, 264 short caps and about 350,000 ft.b.m. of decking to be placed under water.

For cutting off the piles a floating piledriver was fitted with a circular saw suspended on an arbor and driven by a 40-hp. motor, fed by current from the shipyard's power plant. The saw, shaft, arbor and necessary attachments were bought for about $450, and the motor was borrowed from the yard machine shop. The last pile in the shipways was driven Feb. 22, 1918, and pile cutting under water began Jan. 30, while the river was still frozen over. The piledriver was compelled to break its way through the ice, and in fact was hampered and impeded by floating ice throughout its period of service.

Although the machine was compelled to work from the outshore end and could operate only at water stages high enough to float it over the piles already cut, it proved economical and efficient in operation. The saw could work only three to four hours a day, but it cut through a pile in 40 sec.; a good day's work was 240 piles cut, and at this rate over 20 days were required to cut off all the piles. The pile cutting proved to be the simplest task of those involved in constructing the underwater bents.

By far the most difficult task was the staylathing or drawing into line of the 14 outshore bents of each shipway. This work had to be performed by the divers. The piles in each row were drawn into alignment by 6 x 12 yellow-pine clamps connected by specially designed clamp screws. These had to be applied below the elevation of cutoff, which was from 4 to 10 ft. below the surface of the water, depending upon the tide. The inner pile rows could not be staylathed, as the elevation of cutoff was too close to the river bottom to permit moving the piles; however, the alignment of the rows was excellent, the driving having been done with great care.

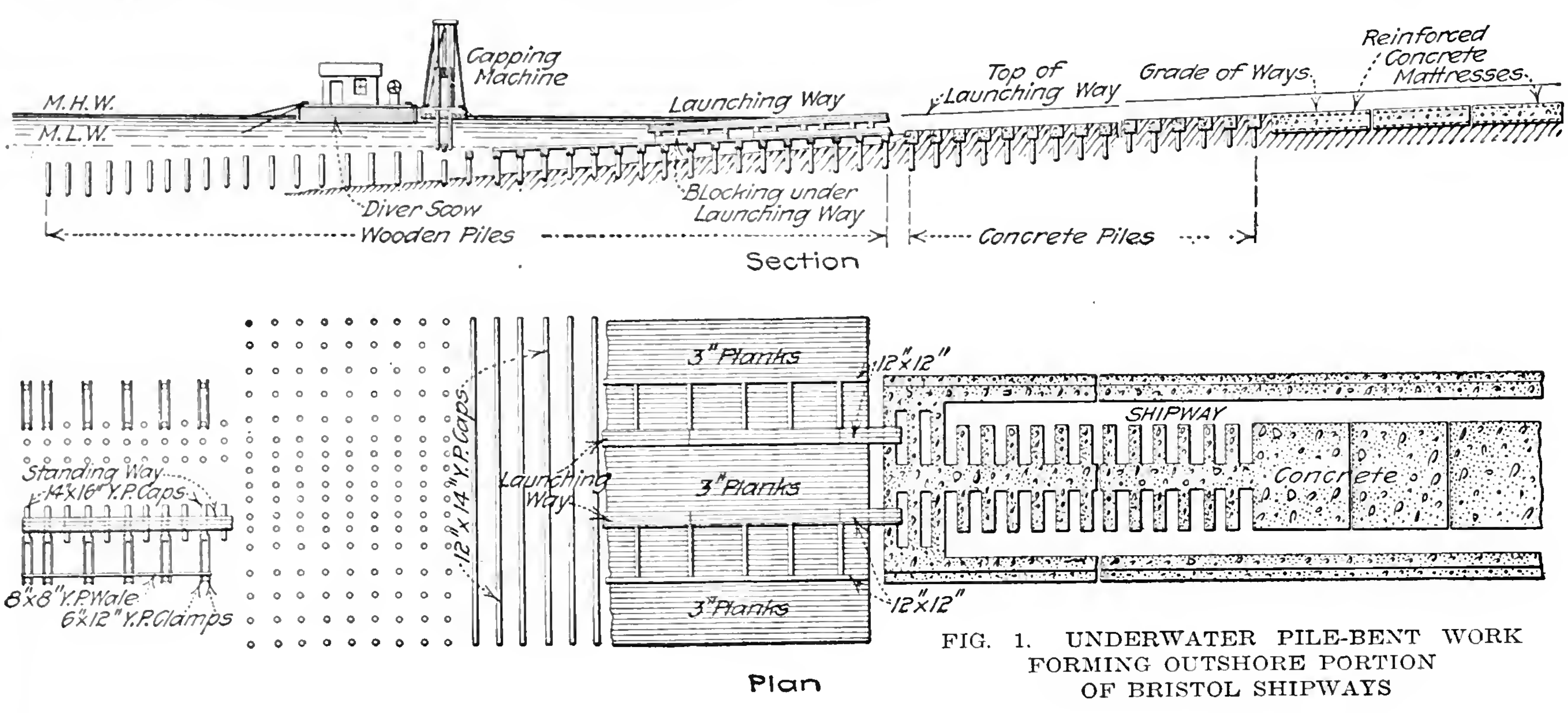


FIG. 1. UNDERWATER PILE-BENT WORK FORMING OUTSHORE PORTION OF BRISTOL SHIPWAYS

Several obstacles made the staylathing extremely difficult work: The rather shallow depth of water in which the divers were working, the ice conditions, and the fact that on account of the low temperature the divers had to wear heavy rubber mitts which hampered

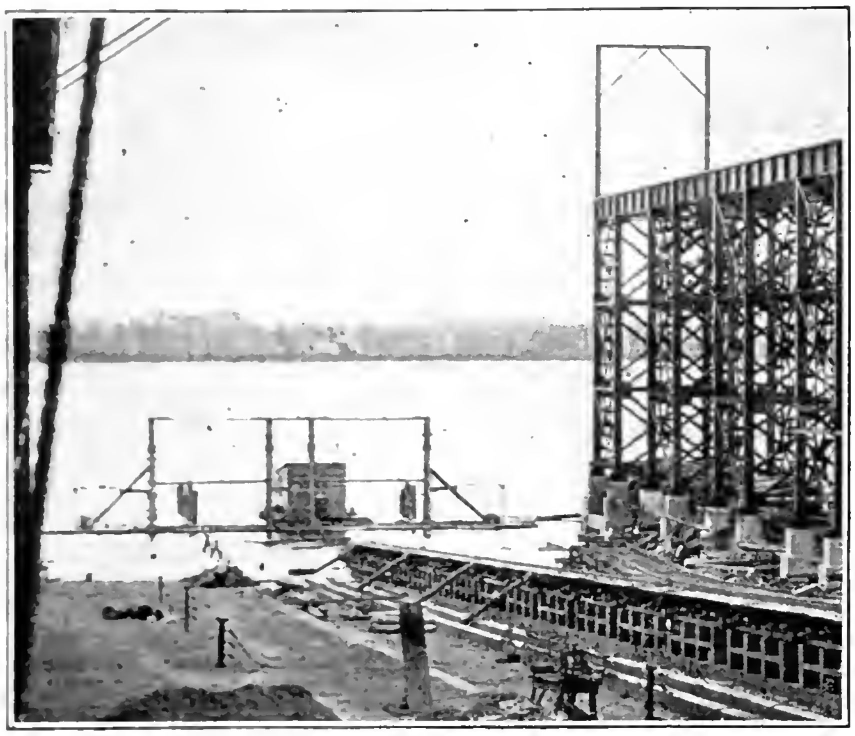


FIG. 2. PILE-CAPPING RIG IN WORKING POSTION OVER LAUNCHING WAYS

their work. A force of 12 divers was employed, the men working in pairs. Two divers averaged four short rows or one-half of a long row of staylathing in an eight-hour day. The total staylathing, therefore, required 210 diver-days, or 17.5 days' work for 12 divers.

In placing the 12 x 14 caps, which were to be fastened to the piles by 1-in. driftbolts 20 in. long, it was necessary to hold the caps down while lining them up and driving the bolts. Four pile-capping rigs were built to facilitate this work. They consisted of floating stages on which were erected gallows-frames supporting spuds weighted with railroad iron. As they were built of timber which was afterward used in the launching ways, the cost of each machine did not exceed $250. A view of one such rig in place over a pile bent is shown by Fig. 2. The construction of the machine is shown in the drawing, Fig. 3.

A full-length cap, 70 ft. long, of 12 x 14 timber, was framed on shore, floated into position, sunk by means of the capping machine, and then scribed by a diver, who marked the position of each bearing pile on the under side of the cap with a scribing knife. Then the cap was floated ashore and, elevations having previously been taken on each pile in the row, the cap was framed by dapping or shimming when necessary to bring it to an even bearing on all piles, and by bolting 6 x 12 fishplates on the sides in cases where one or more piles were slightly out of alignment, in order that the load should be distributed over the full bearing surface of each pile. Holes were then bored and the driftbolts driven through the caps. The cap was again floated to place and sunk on top of its bent. A diver working from each end would place a pipe over each driftbolt in succession, the pipe extending above the surface of the water, and dock builders working on the floating stage of the machine would drive the bolts home by means of weighted rods inserted in the pipes.

Each cap, after it was placed, was carefully inspected by a master diver to determine that it had a full bearing on each pile and that the drift-bolts were in each case driven home. Only very few caps had to be wedged up and reframed.

Two divers, assisted by six dock builders, would place three long caps or eight short caps in an eight-hour day. It is estimated that all the caps required 318 diver-days and 954 dock builder-days.

The decking was assembled on shore into platforms of suitable size to be sunk and spiked by the divers.

Assembling the total labor and plant cost of completing the outboard portion of the 12 shipways, the sum is found to be $33,919, itemized as follows:

COST OF LABOR AND PLANT, EXCLUDING MATERIAL AND PILEDRIVING, FOR OUTBOARD PORTION OF TWELVE SHIPWAYS AT BRISTOL

Divers, tenders and their equipment	$22,705
Dockbuilders assisting divers	7,824
Cutting off piles	1,890
Pile-capping and cutoff machines	1,500
Total	$33,919
Total per way	$ 2,826

It is estimated that the cofferdam method would have involved an expenditure of about $4920 per shipway for merely driving and pulling the steel-pile cofferdam, exclusive of the cost of piling, pumping and labor of cutting off and capping the bents. This applies to conditions at Bristol; possibly the design of the ship-

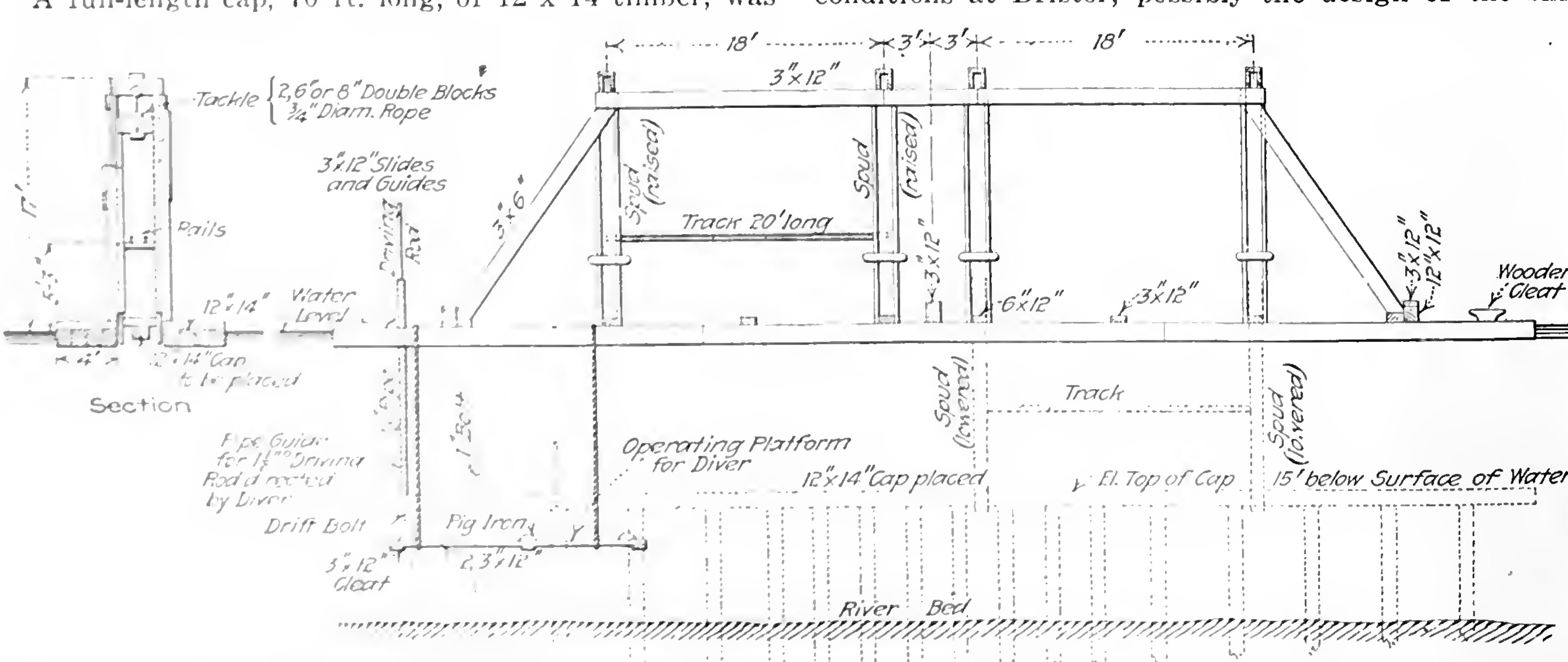


FIG. 3. PILE-CAPPING RIG WITH FLOATING PLATFORM, WEIGHTED SPUDS, DIVER'S PLATFORM AND DRIVE PIPE

ways at the other yards would not require as extensive a cofferdam, and in the absence of reliable figures on the cost elsewhere it is not intended in this discussion to draw any comparisons.

It is the purpose of the preceding to encourage engineers who have a prejudice against underwater construction to believe that this class of work can be handled economically, especially in these days when the wages of divers have not increased in proportion to the pay of other classes of labor. The capping machine is a very simple mechanism, as the photograph reproduced in Fig. 2 shows, and it proved very efficient.

By May 15, 1918, the work on all 12 shipways had been completed. John Monks & Sons of New York were the contractors. Though all of the work was carried on under the most adverse weather conditions, it is fair to summarize the whole case by saying that the final costs were at least 50% less than those which the cofferdam method would have involved, and the Bristol shipways were completed before those at the other two yards.

Council Bluffs Water Treatment in 1918

Substantially the same amount of money was spent for treating the Missouri River water by the water department of Council Bluffs, Iowa, in 1918, as in the previous year, despite the fact that chemicals cost slightly more per pound. The water is clarified by sedimentation, lime and alum coagulants, and sterilized by liquid chlorine. The average turbidity of the river water was 2380 p.p.m., of the settled water previous to coagulation, 1570, and of the final product, 11. Bacterial counts at the same points were 47,760, 1223 and 76. B. coli are always present in 1-cc. river samples, in 92% of the 1-cc. settled samples, and 6% of the 1-cc. treated samples. The 16 gr. per gallon of alum used cost $26.20 per ton, the 0.7 gr. per gallon of hydrated lime, $14.90 per ton, and the 0.258 p.p.m. of liquid chlorine cost 15c. per pound. The total cost of chemicals per 1,000,000 gal. was $4.06. S. L. Etnyre is superintendent.

Supporting Blast Furnace While Replacing Foundation

Well Braced Timber Trusses and Old Crane Girder Utilized—Cracked Brickwork Renewed by Concrete, Using Skip Bridge

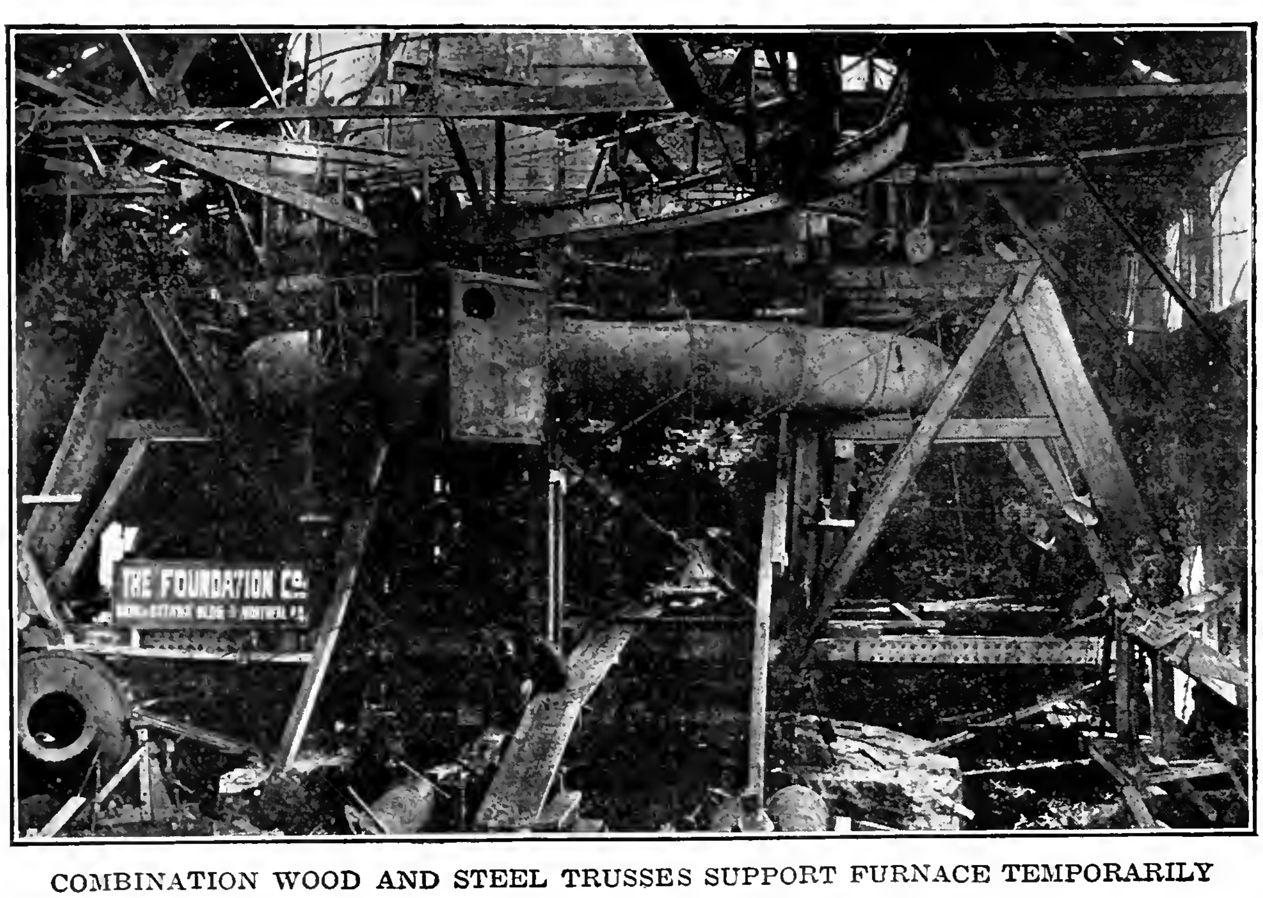
By C. W. Lush
The Foundation Co., Limited, Montreal, Can.

Renewal of the foundation under a blast furnace without disturbing the shell was recently accomplished for the Dominion Iron & Steel Co., at Sydney, N. S., which operates six blast furnaces. These are relined and remodeled in accordance with a schedule providing for the continuous operation of at least three, and generally four, furnaces. During the remodeling of No. 3 furnace the foundation was found to be badly split and veined with iron, and in order to provide permanent support it was decided to install an entirely new foundation instead of reinforcing the damaged one, as was first contemplated. A contract for this portion of the work was therefore made and work started early in July, 1918.

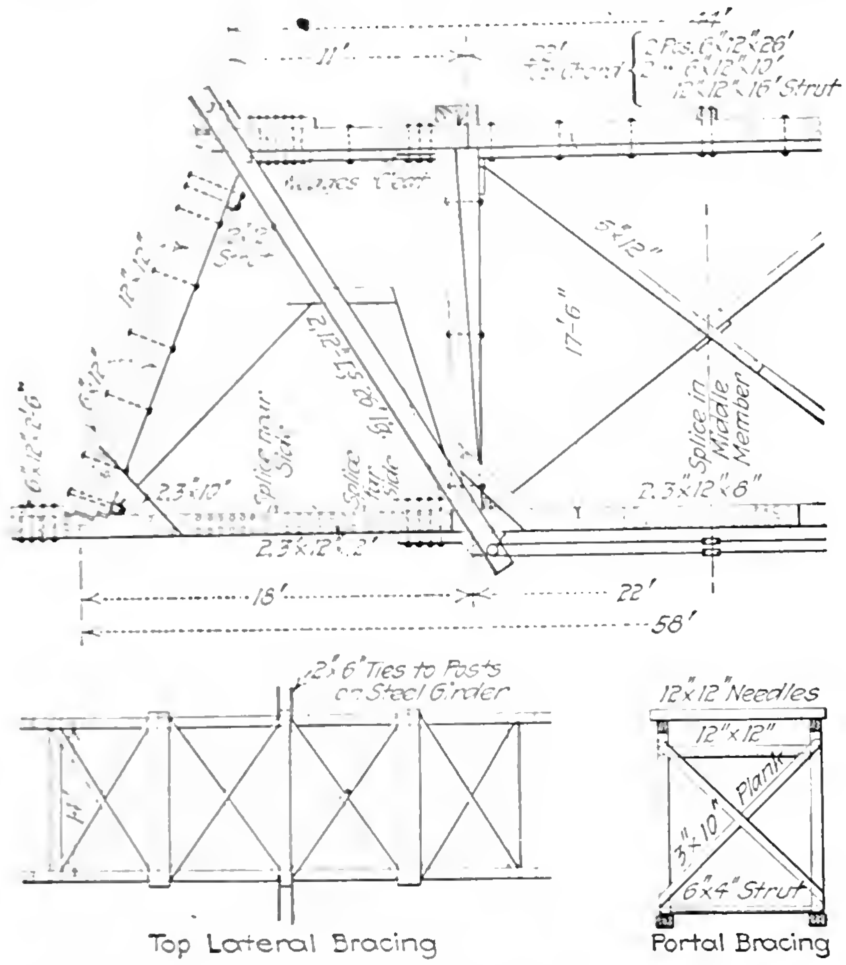
At this time the lining, bosh, hearth jacket and piping had been removed, and a choice of several methods of executing the work was afforded. The problem comprised the supporting of the furnace shell, bustle pipe and column heads, together with some loading from the bleeder pipes, reaction from the skip bridge and severe wind pressures from any direction of the compass. The contractor was required to maintain all existing structures at practically their original elevations.

Comparative studies of methods resulted in a decision to use two wooden trusses (with steel end diagonal web members) bearing on the side walls of the cast house and taking the load of the furnace at the mantle, as the main supports, while an old crane girder already on the site was utilized to take the wind load transverse to the trusses and to help support the bustle pipe. A general view of the shoring and of the principal physical features affecting the work is reproduced. Unique shoring details resulting in high salvage of material, and the adaptation of the construction details to existing conditions at the work, successfully solved the problems of high material costs and difficult labor situation obtaining at the site. The bolster castings and bearing pins used to distribute truss stresses at panel points were detailed to be available later for use as derrick foot-blocks and gudgeon pins.

The two main trusses were first erected, and the load was thrown on them by jacking up under the end bearings. Next the old crane girder, which had previously been placed in position, received its portion of the load by tightening the wedges under the posts bearing on it. The brackets supporting



COMBINATION WOOD AND STEEL TRUSSES SUPPORT FURNACE TEMPORARILY



DETAILS OF COMBINATION TRUSS OF 58-FOOT SPAN

the bustle pipe were then removed from the furnace columns, and the pipe was supported on secondary bents in the main trusses. Finally, the furnace columns and base plates were removed, giving a comparatively clear working space for the necessary excavating.

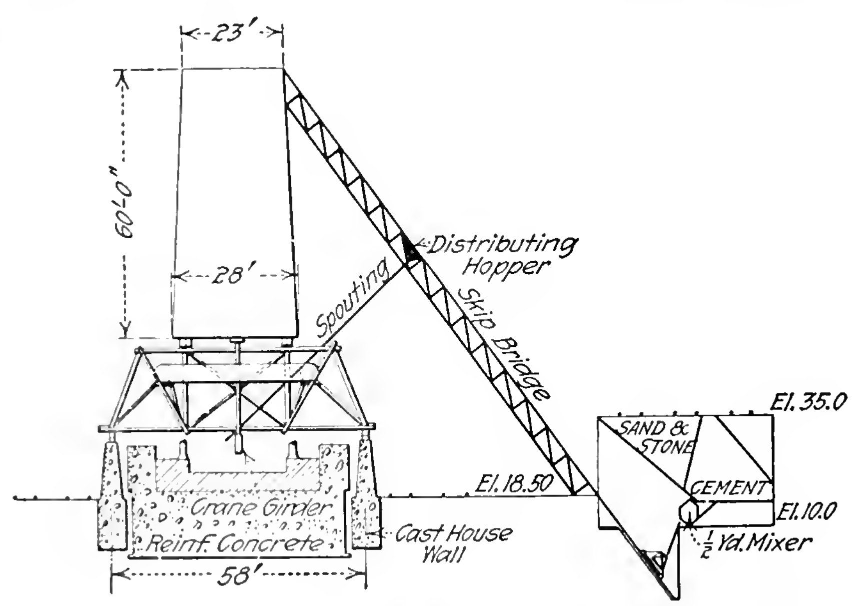
The excavation comprised about 1100 cu.yd. of brick and concrete in the old foundations, 500 cu.yd. of earthwork and a "salamander" weighing 100 tons embedded in the old foundation. The old foundation was broken up by light shots in holes from 2 to 5 ft. deep. One jackhamer working continuously was able to do the necessary drilling. A two-drum engine, through special rigging, operated two dirt buckets simultaneously, and, together with a five-ton crane, handled the material from the pit to three dirt hoppers emptying into cars alongside the cast house. The "salamander" was drilled preparatory to breaking it up, but as it was later found to be only 4 ft. deep it was dropped to the bottom of the excavation and buried under the new foundation, at a considerable saving in time, and without risk of accident to the shoring trusses.

The new foundation consisted of about 1500 cu.yd. of concrete, 140 tons of billet and rail reinforcing and 100M. brickwork. The alternate panels of rails were fabricated on the cast house floor during the excavating period and swung into place, and intermediate rails were erected immediately upon the completion of the concrete footing course.

The concrete for the work was handled by a plant made by adapting the idle coke bins and skip bridge of No. 3 furnace. The general features of this layout are shown in the diagram. Sand and stone were brought in cars on the ore tracks and dumped or unloaded by the ore bridge into the remodeled coke bins having a storage capacity of 125 tons of stone and 60 tons of sand. Cement was unloaded from the cars down a chute to a 250-bbl. storage platform level with the charging hopper. The mixed concrete was hauled up the skip bridge in a car improvised out of one of the dirt buckets and two pairs of spare lorry wheels; it was dumped into a distributor hopper and chuted into the foundations.

When the foundation was prepared for the column bases the columns were swung into place and hung from the mantle ring, the base plates were set under them and jacked up with two 100-ton jacks, and damp grout was rammed under the bases. After the grout was set the shoring screws were slacked off, the trusses were dismantled and the brackets were replaced under the bustle pipe. Finally, the protection ring of concrete was poured around the new hearth brickwork, this being completed Nov. 2, 1918.

The entire operation was successfully finished without any accidents whatsoever, under unusually adverse weather conditions including windstorms with recorded velocities as high as eighty miles an hour. The final settlement of the supported structures was between ¼ and ½ in., the furnace shell being maintained plumb at all times.



SKIP BRIDGE ADAPTED TO WORK OF PLACING CONCRETE

The work was designed and executed by the Foundation Co., Ltd., of Montreal, under the general direction of R. E. Chadwick, Eastern manager, with the writer as superintendent in charge of construction.

Street-Cleaning and Ash-Collection Costs

Unit costs of street cleaning and ash collection for 1915 to 1918, inclusive, for the City of Cincinnati, are published in the annual report of the Department of Street, Sewer and Catch-Basin Cleaning. In practically all the operations, the costs for the year 1918 were much higher than those for the previous years. The superintendent of this department is Fred Maag. The figures are given in the table below:

	1915		1916		1917		1918	
	Unit Cost	Unit Cost with Overhead	Unit Cost	Unit Cost with Overhead	Unit Cost	Unit Cost with Overhead	Unit Cost	Unit Cost with Overhead
Flushing, *squares	$0 137	$0 277	$0 119	$0.241	$0 121	$0.268	$0.120	$0.274
Street sweepings, cu yd	242	.434	.270	.476	.286	.526	.332	.633
Ash collection, cu yd	277	465	.282	468	.299	.515	.344	.613
White wings, 1,000 sq yd	272	.312	.305	.352	.301	.247	.313	.360
Broom gang, *squares	268	324	.243	295	238	282	.264	.305
Gutters, *squares	132	147	.136	.153	.144	.162	.138	.155
Gutters after flushing, *squares	148	164	.136	151	.140	.157	.167	.187

* 1 square = 16,000 sq ft or 1 square = 400 lin ft

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Contractor Actually Lowers Bid

Sir—I inclose a clipping which may be of interest to you as something rather unusual in contracting. The reduction in price mentioned will amount to about $1300.

JOSEPH KEMPER,
City Engineer.
Utica, N. Y.

[The clipping to which reference is made is from the *Utica Press* of May 22, 1919. The following indicates the facts in the case:

A contractor who had put in a bid to do some paving, whose bid had been accepted and who had begun work, wrote to the city lowering his bid because he found he could do the work for less and still make a profit. This letter, from the Harry W. Roberts Co., continues as follows: "Certain changes which we have been able to effect in the cost put forward at the time the bids were prepared make it possible for us to authorize a reduction of 16c. per square yard on the pavement prices on both sections of Hart St., and on Gilbert St. In the event of our accomplishing reductions in the cost of any other local paving contract, we propose to offer a modification of contract terms corresponding to our cost saving."—EDITOR.]

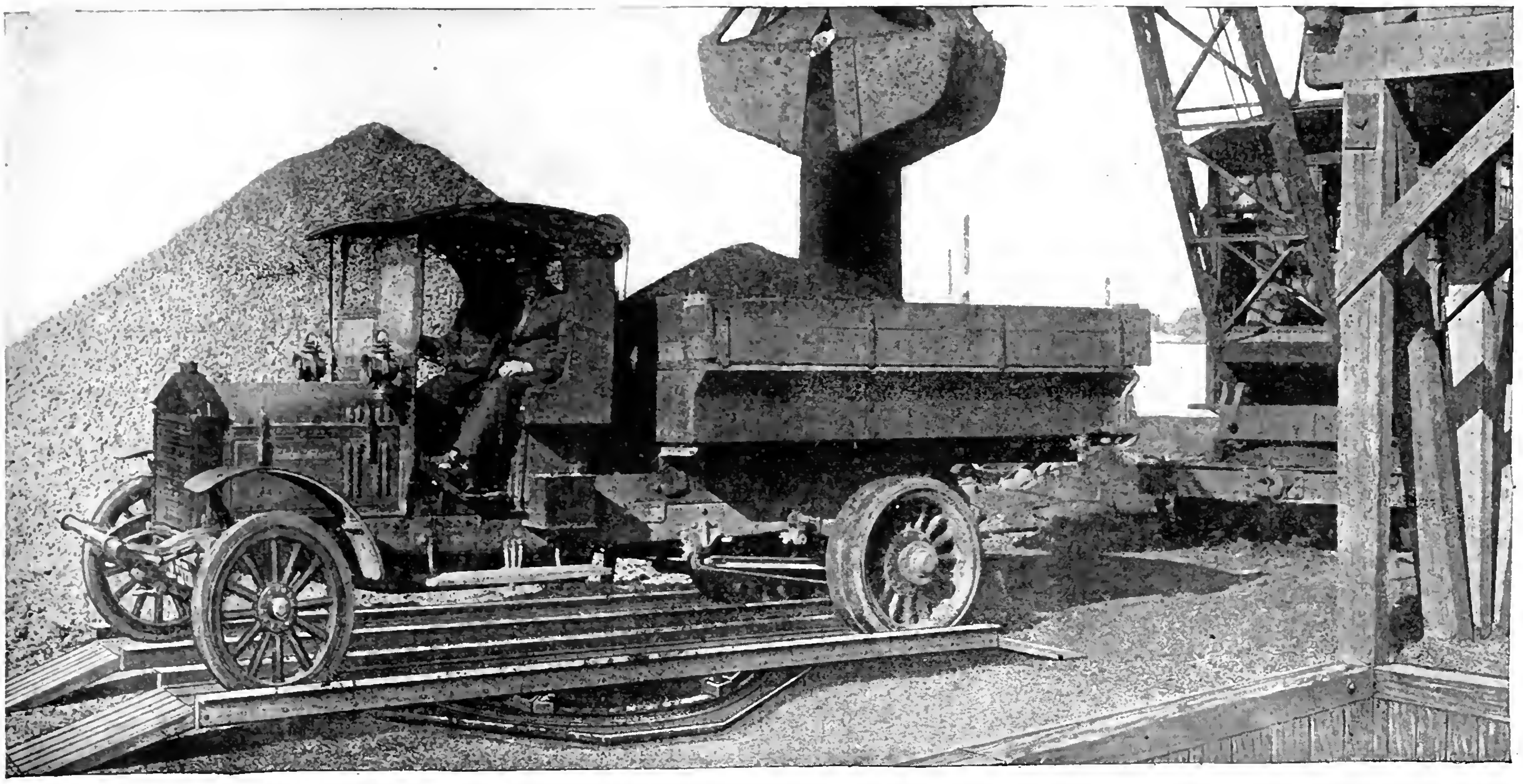
Portable Turntable for Motor Trucks

Sir—The letter of Fred C. Beam, of Lima, Ohio, published in your issue of May 1, 1919, p. 884, under the heading "Who Can Solve this Contractor's Problems?" particularly interests us. Mr. Beam suggests that a portable turntable suitable for use with motor trucks would fill a large need and appeal particularly to operators of motor trucks on construction work. For several months we have spent considerable time and money in the development of just such an equipment, and are now ready to supply a practical turntable of this kind.

Our turntable is the conception of a man who has devoted many years to supplying contractors' equipment and motor trucks for all classes of construction work. He has carefully studied the utility of motor trucks, particularly in connection with road construction. Several years ago he anticipated the need for some mechanical means of turning motor dump trucks when attempts were made to deposit sand and gravel on the subgrade of roads of insufficient width to permit trucks to turn around.

Another practical use for such a turntable is in connection with a revolving steam shovel. When it is set adjacent to and within range of the shovel dipper, a contractor can use motor trucks for hauling away from the shovel. Heretofore this has not been practical except under especially favorable conditions, owing to the difficulty in getting trucks in proper position and started on soft ground. In such circumstances much money has been spent to provide suitable places at which to turn trucks, to obviate the necessity of backing long distances at slow speed, taking undue chances of running over a cliff or into ditches, or getting into deep mud. Those who have not taken unusual precautions doubtless can recite sad tales of delays, pulling trucks out of mud holes and creek bottoms, with damage to subgrade, excessive repair and maintenance bills, excessive wear and tear on their expensive equipment, personal injuries, etc.

Portability on the job and strength successfully to handle loaded dump trucks up to the largest capacity of any make, are, of course, prime requisites for the desired turntable. We believe we have those points well provided for, yet have kept the total weight of our turntable low, nor does it set so high as to cause diffi-



PORTABLE TURNTABLE FOR TRUCKS IS MADE UP IN SECTIONS TO FACILITATE HANDLING

culty in getting on the platform. Our turntable is constructed to permit being pulled along the subgrade by truck or steam shovel or steam roller, without damage to subgrade or machinery. It is made up in sections to facilitate hauling it to the job, and is easily and quickly assembled. It can be furnished either hand- or power-operated.

This turntable will doubtless save much valuable space in material yards, docks, freight yards, etc. It will increase the utility of motor trucks by removing a very serious limitation heretofore encountered by almost all road contractors attempting to use motor dump trucks in the ever-increasing scope of our country's roadbuilding program.

M. D. RIKER,
Vice President, McKiernan-Terry Drill Company.
New York City.

Chart for Solution of Manning Formula

Sir—The accompanying chart for the solution of the Manning formula for the flow of water in pipes or open channels has been so useful to me that it may prove useful to others. It is relatively simple to work with, gives results without bad angles of intersection, even in the extreme ranges, and covers all probable ranges of the four variables. The percentage of accuracy is the same throughout the entire range. My results indicate that the error should be less than 2% in determinations of velocity, or 4% in slope determinations.

Manning's formula, which gives relatively satisfactory results for channels of small or moderate size, and with usual slopes is

$$v = \frac{1.49}{n} m^{\frac{2}{3}} s^{\frac{1}{2}}$$

in which v is the mean velocity of flow in a pipe or open channel, m is the hydraulic radius of channel, s is the slope of the hydraulic gradient, and n the coefficient of roughness, taken to be identical with Kutter's n. Suggested by Robert Manning in 1895, it was published in 1915 in Parker's "The Control of Water."

An incidental advantage in this chart lies in the ease with which different slopes or roughness factors may be compared, and the effect of changes visualized. Thus, if hydraulic radius and roughness factor are known, a horizontal pencil line drawn through their intersection on the chart crosses each slope line vertically below the corresponding mean velocity.

In case it is desired to redraw the chart for practical use, the following instructions may be of service:

The vertical lines form a logarithmic scale, three times repeated, and serve both for hydraulic radius and mean velocity. The horizontal lines are uniformly spaced, and the "slope" lines, s, lie at an angle of 45° to the horizontal. The line $s = 0.01$ starts at the top border line at mean velocity = 1 ft. per second, and $s = 0.0001$ at mean velocity = 0.1 ft. per second. The other slope lines divide the distance between these two into a logarithmic scale, twice repeated, so that the unit lengths of this scale are just half of the main scale.

The roughness lines lie at a slope of three horizontal

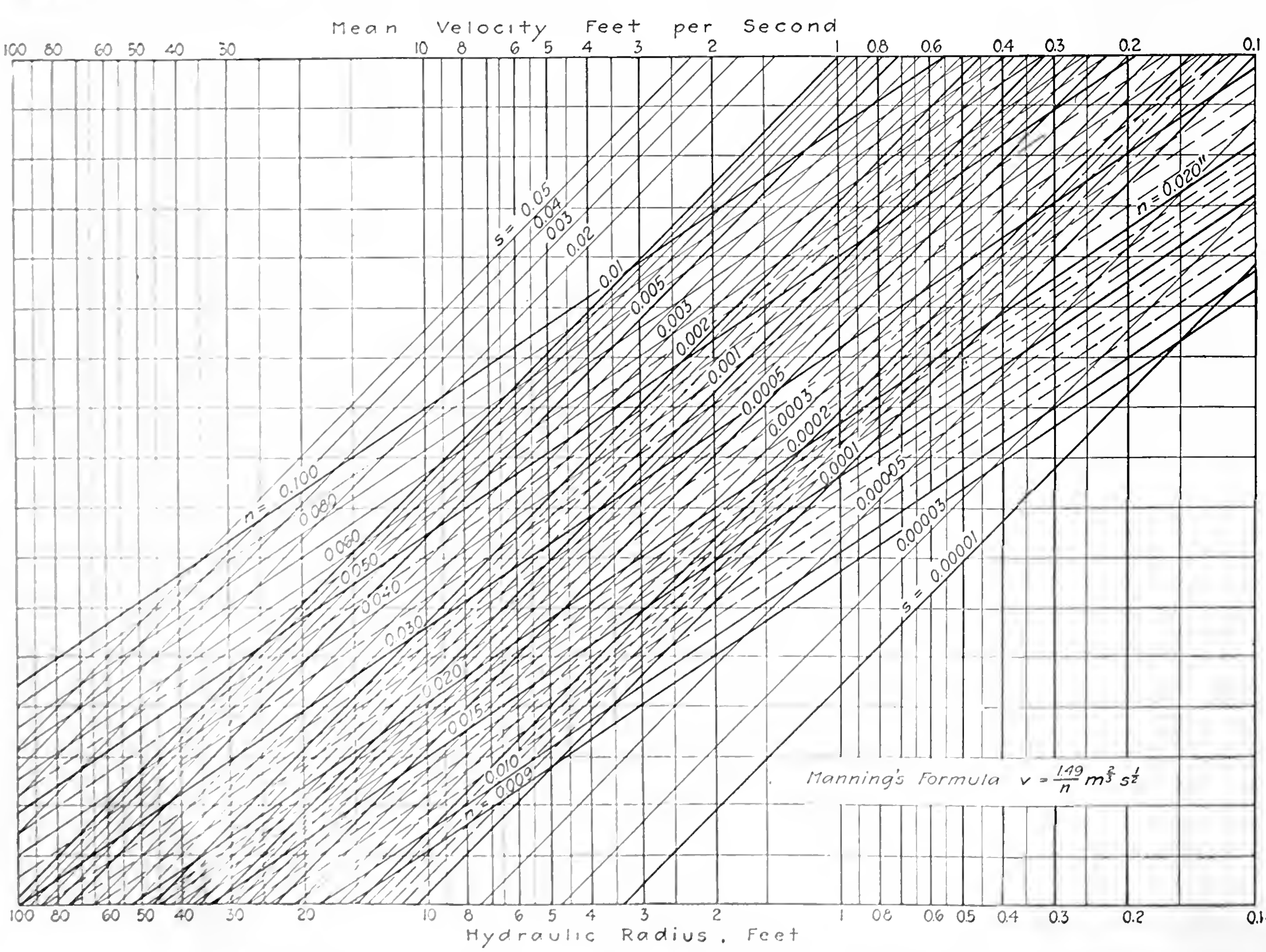


CHART FOR SOLUTION OF MANNING FORMULA FOR FLOW OF WATER IN PIPES

to two vertical, all parallel. They also form a logarithmic scale, and the unit length of this scale, along a vertical line (not at right angles to the lines) is the same as the unit length of the hydraulic-radius or mean-velocity scales. Slope line $s = 0.0001$ intersects mean velocity $= 1$ ft. per second at roughness factor line $n = 0.0149$ (not drawn). This fixes the position of the roughness factor scale. MORTIMER F. SAYRE,

Assistant Professor of Applied Mechanics, Union College.

Schenectady, N. Y.

Plumbers to Be Called Sanitary Engineers?

Sir—Several articles have appeared in *Engineering News-Record* in the past year or so on the subject of what constitutes an engineer. The following is an article which appears in the May issue of the *Valve World*, published by the Crane Co., of Chicago. It is entitled "Why 'Plumber'?"

"Among other features of reconstruction and readjustment we may mention a renaming of the plumber. Whether there is anything in a name or not, we are of the opinion that every plumber in the United States would hold his head a trifle higher and put his trade or his business on a more elevated plane if he were known as a sanitary engineer.

"Let us proceed forthwith to banish the term plumber. It is obsolete or should be. It is lacking in scope. It never can be purged of certain associations that have not tended to give it dignity.

"The *Valve World* will be pleased to attend the obsequies of the term 'plumber' at any time and to hail with hearty acclaim the 'sanitary engineer.' We await only official announcement of the funeral."

The time has surely come when our engineering societies should use their influence to protect the name "engineer." STEWART T. SMITH.

New York City.

Origin of Government Specification for Manila Rope

Sir—In connection with the publication of an abstract of "United States Government Standard Specifications for Manila Rope, adopted Apr. 4, 1918," in your issue of May 15, p. 958, your attention is directed to supplementary information contained in a bureau letter of Apr. 24, 1919, with which mimeographed copies of these specifications were transmitted as an inclosure. It is regretted that no reference was made to the circumstances under which these specifications were adopted, inasmuch as the published article gives the erroneous impression that the bureau is solely responsible for their development. In reality, the joint conference of cordage manufacturers and Government representatives, held Apr. 4, 1918, was the final session of a series of such conferences extending over several months. The conferences were initiated by the Bureau of Construction and Repair of the Navy Department. F. A. Jenks, of the Plymouth Cordage Co., was the conference chairman, and Prof. J. H. Nelson of this bureau's staff served as secretary.

The conferences revised and rewrote an initial tentative draft of manila-rope specifications prepared at this bureau in the autumn of 1917. The initial draft consisted in general of a combination of the diverse specifications at that time in use by various bureaus of the War and Navy Departments, the Panama Canal and the United States Shipping Board. In addition to the use of such specifications, advantage was taken of the results of bureau research into the determination of oil content, the detection of the presence of nonmanila fiber, and the determination of weight, breaking strength and size of rope. The Department of Agriculture furnished the information on which the fiber requirements were based.

An attempt was made to circulate the invitation, to participate in the conference, as widely as possible among the manufacturers of manila rope. The rope manufacturers are chiefly responsible for the final form in which these specifications appear, although their adoption was indorsed by representatives of the Government departments mentioned above. The departments have subsequently used them as the basis for Government purchases of rope. S. W. STRATTON,

Director, Bureau of Standards.

Washington, D. C.

Subdrainage for Country Highways

Sir—Replying to your remarks on my letter in *Engineering News-Record* of May 29, 1919, p. 1080, discussing underdrainage of roads, I wish to thank you for the comment, as a discussion of this question will bring it more directly to the notice of those who are confronted with the necessity of providing a stable roadbed for highways of any kind. In this section of the country many highways are being reconstructed and changed from gravel or macadam to hard surface, long before the bonds issued for first construction have matured.

As to the question whether my letter pertains to "macadam and earth roads almost entirely," I must say that the matter of underdrainage is of the soil. The question of the metal or surfacing of the highway is wholly immaterial; the object is to obtain a subgrade which will most nearly remain in a uniformly stable condition throughout the year.

In the first place, the subgrade for any class of highway must be dry and settled, to permit proper construction. Then the parallel underdrains along each edge of the metal will prevent excess water from reaching the subgrade after construction, and no water can reach it from above because of the hard surface.

Subdrainage for highways is but an application of the principles of drainage for agricultural purposes. The object of agricultural drainage is to remove excess moisture, place the soil in proper condition for the propagation of crops, and prevent heaving of the soil.

If underdrains will prevent heaving in cultivated lands, will they not prevent it in the same soil under a hard-surface road?

I believe that the underdrain will work better if the natural soil, well tamped, is used as backfilling, instead of stone, gravel, cinders or material of like nature which will permit the air current from the tile to escape more directly upward, while to get the full beneficial effect it should also penetrate laterally.

As to tile filling with roots, in our city we have had great trouble with the roots of Carolina poplars finding small cracks in the joints of pipe sewers and filling the pipes. But we have waged a war on trees of that nature and now have very little trouble. M. H. DOWNEY.

Anderson, Ind.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Lowering 240 Feet of Submerged Pipe From Scow in One Section

IN LAYING a submerged 16-in. cast-iron water main across the city ship canal at Buffalo, N. Y., the method adopted was to lower it slowly into a dredged trench, from the side of a scow fitted with A-frames for chain falls. The pipes averaged 155 lb. per foot and had bell and spigot ends for flexible joints of the Metropolitan type, in which the lead is retained in the bell when the pipe is deflected. Lengths of 12 ft. were used on the bottom, while 6-ft. lengths were used at the shore ends to give greater flexibility. At each end provision was made for connection with joints of the standard type. At the crossing the canal is 220 ft. wide, with sloping sides; the channel is 100 ft. wide, with 23 ft. of water. A trench 5 ft. wide was dredged to a depth of 30 ft. below water level in the channel, decreasing toward the banks. The total length of the submerged line was 240 feet.

For assembling the pipes, a deck scow 26 x 90 ft. was used, the whole line being made up into three sections. After each joint was calked the pipe was moved within the limits of deflection before another was added. For lowering the pipe line into place a derrick scow and a piledriver were used, the latter being lashed to the bow of the scow. Six A-frames were erected along one side of the deck of this scow, carrying chain falls for suspending the pipe line. There were three lines also from the head of the piledriver. The deck scow, with the sections of pipe assembled, was moved alongside the derrick scow, and the section for the east bank was picked up and suspended from the chain falls on the A-frames. Then the scow was moved forward and the section for the bottom was similarly suspended, the joint between the two sections being then poured and calked. This joint was deflected by lifting with the derrick leg. The section to be laid on the west bank was next added, this being suspended from the three lines on the piledriver.

When the line was ready for submerging, the derrick scow and the piledriver were swung across the channel in line with the trench, with the stern of the derrick against the east bank. The entire line was then lowered slowly until the east end rested on a pile cradle, where it was securely anchored. Then eight leads of 1½-in. manila rope were attached to the derrick scow, and the load was transferred from the chain falls to these lines, the deck ends of which lines were fastened to snubbing posts.

All the lines were then slacked off gradually, allowing the pipe line to sink slowly to its bed. Guides attached to the pipes indicated the various depths as the pipe sank.

Only 3½ hours were required for the whole operation, from the time when the scows were swung across the channel until the pipe rested on its bed; this was the total interruption to navigation. A diver sent down to hammer up all joints found the pipe and joints in good condition. When the shore ends were connected the line was tested by means of a meter. A small leakage was shown at first, but this gradually decreased until it became negligible.

This work was done in November, 1918, at Hamburg turnpike, for the purpose of providing fire protection to an isolated section of the City of Buffalo. It was done under the direction of George C. Andrews, water commissioner.

Other Articles in This Issue of Interest to Contractors:

Bell Slots in Trench Sides Made Use of Narrow Elevator Possible

BELL holes or slots cut in the sides of a trench permitted the laying of nearly two miles of 36-in. pipe in a trench dug by an excavator which could not cut to the full width desired. This work was done by the Bureau of Water at Buffalo, N. Y., under the direction of George C. Andrews, water commissioner, in 1918, to give additional supply to the American Brass Co. and to provide for future needs of the northwestern section of the city.

A trenching machine and power backfiller that were owned by the bureau facilitated the work and reduced its cost on a stretch of 3100 ft. through the grounds of the New York State Hospital, but for the remainder of the distance the work was in paved streets where the machine could not be used.

A 45-in. trench was the maximum that could be cut with the machine, while a 60-in. width was used on that part of the work done by hand. As the narrow width was not sufficient for lowering the pipe into place and at the same time bracing the sides of the trench at the top to protect the pipelaying operations, the following plan was adopted:

Each side of the trench was cut down about 18 in. for a distance of 6 in. back at the top, allowing room for 4 in. of bracing on each side and giving the necessary clearance for the bells of the pipes. Bell holes were then cut out of the side of the trench by hand. The machine cut a trench 7 ft. deep instead of the usual 6½ ft., and 6 in. of blocking was used under the pipe to eliminate

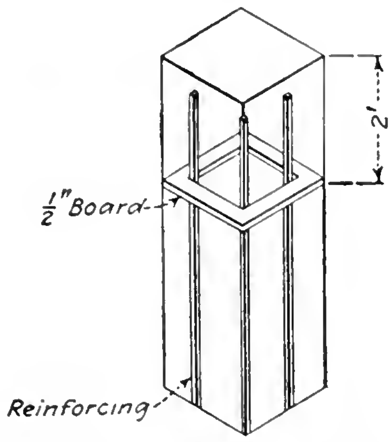
the digging of bell holes in the bottom. This method proved satisfactory and speeded up the work.

Hand labor was employed in handling the pipe, and with a gang of 30 men the excavation and pipelaying proceeded at the rate of about 180 ft. a day. The trenching machine was never worked for more than one-half day, and was kept about two days ahead of the pipelayers. The power backfiller, operated by one man, backfilled the entire trench, with a material saving of labor and time. The greatest number of pipes laid in a single day was 22. The cost of labor for that part of the line done by machine was $4.30 per linear foot, while for the part done by hand labor it was $8. The total cost per foot for the entire line was $23. In comparing the costs of machine and hand labor on this line it should be noted that hand labor was used on paved streets; nevertheless, a great saving is shown by the use of the trenching machine and backfiller.

Two gangs on the work done by hand comprised about 150 men who excavated a 60-in. trench 6½ ft. deep, with bell holes in the bottom, laid the pipe and backfilled, at the rate of 120 lin.ft. per 10-hour day. The pipe was lowered by chain falls and tripod.

Wood Diagram Leaves Top for Concrete Pile After Driving

TO PROVIDE a finished surface at the top of a concrete pile which may be battered during the driving, a special type of joint was used on the Norfolk Army base built during the war. This consisted of a wood diaphragm, made up of ½-in. boards, encircling the reinforcing rods about 2 ft. from the top of the pile, as shown in the sketch. If the hammer spalled the concrete at the top, light charges of powder set just above the diaphragm readily loosened the upper section, permitting its removal and leaving a smooth top, below which no damage extended.

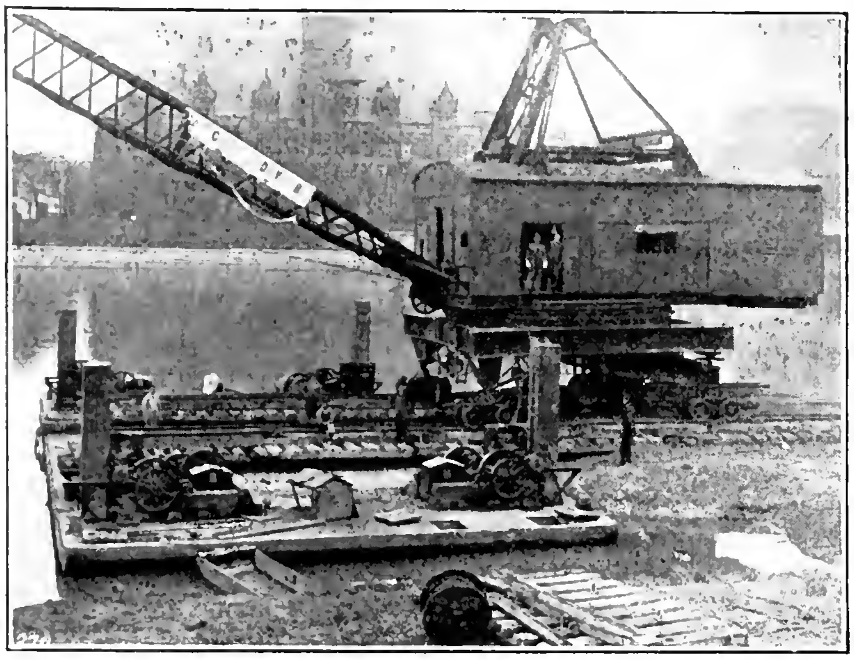


WOOD DIAPHRAGM MAKES JOINT AT CONCRETE PILE TOP

The method was devised by the Raymond Concrete Pile Co., which made the precast piles used in the work.

Dragline Embarked by Grounding Scow

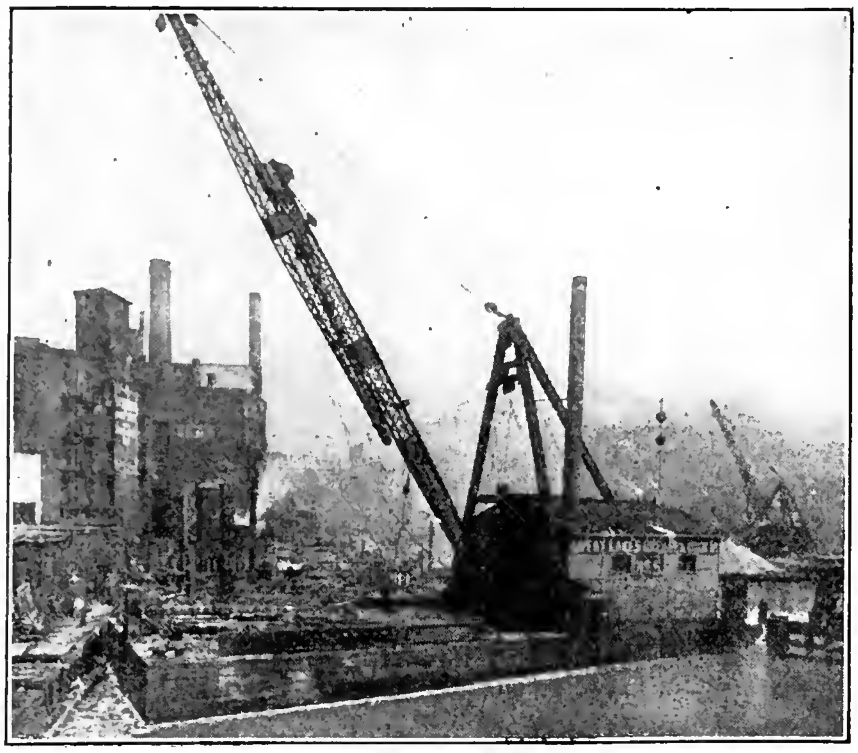
A DRAGLINE excavator weighing over 200 tons was transferred from a river bank onto a scow by the simple expedient, shown by the accompanying illustration, of grounding the scow in a specially excavated shallow slip dredged into the river bank. The dragline dug the slip and dragged its bottom smooth and level, after which the scow was sunk by letting water into it. The shore tracks for the dragline were then extended onto the scow, and the heavy machine was moved into position by its own power. When it was in position the wheels and the underbody were removed, and the dragline was lowered onto and fastened to I-beams on timber sills. The operation was performed at Dayton, Ohio, on the Dayton channel improvement of the Miami Conservancy District. Arthur E. Morgan is chief engineer. Charles H. Paul is assistant chief engineer and C. H. Locher is construction manager.



TRANSFERRING 200-TON DRAGLINE EXCAVATOR TO SCOW GROUNDED ON RIVER BOTTOM

Lengthen Derrick Boom by Second Boom

TO HANDLE 60-ft. 10-ton steel anchor columns in a vertical position, so as to lower them through the pockets of cofferdam bracing, a boom of extra length and strength was required for the steel floating derrick used by the Great Lakes Dredge & Dock Co. at the new Michigan Ave. bridge in Chicago. To secure the necessary length of about 95 ft., a similar but lighter boom for this same derrick was spliced to the main boom as shown in the accompanying view. It was attached by long bolts through timber cross-pieces.



TWO DERRICK BOOMS ARE SPLICED TO MAKE ONE LONG BOOM

The columns handled in this way are embedded in the anchor piers and carry the girders which take the uplift due to the leaves of the bascule bridge.

News of the Week

New York, June 5, 1919

C. M. Holland and Board To Build Hudson Tunnel

Tunnel Engineer Now In Field Charge of East River Work Selected as Chief Engineer

On June 3 the Joint Interstate Bridge and Tunnel Commissions of New York and New Jersey made the final selection of the engineers who are to direct the construction of the highway tunnel under the Hudson River recently authorized by the two states. Clifford M. Holland, now tunnel engineer of the Public Service Commission (New York City), in charge of rapid-transit tunnel construction under the East River, was chosen as chief engineer. At the same time an advisory board of engineers was created, to guide in the decision on the layer problems involved.

The advisory board is composed of J. Vipond Davies, of the consulting engineering firm of Jacobs & Davies, engineers of the Pennsylvania R. R. Hudson River tunnels and engineers and constructors of the Hudson & Manhattan tunnel system; Prof. William H. Burr, former member of a board of engineers which studied the feasibility of a Hudson River tunnel for the Public Service Corporation of New Jersey; Col. W. J. Wilgus, former vice-president and chief engineer of the New York Central & Hudson River R. R., and originator of a tunnel project for freight distribution in New York City in conjunction with a Hudson River tunnel; Col. Henry W. Hodge, consulting bridge engineer and former member of the Public Service Commission of New York City; Maj. John A. Bensel, former chief engineer of the Department of Docks and Ferries, New York City; and E. A. Byrne, chief engineer of the Department of Plant and Structures (Bridges and Ferries), New York City. Mr. Byrne, it is reported, will serve without compensation, while the other members of the board will receive annual retainers of $10,000.

Advisory Committee on Shipping Law Revision Appointed

Revision of the navigation laws in regard to measurement of vessels, standardization, inspection of construction, and other matters affecting the competition of American ships with those of other countries, is to be studied for the Shipping Board by a committee just appointed. The results of the committee's work will be the basis of recommendations to Congress for appropriate legislation. The committee is composed of P. A. S. Franklin, president of the International Mercantile Marine Co.; J. P. Kirlin, admiralty lawyer, New York; H. F. Alexander, ship owner, Seattle; E. E. O'Donnell, ship owner, Boston; H. L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Co.; A. G. Smith, ship owner, New York, and D. T. Warden.

Employment Bureaus

Engineering Societies' Employment Bureau, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Many Memorial Day Launchings

In celebration of Memorial Day an unusual number of launchings was carried out in the various shipyards of the country on May 30. The most notable performances were made at the two Government fabricated shipyards at Hog Island, Penn., and Newark, N. J. Five 7800-ton ships were launched at Hog Island. The Submarine Boat Corporation, at Newark, launched three 5000-ton vessels; with these it has put into the water 52 hulls since its maiden launching on May 30, 1918.

Elevated Railway Extension, New York City, Begun

Construction of the elevated portion of the Pelham Bay Park branch, Lexington Ave. subway, New York City, began during the past week under a contract executed between the Public Service Commission and the Terry & Tench Co., Inc., for $586,700. The new structure will extend from the present subway terminus at Whitlock Ave. to Pelham Bay Park. Foundations for the columns are already completed.

Power Legislation Once More Before Congress

Three New Water-Power Bills Introduced, and Funds Asked for Power Survey of Entire Country

Legislation providing for the opening up of the tremendous power possibilities of the country has been introduced into the new Congress. The legislation was defeated by the filibuster at the end of the last Congress. Water-power bills in three different forms have been presented to the Senate, and the House of Representatives has passed a rule providing for the creation of another special water-power committee similar to that which worked a bill through the house at the last session of Congress. The three bills introduced in the Senate are by Senator Jones of Washington (Senate 152), by Senator Walsh of Montana (Senate 220), and by Senator Shields of Tennessee (Senate 651).

The movement to obtain appropriations for a power survey of the United States is again under way. The estimates of appropriation presented by Secretary Lane of the Department of the Interior to the last Congress have been renewed, and are now before the appropriations committee of the House of Representatives. These appropriations would permit the Geological Survey to expend $250,000 in studies of power supply during the coming fiscal year. Of this amount $50,000 would be used in a general engineering and statistical survey of the power resources of the United States. The balance of the appropriation would be used for an intensive survey of power possibilities along the north Atlantic seaboard, where the power famine is greatest. Hearings will be started immediately before the appropriations committee of the House.

Federal Industrial Relations Commission Planned

A bill creating a Federal Industrial Relations Commission has just been introduced in Congress. If it is passed, a commission of four would be formed whose duty it would be to promote industrial peace and prosperity by dealing with the causes and conditions provocative of industrial discontent and unrest.

Functions as follows are delegated to the commission: (1) Exert its authority to relieve unemployment; (2) coöperate with Government departments to equalize and regularize employment opportunities; (3) establish standards of industrial relations for Government

departments in employment and purchasing; (4) represent the public interest in labor disputes; (5) promote and develop adjustment boards for the standardization of wages; (6) promote uniform legislation in all matters relating to industrial peace and welfare; (7) establish educational agencies for training administrators of employment; (8) maintain a personnel bureau for rating and listing labor administrators; (9) coöperate with the Departments of Commerce and Labor, and (10) report to Congress a plan for industrial insurance for old age, accident, injury, etc.

Each commissioner would receive a salary of $5000, and the commission would be composed of one employer of labor, one representative of wage earners, one economist, and one specialist in labor administration. One of these must be a woman. The regular term, after a graduated adjustment so that all will not retire at once, is five years.

Secretary of Labor Asks Continuation of Employment Service

Enactment of legislation to provide a permanent public employment service has been requested by Secretary of Labor Wilson in a letter of May 30 to Representative J. M. C. Smith, chairman of the House Committee on Labor, and Senator Kenyon, chairman of the Senate committee.

The Secretary asks that the United States Employment Service be continued as a permanent bureau of the Department of Labor, in charge of a director general to be appointed by the President. The plan embodies the suggestion for full coöperation with the various states.

Bill to Promote Engineering and Industrial Research

On May 20 the Gronna bill for the promotion of engineering and industrial research was introduced into the United States Senate. It provides that the Secretary of Commerce and the National Research Council shall be designated as a national board of engineering and industrial research. No compensation other than actual expenses of the members shall be paid. The board is to appoint in each state and territory a research board of "five engineers or scientists engaged in the development of engineering and industrial science" to have immediate conduct of the research provided for by the act, in their respective states or territories. Board members are appointed for five years, and an executive committee of six is provided for the purpose of coöperation, and to determine whether proposed investigations are new, needful and justifiable. A majority vote of this executive committee is required to authorize any research work along lines clearly outlined in the act. Bulletins are to be published giving results of investigations. The sum of $15,000 per annum is appropriated to the Department of Commerce and also to each state and territory.

Canadian Senate Passes Railroad Bill

Provides for Canadian National Railway Company To Operate Properties for Government Account

The bill incorporating the Canadian National Railway Co., passed by the Canadian House of Commons May 6, was passed by the Senate May 27 and will become law on receiving the assent of the Governor General. The bill provides that the Canadian National Railway Co. shall operate, for Government account, 31 major properties and 14 subsidiaries, included in the Canadian Northern System.

The bill recites that it is expedient to provide for the incorporation of a company under which the railways, works and undertakings of the companies of the Canadian Northern System may be consolidated and, together with the Canadian Government Railways, operated as a national railway system.

It provides that the Government may nominate not less than five nor more than 15 directors, who are incorporated under the name of "Canadian National Railway Co.," stock ownership not being a necessary qualification.

The Government may declare that the company shall have a capital stock, with or without shares, in such amount as may be deemed expedient, vesting the stock with the Minister of Finance. From time to time the Government may entrust to the company the management and operation of any railways or works controlled by the Government.

All expenses incurred in the operation and management of the company shall be paid out of Government revenues and, in the event of a deficit, the amount is to be paid by the Minister of Finance out of the consolidated revenue fund and included in the estimate submitted to Parliament. In the event of a surplus, the amount will be paid into the consolidated revenue fund.

The properties and works of a number of the constituent and subsidiary companies of the Canadian Northern System are declared by the bill to be "for the general advantage of Canada" and therefore subject to Federal and not provincial jurisdiction. Provision is made for the extension of the time of completion of a number of lines which the Canadian Northern System was authorized to construct, for two to five years. The company is given wide powers for constructing and operating transportation systems, for acquiring securities and obtaining advances, and for the issue of bonds, debentures or other securities for new construction.

Chicago Railway Electrification

A 15-year program for electrification of the Illinois Central R.R. at Chicago is to be included in the proposed ordinance for improvements along the south shore. As agreed upon by the railway, the Chicago commission on railway terminals and the council subcommittee on railway terminals, the ordinance is to provide that within five years after its passage the railway will have its suburban service operated by electricity, and within 10 and 15 years will have this extended to its freight service north and south of 12th St., respectively.

To Reinforce Niagara Arch Bridge for Heavier Traffic

Reconstruction of the Niagara railway arch bridge, which carries the tracks of the Grand Trunk Ry. across the Whirlpool Rapids Gorge, Niagara Falls, N. Y., has just been put under way, contracts having been let last week. The bridge as now existing has a designed capacity not exceeding Cooper's E40 loading. Traffic has so increased that reinforcement was thought advisable in order to bring the capacity up to modern loading and meet the growing demands of traffic over the bridge. The principal items of the revision are reinforcement of the floor steel of the main span and the trusses of the approach spans; placing a drainage floor on the railway deck to protect the steelwork and the highway floor; and renewing the highway floor. The cost of the work is likely to run up to several hundred thousand dollars. Contracts for the steel fabrication and erection have been let to the Lackawanna Bridge Co. and Terry & Tench, respectively. The work is being carried out for the corporation, the Niagara Railway Arch Bridge, under the direction of C. E. Fowler as consulting engineer.

Fifth National Exposition of Chemical Industries

The fifth national exposition of chemical industries will be held in the Coliseum and the First Regiment Armory in Chicago during the week of Sept. 22, 1919. As usual, there will be a number of society meetings held jointly with it. For these meetings, to be held in connection with the exposition, programs are in preparation, which include the meetings of the American Institute of Mining and Metallurgical Engineers, the American Electrochemical Society, the American Ceramic Society, and the Technical Association of the Pulp & Paper Industry. The office of the management of the exposition was changed June 1 from New York City to 417 S. Dearborn St., Chicago.

Missouri Road Bond Law Declared Constitutional

By a decision of the Supreme Court of the United States in a taxpayers' suit involving the validity of $3,000,000 worth of road bonds issued by St. Louis County, the Missouri road bond law has been upheld. This law authorizes county officials to issue road bonds and levy taxes therefor upon a vote of county residents. The Supreme Court declares the law to be constitutional. This decision will allow work in St. Louis County, which has been held up for several years, to go forward.

Engineering Council

Observations by National Service Committee

M. O. LEIGHTON, Chairman
McLachlen Building, Washington, D. C.

An Engineer's Unfortunate Experience

Engineers who were enrolled in the Reserve Corps at the beginning of the war will be interested in the circumstances related below. How many engineers had a similar experience? All who did are urged to send a detailed statement to the National Service Committee. If the experience was common the combined testimony may be sufficiently strong to induce Congress to provide for reimbursement. It is not probable that corrective action can be secured on the basis of a few instances. Therefore, the engineers who have knowledge of similar cases and who fail to respond to this invitation may be depriving other engineers who are not so indifferent as to the consequences.

The following letter was addressed to the American Society of Civil Engineers by one of its associate members resident in the Philippines, and by progressive reference finally came to the Washington office of Engineering Council.

The American Society of Civil Engineers,
New York, U. S. A.

Dear Sirs:

As you are doubtless aware, the American Society during the recent war played a very considerable part in obtaining the services of engineers for the Army. Literature descriptive of the Engineer Officers' Reserve Corps was circulated throughout our membership and the society's appeal for men was probably responsible for a very large number of volunteers. In view of this fact, I am taking the liberty of advising you of certain instances in which the War Department, through the Chief of Engineers, seems to have violated the agreement under which the engineer officers were induced to offer their services. I am doing this with the hope that the society may be instrumental in securing legislation that will result in a partial reimbursement to the men for some of the financial loss that they suffered through certain rulings of the War Department.

Among other things, we were informed that reserve corps officers when ordered to active duty would receive the pay and allowance that officers ordinarily do when changing stations. Any number of Western engineers, several of them located in Alaska, applied for commissions in the first Engineer Reserve Corps. After their applications had gone forward the reserve corps was abolished by the War Department. Without receiving any information to this effect these men were telegraphed offers of commissions in the Engineers, U. S. A. They were accepted and ordered to Camp A. A. Humphreys, Virginia, for duty as students. Upon their arrival there they were informed that they would receive no travel allowances at all. The 7c. a mile that they expected was not due them because they had accepted commissions in the regular Army, not in the reserve corps. This was the first intimation that they had as to their new status. Most of the men, particularly those from Alaska, had been to a very considerable expense in traveling, as much as $250 in some cases, and naturally consider themselves unfairly treated.

Another instance, one which covers my own case, occurred as follows: Some 25 or 30 of us entered the service in the Philippine Islands. We were discharged in the States, most of us in the Eastern part. Our discharges came just too late to permit us to catch the December transport for the Philippines, so we were forced to wait for the January boat, which arrives in Manila about Feb. 15. We were thus over two months without pay, our Army pay having stopped on the date of our discharge and our pay as civilians not beginning until our arrival in the Philippines. Anticipating these conditions, some of the men requested that they be ordered to the Philippines and discharged there, or that they be returned to the inactive list in the reserve corps, so that they could return to their homes with pay. Both of these requests were refused, and the men discharged along with the rest.

Several of us called on various Army officials in Washington and were told in every case that new legislation was necessary before we could be reimbursed. It is to acquaint you with these facts and to solicit your assistance in securing the necessary legislation that I am troubling you with this letter.

We all received a letter of appreciation from Major General Black in which we were heartily thanked for the way in which we had responded to our country's call, etc. A little consideration in the orders getting us into and out of the service would have been more to the point.

On May 1 a letter was addressed to the Secretary of War in which the above communication was quoted, with a request as follows:

Will you be good enough to inform Engineering Council through the undersigned whether the facts as related in the letter above quoted are interpreted by the War Department in the same way as by Mr. ——— and whether there is an official intention to present the facts to Congress for the purpose of securing authority to reimburse discharged engineer officers of the Army whose experiences were similar to that above related.

Up to May 24 no response had been received from the War Department, but we have hopes. While the author of the above letter recites an unfortunate train of circumstances, which seemingly reflects discredit on someone, judgment should for the time being be tempered with consideration. This war has been so big a thing that the mental capacity of man has been quite inadequate to direct everything rightly. An injustice has been done, but the correction in this case lies not in placing the blame but in securing reparation. Our Government is essentially just and the Congress will not advisedly do injury to any man. Let us have all the facts.

Bill Raises Salary of Director of Bureau of Public Roads

The agricultural appropriations bill, H.R. 3157, which was introduced in the House of Representatives May 26, 1919, provides a salary of $6000 per annum for the Director of the Bureau of Public Roads. The salary heretofore has been $4500. The total appropriations in the agricultural bill amount to $31,691,562. Among appropriations interesting to engineers, there may be mentioned those for the Forest Service, amounting to $5,966,869, of which $450,000 is for use in improving the roads, trails, bridges, fire lanes, telephone lines, cabins, fences, etc., in the national forests; for the Bureau of Chemistry, $1,381,571, and for the Bureau of Public Roads, $594,320.

$1,000,000 Trust Fund Bequeathed to Philadelphia

The will of Thomas Skelton Harrison, former American minister and consul general to Egypt, which was recently probated in Philadelphia, provides a trust fund of nearly $1,000,000 to be used in improving conditions in the municipal government of Philadelphia. It provides for a board of seven men to apply the fund to various municipal needs.

Army Engineer Board to Recommend System of National Roads

A board of Army officers has been appointed to consider a system of national highways in connection with the rural post roads system, for which appropriations were provided in the postoffice appropriation bill, passed Feb. 28, 1919. The board will be directed to prepare specific recommendations, to be submitted for the approval of the Secretary of War. The board will consist of Gen. E. E. Winslow, of the Corps of Engineers, and Maj. J. M. Ritchie, of the Motor Transport Corps.

Bureau of Mines To Dedicate New Pittsburgh Laboratories

The new million-dollar laboratories and workshops of the Bureau of Mines in Pittsburgh, Penn., will be dedicated Sept. 29-Oct. 1. The feature of the dedication will be a national "safety-first" meet, at which teams of miners from all over the country will compete for a cup and medals for rescue work and first aid to the injured. As there is great rivalry among teams of various mining companies it is expected that these contests will take at least two days. At the last national "safety-first" meet held in 1911 more than 18,000 miners were present. The contests are open to all teams from mining and metallurgical industries in the United States.

New Water-Supply for Phoenix

Plans for a gravity mountain water-supply for Phoenix, Ariz., provide for a 42-in. pipe line 157,500 ft. long from the Verde River, with an infiltration system at the upper end, and discharging into a reinforced-concrete covered reservoir of 25,000,000-gal. capacity. The cost of the project is estimated at $1,350,000. These plans have been prepared and submitted to the city commissioners by L. B. Hitchcock, city engineer, and Hiram Phillips, consulting engineer, St. Louis, Mo.

Salt Lake City Has $890,000 for Water-Works Improvement

In the bond issue of $2,000,000 recently approved at Salt Lake City, Utah, the sum of $890,000 is assigned for improvement of the water-supply and distribution system, and it is expected that contracts will be let and considerable work done during 1919. A gravity high-line supply conduit from Parley's Cañon will cost about $300,000; this will be of reinforced concrete and will be 26,000 ft. long, with a daily capacity of 34,000,000 gal. Feeder mains for this conduit, 10 to 24 in. in diameter, together with ordinary water-main extensions, will cost about $240,000. Other items include $200,000 for purchase or exchange of additional sources of supply; $100,000 for the conservation of City Creek by constructing one or more small reservoirs; $50,000 for developing various sources of local supply for serving the parks. S. Q. Cannon is city engineer.

Constructive and Progressive Aspects of New Branch of Engineering

National Conference on Town and Regional Planning, Industrial Cities, Zoning, Steam Railroads

That town planning is municipal engineering at its highest level, embracing and coördinating the many and various elements in municipal design, becomes more evident with each National Conference on City Planning. At the eleventh of these gatherings, held at Niagara Falls and Buffalo, May 26-28, most of the subjects discussed were in the domain of the engineer, and engineers made up a goodly percentage of those present.

That the city planners are dealing with practical matters and are making progress in their work the country over is shown by the main features of the latest conference. These included discussions and reports on planning industrial cities, zoning in cities of all classes, regional planning to meet the needs of groups of cities and their tributary areas, and the steam railroads as related to both industrial and regional planning. Besides these four subjects, civic centers and soldiers' monuments were considered.

Hereafter the conferences will be continued more nearly along the lines followed for the first eight years than was contemplated two years ago when the American City Planning Institute was tentatively formed. Conference members of a year's standing may become members of the institute, which will be devoted to research work, provided they have been for at least two years in charge of some city-planning work of a major character. This work is so defined as to include both landscape and building architects, engineers and lawyers engaged in city planning. Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City, was elected as president of the conference for 1919-20, and was reëlected as secretary of the conference.

President Olmsted's Address

Lessons drawn from his war experiences in planning cantonments and war-industry housing projects were the chief features of the address of F. L. Olmsted, who retired as president of the conference after serving 10 years. The difficulties encountered in securing coöperation in a complex undertaking, Mr. Olmsted said, are not so much due to the work in hand as to the mental and moral inertia that keeps different persons from getting together. The two chief dangers are (1) excessive departmentalization, under which each does his part sequentially and independently instead of in coöperation, and (2) some one man assuming that he knows it all and trying to make all his associates his subordinates.

Turning to another phase of his subject, Mr. Olmsted said that, so far as he remembered his experiences with the United States Housing Corporation, Philadelphia was the only city that had clearly distinct street plans showing what thoroughfares are needed beyond the district limits. Still another remark by Mr. Olmsted that will appeal to engineers was his statement that any proper city engineering organization should have a staff, if only a single man, engaged wholly in planning for the future needs of the city.

Commenting on Mr Olmsted's remarks, Arthur C. Comey, city planner, Cambridge, Mass., said that "however we may feel about it, municipal engineers are going to do a large part of town planning." This class of work will increase by force of the recent examples set by the Government, and there are not enough professional city planners to do it all. The city planning conference should bring in the municipal engineers.

Planning Problems of Industrial Cities

Growing attention is being given of late to the planning problems of industrial cities. These problems were outlined by John Nolen in a paper abstracted elsewhere in this issue, and they were specifically illustrated by wall plans from reports by Mr. Nolen on Niagara Falls, N. Y., Akron, Ohio, and Flint, Mich. Akron, Mr. Nolen said, has only one street extending clear through it unbroken, and that one is narrow.

Continuing this general subject and at the same time extending it into the field of one of the main topics, regional planning, Warren H. Manning, city planner, Boston, outlined a study he had made of the industrial-planning needs of Birmingham, Ala. The city has no up-and-down thoroughfares, only crossways. The adjacent villages, industrially related, should be connected with the city. Zoning is needed, and since the life of a building is 30 years, after which it becomes second-class, zoning for Birmingham is planned on the assumption that after 30 years the residence section on the lower level will become a manufacturing district, the houses going back to the higher levels.

As related to industrial planning, the rehousing operations of the Relief Commission of Halifax, N. S., were outlined by George A. Ross, of McDonald & Ross, Montreal, architects to the commission. Of 750 permanent new homes planned, some 200 are nearing completion. Although the devastated area was hilly, the original streets were laid out on the gridiron plan. Two diagonal streets have been provided to give better grades between the higher and lower levels. Street widths have been fixed to accord with grades, length and rise of streets. To give quick shelter, frame houses on a court-group plan were built. These will afford low-rent houses after their temporary occupants have moved. With a few variations in ground plan, 24 types of exteriors were secured for these group houses. A total of 110 individual houses has been built, and contract plans for 150 more are under way. Experience has shown that "hydrostone" or steam-cured hollow concrete blocks can be built for only 2.5% more than the cost of frame houses. The homes wrecked by the explosion two or three years ago were valued as of the date of the explosion. The relief fund bears the difference between their valuation and the actual cost of the new houses. In special cases, after careful investigation, aid is provided beyond that just mentioned. These statements apply to householders able and willing to acquire homes on mortgage.

The Steam Railroad and the City Plan

The relation of steam railways to the city plan was outlined by E. J. Fort, city manager of Niagara Falls, N. Y., and was also considered with special reference to that city by him and by Walter McCulloh, consulting engineer, Niagara Falls, and J. L. Harper, chief engineer of the Niagara Falls Power Co. Mr. Fort's paper is abstracted elsewhere in this issue. Mr. McCulloh reviewed four plans of railway relief prepared for Niagara Falls, those of the New York Central, the Grade Crossing Commission, John Nolen and E. P. Goodrich. Mr. Harper urged that in view of the great power developments of the future, resulting in a city extending to include Lockport, railway planning should cover more than the present small corner occupied by Niagara Falls.

The railroad problem was also discussed by J. E. Noulan Cauchon, engineer, Ottawa, Ont. As a matter of railway economics, Mr. Cauchon said, the railway problem is one of maximum tonnage on minimum grades, but the community requires safety and amenity as well. The speaker outlined railway relocations planned by him for Ottawa, Hamilton and London, Ont. These and the various plans for needed railway changes at Niagara Falls afford illustrations of one of the many city-planning activities of the day.

An Extension of City Planning

So important was regional planning considered by the framers of the conference program that an entire session was devoted to it. Papers were read by Thomas Adams on the general subject and by Morris Knowles on its more strictly engineering features. The paper by Mr. Adams is abstracted elsewhere in this issue. Regarding Mr. Adams' paper, it should be noted further that it included a detailed study of the Niagara Falls district on both sides of the international boundary, accompanied by maps and diagrams showing populations, resources and public utilities. Sewage-disposal prob-

lems of the region were discussed by T. W. Barraly, city engineer of Tonawanda, N. Y., who seemed to favor disposal through a combined sewage and power canal leading from Buffalo to Lake Ontario.

In general discussion, R. A. Pope, of New York City, said that regional planning is dependent on economic governing conditions and is therefore essentially within the province of the engineer. E. P. Goodrich, consulting engineer, New York City, said he was engaged in two regional studies that take into account the resources and export possibilities of the district.

Still another phase of regional planning, water fronts, came up at another session, when the Palisades Interstate Parkway of New York and New Jersey was described by W. A. Welch, chief engineer, and a proposed extension of the New York State Reservation at Niagara Falls so it would reach nearly the whole length of the United States side of the river—as does already the Dominion Reservation on the Canadian side—was outlined by Ansley Wilcox, of Buffalo. In this connection may be mentioned also a description of the proposed "peace bridge" across the Niagara River at Buafflo. A small appropriation for the study of this project was recently vetoed by Governor Smith of New York.

ZONING PROGRESS AND POLICIES

No subject evoked more interest, information and opinion than zoning. A supper session was devoted to brief reports on progress and an afternoon to residential zoning. Among the cities that have enacted zoning regulations are New York, St. Louis, Los Angeles, Oakland, Alameda, Berkeley and Palo Alto. Zoning for some cities has been authorized by the legislatures of New York, Pennsylvania and Nebraska, and by constitutional amendment in Massachusetts. Zoning regulations are being framed or are seriously proposed in Cambridge, Mass.; Buffalo, Cleveland, Detroit, Spokane, Portland, Ore.; San Francisco and other cities. A summary of the facts on zoning progress brought out at the conference may be obtained from Herbert S. Swann, 277 Broadway, New York City.

Archer C. Comey, of Cambridge, Mass., who opened the discussion on residential zoning, said that zoning as a whole is the largest single element in city planning. He thought that zoning regulations should be simple and drawn to last for 25 years. Zoning will stop four-fifths of the billboard nuisances in residential districts.

Charles H. Cheney, of San Francisco, held that regulations should be changed frequently to meet changing conditions. He urged that residence, business and industrial zones are necessary to insure reasonable rentals to wage earners. Unless land owners know that a given area will be restricted to residences they will insist on wide streets and heavy pavements suitable to business districts, thus increasing the price of lots beyond what low-priced dwellings can stand. The fundamental data for zoning are costly but necessary. They can be obtained in large part from the telephone companies, which are compelled to plan 20 years ahead. In establishing zones, neighborhood opinion should be secured, Mr. Cheney urged. This serves not only as a guide, but when brought out unmistakably is an argument that convinces the city councils that finally enact zoning ordinances. In Berkeley the Chamber of Commerce fixed the limits of the business district and the Manufacturers' Association set the bounds of the industrial zone. Harland Bartholomew, engineer of the St. Louis Planning Commission, said that zoning is a matter of four-fifths fact and one-fifth judgment. The facts should be put on paper, after which the plan can be worked out.

CIVIL CENTERS IN THEORY AND PRACTICE

A paper on the "Common Sense of the Civic Center," by Nelson P. Lewis, New York City, is abstracted in this issue. The group plan at Cleveland, on which more than $15,000,000 of obligations for land and buildings have been incurred, was described by Robert Hoffmann, city engineer. A county court house, a city hall and a Federal building have already been completed as parts of the group plan; a municipal hall is under construction and a public library has been planned and partly financed. Most of the large area of land for the mall has been acquired but not all of it has been cleared and, as the buildings thus far erected are scattered, the large outlay already incurred does not make a unit impression on either stranger or citizen. Perhaps, Mr. Hoffmann suggested, this was one reason why the voters recently agreed to a radical change in the plan for the location of the union station.

In a talk on "Soldiers' Monuments in Relation to the City Plan," by H. E. Jackson, of the Bureau of Education, Washington, D. C., it was urged that these express the spirit that animated the soldiers; also that it would be well to defer for some years, as have the French, attempts at works of art, since it is too early as yet to work out properly the ideals suitable for permanent war memorials of a purely artistic character. Speaking along other lines, Mr. Jackson pleaded for community or neighborhood organization and for social engineering. Four or five universities are considering courses for training social engineers, he said, and one has already decided to establish such a course.

Before adjournment the conference adopted resolutions urging the Bureau of the Census to adopt, for cities of 10,000 or more, the same districts or multiples of the same as were used in 1910; requesting the Secretary of Labor to urge mayors of all cities to appoint city-planning commissions; and asking the board of governors of the city planning conference to appoint a committee to study regional planning.

Finally, the city planning conference was notable for its large attendance and sustained interest through almost continuous sessions for two and a half days, for its social luncheons and dinners and, last but not least, for its undoubtedly favorable reaction upon both Niagara Falls and Buffalo, each of which is awakening to its great need for city planning. This reaction was especially notable in Niagara Falls, where the newspapers and some of the people are beginning to realize how little man has done for the convenience and amenities of a city for which nature has wrought on so grand a scale.

Dust Explosion in Grain Mill Causes Serious Damage

Nearly 50 persons were killed and about $3,000,000 worth of property was destroyed May 22 as a result of a dust explosion in the feed-grinding mill of the Douglas Corn Products Co., at Cedar Rapids, Iowa. A consequent fire caused much of the damage. Experts from the Department of Agriculture are making an investigation.

Dallas Engineers Get Together

The Dallas Chapter of the American Association of Engineers was installed May 25 by C. E. Drayer, national secretary. The meeting was attended by nonmembers, and resulted in the starting of a Dallas Engineers' Club, to include all engineers of that city. A committee is being formed, composed of representatives of all national societies, to study the situation and to report with recommendations. The suggestion for an all-inclusive local club was made by Jacob H. Brillhart, representative of the Texas Association of Members of the American Society of Civil Engineers.

Licensing was indorsed unanimously, and a committee was appointed to go over the bill drafted by the Texas Association of Members of the American Society of Civil Engineers. All engineers in the state will be enlisted to support the final bill.

Civic activity, publicity, legislation, compensation, national and local organization were discussed. The suggestion that there be an all-inclusive democratic national organization that could speak with authority on public questions and speak with a voice that would be heard was heartily applauded. The thought was expressed that such an organization should be parallel in form to our political government, so that proper contact could be developed for political activity.

Civil Service Examinations

California.—Civil engineer, grade IV, $2700 to $3900 per year; examination in Sacramento, San Francisco and Los Angeles as soon after June 14 as possible. File applications with State Civil Service Commission at Sacramento before June 14.

California. — Construction engineer (civil engineer, grade III), $2100 to

$2700 per year; examination in Sacramento, San Francisco and Los Angeles, June 20. File applications with State Civil Service Commission at Sacramento before June 14.

California.—Civil engineer, grade II, $1500 to $2100 per year; examination in Sacramento, San Francisco and Los Angeles, June 20. File applications with State Civil Service Commission at Sacramento before June 14.

California. — Senior engineering draftsman, grade II, $1500 to $2100 per year; examination in Sacramento, San Francisco and Los Angeles, June 20-21. File applications with State Civil Service Commission before June 14th.

New York.—Heating and ventilating engineer, office of state architect, $1500 to $2500 per year, June 28, apply to State Civil Service Commission at Albany for application forms before June 16.

United States

For United States civil service examinations, listed on the following page, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File application before June 10.

Assistant designing engineer, Naval Ordnance Plant, South Charleston, W. Va., $9.20 per diem. July 8. File applications before July 8.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

Calendar

Annual Meetings

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 9-13, Buffalo, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

Engineering Societies

The San Francisco Association of Members of the American Society of Civil Engineers made an inspection trip to the Mare Island Navy Yard May 24. About 60 members of the association made the trip, and were taken in automobiles to the various points of interest on the island, including the 150-ton floating crane, an electrically welded steel barge, the construction of battleships and destroyers, the operation of electric furnace, foundries, large machine shops, etc.

The Western Society of Engineers was addressed June 2 by Maj. Robert I. Randolph, 535th Engineers, Service Battalion, who spoke on his work in France in heavy railroad construction in the Toul sector. Capt. Paul Hansen, Sanitary Corps, U. S. A., who also served in the Toul sector, spoke on problems in connection with supplying the troops with water. On June 20 and 21 the society will celebrate its 50th anniversary. On the first day, engineering progress during the past 50 years will be the topic of discussion, and on the following day there will be a basket picnic at The Dunes.

The Engineers' Club of St. Louis held a joint meeting May 28 with the St. Louis Section of the American Institute of Electrical Engineers. The meeting was addressed by H. Weichsel, chief designing engineer, Wagner Electric Manufacturing Co., who spoke on "Insulation Resistance of Electrical Machinery," and by Prof. A. S. Langsdrof, dean of the schools of engineering and architecture, Washington University, on "Circulating Currents in Direct-Current Armatures and on Phase Relation in Interconnected Polyphase Systems."

The Technology Club of Syracuse, N. Y., held its annual meeting June 2. A dinner was given in honor of members who have returned from military service, each of whom spoke briefly of his experiences. The following officers were elected: President, Prof. Louis Mitchell; vice-president, Charles C. Trump; secretary, K. V. Farmer; treasurer, Marshall B. Palmer.

The Pittsburgh Chapter of the American Association of Engineers' banquet and ball, May 27, in honor of engineers returned from the Army and Navy, had Major Gen. William M. Black, Chief of Engineers, U. S. A., as the honor guest and principal speaker. About 200 guests were present. The Engineers' Society of Western Pennsylvania and and the Pittsburgh Association of Members of the American Society of Civil Engineers coöperated in the program.

The Civil Engineers' and Inspectors' Union, affiliated with the American Federation of Labor, was recently organized in Boston, with the following officers: President, Percival H. Mosher; vice-president, Frank McLaughlin; financial secretary, Leo S. Stone, 108 Waumbeck St., Roxbury; treasurer, William J. Cochran. The headquarters of the organization are at 3 Boylston Place, Boston.

The Southern California Association of Members of the American Society of Civil Engineers held a meeting and dinner May 14, at which the Hon. W. A. Johnstone, of the California State Water Commission, and the Hon. Jonathan S. Dodge, chairman of the Los Angeles County Board of Supervisors, were guests. Papers by F. H. Olmsted, Dr. Ford A. Carpenter and A. L. Sonderegger were read as a continuance of the symposium on flood control.

The Jackson, Mich., Engineering Society was addressed May 19 by W. L. Fox, of the Fox Machine Co., who spoke on the value of shop practice to draftsmen. A paper was read on "What the University of Michigan Extension Course Can Do for the Jackson Engineers."

The Oklahoma Chapter of the American Association of Engineers was installed June 2 by C. E. Drayer, secretary of the national organization. The officers of the chapter are: President, Fred L. Verity, and secretary, Erle K. Ramsey, office engineer, Oklahoma City.

The Society of Engineers of Topeka, Kan., held a regular meeting May 29, at which O. W. Griggs, valuation engineer, Santa Fé R.R., spoke on the subject of evaluation.

The Pennsylvania Railroad Section of the American Association of Engineers will hold its first annual meeting in Pittsburgh June 28. The headquarters of the section are at 1318 Fulton Bldg., Pittsburgh.

Personal Notes

MAJ. FRANK M. MASTERS, U. S. A., has received his discharge from the service and has opened offices for the practice of engineering at 204 Locust St., Harrisburg, Penn. Major Masters was inspecting manager, Philadelphia Ordnance District, and recently served as a member of the Philadelphia Claims Board.

LIEUT. F. H. DECHANT, U. S. N. R. F., formerly civil engineer, Bureau of Yards and Docks, Navy Department, at Quantico, Va., has obtained his release from active duty and is transferred to the inactive list. He has become associated with WILLIAM H. DECHANT & SONS, civil engineers, Baer Building, Reading, Penn.

M. J. SCAMMELL has resigned as assistant general manager of the Sparrows Point, Md., plant of the Bethlehem Steel Corporation. He has been connected with the plant since 1912, when he was appointed superintendent of

blast furnaces. In the reorganization in 1916, when the Bethlehem Corporation took the plant over, he became general superintendent of the steel mill and later was made assistant general manager of the plant.

FRED J. DEUTSCHMANN, Aurora, Ill., whose appointment as city engineer of Mitchell, S. D., was noted in *Engineering News-Record* of May 22, 1919, p. 1039, has not accepted the appointment, but will continue with the Wells Engineering Co., of Aurora, in charge of the construction of municipal and sanitary work.

CAPT. L. R. TILLOTSON, LIEUT. JAMES IRONS, and RAY A. FINNEY, all of whom have received their discharge from the 110th Engineers, U. S. A., have become associated in partnership under the firm name of the SHAWNEE COUNTY ENGINEERING CO., Topeka, Kan., and will specialize in highway engineering.

E. G. LANE, who was appointed chief engineer of the Baltimore & Ohio R.R., Lines West, in September, 1918, from the position of engineer maintenance of way, has been appointed with jurisdiction also over the maintenance-of-way department of the Baltimore & Ohio, Lines West, including the Dayton & Union R.R. and the Dayton Union R.R.

LIEUT. COL. GEORGE A. JOHNSON, Construction Division, U. S. A., and MAJ. WEBSTER L. BENHAM, Construction Division, U. S. A., have become associated in partnership under the firm name of JOHNSON & BENHAM, consulting engineers, with offices at 150 Nassau St., New York City, and the Pathfinder Building, Kansas City, Mo. Colonel Johnson, who is still in the service, but anticipates discharge in the autumn, was originally officer in charge of the water and sewer section in the Construction Division. He later became second in command of the maintenance and repair branch of the Construction Division. Major Benham received his discharge from the service May 1, having served as officer in charge of utilities and as construction quartermaster at Camp Funston, Kansas. He was later appointed regional supervising utilities officer for camps in the Southwest, and in March of this year was ordered to Washington as assistant to the chief of the Construction Division. The new firm will engage in general engineering practice.

CAPT. THOMAS GRIFFIN, Ordnance Department, U. S. A., who was recently discharged from the service, is now established at 2 Rector St., New York City, where he will engage in a general engineering business, specializing in the export of engineering supplies.

SEYMOUR CORLEY, 15th Engineers, U. S. A., recently discharged from the service, who was formerly connected with the Des Moines Bridge & Iron Co., has become superintendent of water-works and sewerage construction for Lawrence & McCann, general contractors, Eveleth, Minn.

CAPT. CHARLES DUBOIS, Construction Division, U. S. A., has received his discharge from the service and has become associated with the Bickle Co., engineers and contractors of Kansas City, Mo., and will specialize in highway construction.

C. E. BRASHEARS, formerly city engineer of Yakima, Wash., has been appointed inspecting engineer of the Yakima County sections of the Inland Empire Highway, which will be built this summer under the State Highway Department.

CAPT. LEWIS A. STEPHENSON, Ordnance Department, U. S. A., who was formerly stationed at Camp Funston, Kansas, has received his discharge from the service and has opened offices in Kansas City, Mo., for the practice of engineering.

G. CLYDE BALDWIN, engineer in charge of the United States Geological Survey office at Boise, Idaho, since 1911, has been transferred to Idaho Falls, in charge of the new office at that point.

CARL PAULSON, United States Geological Survey office, Atlanta, Ga., has been appointed engineer in charge of the office at Boise, Idaho, succeeding G. CLYDE BALDWIN, transferred to Idaho Falls, as noted above.

FRED CLECKNER has received his discharge from the service in the 309th Field Signal Battalion and has resumed his former work with GANNETT, SEELYE & FLEMING, engineers, Harrisburg and Erie, Penn.

DANIEL W. CHAMBERLAIN, assistant division engineer, California State Highway Commission, has been appointed assistant highway engineer for Fresno County.

E. C. CONNOR has been appointed chief engineer of public utilities of Dallas, Tex.

LEROY E. WOLFE, formerly of the Virginia State Highway Department, has become associated with the du Pont Co., Wilmington, Del.

W. B. SHORT, water department, City of Tacoma, Wash., has been appointed city engineer and manager of the water department of Bellingham, Wash.

A. R. SWEN, chief engineer, Iowa Railway & Light Co., Cedar Rapids, has resigned to become associated with H. R. GREEN, consulting engineer of Cedar Rapids.

J. B. CROLY has been appointed district manager, at Vancouver, B. C., in charge of the new office of the Dominion Engineering & Inspection Co., of Montreal.

B. H. MCCAMMENT and E. F. ERNEST, both of whom have received their discharge from the 110th Engineers, U. S. A., have become associated in partnership under the firm name of the FEDERAL ROAD ENGINEERING CO., Columbian Building, Topeka, Kansas.

LEONARD L. RYAN has been appointed manager of McCracken, Kansas.

OBITUARY

HENRY K. OWENS, consulting engineer, Seattle, died in that city, May 15, at the age of 61. He went to the Pacific coast in the employ of the engineering department of the Northern Pacific R.R. at the time of the completion of the line through to Seattle. He was afterward engaged in laying out the business district of the new City of Seattle after the fire in June, 1889. In recent years he had engaged in hydro-electric and irrigation development, including much work in the Columbia River district. At one time he was retained by the Northern Pacific as consulting engineer in the development of irrigation work in the settlement of reclaimed lands in Yakima Valley, Washington. He had made extensive studies in the possibilities of water-power and irrigation development in the Northwest.

PROF. ERNEST MARCEAU, president of the Polytechnic College, Laval University, Montreal, and chief engineer of canals, Province of Quebec, died at Sault au Recollet, Que., May 23, at the age of 60. He took his degree as civil engineer at Laval University in 1879 and joined the engineering department of the provincial Government. In 1894 he was appointed chief engineer of the Province of Quebec. For the past 10 years he served as president of the Polytechnic College.

FREDERICK T. CRANE, city engineer of Orange, N. J., for the past 25 years, died in that city, May 31, at the age of 65. For some years previous to his appointment as city engineer of Orange he had been engaged in railroad-engineering work. In 1916 he was nominated a member of the New Jersey State Department of Health.

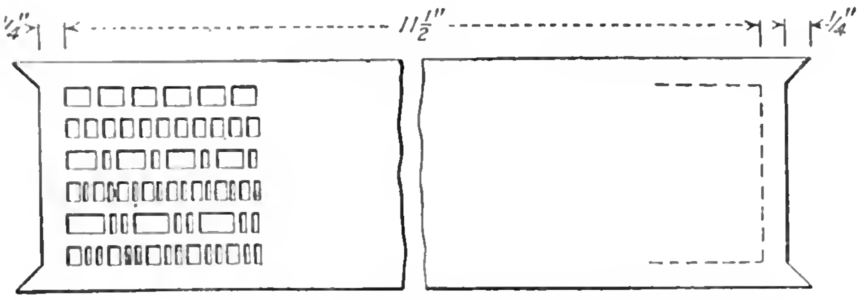
JOSEPH O. B. WEBSTER, for many years topographical engineer of New York City in charge of the laying out of streets, died in New York, May 30. He entered the service of the city in 1870 and for the past few years had been engaged in the engineering department of the Borough of Manhattan.

WILLIAM B. HOUGH, president of the Metal Building Materials Co., Chicago, died May 29. He was graduated from the Massachusetts Institute of Technology in 1900.

TIMOTHY M. RYAN, building contractor, of Seattle, died in that city, May 24. Mr. Ryan had been engaged in the contracting business during most of his 30 years' residence in Seattle.

Dot and Dash Lines Drafted by Simple Device

The drawing of uniform dot and dash lines may be accomplished by means of the simple ruling device shown in the accompanying illustration, which is formed by perforating very thin celluloid with rows of rectangles of varying widths. To manufacture the instrument celluloid of 1/100-in. thickness is used. This is punched with the desired spacings and then rolled into a bow shape.



CELLULOID DOT AND DASH RULING DEVICE

The method of use is to place the celluloid over the drawing where a dotted or dot-and-dash line is desired, with the concave side of the bow downward. A straight-edge is then placed over the particular row of spacing desired, and a right-line pen is drawn over the celluloid touching the paper at the perforations. Upon removing the straight-edge, the spring in the instrument throws it upward from the paper. This prevents blotting.

The instrument is about to be placed on the market by the Defiance Manufacturing Co., of New York, which is the sole licensee under the patents.

Grand Central Palace, New York, to Become a World Trade Mart

Upon the return of the Grand Central Palace, of New York City, to the Merchants' and Manufacturers' Exchange, it is proposed to develop the building as a center for the extension of American commerce in foreign countries, as well as for the importation of foreign goods into America. The building, which is 12 stories high, was taken over by the Government for a base hospital, and is now being vacated.

Industries will be grouped and permanent exhibits placed on the eight upper floors. The four lower floors will be utilized for the annual expositions which have made the building famous heretofore.

Some of the permanent exhibits that will be installed in the near future include farm implements and tractors, hardware and home furnishings, mining machinery, railway equipment, textiles and printing machinery.

It is believed that such a building will be of great service to foreign buyers in expediting the selection of goods, and to domestic dealers and jobbers in selling. The office of the Merchants' and Manufacturers' Exchange is at 405 Lexington Ave., New York.

Union Meeting of Manufacturers of Handling Equipment

The Material Handling Machinery Manufacturers' Association, 35 W. 39th St., New York City, announces a coalition meeting of all manufacturers of mechanical handling equipment in the United States. The meeting will be held at the Hotel Astor, New York City, June 11, 1919. The invitation is extended to all manufacturers of cranes, winches and hoists; elevators; gravity and power-conveying machinery and apparatus; industrial trucks, tractors and trailers; bulk-handling machinery, and all makers of equipment and accessories such as storage batteries, bearings, rope for hoists, buckets, electric controllers and apparatus, etc. The advertising managers of the various companies are invited to hold a preliminary meeting at the Hotel Astor on Tuesday evening, June 10.

An interesting program has been prepared, at which speakers of national reputation will talk on the various aspects of coöperative advertising and promotion. A general "forum" discussion will be conducted in the afternoon. Further particulars can be obtained from Zenas W. Carter, secretary of the association promoting the meeting.

Business Notes

THE NEW YORK TESTING LABORATORIES, mining, metallurgical and chemical engineers, announce that they have opened new offices and laboratories in New York City, at 74-80 Washington St. In addition to its other work, this organization will specialize in inspection of materials at the source, and will act as consultants in smelting, foundry, drop-forging and heat-treating practices and in investigation of metallurgical shop troubles.

THE H. K. FERGUSON CO., Cleveland, Ohio, announces the appointment of Lieut. E. D. Stearns as sales manager. Before entering military service Lieutenant Stearns was a member of the Fort Pitt Engineering Co., of Pittsburgh.

THE EQUIPMENT CORPORATION OF AMERICA, Lumber Exchange Building, Chicago, Ill., announces the following changes in its organization: H. Grant Leonard, assisted by J. L. Shields, will be district manager of the Pittsburgh office, which has been moved to quarters in the Empire Bldg. Alfred Reynolds, formerly field salesman in the Chicago district, has been made Chicago district manager. The Philadelphia district branch office, in the Land Title Bldg., has increased its capacity.

THE SILENT HOIST CO. announces the removal of its New York office to 487 Broadway.

THE FERGUSON INDUSTRIAL CO. has been incorporated to transact a general contracting business, with main offices in the Spitzer Building, Toledo, Ohio. J. E. Ferguson is president and treasurer and P. H. Dexheimer is vice-president and field manager of the company.

THE MURRAY IRON WORKS CO., Burlington, Iowa, announces that F. C. Orrell has resigned as manager of the Minneapolis office of the Allis-Chalmers Manufacturing Co. of Milwaukee, to assume charge of the Chicago office of the Murray Iron Works Company.

THE ACME BLUE PRINT PAPER CO., 115 S. Dearborn St., Chicago, announces its entrance into the field as manufacturer and dealer in drawing materials, sensitized papers and blueprinting.

Trade Publications

The following companies have issued trade publications:

THE CLARK TRUCTRACTOR CO., 80 E. Jackson Boulevard, Chicago, Ill.; folder, 6¼ x 9¼ in., four pages, illustrated; describes a light three-wheel machine of 1½-ton capacity for industrial work; it can be used as a tractor or fitted with a box or dump body for carrying material.

THE S. G. H. RUBBER-STONE CO., Detroit, Mich.; booklet, 6 x 9 in., 19 pages., illustrated; subject, "The Modern Roadway," as built of "Rubber-Stone."

THE REDWOOD MANUFACTURERS' CO., Hobart Building, San Francisco, Cal.; catalog, 6¼ x 9¼ in., 115 pages, illustrated; describes the construction and installation of "Remco" Redwood pipe, and gives technical data in tabular form, covering such information as that necessary in proportioning water-power installations, capacity of pipe at various heads and with various diameters of pipes, discharge in gallons per minute and hour with velocity in feet per second, velocity head in feet and loss of head in feet per 1000 ft. of length, for sizes of pipe from 2 in. up to 144 in. in diameter.

THE STORMS MANUFACTURING CO., Crawfordsville, Ind.; folder, 3¾ x 9¼ in., 18 pages, illustrated; describes one-man collapsible steel forms for small and large concrete culverts for roads.

May Contracts Aggregate $100,000,000

Bids Wanted Now on 200 Projects—General Advance in Lumber—Prices at Several Centers

By Alden W. Welch

In bemoaning the slackness of the construction season it must not be overlooked that contracts let in May, alone, aggregated $100,000,000 and in number exceeded 1200. Furthermore, on May 29 bids were wanted on 203 projects. These projects will soon materialize as contracts awarded, in which event more than a thousand contractors will have plenty of new work for their organizations.

The need for construction in every field is so acute that the situation cannot be called satisfactory until all contractors are busy. The improvements in the past two months, however, are notable. The 655 contracts awarded in March aggregated $48,000,000, about half the record for May. The table shows the increase participated in by every department of construction. So noteworthy is the acceleration that no one branch can be singled out for particular commendation. Specially gratifying, however, is the activity in public works, as shown for sewers, bridges, roads and dredging.

Better Demand for Steel

The demand for steel has improved. The failure of the Railroad Administration to break the price of rails has created a better sentiment in the industry. It is believed that the 200,000 tons reluctantly placed will be followed by further business from the railways. Other important orders were placed by automobile manufacturers, one being for 300,000 tons of billets, sheets, wires and tubes. Lower ocean freight rates have stimulated exports. As showing that the price is being maintained to Pittsburgh levels in England, a recent sale of billets was at $63, including ocean freight at $20. British billets are $67.28.

The most important price change since last month is in lumber, the rise being nation-wide. The high mark occurs in St. Paul, where 1-in. fir jumped $7 per 1000 ft. b.m. In the statement of conditions in the various centers of the country, which follows, the lumber situation is detailed. Lumber prices have not fluctuated in Chicago or St. Louis, and only slightly in New York, but Baltimore, Kansas City, Los Angeles, San Francisco and Seattle deserve attention.

Baltimore—The downward tendency in cost of building materials continues slight but steady, with its most noticeable effect in the cement and steel markets. Plain structural steel is being sold on the jobbing basis at $54 a ton, f.o.b. Baltimore, or $2.70 per 100 lb., with bar sizes and shapes under 3-in. at 10c. less; fabricated steel is being offered at prices varying according to whether light or heavy, but averaging $90 to $95 a ton; for floor-beams and columns $90 to $100 a ton is asked. These are decided drops over April. Cement, sold a month ago at $3.45 per barrel in more than 5-bbl. lots, can now be had at $3.10 a barrel.

The lumber market, apparently, is experiencing the most fluctuation, prices for the various grades rising and falling, on small margins, in sensitive touch with the law of supply and demand. At this writing lumber (common) is bringing $42 to $46 per 1000, delivered from local yards in city; heavier timber, up to $54, delivered. Common brick, sand and gravel prices have not changed since last month.

St. Paul—Recent bids show decreases in the following commodities: $3\frac{1}{2}$-in. creosoted wood block, from $2.20 to $2.13 (St. Paul specifications); natural Austin cement, $1.55 to $1.45; brick paving block, $37.50 to $36.50. There is a slight increase all along in lumber, the most notable being a jump of $7 in 1-in. rough fir, and $4 in 8 x 8-in. pine.

Kansas City, Mo.—Crushed stone has advanced from $1.70 and $1.80 for $1\frac{1}{2}$- and $\frac{3}{4}$-in., respectively, to $1.90 and $2; common brick, from $14 to $15; yellow pine, 1 in., rough, 10 in. and under, 16 ft. and under, has jumped $2.75 per 1000, and yellow pine, 2-in. t. and g., dressed and matched, same sizes, has advanced $1.50. These advances are due to an active "Build Now" campaign. The *Star* of Sunday, May 25, contained 60 want ads for carpenters, several for from 25 to 60 men.

Lumber Stocks Oversold

Many of the Southern and Western lumber mills have withdrawn from the market because they have oversold their stocks to a point where it will require the accumulation of the next 30 to 60 days to cover present orders. The present ocean rate of lumber of $51.75 per 1000, as against a pre-war rate of $9, is causing foreign private concerns to hold back on orders now.

Lumber firms controlling large Southern mill interests say that if the rate drops as expected—to about $40 by Sept. 1—lumber will go to the highest bidder, and it is expected that the European demand will be so great that an abnormal advance at home will follow. Stocks of all kinds of lumber in the hands of manufacturers today are said to be the lowest in history. Foreign governments, which are demanding lumber of all grades and sizes, are glad to get it at the present market price, despite almost prohibitive freights.

Public work has been retarded in the past few weeks by unfavorable weather conditions. It is improving, however. Many very large contracts, especially sewers, one for $1,500,000 and another for $2,500,000; also a diking project of $1,000,000 will be ready for letting by the city in the near future.

San Francisco—The rise in lumber prices is said to be due to increased demand. Mill owners claim they were not making sufficient profit, so they advanced their prices as soon as the demand warranted. The new prices are published in the section following this article.

Los Angeles—With a steady increase in the volume of building and engineering operations, and with the prospect of a labor shortage, no reduction in the price of construction materials is looked for in Los Angeles. Lumber prices have advanced about $4. Prices of other materials, with the exception of a few like explosives, rope, etc., remain steady. These exceptions show reductions in price, due, no doubt, to the creation of a surplus through the cessation of hostilities. Building construction, street and highway work, irrigation, drainage and sewer installation and hydro-electric development are all back practically to a pre-war stride.

Seattle—Between Apr. 23 and May 23 the price of lumber, wholesale, carload lots, to dealers, f.o.b. Seattle, best grade only, advanced from $17.50 to $20.50. This increase is attributed to steady demand from all parts of the United States and the growing number of orders from Europe. There is a decided shortage of stocks. Mill stocks are practically depleted and production is below normal. Official figures show orders are about 10% above normal, production about 10% below normal, and shipments about normal.

Contract prices for recent work have averaged 10 to 15% below those of last year. Conditions generally seem to be more stable and contractors are showing much more interest in bidding.

ANALYSIS OF CONTRACTS LET IN MARCH AND MAY, 1919

Water-works	Sewers	Bridges	Streets and Roads	Excavating and Dredging	Industrial Works	Non-Industrial Buildings	Federal Government	Miscellaneous	
24	75	7	302	6	115	75	37	40	Number let in March
33	113	30	551	15	185	138	66	103	Number let in May
$710,000	$1,456,000	$117,000	$16,423,000	$698,000	$11,861,000	$11,617,000	$4,766,000	$1,081,000	Value of March contracts
$1,160,000	$5,145,000	$1,887,000	$27,866,000	$1,038,000	$22,672,000	$20,719,000	$6,204,000	$9,992,000	Value of May contracts

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor* CHARLES WHITING BAKER *Consulting Editor*

Volume 82 NEW YORK, THURSDAY, JUNE 12, 1919 Number 24

Factory Methods in Pile Casting

CIVIL engineering construction rarely lends itself to factory methods or to the utilization of the economies of multiple production of small units, but there are cases where such methods can be applied, where machinery supplants hand labor to an extent far beyond the common practice, and where there are consequent marked economies. One such instance is the pile-casting yard at the Norfolk Army base, described on another page, and another is the similar yard at the Boston Army base, which, though not here described, has many of the details of the Norfolk yard. Pile production at these yards made remarkable and regular progress, corresponding in every way to the best factory work. The application of machinery and proper routing played a large part in the results secured.

Deceiving the Draftsmen

IN THE May issue of the *Monad*, Robert W. Shelmire calls attention to the pernicious character of the advertising of certain schools for draftsmen which quote such extravagant promises as "from $35 to $100 per week to start," following a short course in mechanics or drafting. He points out that of 13 advertisements of similar tenor in *Popular Mechanics*, 10 give Chicago addresses, and calls upon the engineers of the American Association of Engineers to investigate these schools and compel them either to tell the truth or, through the force of public opinion, go out of business. We earnestly hope that action will follow Mr. Shelmire's appeal. With draftsmen generally dissatisfied, and properly so, with their compensation, matters should not be made worse by bringing new men into the ranks with promises that are not likely to be fulfilled.

Concordant Tests Wanted

CONCRETE proportioning is the livest issue today in the field of concrete. For the time the questions of cement specification and stress determination—two of the old controversies—are dormant, but the work of Edwards and Abrams reported last year has started a train of confirmatory investigation which is just now reaching publicity. Only a part of the current discussion of the subject is given in this issue; more will follow in this journal in the next few weeks, and there is little doubt that the Testing Materials and Concrete Institute conventions the last week in June will bring together in discussion several of the more important investigators. Until the time when all the current evidence shall be in, it would be futile to attempt any summary of the facts as they have been presented. It is worth while now, however, to note the dissonance of the laboratory tests as presented in the article in this issue, and to suggest to the American Society for Testing Materials and the American Concrete Institute that here is a fertile field for controlled duplication of tests in many laboratories. Until a program of experiments, laid out by some central body and conducted in many responsible laboratories, develops some concordant results, the proponents of the various theories or methods can hardly wonder that the man in the field still sticks to his old 1 : 2 : 4 mix.

Seeing Themselves as Others See Them

CONTENTED for decades with the unsurpassed scenic grandeur of its cataract, and more than content with its money-making possibilities, first from its tourist traffic and later from hydro-electric power, Niagara Falls is only now awakening to the fact that as a municipality it has done nothing to make itself attractive to either its visitors or its citizens. To a few of its people vision has come recently, resulting in some attention to city-planning needs. The City Planning Conference held at Niagara Falls May 26-29, 1919, brought home to many residents of that city for the first time how ugly the man-made part of the city is to the visitor who gets away from the river front or who views the American side of the upper part of the gorge from the Canadian side. Never before in the automobile tour of inspection that prefaces the city-planning conferences have the visitors to a conference city had so depressing a trip as the one on May 26 through the residential, business and industrial districts of Niagara Falls. This was evident to residents of the city who attended the conference sessions, and the local press advertised rather than hid the fact. It is to be hoped that seeing themselves as others see them will give impetus to the city-planning movement at Niagara Falls.

Shipbuilding at Its Climax

WITH the month of May, American Shipbuilding reached the climax of its achievement. Through the great enterprise of the Emergency Fleet Corporation, the industry was magnified ten or twenty times within the past two years. For many months its producing capacity has been in process of development, until it has now reached peak production. A total of 768,025 dead-weight tons was completed and delivered, the main part of this tonnage composed of 87 large steel vessels, averaging over 6700 dead-weight tons carrying capacity. This performance represents an increase of nearly half over the April output. Yet even the present production does not represent the full power of the remarkable shipbuilding machine which the country created, for there has been a steady contraction in operations since last November. Wood shipbuilding has been discontinued, and in the steel and concrete yards cancellation of contracts and enforcement of normal-

time schedules have slowed up the pace. At maximum output, it may fairly be concluded, a monthly production well exceeding 1,000,000 dead-weight tons might be attained with the facilities now in existence within the borders of the United States. Launchings during May lagged behind completions, apparently for the first time since our war shipbuilding began; yet with 706,000 tons launched during the month and keels laid for 596,000 tons, it may be anticipated that the May deliveries may be surpassed by a small margin for a month or two to come. In effect, however, the program is now on the decrease. Future stagnation of our great shipbuilding industry can be prevented only by foreign orders: while no relief in this direction has yet come, there are grounds for optimistic feeling. Sound conditions of demand exist, as is evidenced by some recent sales of vessels on the part of the Shipping Board in which no less than $210 per dead-weight ton was obtained. Shipbuilding for private account may therefore be expected to be fairly active after the Fleet Corporation's orders are executed. For many years, however, the production record which today is a reality will stand as an unapproachable record.

Some Shipbuilding Cost Figures

CHAIRMAN Hurley of the Shipping Board has just given out the first figures on the cost of shipbuilding under the Emergency Fleet Corporation's program. For the total of 2434 vessels, aggregating 13,885,106 dead-weight tons, $206 per dead-weight ton will have been paid when all is over. This figure includes nothing for shipyard plant extension or housing and the like, items that are separately accounted for. But while $206 is actually paid out by the Government, it is partly offset by certain important tax payments. Income and excess profit taxes have been paid by shipbuilders in amounts ranging up to $40 per dead-weight ton, and Chairman Hurley estimates that the average payment has mounted to $25 per ton. Large additional tax payments have been made by the industries that furnished materials for the ships—wood, steel, engines, and equipment—but the amounts are not readily ascertainable. It is evident, then, that the net cost of the ships to the Government has been less than $180 per dead-weight ton, by no means an extravagant figure on the general scale of the times. The actual cost to the shipbuilder, of course, is considerably lower, and this cost is the figure by which the competitive capacity of the industry will be determined.

Standardization Referred to Societies

WITH the Engineering Standards Committee's action in deciding upon complete reorganization, some difficult problems are placed before the councils of the five founder societies, whose approval or disapproval is required. As approval will mean assuming an obligation to finance the work, particular point is given to the situation, for in these times engineering societies find it necessary to inquire rather carefully whether a proposed expenditure will give commensurate return. In the case in hand the uncertainties and problems are largely chargeable to the unfortunate fact that the committee has failed to define, or even roughly describe, what the term "engineering standards" shall cover. This was a remarkable omission at the time of original organization: it is even more remarkable now. It invested the committee from the start with vagueness of purpose and function, and the impression made was not improved through the committee's failure to make contact with the profession at large. Now, with the broadening into an "association," a much enlarged body in which technical and commercial organizations of all kinds may hold membership and the founder societies will play a subordinate part, this same vagueness is intensified, to the extent of inspiring doubt as to the engineering control and even as to the technical status of the association's future activities.

The officials of the committee have decided to withhold the details of the proposed reorganization from public knowledge until the founder societies have had an opportunity to act. It may be assumed, however, that the general scheme sketched by Dr. E. B. Rosa in *Engineering News-Record* of May 1 and May 8, 1919, is to be followed, though perhaps on a reduced scale. The motive leading to reorganization was to extend the scope of the committee's work to cover the preparation of industrial safety codes, such as rules for the construction of elevators, ladders or machine guards—something rather widely different from specifications for materials, standards for machine screws, or sizes of hydrant threads.

In these circumstances three important questions present themselves: What field of work will the association occupy? Is this field now taken care of in reasonably satisfactory manner? Will the association improve the results now being achieved, or will it injure or destroy existing institutions? These questions, concerning which the committee itself has hitherto maintained silence, are at the core of the difficulties referred to. As we suggested in our issues of Apr. 10 and Apr. 17, the issue is the sound continuance of most important work now being carried on, and perhaps even the survival of societies now flourishing.

Will Large Contracting Organizations Take Up Highway Work?

OF LATE there has been much urging of large contracting organizations to engage in highway work. The large future confronting the highway field has been pointed out, as well as the opportunity to secure sizable contracts worthy of the resources and skill of large organizations.

From the standpoint of the public there can be no doubt that it is desirable to let contracts for long stretches, provided capable contracting organizations having sufficient resources to buy adequate plants can be induced to take up the work.

But how does the large contracting organization regard the highway field?

To answer that question one of the editors of *Engineering News-Record* has sought the opinion of the officers of some large construction companies which have heretofore engaged in other work than highways but which are now contemplating entering the highway construction field. Their views, as summarized by Mr. Hill, will be found on p. 1150 of this issue. The story merits the most careful consideration of highway engineers.

In many of the charges which Mr. Hill sets down, as the temporary spokesman for these large contracting companies, will be recognized faults frequently alleged

against those who employ contractors, whether public officials or small private owners. Great as has grown the volume of construction work in recent years (until the war came) there has been no conspicuous change in the relationship between contractor and owner on the general run of small and average-size public-works jobs. There the contractor is still mistrusted and is not accorded the standing given to any other business man. Obviously, there are some things that cannot be fully defined in the specifications, and for the interpretation of these clauses the contractor is in the hands of the engineer. That is to be expected, but the insertion of meticulous clauses which at the sole judgment of the engineer, or of a subordinate under him, may be used to the disadvantage of a contractor is not conducive to that kind of relationship which should exist in a contract supposed to be mutual. These clauses can be offset only by a reputation for fair treatment, and such a reputation, the contractors believe, has not been established.

That the just causes for complaint must be removed needs no long demonstration. For a time the large contracting organization will be glad to take any work to keep busy, but just as soon as there is opportunity to pick and choose—in other words, when the volume of construction approaches that of the pre-war period—the large, competent, financially strong construction organization will select work in which the relationship not merely leads to profit but rests on the conviction of the owner that the contractor for a fair price will do a thoroughly good piece of work.

If the big contracting organization by the time the pre-war demand is approximated has not found the assurance that it will find in the highway field fair compensation and fair treatment in return for honest work, it will employ its resources elsewhere and the great opportunity which now lies before engineers to secure the services of these competent organizations for the benefit of the public will have disappeared.

We recognize, and so does Mr. Hill, that legal requirements are responsible for some of the undesirable features in public-works contracts. But, as Mr. Hill well says, the facts alone are important.

The Growth of the Draftsmen's Unions

FROM various parts of the country come reports of the rapid growth of draftsmen's unions. The international federation states that it has 5000 members in 25 locals, and that the Chicago branch alone has 700 members. In certain of the municipal departments in New York a majority of the draftsmen have joined, while in San Francisco not only have most of the draftsmen entered the union but 85 per cent. of the assistant engineers in municipal service as well.

While at first thought such growth is surprising, it is evident on reflection that it is but another manifestation of the dissatisfaction with compensation that has been with us for the past eight or ten years. That dissatisfaction has, of course, increased very materially on account of the price changes during the war.

To understand what is happening, however, one needs but to recall that six years ago a committee was appointed by the American Society of Civil Engineers to study the subject. That was evidence of dissatisfaction, and a groping after a remedy. Later came the American Association of Engineers with a welfare program that included the matter of compensation, and its rapid growth has certainly been due in part to its emphasis on this question. Now another agency comes forward, and, pointing to its effectiveness in other lines, offers its aid in the effort to get higher compensation.

Nor are the unions and the American Association of Engineers alone in making efforts in this direction. Engineering Council appeared before the railroad wage board and at the present time has at work a committee on compensation and classification of engineers. Its three subcommittees—on Federal, railway and on state and municipal employment—are actively at work making their classifications and getting the necessary data on which to build the proposed minimum salary grades.

The procedures, whether of Engineering Council or of the unions, rest on the theory that engineers must resort to collective bargaining in order to get higher pay. That theory was not accepted, or at least not advanced, by the civil engineers' reports in 1914 and 1917.

Therefore, the organizations at the extremes—the national technical societies (functioning through Engineering Council) on the one hand and the unions on the other—are at one in their theory. The divergence is one of method. The more conservative members of the profession are fearful of the use of "union methods," including the strike, or threat of strike. Those who seek quick results, however, wonder whether effective action can be counted on from the national societies, or their representative, Engineering Council. Right here the two wings join issue.

We have no doubt that the lowliest draftsman, ineligible to membership in the national technical bodies, would much prefer to see the results come through the action of the societies than through the union. He is interested in results chiefly, of course, but is not blind to the prestige which would accrue to all engaged in engineering work if the profession took care of its own. The strike, moreover, does not appeal to men of the type engaged in engineering work, and we should expect considerable defection if a strike were called.

What weapons, then, remain for getting results? There are at least two—the force of public opinion and the mediation of Government agencies. Upon these, both Engineering Council and the American Association of Engineers are relying. They can be made effective agencies, without doubt, but their effectiveness requires well-directed publicity, with a full and strong showing of fact.

What the outcome of present efforts will be remains to be seen. Shall we recede, now that we have advanced so far as accepting the theory of collective action on compensation? In England, as the Webb report on professional organization showed (*Engineering News-Record*, Apr. 10, 1919 p. 712), collective action on compensation is a confirmed part of the procedure of professional societies. Despite what has happened in England, however, it is hard to predict that we shall adopt the method permanently. The draftsmen will retain it, but will the professional engineering bodies? Likewise, it is impossible to tell what will happen as the result of another year or two of effort to secure higher remuneration. The effectiveness of the various procedures will be closely watched, and also the manner of the doing.

Meanwhile, it is important that all should know what efforts are under way, and particularly that those who desire action but are not in sympathy with the idea of getting it through the unions should realize that other bodies have the matter actively in hand.

Tests of Two Recent Theories for Proportioning Concrete

Fineness-Modulus and Surface-Aggregate Methods, Both of Which Depend on Water-Cement Ratio, Do Not Seem to Insure the Necessary Workability of Mix

By G. M. Williams and Watson Davis

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The following tests, made at the United States Bureau of Standards, controvert the fundamental principles of two theories for proportioning concrete which are receiving current attention. Following the article will be found a reply by Prof. D. A. Abrams, the propounder of one of the theories. A reply from Captain Edwards, the advocate of the other theory, will appear in an early issue—Editor.

During the past year two new theories for the proportioning of concrete mixtures have been proposed. One, fully described by Prof. D. A. Abrams in Lewis Institute Bulletin No. 1, "Design of Concrete Mixtures" (see *Engineering News-Record* of Apr. 17, 1919, p. 758), is based upon tests which seem to show that the strength of concrete depends only upon one factor, the ratio of mixing water to cement. The second, proposed by L. N. Edwards of Toronto and presented at the 1918 convention of the American Society for Testing Materials (see *Engineering News-Record* of Aug. 15, 1918, p. 317), bases the quantity of cement upon the surface area of the aggregate and includes a formula for quantity of mixing water to produce concretes having equal plasticity and equal strength. Studies now under way in the Bureau of Standards indicate that neither of these two methods insures what is most necessary in practical concrete work—that is, a proper "flowability" or workability. Some of the results of these tests are given here in proof of this assertion.

The above Bulletin No. 1 states that for a given plastic condition of the concrete and the same mix there is an intimate relation between the fineness modulus of the aggregate and the strength and other properties of the concrete. The grading of the aggregate may vary over a wide range without producing any effect on concrete strength, so long as the cement-water ratio remains unchanged. Referring to the sieve-analysis curves, it is said that any other analysis curve which will give the same total area below the curve corresponds to the same fineness modulus, and will require the same quantity of water to produce a mix of the same plasticity, and gives concrete of the same strength, so long as it is not too coarse for the quantity of cement used. In other words, for given concrete materials the strength depends upon one factor only—the ratio of water to cement.

The "surface-area" method of proportioning assumes as its basic principle that the physical properties are primarily dependent upon the relation of the volume of cementing material to the surface areas of the aggregate.

It is stated that the strengths of mortars are dependent upon the quantity of cement in relation to the surface areas of the aggregates, and the consistency of the mix. Also, that strengths of mortars of uniform consistency containing sand aggregates of varying granular combinations are directly proportional to the quantity of cement they contain in relation to the surface area of the aggregate. It was found that "normal," uniform-consistency mortars of varying cement content and of varying sand gradings were produced when the quantity of water used in the mix was made equal to that required to reduce the cement to a normal-consistency paste, plus an amount equal to the surface area of the sand in square inches divided by 210, i.e.,

$$\text{(1) Water (cc.)} = \left(\begin{array}{c}\text{Weight of cement } (C) \times \\ \text{Percentage required to produce} \\ \text{"normal"-consistency paste}\end{array}\right) \frac{\text{Total surface area of sand (sq. in.)}}{210}.$$

As shown above, the water-cement ratio method, in final result, is not concerned with details of proportioning the cement or grading of the aggregate, but, regardless of the reason for varying the water content, the water ratio dictates once for all the concrete strength.

TABLE I. PHYSICAL CHARACTERISTICS OF AGGREGATES
POTOMAC RIVER SAND AND GRAVEL

Aggregate Number	Weight per Cu. Ft., Lb.	Surface Area, Sq.In. per 100 Gram	Fineness Modulus	Granular Analysis, Per Cent. retained on									
				1½	¾	⅜	4	8	14	28	48	100	Pass 100
40	120	126	6.04	0	24	49	68	81	90	95	98	99	1
264	131	285	6.04	0	62	67	67	67	75	82	89	95	5
270	130	261	6.04	0	38	60	80	80	80	80	90	96	4
271	122	156	6.04	0	23	50	75	81	87	92	96	100	0
274	136	305	6.04	0	56	66	73	75	78	81	85	90	10
276	116	91	6.04	0	26	45	60	81	92	100	100	100	0
278	119	113	6.04	0	28	50	55	84	92	96	99	100	0
280	129	287	6.04	0	57	57	57	83	84	84	84	98	2
1	119	268	5.40	..	0	50	60	86	86	86	86	86	14
2	100	102	5.40	..	00	2	48	96	97	98	99	100	0
3	115	201	5.40	..	0	16	74	86	88	90	92	94	6
4	126	348	5.40	..	0	48	80	80	80	80	80	92	8
5	125	294	5.40	..	0	62	66	70	78	82	88	94	6
6	116	178	5.40	..	0	50	56	66	78	92	99	99	1
7	115	160	5.40	..	0	34	60	72	83	91	100	100	0
8	111	115	5.40	..	0	20	56	76	88	100	100	100	0
9	120	269	5.26	..	0	41	63	71	77	82	92	98	0
51	103	174	4.55	..	..	0	12	56	90	98	99	100	0
53	120	576	4.55	..	..	0	68	68	68	80	85	86	14
55	106	211	4.55	..	..	0	20	60	83	96	96	100	0
57	118	568	4.55	..	..	0	70	71	72	74	74	94	6
58	102	165	4.55	..	..	0	6	56	96	98	99	100	0
61	97	50	6.00	..	..	0	100	0	..	..	..	..	...
62	112	270	4.60	..	..	0	60	60	60	80	100	..	...
63	98	300	3.20	..	..	..	..	0	40	80	100	..	...
64	108	310	4.00	..	..	0	20	40	60	80	100	..	...
65	90	800	2.00	..	..	..	..	..	..	0	100	..	...
66	93	420	4.00	..	..	..	..	0	10	90	100	..	...

* Surface areas for aggregates 1.. 9, 40, 264...280 are computed under the assumption that the surface areas of particles passing the 100 mesh sieve are the same as the areas of those retained for unit weight, as was done by Mr. Edwards.

The "surface-area" method requires the selection first of some ratio of cement to surface area of aggregate, such as 1 g. cement to 10, 15, 20, or 25, etc., sq.in. of area. With this ratio fixed and with the quantity of mixing water determined by the above formula, mortars of the same plasticity and of the same strength are said to result.

It is important to note here that *the "surface-area" method after fixing a ratio of cement to surface area of aggregate arrives at the same final conclusion as does the method proposed by Professor Abrams—that strength depends only upon the ratio of mixing water to cement.* The proof of this statement is as follows: Let

C = Weight of cement in grams.

p = Percentage of water for normal consistency of the cement.

A = Total surface area of aggregate in square inches.

$N = A/C$ = square inches of surface area of aggregate per gram of cement. Arbitrarily selected before test.

w = c.c. mixing water.
c = volume of cement in cubic centimeters.
As given previously

$$w = pC + \frac{A}{210} \qquad (1)$$

From above $A = NC$ (2)
Substituting (2) in (1)

$$\frac{w}{C} = p + \frac{N}{210} \qquad (3)$$

in which p and N are constants. To express the weight of cement in the form of volume

$$\frac{w}{0.67c} = p + \frac{N}{210} =$$

constant, which is the water-cement ratio proposed by Professor Abrams for equal strength, or

$$\frac{w}{c} = K$$

It appears from the foregoing that with w/c constant, Professor Abrams should obtain constant strength values in every case, while Mr. Edwards by his theory should obtain constant strength values if the cement content is proportional to the surface area of the aggregate, or if the mixtures be made up by the usual volume method of proportioning, the strengths should vary inversely as the surface area per unit volume of aggregate. In support of the first theory it is shown in Table II of Lewis Institute Bulletin No. 1 that the strengths of 27 concretes made with the same ratio of water to cement are essentially the same, whereas the surface areas of the aggregates per gram of cement varied from 5.6 to 31.3. If the first theory is correct, it would seem that the surface area of the aggregate has little apparent influence on strength, while if the second is correct, varying strengths should have been obtained for the concretes included in the above table.

Relation of Flowability of Concrete to Tests

The fundamental requirement in the process of concreting is plasticity, flowability, workability or whatever that property may be called which makes a concrete placeable with a reasonable amount of work. It is essential that this factor receive proper consideration in the laboratory. For the same flowability an aggregate containing much fine material will require a greater amount of water than one which carries little fine. The judgment of the operator cannot be depended upon to insure concretes of equal flowability when the proportions of cement to aggregate or gradation of the aggregate in the same proportions varies widely, as must often be the case. The adoption of the "slump test" or the "cylinder pull off," as applied to the freshly mixed concrete, was a great step forward in the control of this important factor, but we have found that the cylinder slump test is of value only over rather small ranges of consistencies. It often gives misleading results when used near the limits of these ranges when comparing lean and rich proportions, and also for proportions leaner than 1 : 1 : 2, depending somewhat upon the gradation of the aggregate.

In most of the tests, descriptions of which follow, consistency determinations have been made, both with the cylinder and with what seems to be a more logical and satisfactory means of determining the flowability; that is, with the vibrating steel plate. The plate is supported at its center and on the center of the plate a fixed quantity of concrete is molded in a cylindrical

TABLE II. TESTS OF MORTARS WITH CONSTANT WATER-CEMENT RATIO
(See Fig. 1)

Showing reduction in compressive strength and flowability by the addition of increasing proportions of fine and coarse aggregate to a constant weight of cement and mixing water (w/c constant)

Results are average of three 2 x 6-in cylinders stored in damp closet

Proportions by Weight, Cement	Aggregate	Mixing Water, per Cent. by Weight	* w/c	Standard Ottawa Sand: Density	Surface Area, Sq.In. per Gram Cement	Flowability: 3 x 6-In. Cyl. Slump In.	Flowability: Vib. Plate	Compressive Strength, Lb. per Sq.In.: 7 Days	28 Days	¼–⅜ in. Gravel: Density	Surface Area, Sq.In. per Gram Cement	Flowability: 3 x 6-in. Cyl. Slump In.	Flowability: Vib. Plate	Compressive Strength, Lb. per Sq.In.: 7 Days	28 Days
1	0	31.0	0.465	0.498	0	2½	242	5570	6660	0.498	0	2½	237	5680	7280
1	½	20.7	0.465	0.613	2.0	2¼	230	5580	6710	0.603	0.125	1¾	225	4380	5170
1	¾	17.7	0.465	0.640	3.0	1¾	226	5090	6210	0.652	0.188	1⅞	200	4240	4710
1	1	15.5	0.465	0.669	4.0	1½	222	5130	5870	0.673	0.250	1⅜	187	3940	4970
1	1½	12.4	0.465	0.706	6.0	½	180	4370	5200	0.726	0.375	⅜	160	3300	3950
1	2	10.3	0.465	0.720	8.0	0	135	3365	4060	0.753	0.500	0	137	3060	3300

$^*\frac{w}{c} = \frac{\text{volume mixing water}}{\text{volume cement}}$

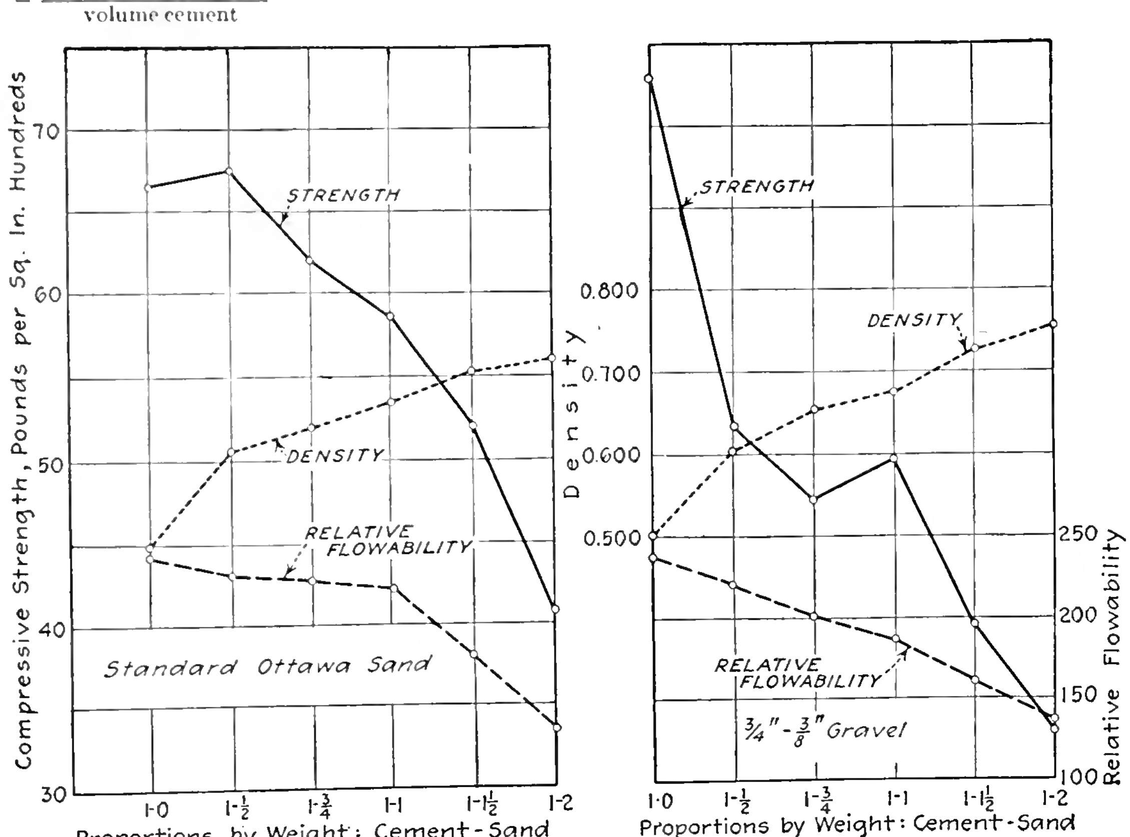


FIG. 1. REDUCTION OF COMPRESSIVE STRENGTH AND FLOWABILITY BY ADDITION OF INCREASING PROPORTIONS OF FINE AND COARSE AGGREGATES TO A CONSTANT WEIGHT OF CEMENT AND MIXING WATER (SEE TABLE II)

form whose height is one-half its diameter, the form is removed and the edge of the plate is struck a fixed number of measured downward blows. The increase in diameter of the concrete expressed in per cent. is designated as relative flowability.

The conditions of the tests were as follows:

Cement—A standard brand of portland cement has been used throughout the series of tests shown.

Storage—All specimens were stored in damp closet or in water, as indicated. A relative humidity of between 90 and 95% was constantly maintained in the damp closet.

Testing—All compression tests were made on standard testing machines of 20,000- and 100,000-lb. capacities. The 6 x 12-in. cylinders were capped one end before testing and the other end was ground to a plane surface. The 3 x 6-in. cylinders were capped top and bottom with neat cement paste at the time of molding and the ends were ground plane just previous to the test.

TABLE III MORTARS MADE OF WIDELY VARYING GRANULAR COMBINATIONS
(See Fig. 2)
(Results Average of two 2-in. cubes at 7 days and three 2-in. cubes at 28 days stored in water)

Proportions—1 part cement to 3 parts aggregate by volume

			Constant Water Ratio					Constant Flowability				
			Mixing Water			Compressive Strength Lb per Sq In.		Mixing Water			Compressive Strength Lb. per Sq.In.	
Aggregate Number	Fineness Modulus	Surface Area, Sq In per Gram Cement	Per Cent by Weight	*w/c	Density	7 Days	28 Days	Per Cent. by Weight	*w/c	Density	7 Days	28 Days
61	6.00	1.6	10.10	0.622	0.757	2890	5190	11.67	0.667	0.730	2290	4050
62	4.60	9.7	9.00	0.622	0.782	3735	5405	11.34	0.780	0.744	2465	4630
63	3.20	12.5	10.05	0.622	0.711	2020	3140	13.15	0.819	0.675	1590	3155
64	4.00	10.7	9.27	0.622	0.757	3060	4590	†12.95	0.865	0.703	1810	3635
65	2.00	22.8	10.73	0.622	0.628	1120	1705	19.10	1.104	0.598	705	1465
66	[illegible].00	12.4	10.52	0.622	0.625	2040	3130	14.60	0.867	0.620	1340	2460

$* \frac{w}{c} = \frac{\text{volume of mixing water}}{\text{volume of cement}}$

† Too much water used

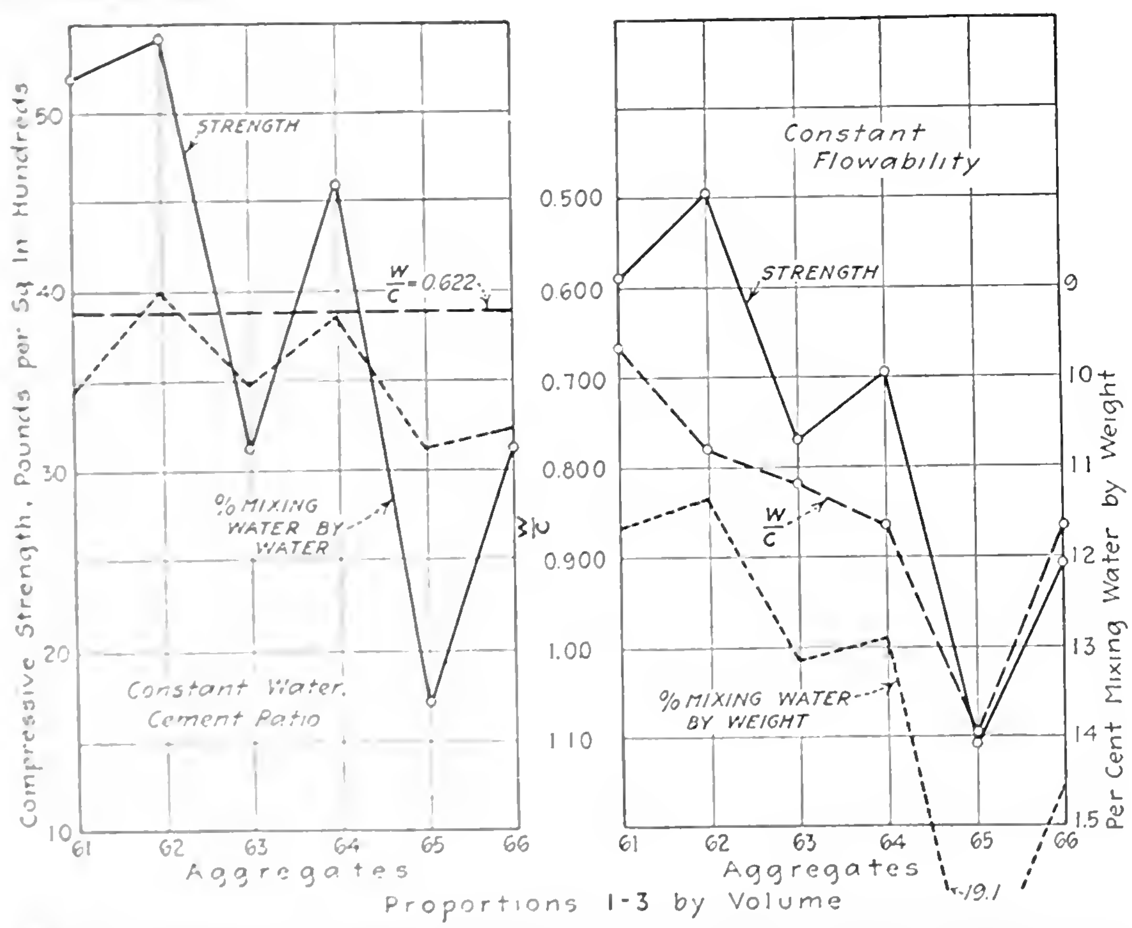


FIG. 2. STRENGTH TESTS OF MORTARS OF WIDELY VARYING GRANULAR COMBINATIONS (SEE TABLE III)

Aggregates—The aggregate, sand and gravel, from the Potomac River, used generally in all classes of concrete construction in the vicinity of Washington, was screened into its various sizes, using screens of the Tyler standard screen scale.

Proportions—All proportions, unless indicated otherwise, are by volume, reduced to weight measure for accuracy.

Method of Mixing—All concrete for 3 x 6-in. cylinders was mixed by hand in large, sheet-metal pans. All specimens in any one series were molded the same day by the same operator. Concrete for 6 x 12-in. specimens was mixed in a batch mixer.

Tests of the Proposed Methods

In Table I are shown the granular analyses and other physical properties of the aggregates included in the tables following.

In Table II (graphically in Fig. 1) are shown the results of tests made by combining constant weights of cement and mixing water with varying percentages of standard Ottawa sand, and of gravel passing the ¾-in. and retained on the ⅜-in. screen. These mixtures are much richer than most mortars ordinarily used in practice, but were made to show the effect of addition of very different aggregates with a constant water-cement ratio. The quantities of aggregate are varied from 0 to 2 parts by weight of the cement. With increase of added aggregate it is seen that density (that is, the ratio of volume of solids, cement and aggregate, to a unit volume of concrete) increases while strength decreases. It is also seen that the mixtures containing standard sand are stronger than those containing the coarser gravel. In general, it was found that flowability was reduced more by the addition of the coarse aggregate than the fine. This was indicated equally well by the slump test and the vibrating plate, and was noticeable to the eye at the time the specimens were molded. Had sufficient mixing water been used in every case to give the same flowability as was obtained for the neat cement, still greater reductions in strength would have resulted.

Attention is also directed to the relation between surface area and strength. In every case the surface areas of the standard sand mixtures are 16 times as large as for the gravel mixtures of the same proportions, and the strengths are considerably higher.

It is usual to conceive of concrete as being made

TABLE IV. CONCRETES MADE WITH AGGREGATES HAVING THE SAME FINENESS MODULUS
(See Fig. 3)

(Showing the variation in compressive strength and flowability with constant water-cement ratio (w/c constant), also same aggregates with flowability constant)
Results, average of four 3 x 6-in. cylinders stored in damp closet.
Proportions, 1 part cement to 3 parts aggregate by volume.

			Constant Water Ratio					† Constant Flowability				
Aggregate	Fineness Modulus	Surface Area, Sq.In. per Gram Cement	Mixing Water, Per Cent. by Weight	*w/c	Density	Flowability, 3 x 6-In. Slump, In.	Compressive Strength, Lb. per Sq.In., 28 Days	Mixing Water, Per Cent. by Weight	*w/c	Density	Flowability, 3 x 6 In. Slump, In.	Compressive Strength, Lb. per Sq.In. 28 Days
1	5.40	15.2	11.50	0.830	0.747	1¼	2350	11.32	0.830	0.758	1⅜	2590
2	5.40	3.2	13.16	0.830	0.719	3	1830	11.09	0.699	0.740	⅛	2380
3	5.40	7.4	11.82	0.830	0 749	2½	1810	10.72	0.752	0.758	¼	3030
4	5.40	14.0	11.00	0.830	0.766	3¼	2490	11.23	0.848	0.755	1⅛	2700
5	5.40	11.7	11.06	0.830	0.764	3	2230	10.32	0.776	0.771	⅞	3160
6	5.40	6.6	11.73	0.830	0.762	3¾	2305	10.60	0.748	0.764	⅞	3460
7	5.40	5.9	11.81	0.830	0.751	3¾	1930	10.13	0.713	0.758	¾	3410
8	5.40	4.0	12.13	0.830	0.739	3	1870	10.52	0.719	0.754	⅝	3210
9	5.26	11.6	11.42	0.830	0.758	2¾	2645	10.52	0.765	0.770	⅞	3220

$* \frac{w}{c} = \frac{\text{volume mixing water}}{\text{volume cement}}$

† Judged by eye and flow when heaped and shaken, checked by cylinder slump test; probably not so exact as later flowability determinations.

up of an aggregate glued together with cement paste. In view of the results shown in Table II it would seem to be more accurate to consider a concrete as being made up of a relatively small quantity of neat cement paste separated and diffused throughout the mass of a large volume of inert adulterant, which results in economy at the expense of strength.

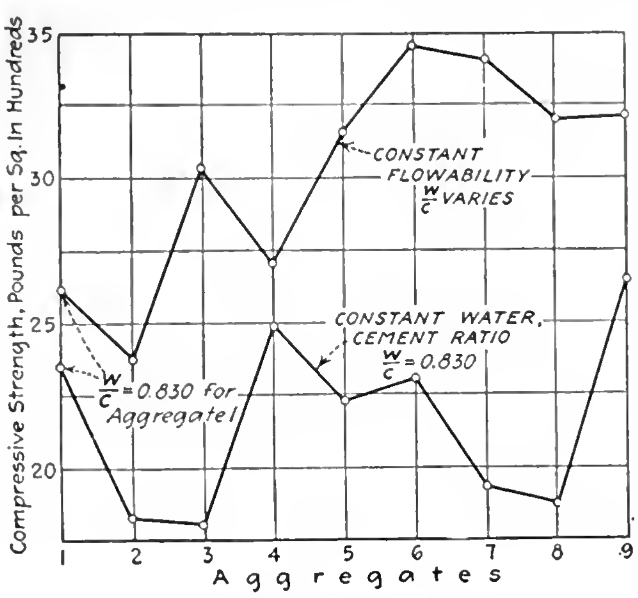


FIG. 3. CONCRETES WITH AGGREGATES OF SAME FINENESS MODULUS
Showing the variation in compressive strength with constant water-cement ratio and also the same aggregates with flowability constant. (See Table IV.)

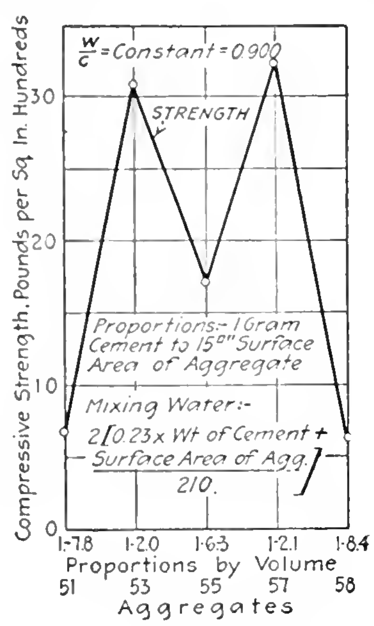


FIG. 4. STRENGTH OF MORTARS PROPORTIONED BY THE SURFACE AGGREGATE METHOD
(See Table V)

In Table III (graphically in Fig. 2) are shown results of tests made by combining one part cement to three parts of aggregates of widely varying granular composition. In one case the water-cement ratio was kept constant, and in the second group the water content was varied to give mixtures having constant flowability. The main points to be noted in this series of tests may be stated as follows: There appears to be little relation between surface area of the aggregate and compressive strength, and with constant water-cement ratio, compressive strength is not constant but varies greatly for the different aggregates when combined in the proportion of one part cement to three parts aggregate.

In the tests shown in Table IV (graphically in Fig. 3) all aggregates have the same fineness modulus, 5.40, with the exception of No. 9, which has 5.26 for its modulus. One part of cement was combined in every case with three parts of aggregate by volume. In one set the water-cement ratio was maintained constant ($w/c = 0.830$) and in the second the quantity of mixing water was varied to give constant flowability. With w/c constant, the flowabilities were found to vary more than is indicated by the results given by the slump test. This was apparent under the trowel and to the eye at the time the test pieces were molded, and was later confirmed when the series was duplicated with flowability constant.

It is seen that with w/c constant there was not only considerable variation in flowability but also a marked difference in compressive strength. Aggregates Nos. 3, 5, 6, 7 and 8 showed large increases in compressive strength when w/c was varied to give equal flowability as compared with No. 1, which was used as the base.

Increase in mixing water generally results in lower strength, but the magnitude of the change in strength varies for each aggregate.

Briefly, there is no apparent relation between surface area of aggregate and strength; also flowabilities and strength were not found constant for a constant w/c.

The series of tests shown in Table V (Fig. 4) was planned to meet requirements of the surface-area method of proportioning. As noted in the table, the actual proportions varied from 1 : 2.0 to 1 : 8.4 by volume, due to the use of 1 g. of cement for every 15 sq.in. of surface area. As for the aggregates shown in the preceding tables, the surface-area calculation is based on the assumption that the particles are spheres and

TABLE V. TESTS OF MORTARS PROPORTIONED BY THE "SURFACE AREA" METHOD
(See Fig. 4)

Proportions—1 gram cement to 15 sq.in. surface area of aggregate;

$$\text{Mixing water} = 2\left(.23 \times \text{Weight of Cement} + \frac{\text{Total surface area of aggregate}}{210}\right)$$

Results average of two 2-in. cubes at 6 days, three 2-in. cubes at 28 days stored in water

				Mixing Water					Compressive Strength Lb. per Sq.In.	
Aggregate Number	Grams Aggregate	Total Surface Area, Sq.In.	Weight Cement Grs.	c.c.	Per Cent. by Weight	* $\frac{w}{c}$	Proportion by Volume	Density	6 Days	28 Days
51	1200	2090	140	84	6.28	0.900	1:7.84	0.686	535	680
53	1200	6920	470	282	16.90	0.900	1:2.00	0.692	1685	3085
55	1200	2540	169	102	7.45	0.900	1:6.30	0.740	1010	1720
57	1200	6700	448	270	16.40	0.900	1:2.13	0 696	1755	3230
58	1200	1980	132	80	6.01	0 900	1:8.36	0.675	510	635

$* \frac{w}{c} = \frac{\text{volume mixing water}}{\text{volume cement}}$

TABLE VI CONCRETES MADE WITH POTOMAC RIVER AGGREGATES HAVING THE SAME FINENESS MODULUS

(See Fig. 5)

Figures in parentheses show corresponding values for Elgin aggregate as given in Table 2, Bulletin 1, Lewis Institute

Showing the variation in compressive strength and flowability with constant water-cement ratio (w/c constant)

Results, average of five 6 x 12-in. cylinders stored in damp closet
Proportions, 1 part cement to 5 parts aggregate by volume

Aggregate	Fineness Modulus	Mixing Water: Per Cent. by Weight	Mixing Water: * w/c	Flowability: 6 x 12-In. Cyl. Slump, In.	Flowability: Vibrating Plate	Density	Surface Area, Sq. In., Gram Cement	Compressive Strength, Lb. per Sq.In. 28 Days
40	6.04	8.10	0.898	7¾	172	0.793	8.0 (8.8)	2315 (2890)
264	6.04	7.51	0.898	†0	116	0.822	19.8 (25.2)	2470 (2580)
270	6.04	7.54	0.898	¼	135	0.818	18.0 (21.5)	2230 (2550)
271	6.04	7.98	0.898	8¼	180	0.812	10.1 (10.0)	1820 (2710)
274	6.04	7.26	0.898	0	131	0.836	22.0 (31.3)	1760 (2440)
276	6.04	8.32	0.898	0	155	0.798	5.6 (5.6)	1880 (2780)
278	6.04	8.03	0.898	¼	170	0.801	7.1 (7.0)	1910 (2750)
280	6.04	7.61	0.898	†0	135	0.818	19.7 (19.7)	2610 (2780)

$^*\frac{w}{c} = \frac{\text{volume mixing water}}{\text{volume cement}}$

† Cylinder picked up in hands without losing shape and carried back to mixer.

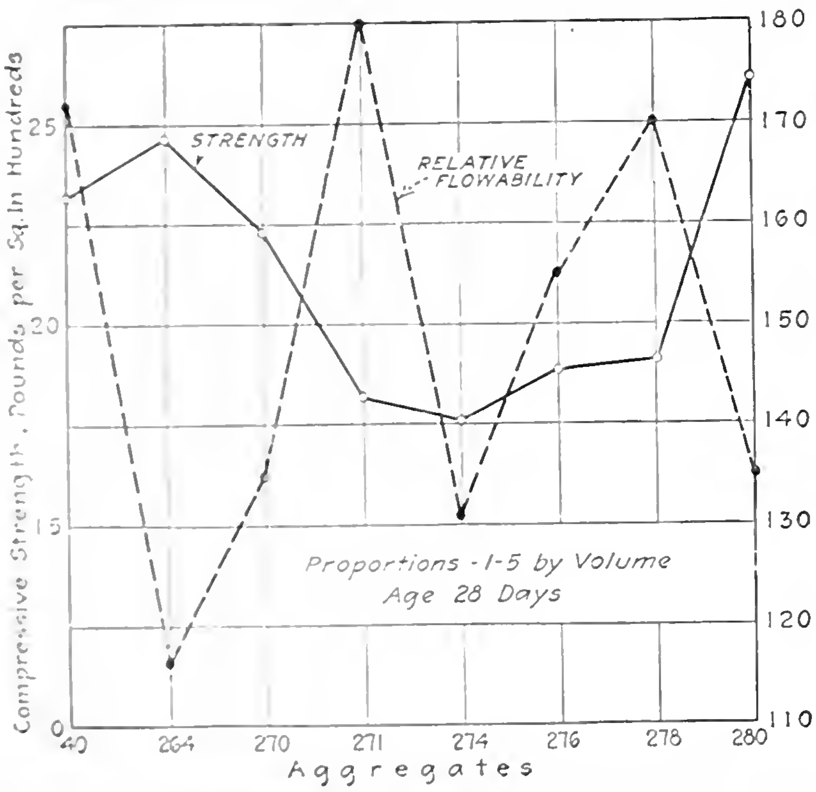


FIG. 5. CONCRETES MADE WITH AGGREGATES HAVING THE SAME FINENESS MODULUS

Showing variation in compressive strength and flowability with constant water-cement ratio (See Table VI)

that their average diameter is the mean of the openings in the sieve passed through, and retained on. Values obtained are only approximate, but are probably proportional to the true areas, which it is impossible to determine.

The formula proposed for determining the quantity of mixing water furnishes far too small an amount of water to produce a workable mix for all aggregates. In these tests the quantity was doubled, and those aggregates having small surface areas were too dry, and those with large surface areas entirely too wet.

Water Formula Is Inadequate

The inadequacy of the water formula is shown by comparing the amount which it would specify for a 1 : 3 standard sand mortar with the quantity which is ordinarily used in the laboratory.

Percentage for normal consistency = 24.

Surface area standard Ottawa sand = 400 sq.in. per 100 grams.

Assume batch of 500 grams cement and 1500 grams sand.

By "surface-area" water formula

$$\text{Water} = 0.24 \times 500 + \frac{6000}{210} = 148.6 \text{ cc. or } 7.42$$

per cent.

The United States Government specification for portland cement specifies 10.5% of mixing water for a cement having a normal consistency of 24. Water = 10.5 × 2000 = 210 cubic centimeters.

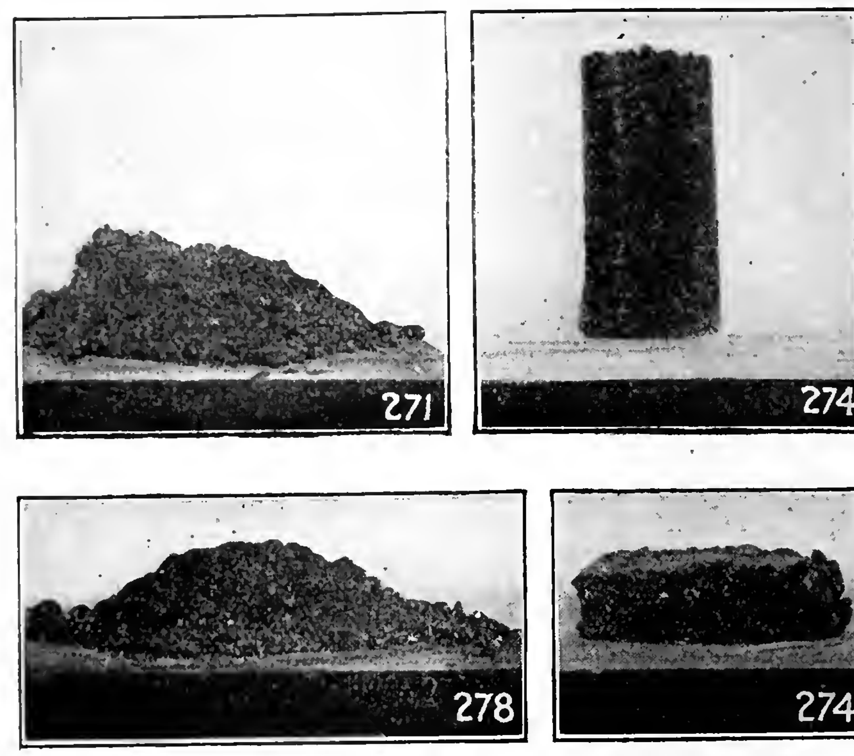


FIG. 6. RESULTS OF SLUMP AND FLOWABILITY TESTS OF THREE AGGREGATES. NOTED IN TABLE VI

Upper views show conditions after completing the cylinder slump tests; lower two views show specimens after the flowability tests

The "surface-area" normal-consistency mortar would therefore contain 61.4 less grams of water for a batch of 2000 grams.

It was foreseen that strict adherence to this formula was impracticable, and all calculated water quantities were therefore multiplied by 2, resulting in a constant water-cement ratio of 0.900. A very large proportion of the advantage which should have been obtained in the rich mixtures was thrown away by the excessive quantity of mixing water. It is an admitted fact that the granular composition of an aggregate is reflected by the amount of water required to produce a concrete of the same flowability, but, as shown previously, since the water-cement ratio is constant, no consideration is given to variation in the amount of surface area. The formula is equivalent to one which bases the water required on cement content only.

In view of these tests and the variation in water required for different proportions, or for aggregates varying widely in granular composition in the same proportion, it is difficult to see how by any chance a 1 : 2 could be compared with a 1 : 8 combination as to strength, as stated in Lewis Institute Bulletin No. 1, if proper consideration is given to flowability, or even if *w/c* is kept constant. Here the widest possible range in flowability between the 1 : 2 and 1 : 8 proportions was observed with *w/c* constant. Modifying the mixtures to obtain equal flowabilities would have resulted in much greater differences in strengths than those obtained.

The tests included in Table VI (Fig. 5) are duplications of the concretes shown in Table 2, Bulletin No. 1, Lewis Institute, so far as duplication can be made in another laboratory. A part of this Table 2 is shown in parentheses. Instead of Elgin, Ill., aggregate, the local

Potomac River sand and gravel were used. The material was separated by screening on the various sieves and then recombined in the percentages shown in this table so as to have the same fineness modulus of 6.04.

Using cement from the same lot with eight of these aggregates numbered in Table VII to correspond with the numbers in Lewis Institute Table 2, batches of one part cement to five parts of aggregate were mixed in a batch mixer with the quantity of water specified by the formula for a 1: 5 proportion, modulus 6.04, and molded into 6 x 12-in. cylinders. The 1.10% consistency was used, giving the same ratio for all aggregates with a value for *w/c* of 0.898. Five 6 x 12-in. cylinders were tested at the 28-day period with the results shown in Table VI.

The slight difference shown for square inches of surface area per gram of cement, between the figures given in the accompanying Table VI and Table 2 in Lewis Institute Bulletin No. 1, are probably due to our regarding the surface area of aggregate passing the 100-mesh sieve as equal to that of the particles retained, as was done by Mr. Edwards in his report.

The results shown for the slump test and the flowability test indicate the wide variation in flowability. After the slump test was made with aggregates 264 and 280 and no slump was found, the masses of concrete were picked up by hand and carried back to the mixer without losing their shape. Aggregates 40 and 271 were of a consistency suitable for reinforced-concrete construction. Aggregate 278 resulted in what would be termed a harsh-working concrete, apparently being too dry as measured by the cylinder slump test, but showing very good flowing qualities as indicated by the flowability test.

In Fig. 6 are photographs of the cylinder slump test on batches made with aggregates 271 and 274, respectively, showing the marked difference in consistency as shown by this test. There are also photographs of the vibrating plate test for flowability on concretes made with aggregates 278 and 274. The difference in the spread caused by the vibration of the plate can be plainly seen.

The results of Table VI fully confirm the results obtained for constant water-cement ratio as shown in Table IV both as to differences in flowabilities and strengths. The results also confirm the statement in Lewis Institute Bulletin No. 1 that there appears to be no direct relation between the surface area of the aggregate and the compressive strength of the concrete.

The tests here reported indicate that the discrepancy noted between our results and the results obtained by Professor Abrams and Mr. Edwards is due fundamentally to wide differences in the consistencies, or flowabilities, of the concrete mixtures. While we have found large variations in the strengths of different concretes in which the water-cement ratio is maintained constant, this is of secondary importance in view of the fact that the concretes as made were not of comparable consistencies.

In view of the potent influence of a small amount of mixing water on the strength of concrete, the proper testing of concrete in the laboratory requires that the desired consistency, or workability, or plasticity, or flowability (all here meaning the same thing) shall be definitely arrived at. The need for an apparatus capable of measuring this property with considerable accuracy now seems apparent, and we believe the development of such an apparatus is worthy of the concentrated effort of all who are engaged in the study and testing of concrete.

Conclusion

In the field "flowability" is a fundamental requirement in order that economy in construction and good workmanship may result. Increased flowability may be obtained by the use of more mixing water alone, or by the use of more cement or fine aggregate, which, in turn, will require an even larger quantity of water. Since flowability is obtained by the use of more water, which in turn tends to lower compressive strength, it is of the greatest importance that concretes as tested in the laboratory have the same flowabilities, otherwise they are not comparable. On any work there is some minimum condition of flowability which must be obtained, and an endeavor should be made to attain this same condition in the laboratory so far as possible.

That this same condition of flowability cannot be obtained if the water-cement ratio is to be kept constant is the basic criticism which we have to offer to the two theories under discussion. If *w/c* is kept constant, even for a given ratio of cement to aggregate, then the condition of equal flowability must be disregarded.

If, as we believe, flowability is a fundamental consideration, then *w/c* is only an incidental relation, which is the resultant of the more important factors, cement, aggregate, and flowability, and, in itself, is of no direct value to the engineer in proportioning concrete materials. The *w/c* relation considers only water and cement. From the results of the foregoing tests it is apparent that (1) flowability, (2) cement, and (3) aggregate are the three important factors to be considered in the proportioning of concrete mixtures. The proper flowability is essential for the economical handling and placing of the material; it is desirable to reduce the quantity of cement to a minimum for economy; and the choice of aggregate is usually limited, but can often be improved somewhat in quality at slight expense. Water, while an essential, is dependent entirely upon the above three factors.

Any method of proportioning concrete which can be generally applied must therefore take these variable factors into consideration, and, whatever the brand or quantity of cement, whatever the type, physical condition, or quantity of aggregate, flowability of the concrete must be considered, first and last, as of fundamental importance.

Aggregates Too Coarse in Bureau of Standards Tests

Most of the Aggregates Are of Unusual Gradings Which Were Advised Against in Use of Fineness-Modulus Method

By Duff A. Abrams

Professor in Charge of the Structural Materials Research Laboratory, Lewis Institute, Chicago

IN THE following discussion of the tests by Messrs. Williams and Davis, little will be said with reference to the surface-area method of dealing with concrete mixtures proposed by Captain Edwards. My views on this subject, together with new test data, are to be presented in a later communication to *Engineering News-Record*. This discussion will refer only to such por-

tions of the Bureau of Standards report which deal with the water-ratio fineness modulus method of designing concrete mixtures which was developed in this laboratory.

The authors state that "studies now under way in the Bureau of Standards indicate that neither of these two methods insures what is most necessary in practical concrete work; that is, a proper flowability or workability." I do not see that there is any necessary relation between these methods and the flowability of the concrete. Any desired degree of flowability can be secured by methods which are well known to every practical concrete man: that is, by using more water, richer mixtures, different grading of aggregates, other methods of handling, or some combinations of these factors. What we have attempted to do is to bring out the basic principles of concrete mixtures in a way that would eliminate "rule-of-thumb" methods of dealing with materials and proportions, and to enable the engineer to "design" a concrete mixture and estimate the influence of given changes in the composition of the concrete.

It is true that the method proposed by Captain Edwards can be reduced to the relation between the water-ratio and the strength of concrete. However, there is a very important difference between the surface-area method and our own in that, according to my views, Captain Edwards' method does not give the proper quantity of water as between mixtures of different makeup. The algebraic proof given by the authors establishes nothing more than what Captain Edwards originally assumed; namely, that the strength of the concrete is constant for a constant surface area of aggregate, so long as the quantity of cement and water are based on surface area. It will be pointed out in my discussion of Captain Edwards' report that the uniform strength obtained in his sand-mortar tests was due to the fact that a constant water-ratio was used.

The importance of workability, or flowability, as the authors have termed it, has been fully realized and pointed out in all of the reports emanating from this laboratory. I agree that the slump test which we have used is not ideal, but I fail to see how the vibrating-plate method can be any improvement. It is different; but there must be numerous difficulties in the way of standardizing such a determination, and it would not lend itself to the requirements of field use as readily as the slump test on 6 x 12-in. cylinders. The authors have used the 3 x 6-in. cylinder in making most of their slump tests. It would not be expected, from our experience, that this size of cylinder would give dependable results. Apparently, the slump values are from a single determination. Not fewer than five tests should be used for this purpose when endeavoring to establish principles.

Tables Discussed in Detail

A brief discussion will be given of the tests in each of the tables. It is notable that in most of the tables the mixtures and gradings of aggregates are quite unusual and do not at all represent the type of concrete with which the engineer has to deal. It will be shown that in these tests the authors have disregarded two essential considerations pointed out repeatedly in our Bulletin No. 1, "Design of Concrete Mixtures," as follows: (1) The grading of the aggregate should not be too coarse for the quantity of cement used; (2) the concrete must be plastic. These requirements are mentioned by the Bureau of Standards' engineers, but they were entirely overlooked in planning the tests and making the specimens.

There is a great diversity in the form and size of test pieces used, consequently it is impossible to make any cross-comparisons, but each table must be studied separately. The results are, in general, the average of two or three specimens made from a single batch. In Table VI, five specimens were made. Our experience has shown that this method will not give concordant results. Practically all of our experimental work is based on the results of from 5 to 10 cylinders, each made from a separate batch on different days. Two to 5 specimens *from a single batch* are little more dependable than a single specimen. It is the *batches* that vary more than the specimens in a batch. This emphasizes the necessity of mixing as many batches as possible. In many instances the specimens used were of small size—probably too small to give good results with the size of aggregate used.

The concretes in Table II were of a freakish nature in four respects: (1) Very rich mixtures were used; (2) the aggregates were of sizes that are never used in concrete; (3) in the leaner mixtures the grading of the aggregate was too coarse for the quantity of cement; (4) the last two mixtures were too dry for proper workability. The coarsest gradings which are permissible with a given quantity of cement are given in Table 3 and Fig. 5 of our Bulletin No. 1. It is there shown that for a 1:2 mix with aggregate graded up to $\frac{3}{4}$ in. the highest permissible fineness modulus is 5.90, whereas the authors use 7.00. The water-ratio for the two leaner mixtures in this table is about 70% of that required in accordance with our water formula. If we eliminate the last two tests in this table, we find that the remaining four results of the standard sand mortars gave a mean variation from the average of 4.4 and 5.1% at 7 and 28 days, respectively. The corresponding values for the $\frac{3}{4}$-in. gravel are about 12 and 16%. The standard sand tests are as uniform as would be expected from the number of specimens made and the extremely rich mixtures used. However, the two groups of tests are not consistent in themselves. It is not clear why the gravel tests should give results entirely different from the standard sand tests, unless it can be attributed to the large size of the aggregate used in the 3 x 6-in. cylinders, or to some other variation in method.

In Table III we find again that the principles of using plastic mixtures and avoiding too coarse aggregates for the quantity of cement used have been entirely disregarded. All but the first test in the "constant water ratio" group are too dry, as shown in Table A herewith.

TABLE A. TESTS WITH CONSTANT WATER RATIO IN TABLE III OF WILLIAMS AND DAVIS PAPER

Aggregate No.	Fineness Modulus Used	Fineness Modulus Allowed	Water Ratio Used	Water Ratio Required	Remarks
61	6.00	4.70	0.62	0.60	Much too coarse
62	4.60	4.70	0.62	0.69	Little dry
63	3.20	3.10	0.62	0.79	Little too coarse; too dry
64	4.00	4.30	0.62	0.73	Dry
65	2.00	1.85	0.62	0.94	Little coarse; very dry
66	4.00	2.50	0.62	0.73	Much too coarse; too dry

The fineness modulus "allowed" is taken from our Bulletin No. 1. The water-ratio required was calculated from the water formula used in our tests. Only *one mixture* (62) out of the entire group of six can be considered normal concrete, and even in this instance the grading of the aggregate is freakish.

It will be noted that the water-ratios used under the "constant-flowability" tests show almost a constant increase over the quantities given by our water formula, which verifies the results of our slump tests. Since all of the mixes in this group are plastic, we would expect the strength to be reflected by the water-ratio, had it not been that four of the aggregate gradings were too coarse. The remaining two tests (62 and 64) show a satisfactory agreement between the water-ratio and strength. All of the aggregates in Table III were of a grading which would be termed "freakish." In No. 61 there is no material finer than the No. 8 sieve; in 62, 63 and 64 there is no material finer than the 48 sieve. In 65 a uniform size of aggregate is used, and in 66 practically all of the material is between the 14 and 28 sieves. These features are in addition to the consideration of being too coarse for the quantity of cement used. The conclusions of the authors based on these tests are entirely erroneous, since they failed to take into account the obvious limitations in the composition of the concrete.

In Table IV we find that two aggregate gradings are decidedly too coarse for the quantity of cement used, and six of the remainder are so near the border line that slight variations in manipulation of the concrete might make them too coarse. Aggregates 7 and 8 are decidedly freakish in that all material below the 48- or 28-mesh sieve is omitted. This may account for the low strengths, although in general such a result would not be expected from these gradings. If we consider the strengths secured from aggregates 1, 4, 5, 6 and 9, (which are the only ones approaching normal concrete mixtures) it will be found that the variation in strength is less than 5%, whereas in the same table the variation of two tests using the same aggregate (1) and same water-ratio is 10%. In other words, the tests which the authors have offered as proving the incorrectness of the water-ratio theory give only one-half the variation found in duplicate tests in the same group. Aggregate 4 gives practically duplicate tests which vary 8%. It will be noted also that the tests given for "constant flowability" show a greater variation in slump than do the tests under "constant water-ratio."

The tests reported in Table V are the average of two or three 2-in. cubes. In this group we find that concretes from aggregates 51, 55 and 58 are too coarse for the quantity of cement used, and too dry. The fineness-modulus value used throughout is 4.55, whereas our Bulletin No. 1 points out that the maximum value which may be used with the grading and mixture used with aggregate 51 gives a fineness modulus of 3.50; for aggregate 55, 3.10 and for aggregate 58, 3.60. In other words, there are only two tests out of the group that can be considered as giving usable strength results; both of these are approximately 1: 2 mix. These two mixes having the same water-ratio give uniform strength, in spite of the wide variation in grading of the aggregate, as would be expected. The conclusions of the authors, based on these tests, are obviously erroneous.

Laboratory Variation Inexplicable

I am unable to offer an explanation for the strengths found by the authors in their Table VI, in which they have duplicated eight of the gradings used in Table 2 of our bulletin. Our tests gave uniform strengths, whereas the tests made by the Bureau of Standards are quite variable. It is possible the explanation may be found in the method of mixing the concrete. While the details of the mixing are not given, it seems probable that a batch of about 1 cu.ft. was mixed in a machine having a capacity of 5 or 6 cu.ft. Considerable experience in our own laboratory has indicated that single batches of machine-mixed concrete are likely to be erratic. This would be especially true of fractional batches which were probably used in this case. [The Bureau of Standards tests in Table VI were made from concrete taken from a full machine batch. The smaller specimens in their other tables were hand-mixed.—Editor.] It should be pointed out that the gradings used in our tests were somewhat too coarse. Subsequent experiments led us to recommend the use of 5.80 fineness modulus for the size of aggregate and mix used in this group. A slight variation in the methods of manipulation might throw these mixtures into the region where they would be too coarse.

The authors have misunderstood the statement in our Bulletin No. 1 concerning the comparison between 1: 9 and 1: 2 mix so far as strength is concerned. My purpose in making this comparison was to bring out the fact that the strength of the concrete has no necessary relation to the quantity of cement used. Our tests did not give uniform workability; on the other hand, the workability was very different. Nor was the aggregate of the same size or grading. The tests did, however, bring out emphatically the essential dependence of strength on the water-ratio, which is quite contrary to the statements found in most of the textbooks, to the effect that the strength of the concrete is proportional to the amount of cement used.

It will be of interest to study the mixtures used with reference to the gradings of aggregates and consistency of concrete. Table B herewith gives the result of such a study.

TABLE B. COMPARISON OF MIXTURES IN TABLES II TO V, WILLIAMS AND DAVIS PAPER

Table	Number of Mixes Falling in Each Group: In Table	Too Coarse	Too Dry	Too Coarse and too Dry	Freak: Mix	Freak: Grading
II	12	4	4	4	8	12
III	12	8	5	3	? (1-3)	12
IV	18	4	0	0	? (1-3)	6
V	5	3	3	3	......	4
Total	47	19	12	10	......	34

The tests in Table VI are omitted from this discussion, since the aggregates were duplicates of certain gradings used in our tests. Over 40% of the aggregates were too coarse for the quantity of cement used; 26% of the mixes were too dry; 21% were both too coarse and too dry; 72% of the aggregates were of "freakish" grading.

Freak mixtures and gradings should not give results essentially at variance with fundamental principles. There is no reason to expect that mixes which are much too dry for plasticity will follow definite laws. Such tests should not be cited as establishing the errors of principles which are based on thousands of tests of concretes of normal composition. It has been pointed out that in the majority of instances the grading of the aggregate was too coarse for the quantity of cement used, and in a large number of instances the mixtures were too dry. In some instances concrete suffered from both of these ailments. In view of the shortcomings mentioned above, the tests reported by the Bureau of Standards cannot be interpreted as a serious criticism of the methods of design of concrete mixtures developed by this laboratory.

Large Construction Companies Shun Road Work

Politics, Narrow Business Practices and Petty Contract Restrictions Are Objectionable to Construction Managers of Large Affairs

By C. S. Hill
Associate Editor, "Engineering News-Record"

Roadbuilding is now the largest single task before the construction industry of the United States. Unless the leaders of this industry as well as the rank and file of contractors who have for the most part, and also most capably, performed the lesser tasks of preceding road programs, shall array themselves with Federal, state and community officials to advance this task, its accomplishment will be retarded. How large construction organizations regard road construction as an opportunity for employment is, therefore, a question of vital importance. The answer, as it appears after careful inquiry and conferences with directors of such organizations, is presented in the article and discussion which follow—Editor.

To EXPEDITE the enormous program of construction which confronts them, public road officials need to enlist the services of large construction organizations—those organizations which heretofore have perceived nothing that offered profitable occupation of their resources in the small isolated-contract method of doing road work. A favorable conjunction of circumstances has placed these contractors for a time at the call of road officials. Large hydraulic developments and heavy railway, bridge and foundation work have been stopped. Until they start again, contractors who have looked to them for employment will turn to road work. It depends upon the acumen of road officials whether they continue in road work. Candidly, the likelihood that they will is not too promising.

Large contracting organizations cannot be permanently interested in road construction, unless they can be assured contracts of sufficient magnitude to command their full resources, and unless they be accorded the broadminded consideration in road work to which they have been accustomed in work for private corporations. With these inducements lacking, those large contractors who have for the moment exhibited an interest in road construction will withdraw to their old lines of enterprise as soon as bridge, railway, foundation work and kindred kinds of heavy construction resume their pre-war activity.

Character of Business Relationship

The importance of large-mileage road contracts has been fully emphasized in *Engineering News-Record* of Mar. 13, 1919, p. 503, and of Apr. 24, 1919, p. 831. Little has been done anywhere, however, toward defining the new conditions which must be created in business relationship between contractors and highway officials. Diplomacy and, perhaps, to some extent, delicacy, have kept contractors from speaking frankly. We propose to do so here, but first it is desirable to understand the character of the business relationship between the large construction companies and their private-works clients.

Contractors who have grown great through successful construction for private industries are considered and treated by those interests as experts in construction and as men of affairs. The master-and-servant relationship has disappeared, and in its place has grown something akin to the relationship of partners in a mutual enterprise. A certain flexibility is a tacitly recognized factor of any formal agreement into which owner and contractor enter. Cognizance is given by both to possibilities which may readily arise and which may change the complexion of an agreement, and both stand prepared to concede modifications in prices and requirements where they are demanded by fair dealing and mutual justice. Honesty of intention is conceded by both parties to the agreement, and meticulous prescriptions to prevent either from overreaching the other are largely discarded.

These statements do not picture an imaginary relationship; it exists in its fullest measure between many well known contractors and their clients. All unusually successful contractors enjoy this relationship in great measure. That they do, and that the advantage is real, is evidenced by the fact that these contractors will generally bid lower on private than they will on public work.

Large Organizations Not Attracted

Stress is laid on this relationship between the large construction organization and its private-works clients, because it has an important bearing on the task of enlisting the service of these organizations in the road-construction industry. They are not greatly attracted by the opportunity as they appraise it. Some of the reasons, as given by contractors, can be briefed as follows:

Road construction has brought too many hardships upon contracting in the past few years. It has been directed with too little active sympathy with the contractor's difficulties.

Too great willingness has been shown to take advantage, at the expense of the contractor, of a rising price and wage market.

The practice of calling for bids merely to try out the market, with no intention of awarding contracts, is too common.

There is too common neglect to state them when limiting prices will rule.

Too great stress has been laid upon possibilities of dishonesty.

Bludgeon clauses are too many in road specifications.

Low prices often overshadow contracting experience and financial ability.

Too many road departments have attained a reputation for "breaking" contractors.

All of these accusations can be proved by example. There are too many to permit full elaboration of each, but it is worth while to consider a few and show how the large contracting organization, whose entry into road construction is being considered, is reacting to their influence.

Bludgeon clauses are perhaps no more common in road specifications than they are in the specifications for other pubic works, but they are frequent. That such a meaning of these clauses is intended will be denied. Consider, however, this clause: "Portions of the pavement showing voids in the concrete after finishing and removal of the side forms shall be rejected." Beyond

doubt the engineers who wrote this clause intend a fair and reasonable judgment on porous spots in the pavement edge. What, however, was the practical effect of the clause on the large construction organizations which bid on this specification? One firm did this: It assumed that existence of a porous spot entailed the removal of a day's run and made its estimates in accordance with this assumption. More broadly, the effect is this: Contractors who have built up a great business by honest workmanship, and who are accustomed to have their honesty conceded by managers of large enterprises, resent such clauses as indicative of an assumed necessity to prevent cheating, and regard them as convenient weapons in the hands of engineers and inspectors for holding up the work and imposing needless penalties.

Lowest-Price Slavery

Another reason why the large contracting organization regards road work with indifference when other work is to be had is that price has too great weight with the public roads official. If any bidder's price is right and his bonds are unquestionable, he obtains the work, no matter how unfavorably he may compare with the large organization in reliability, equipment, resources and all else which ordinarily are held to be assurance of a successful business transaction. No doubt, the road official is largely the slave of the law in this matter, but this does not alter the facts nor their effect on the large contractor. He demands a fair profit for his work because he expects to put all his resources behind his promise that the purchaser shall get what he has asked for in quality and speed of construction. This guarantee he considers worth paying for, and he has small patience with the kind of client who shops about for the lowest bidder and trusts to the security of his legal hold on the bidder to obtain acceptable work.

It is, perhaps, not a generous thought, but the large contractor wonders if the road official is not just now inquiring whether, in some way, he cannot unload his own burden of rising prices on the contractor. A great many road projects for which the people have appropriated money were predicated on pre-war prices. Now the road officials find that they cannot deliver the mileages promised. Their attacks on the price levels of materials have failed to obtain reductions. Shopping about for low bids is a possible way out of the dilemma in which they have been involved. Contractors are free to impute to the road official this disposition to shift his burden, and the thought does not add inducement to road contracting as an opportunity for the large construction organization to extend its business.

Large construction firms, when they make bids, demand reasonable assurance that it has been definitely decided to award contracts and to award them promptly. An occurrance of recent date illustrates what happens too often. Bids were called for and received on a job amounting to about $150,000. A well known, large company was the low bidder and expected the award of the work. Later it was learned that the decision to proceed with the improvement had not been definite, and, when the prices were seen, the road officials concluded that they "would not go ahead at present." In other cases limiting prices are determined but are not published in advance. The reaction of large construction companies to experiences of this kind is fairly indicated by one which asserted that it was "becoming disgusted with the whole road game."

Most of the large construction companies which contemplate embarking on road construction expect to equip themselves on a large scale. A season's work will not pay them for the investment which they contemplate; they must see ahead a number of years of activity. To be specific, one large organization in estimating for a recent letting figured upon spreading its original plant outlay over five years. It could not otherwise have named a price which would have had a chance of being accepted. Contractors who plan in this far-sighted manner are the kind wanted in road contracting, but they frankly assert that they find little encouragement, in the attitude of road officials, for their broad planning. Road-construction plant is special plant. Few of its units are stock equipment of the general contractor who does railroad or heavy industrial work, and few of them can later be used in his general work. He must see the opportunity for continuous, profitable road contracting, or he cannot afford to invest in the special plant required.

Conclusion

Demonstration need not be carried further. If highway officials wish to enlist large general contractors in road construction, they can do so. Lacking normal outlets for action, these contractors are seeking opportunities in road construction. They will, for the moment, submit to the handicaps of road contracting. But if the road official wishes to retain these large organizations among the contractors at his command in prosecuting his large construction program, he must clear away the indictment which they have drawn against his methods. Let us be clear at this point. These large construction companies are not supplicating the road official to change his methods in their behalf. Indeed, they are, personally, very little concerned about his reform. Until he reforms, however, they shun extensive business transactions with him.

Suspected anxiety on the part of large contracting organizations to embark in road construction cannot be capitalized by road officials. There is no such anxiety. These organizations regard road construction merely as a possible but doubtful field. On the other hand, in the opinion of the contractors interviewed, the road official can proceed with success toward enlisting these organizations in road construction if he will: (1) Decide definitely before bids are asked that contracts are to be awarded, and then make awards promptly; (2) give weight to the contractor's resources and reputation for efficient work, instead of letting low price control; (3) adopt the practice of private industries in dealing with the contractor on a fair-price, good-construction basis, and (4) eradicate the practice of binding the contractor to honesty with meticulous, punitive restrictions, readily capable of being used unfairly against the contractor.

Designers of Louisville Lift-Bridge Machinery

Through oversight, the article in *Engineering News-Record*, May 22, 1919, p. 1007, describing the design of the new superstructure of the Louisville bridge, did not credit the firm of Waddell & Son, Inc., of Kansas City, Mo., and New York City, with the design of the towers and machinery of the 260-ft. lift span This firm acted as consulting engineers to the contractor.

Reline Mine Shaft on Steep Slope With Concrete

A Combination of Monolithic, Precast and Cement-Gun Methods Used in Old Shaft on Vermilion Iron Range

THE first steel-lined shaft sunk on the Vermilion iron range in Minnesota is being relined with monolithic concrete and precast-concrete lumber. This is the 1200-ft. Pioneer B shaft at Ely, Minn., which is on a slope of 70 degrees.

The sets forming the horizontal sections between which the vertical lath are placed were of 30-lb. steel rails, the lath being timber. Between some of the sets 1¼-in. wire cable was used, spaced on 6-in. centers, behind which timber was placed. On account of considerable wear and scaling of the rails, it was decided to secure a more rigid shaft by incasing the rails in concrete and putting in new steel dividers. The walls of the shaft are very irregular, so that the new concrete ranges in thickness from 4 to 24 inches.

For about 50 ft. from the top of the shaft, 3 x 10-in. concrete lath were placed between the sets, which are composed of 6-in. steel H-beams and are spaced 5 ft. on centers. Steel angles riveted on the inside of the sets hold the lath in position. Below this, to the 950-ft. level, the spacing of the sets is 4 ft., and the lining will be monolithic concrete. From the 1200-ft. level to the 950-ft. level, precast timbering was placed similar to that used for the first 50 ft. of the shaft.

Monolithic Concreting Continuous

Monolithic concreting was started from the 950-ft. level Oct. 1, 1917, and proceeded at the rate of about 50 ft. a week. Concrete is mixed in proportions of 1:5, the local, bank-run aggregate containing about 50% each of sand and stone. As much of the work was done in winter, a wooden shed was built, 28 x 112 ft. and 12 ft. high. The aggregate is brought in by teams, and men with wheelbarrows then carry the sand and stone up a runway to a ¾-yd. mixer.

In order to make the work in the shaft continuous, a 1-yd. auxiliary hopper for concrete has been constructed at one side of the head of the shaft. The wooden box on the mine skip is easily able to hold 1 cu.yd. When it comes to the surface for concrete, the shaft face of the auxiliary hopper is opened by a lever, and the concrete slides into a box. After it is lowered into the shaft, a slide valve covering a hole 8 in. square at the bottom of the box is opened, and the concrete slides into the forms through a flexible 8-in. pipe having sections 4 ft. long.

The upper or hanging side, and the ends or short sides of the shaft, are thoroughly clean, as water is pouring down practically all of the time. With a little cleaning on the bottom side, the walls are ready for concreting. About 75% of the time is required to clean the walls, to fix the forms, place the reinforcement and arrange the bolts needed in the shaft forms. The remaining 25% is used in concreting. After an 8-ft. section is prepared it can be poured in one day. Wire-mesh reinforcement is used on the ends and hanging sides, being cut into 4-ft. lengths and so bent as to come within an inch of the face of the concrete.

In concreting, 12 sets of steel forms are used on the bottom sides, but wood forms are used on the ends and hanging side. These wood forms are being left in place. The sections of steel forms, alternately 3 ft. and 1 ft. high, allow for putting in the dividers, which are built of 3-in. channels, 5-in. H-beams and I-beams being the ladderway and skipway, while a 3-in. channel and I-beam form the dividers between the skipways. These dividers are placed directly above or below the old 30-lb. rail dividers.

An ingenious method is used in moving forms. A tugger hoist is rigged up on a post across the shaft in the ladder and pipe compartment, from which a rope guided by a ring on a trolley runs to a block and then down into the shaft. By the attaching of the end of the rope to hooks in the forms, the latter are easily handled and shifted.

Speed of concreting is limited by the mixer, which handles 8 cu.yd. an hour to the 1000-ft. level. As this is done only part of the day, only one crew is used at the surface, one man dumping raw materials into the mixer, one man handling cement from the stockhouse, three men on wheelbarrows, one man controlling the machine and handling the water.

Three shifts a day of four men each are used in the shaft. All of the men were specially picked for this work, being of a higher grade of intelligence than the usual run of mine laborer.

Steam is obtained from the mine boiler house, and the temperature in the shed is kept during cold weather at about 60°. A bare steam pipe along the wall helped to warm the stone and sand.

The cement-gun system is proposed for places where the hanging or upper side is only a few inches deep, as there is some question whether monolithic concrete of that thickness will adhere to the upper side of the shaft. Up to Jan. 1 the cement-gun had not been used, and for 100 ft. around the 700-ft. level the whole shaft was monolithic. On the bottom side the concrete extends an inch beyond the old steel rails, while on the hanging side and ends it extends ½ in. beyond the steel, giving a solid concrete face on all four sides. Plans for all this work were made in the Duluth office of the Oliver Iron Mining Company.

Comparison of Blows of Dull and Sharp Drill Points

ROCK drill points are the least effective and have the least penetrative results, blow for blow, when they strike the rock with most force and the shock is felt the most. This statement is made by Frank Richards in an article in *Engineering and Mining Journal* of Apr. 26, 1919, p. 735, where the apparent paradox is explained by the fact that with equal imparted energy the dull drill-bit is stopped more quickly than the sharp one. This the writer believes to be the cause of the breaking of many bits. A short abstract of the paper follows:

When impact is figured, the force of the blow struck is proportional to the suddenness with which the propelled mass is arrested. This may be clearly illustrated by the case of a reciprocating piston drill. Assume a drill with a piston 3 in. in diameter and a stroke of 6 in., and that in the working stroke of the piston it is driven the entire distance by an effective air pressure of 50 lb. per square inch. The area of the piston is almost 7 sq.in. As the assumed stroke of the piston is ½ ft., the resulting energy is $7 \times 50 \times \frac{1}{2} = 175$ ft.-lb.

The resistance will, of course, be greater in proportion as the distance in which the force is dissipated is shorter. Thus the resistance required to overcome 175 ft.-lb. of imparted energy would be 6 $\times$ 175, or 1050 lb., say 1000 lb., if the stoppage occurred within a distance of 1 in. Then, 4000 lb. of resistance would be required to stop the movement within $\frac{1}{4}$ in. and 16,000 lb. or eight tons, if within $\frac{1}{16}$ inch.

A penetration of $\frac{1}{16}$ in. approximates rock dri.. cutting conditions. Thus, at the rate of several hundred times a minute eight tons are applied and alternately stopped entirely. The rock strikes the bit with the same force as that with which the bit strikes the rock—the force must be precisely equal in each direction from the point of contact—and the greater the force at any instant with which the bit strikes the rock, the greater also must be the reacting force taken up in internal resistance in the body of the bit. The higher this reacting force the more likely it is that the bit will break.

Limit of Wear Should Be Fixed

Drills must wear, but the limit of permitted wear should be sharply defined, and systematic maintenance of bits in sharp condition should be recognized as the most profitable investment possible in connection with rock-cutting operations. In this connection power-drill sharpeners are to be commended as giving incomparably greater efficiency, as compared with hand sharpening.

The above theory was strikingly illustrated in a recent test, when it was found that the breakage in bits was very high, 10 bits being broken in a day's run. In every case it was found that the broken bits had become so dull as to lose their cutting power. In the next day's run care was taken to change the bit as soon as cuttings ceased to drop regularly from the hole. With this system it was found that no drill bit was broke in the day's run, with the exception of one dull bit which was used as a test and which broke within two minutes.

Highway Transport Engineering—a New Technical Field

Breadth of Training Necessary for the Transport Engineer—Many Problems to Be Solved—Suggested Course of Study

A BREADTH of training far more comprehensive than has been considered essential for many technical branches will be required for the proper equipment of the highway transport engineer, according to Prof. Arthur H. Blanchard, of Columbia University. In dealing with this topic before the annual meeting of the National Highway Traffic Association in New York, he outlined courses of study to be followed in preparing for this profession, linking them up with the problems which must be solved. Having sketched briefly the phenomenal expansion of highway improvement in highway transportation in the United States, and having contrasted the problems met with here with the experience in England, where highway-transport regulation came to a head some years ago, Professor Blanchard continued:

The development of highway transportation creates a demand for men having knowledge of and trained in a new technical field. Fundamentally, highway-transport engineering deals with the science, art, economics and business of the highway transportation of passengers and commodities. Breadth of knowledge is essential, as the highway-transport engineer must, in many fields, deal with social and economic conditions, and must always have before him the fundamentals of sound business methods.

In the opinion of some, highway transport may not be considered as belonging to the field of technical training and education. On sober thought, however, it will be seen that this branch of knowledge comes well within the classic definition of engineering embodied in the royal charter of the Institution of Civil Engineers of Great Britain, which, in part, is as follows: "The art of directing the great sources of power in nature for the use and convenience of man as the means of production and of traffic in states both for external and internal trade."

Comprehensive courses in highway-transport engineering to be offered by educational institutions should include the following basic subjects: Economics, political economy, social science, business and contract law, scientific management, business organization, cost accounting, interstate commerce and marketing and distributing systems.

What Highway-Transport Engineer or Manager Should Know

The highway-transport engineer or manager should have a knowledge of all of the following special subjects:

History of American transportation and rural development; English highway transport methods and legislation; interrelationship of highway, railway and waterway transportation, including influencing factors of distances, rates, kinds of freight and equipment; port, terminal and warehouse facilities; interrelationship of highway transport, good roads and rural development; the "back-to-the-farm" movement, which is a function of three fundamentals—namely, building of systems of good roads, utilization of highway transport, and establishment of economic distribution from producer to consumer.

He should also have a knowledge of the subjects under the following heads:

American Highway Traffic Legislation—National, state, county, township and municipal laws, licenses, taxes and traffic regulations, especially those covering speeds, weights and dimensions of motor trucks, trailers and motor buses.

Fundamentals of Highway Engineering Affecting Economic Highway Transport—Administration of highway departments; highway systems; location, drainage, foundations, grades, curves, widths and shoulders of highways; characteristics of different kinds of roadway, with particular reference to traction; snow removal; guard rails, culverts and bridges; highway signs.

American Highway Transport Methods—Comparison of horse and motor transport, municipal haulage, muncipal delivery systems, store-door delivery, intercity haulage, long and short haulage outside of cities, rural motor express, return-loads bureaus, motor-truck parcel post, plant and factory haulage, Army transport methods, horse transportation methods; efficient methods of packing, handling, loading and unloading raw and manufactured materials; highway transport management; fundamentals of cost of highway transport, cost and record systems; organization of motor-haulage companies; labor for highway transport.

Motor-truck, Motor-bus, Tractor and Trailer Mechanism, Operation, Inspection, Maintenance, Repairs and Cost Data—Adaptability of different types of trucks and bodies; disadvantages of overloading and overspeeding; economic utilization of tractors and trailers; garages; accessories, such as tires, fuels, lubricants and mechanical devices.

Transportation Surveys—Investigations of highway routes, highway-transport legislation, traffic regulations, rural and urban transportation opportunities, competing carriers, including railway, waterway and other highway-transport facilities, and all other factors which may affect the transportation business which it is intended to establish.

Engineering Standards Committee to Reorganize

Proposes to Become an "Association" to Include a Wider Field of Work — Membership Open to All Interested Bodies

A REVISED constitution was adopted by the American Engineering Standards Committee at a meeting held May 17. This new constitution has been submitted for ratification to the councils of the five societies which formed the committee, the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers and the American Society for Testing Materials. The proposed reorganization developed from a meeting of organizations interested in formulating safety codes, held at Washington on Jan. 15, at which the American Engineering Standards Committee was described by its chairman, Prof. C. A. Adams, and a proposal was made to have the safety-code work carried on under the rules of the committee. It was objected, however, that the safety-code conference could hardly be expected to submit its work for approval to a committee on which its own members had no representation. In order, therefore, to bring about a form of organization with broader character of representation, the revision of the constitution was formulated.

Details of the contents of the new constitution are withheld by the committee. Essentially, the reorganization, which changes the name "committee" to "association," provides for increasing the body by taking in representatives from other organizations than the five founder societies and the three Government departments originally named, and fixes the dues of the societies represented. The new constitution also makes it optional with member societies to submit to the association for approval any or none of the standards which they may formulate. Commercial and scientific or noncommercial standards are governed by somewhat different rules concerning the constitution of committees.

Explanatory Statement by Committee

In announcing its action, the Engineering Standards Committee states:

It is anticipated that in nearly all cases the approval of standards and committees by the association will be requested. In case it is considered advisable, the association is authorized to call a meeting of those who would be interested in the formulation of a new standard or the revision of an old one, to select one or more sponsor societies. The sponsor society or societies will appoint a sectional committee to formulate or revise the standard. This sectional committee will report to the sponsor when its work is completed. The sponsor may then request the association to approve. The association deals only with the sponsor and acts only at its request.

In further explanation of the manner of action of the proposed association, it is stated:

The association thus acts only to bring together those interested in a common object, and, when they have completed their work will at their request certify that it has been done in such a manner as to justify its adoption. Nothing revolutionary is proposed; it is merely an extension of present practice. The executive committee of the American Society for Testing Materials now passes on the composition of committees, ascertains that their conclusions are substantially unanimous, and, if so, reports them to the society for acceptance or rejection. The association does the same for groups of organizations. Its board of directors performs the same functions as the executive committee of the American Society for Testing Materials, and the association as a whole accepts or rejects. It neither selects sponsors nor sectional committees; it does not consider the subject matter of a standard, nor the procedure under which it is arrived at, except that it requires sufficient information from the sponsor to show that the conclusions are substantially unanimous and that the sectional committee is balanced and representative.

It may be asked whether there is sufficient reason for the existence of the association. This, naturally, has been carefully considered, and it is the unanimous conclusion of the committee and of all those who have been consulted who have been active in standardization work that such an organization is urgently needed. In the past there have been many occasions when two or more organizations have formulated standards for substantially the same thing. Often these differences have been very slight, but neither has been quite acceptable to the other party. In the majority of such cases, if these organizations had been brought together at the start they could have agreed on a standard that would have been satisfactory to both. The American Engineering Standards Association will furnish a means by which any organization intending to define a standard can readily ascertain what others are interested, and should be consulted in regard to it. At present there is no such means.

Expect Present Organizations To Ask Assistance

There is nowhere anything approaching a complete list of the organizations doing standardization work, much less any list of the standards proposed or in preparation. The enormous advantage of having any standard generally accepted, and the much greater probability of accomplishing this if it is prepared under definite conditions that have proved effective in the past, will, it is believed, cause most of the organizations engaged in such work to ask and receive the assistance of the American Engineering Standards Association. It provides definite machinery for securing coöperation and preventing duplication of work. It establishes definite rules securing the absolute autonomy of any group engaged in the development of standards, and insures that this group shall receive full credit for its work. With the assurances of coöperation that the American Engineering Standards Association has already received, we believe that there is no question of the advisability of forming the more broadly representative association. Several organizations have already presented requests for the approval of existing standards, and we are informed that many others only await the notification of the committee that it is fully organized

It has been impossible to make any public statement of the committee's plans until they had been definitely formulated. This, we feel, has now been accomplished, and we can therefore state what it is hoped to accomplish and the methods proposed for the purpose.

G. C. Stone, vice-chairman of the committee, is directing its work for the time being. C. B. Le Page, 29 W. 39th St., New York City, is acting secretary.

Class in Art for Engineers

According to the *Bulletin* of the Art Institute of Chicago, a member, who is an engineer by profession and the head of a large engineering company in Chicago, came to the institute over a year ago with the desire that a class be formed for the men in his office, that they might become familiar with the collections in the Art Museum and develop a love of and desire for beauty. This course held an interested group and has just been organized for another year, meeting weekly, with attendance voluntary, the extra time being made up at the end of the day.

Mechanical Handling the Feature of Concrete Pile Yard

At Norfolk Army Base Both Bearing and Sheet Piles Were Rapidly Turned Out in Plant at Which Manual Labor Was Reduced to a Minimum—Concrete Mixed Alongside Each Pile

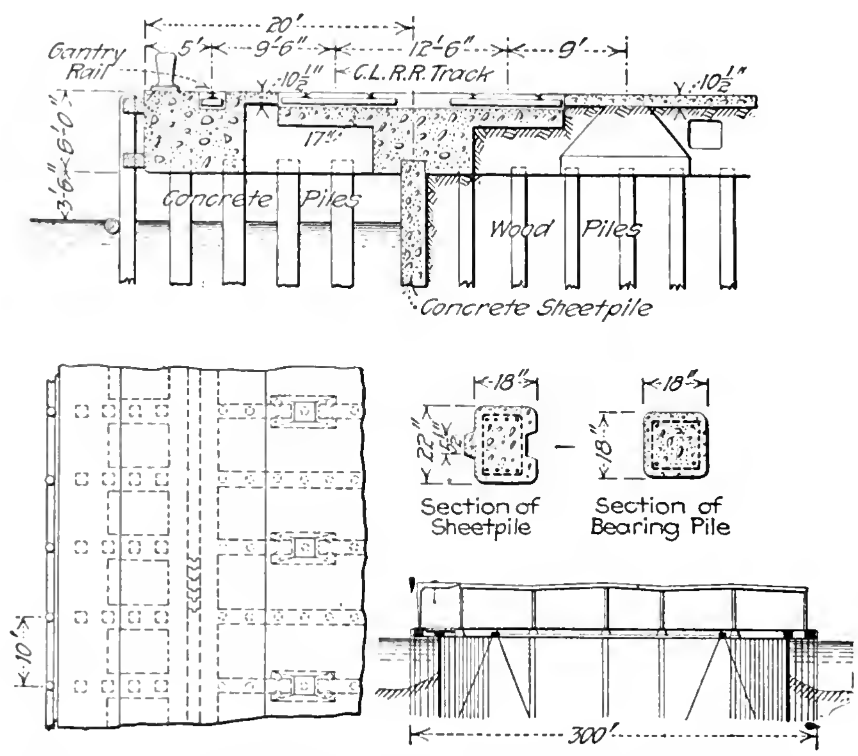
OVER 7000 reinforced-concrete bearing and sheet piles had to be cast in the summer of 1918 for the Norfolk Army supply base. In order to insure the completion of the contract in the short time allotted, there was built at the site a special pile-casting yard of extraordinary elaboration and size, and the casting was completed there in the required time. In all, there were cast 7442 piles, using 35,200 cu.yd. of concrete and 6400 tons of reinforcing steel, in the four months during which the plant was in operation. The highest number of piles cast in a 10-hour shift was 141, representing 620 cu.yd. of concrete. Every advantage was taken to substitute mechanical handling for manual labor.

The Norfolk Army supply base has as an integral part two piers, each 300 ft. wide and 1328 ft. long. On account of the nature of the ground and as a protection against the teredo which infests those waters, the type of section shown in the accompanying drawing was adopted. This, it will be seen, comprises a fill over the middle 260 ft. of the pier, retained by reinforced-concrete sheet piles, with wooden piles in the fill portion and an extension platform, carrying a gantry crane, with reinforced-concrete bearing piles. There were, therefore, two types of concrete piles to be cast, a rectangular tongue-and-groove sheet pile 18 x 22 in. in section, and a bearing pile 18 in. square.

The sheet piles varied by 5-ft. increments in length from 35 to 65 ft., while the bearing piles varied from 50 to 65 ft. Special sheet piles were also cast, consisting of corner piles, double-tongue and double-groove piles, closure piles 15 in. wide, and wedge piles narrowing from 18 in. at the top to 9 in. at the bottom. The bottom of the sheet piles was beveled 6 in. in 2 ft. on the groove side to facilitate crowding the piles together, and the bottom of the bearing piles tapered in 8 ft. from their full section to 10 in. square. The reinforcement consisted of a 1¼-in. deformed bar in each corner with ¼-in. hoops, spaced as required in the design. Additional reinforcing bars were used to take care of stresses set up by the methods that were required in handling the piles, the length and size of the bars depending upon the length and weight of the piles.

Two Yards Had to Be Built

A number of views of the yard in which the piles were cast are shown, as well as a drawing of the layout. As shown on the sketch, there were two yards, an east yard and a west yard, on either side of a central main-line track from which the aggregate was delivered. The details of the two yards were somewhat different, but in both every effort was made to magnify the use of machinery on account of the labor shortage at the time when the work was carried out. Both yards are laid out in a straight line controlled by straight tracks running parallel to the main delivery track. In the east yard the steel-fabricating shed was at one side of the yard, delivering reinforcement to the forms on the concreting platform. In the west yard the steel-fabricating shed was at the extreme end of the yard. In the east yard the steel and the finished piles were handled from a steel gantry crane spanning the casting platform. In the west yard this work was done by a locomotive crane. Both yards used a traveling concreting bridge, but the east yard had its aggregate fed from an aggregate car traveling on a track from the storage bins, whereas in the west yard there was a plank runway on which man-handled wheelbarrows transported the aggregate. The entire casting yard is about a mile from the water front on a comparatively level area. The foundation

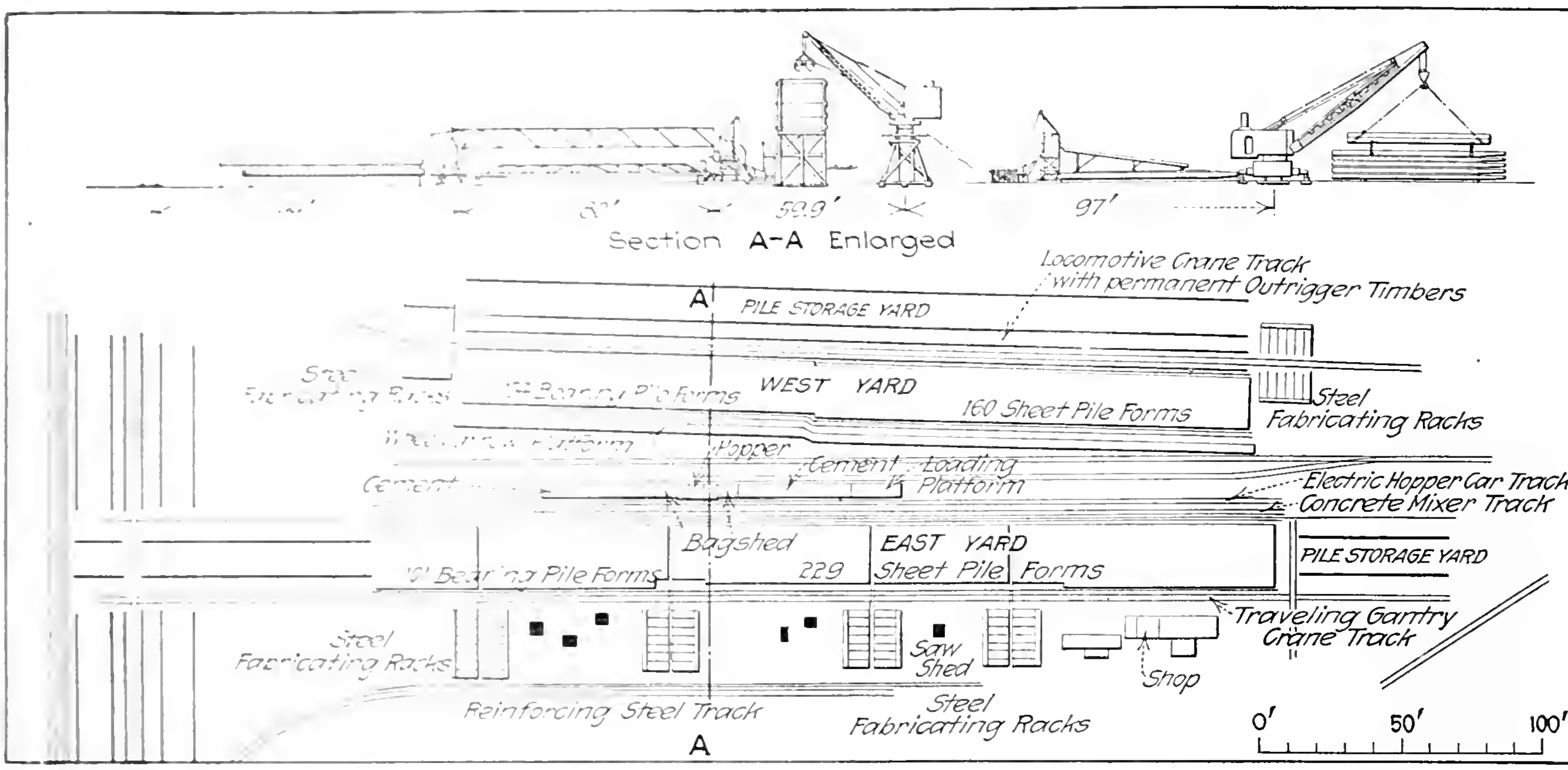


DETAILS OF CONCRETE PILES USED ON THE PIERS OF THE NORFOLK ARMY SUPPLY BASE

upon which the forms were built was substantial and unyielding, which permitted the casting of the piles very straight and true.

The reinforcement was fabricated on special racks in the sheds alongside the pile yards. These racks, as shown in one of the views, were placed about 4 ft. above the ground and were supported on 2 x 4-in. stakes and stringers. Strap iron was laid on top of the stringers to facilitate the movement of the steel without unduly wearing the supports. Fabrication was carried on under the shed on cantilevered brackets raised to such a height as to carry the two upper rods the proper distance above the runway stringers. When necessary, these longitudinal rods were spliced together and thoroughly wired after splicing. The ¼-in. hoops were then swung into place and fastened to the longitudinal rods, using No. 12-gage annealed iron wire or a special connection. When the reinforcement was finally fabricated it was pushed off the brackets onto the stringer and slid along until it reached the ends of the racks.

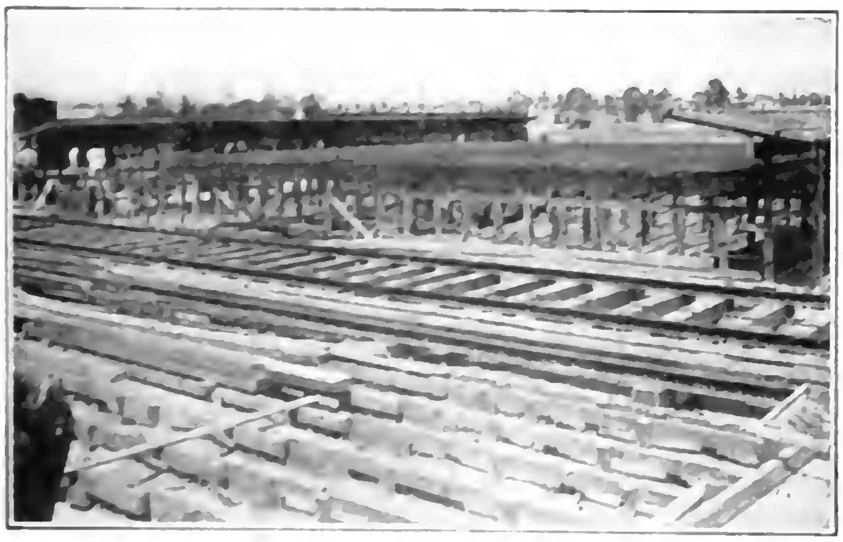
In the east yard fabricating shed the assembled reinforcement was dropped onto a long flat truck running on a narrow-gage track parallel to the direction in which the steel was fabricated and pushed out onto the casting platform, to be set in place by the gantry crane. In the west yard shed, as shown in the general view of the yard, a standard-gage track ran between the two halves of the casting shed, and the steel could be transported where required by the locomotive crane traveling on the track. A rigid beam with multiple supports was used in lifting the steel.



GENERAL LAYOUT OF CONCRETE PILE-CASTING YARD AT NORFOLK ARMY SUPPLY BASE

The forms in both yards were of cut lumber resting on continuous fills. The bottom forms were stationary, and the side forms were set and wedged at the bottom as required, the tops being set to line with templets, and 1 x 2-in. nailing strips were nailed on top of the forms to keep them from moving. In the east yard the casting platform on which these forms were placed had on either side a single rail and a track which carried, respectively, a pile-handling gantry of steel framing and a wooden concreting bridge.

The operation of concreting in this yard was carried on about as follows: The material was brought in on the main track, and the sand and gravel unloaded from an elevated trestle by gravity. A locomotive crane operating on this trestle lifted the sand and gravel from the ground where it had been dumped to the bins alongside of the east yard. From these bins the material was deposited by gravity to a measuring hopper, where the proper proportions of sand and coarse aggregate were measured and mixed, and from these measuring bins the coarse aggregate ran by gravity into a special aggregate car which traveled on a track running alongside of the aggregate storage bin. This car was run by electricity to the mixer, which was also moved on a parallel track and which was at the time of concreting placed immediately opposite the pile to be poured. Over this pile was the concreting bridge. The batch in the aggregate car was run by gravity into the skip of the mixer and there mixed. After being mixed the concrete ran by gravity into the car supported on the concreting bridge which ran immediately over the pile. This car had a bottom-drop door through which the concrete was deposited at any point in the length of the pile.



REINFORCEMENT FOR PILES WAS FABRICATED UNDER SHED AND MOVED TO CENTRAL TRACK

This method of handling the material permitted the concrete to be mixed immediately over one end of the pile, and there was no danger of the aggregate becoming separated by reason of transporting the concrete a long distance. As the yard was over 1800 ft. long this difficulty in so hot a climate in the summer would have been very hard to overcome. By the method employed the concrete could be deposited in a very few seconds after it was out of the mixer.

The electric-driven hopper car, which delivered the dry batch from the central hopper to the mixer, consisted of a hopper which discharged directly into the loading skip of the mixer. It was mounted on trucks, and the motive power was furnished by a 15-hp. motor geared to one axle, and with a street-car motor control. The mixer was mounted on a car which was moved along by a rope from a hoisting engine or by use of a pinch-bar. The two wooden concreting bridges, with a span sufficient to cover the longest pile, were designed and made on the work to carry the concrete car the full length of the pile. The trusses were built of timber and rods.

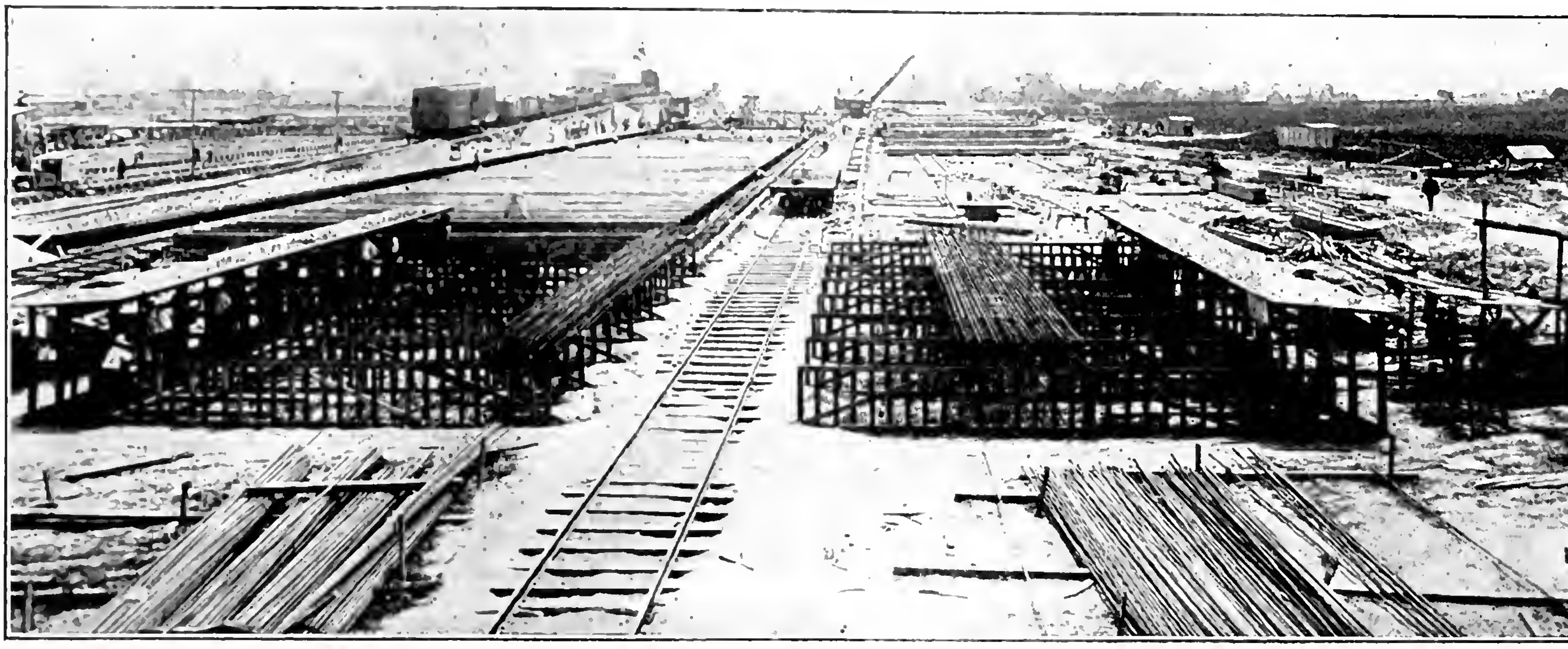
After the piles were cast they were handled by one of the two steel gantry cranes, which were propelled by a three-drum hoisting engine mounted on a car at one end of the pile. Two drums were used to pull the car and the gantry back and forth. The third drum was used to raise and lower the pile, the rope being reeved through a series of tackles which lifted the beam at four points. Adjustments were made at each of the four points by means of turnbuckles. The beam was made up of two 18-in. I-beams with their flanges riveted together.

Cement was handled in different manners. Wherever possible it was used directly from the cars to the dry-batch car, in order to avoid rehandling, but a cement house was provided holding a number of cars of cement as an emergency to take care of any situation.

In the west yard, which was built after the east in order to increase the output on account of the developing program of construction, additional gantry cranes were not available, so the work of handling the reinforcement and the finished piles was taken care of by a 150-ton locomotive crane mounted on a standard-gage railroad track. In this yard no piles longer than 55 ft. were cast. The mixing plant consisted of two ¾-yd. mixers, one driven by steam and one by electricity, mounted on elevated trucks traveling on a standard-gage track.

The steam mixer discharged into an inclined chute with removable bottom section, the chute being mounted on 4-in. cast-iron casters traveling on a movable plank track. The electric mixer had a concrete bridge and bottom-dump bucket, similar to those used in the eastern yard, except that, being shorter, this one was built as a unit with the mixer truck and traveled with it.

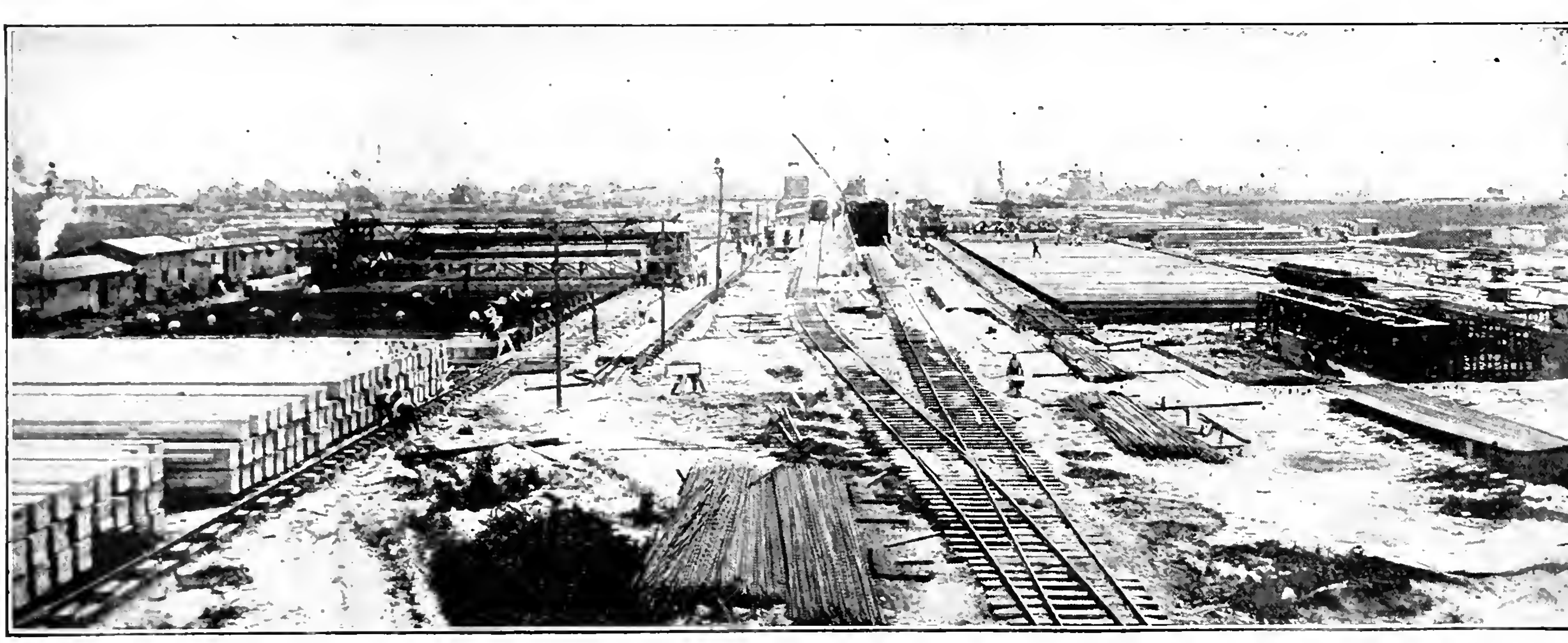
Both mixers were served with concrete material by wheelbarrows operated on a track runway about 5 ft. high along the edge of the storage pile. Cement was used directly from cars when possible, or was delivered by wheelbarrows from the east yard cement shed through two alleys left for that purpose in the storage pile. In the west yard the locomotive crane handled the finished piles to the pile storage on the other side of the track.



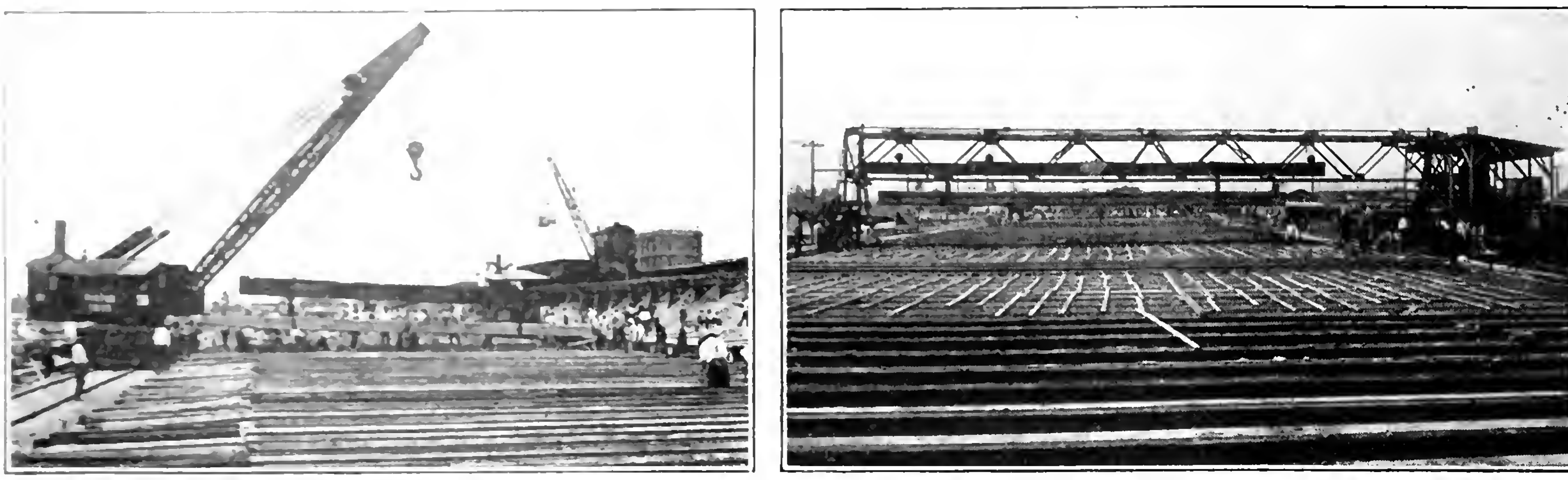
LOOKING DOWN LOCOMOTIVE-CRANE TRACK IN WEST YARD; FABRICATING RACKS IN THE FOREGROUND. AGGREGATE TRESTLE IS AT THE LEFT

The storage yard for the curing of piles was carefully prepared, in order to prevent damage to the piles due to uneven settlement. Two rows of standard railroad ties were set 2½ ft. c. to c. on a graded bed. On these ties continuous 6 x 12-in. timbers laid on the flat were placed about 36 ft. c. to c., or about under the pile-lifting point. Piles were usually stacked on these timbers four high with the gantry cranes and five high with the locomotive cranes. There was about 4-in. clearance between the stacks of piles, and successive layers of piles were separated by 3-in. timbers laid on the flat.

During exceedingly hot weather the piles were sprinkled while in the storage yard, to aid in curing. The storage period was about three weeks, although



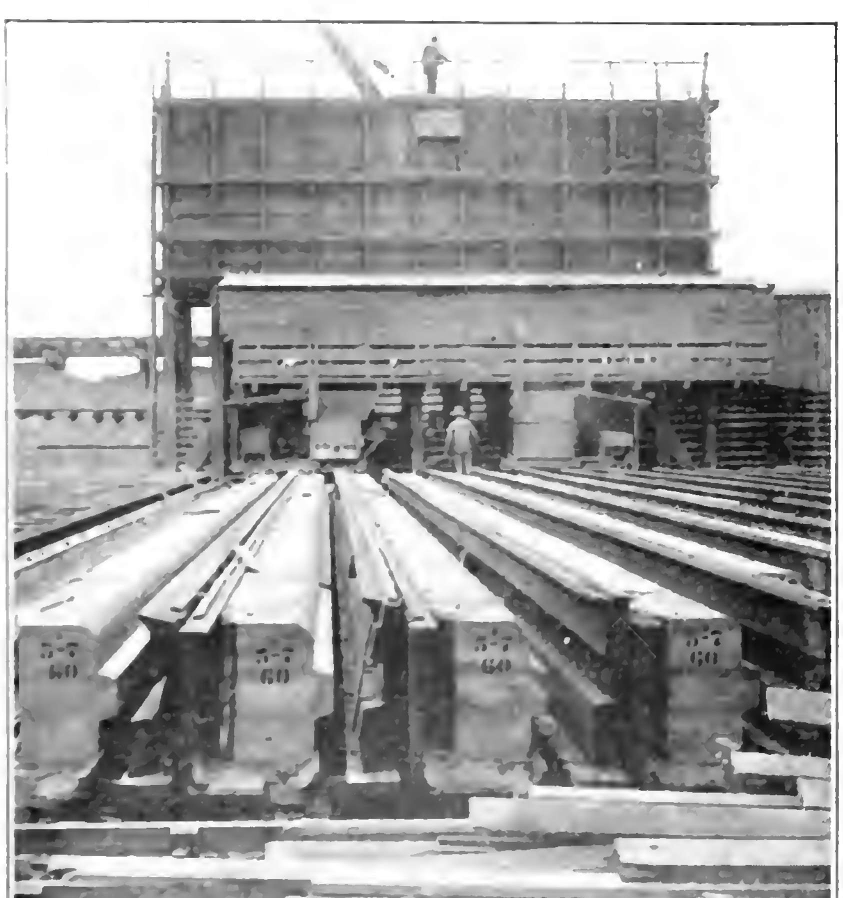
LOOKING DOWN CENTER OF PILE-CASTING YARD; EAST YARD AT RIGHT, WEST YARD AT LEFT. AGGREGATE TRACKS IN CENTER



HANDLING PILE WITH LOCOMOTIVE CRANE IN WEST YARD; WITH STEEL GANTRY IN EAST YARD

many piles were driven successfully in 14 days, and in the case of wedge piles they were driven in seven days without any damage whatever. In transporting the piles to the work they were loaded on heavy, steel-body flat-cars of 80-ton capacity, five or six to the car. The usual trainload consisted of three loaded and four idler cars. Some of the piles weigh as much as 13 tons.

Owing to the great demand by Government improvements in the neighborhood for coarse aggregate, it was necessary to use different kinds of material, crushed granite, limestone, and washed bank gravel being used at various times, but all in the proportion of 1:1½:3. On account of the small space between the reinforcement and the forms, it was necessary to use a stone of small size, the best result being obtained by a maximum diameter of 1 in. The bulk of the fine aggregate was coarse, washed bank sand. The workmanship in connection with the placing of the concrete was very thorough. Spading was continually carried on, and no expense was spared to be sure of good quality of concrete. Running it too wet was not permitted, because the concrete was deposited from the car immediately above the place where it was required.



HEAVY CONCRETE SHEETPILE ON CASTING PLATFORM

Electric-driven aggregate cars in background in front of material storage bins

The work was done by the Raymond Concrete Pile Co., of New York, for the United States Government, with Porter Bros., of Wilkes-Barre, Penn., as general contractors. Col. M. A. Butler was constructing quartermaster in charge of the work and A. O. Leach and G. F. Bowlus were supervising engineer and division engineer, respectively, for the Government. A. F. Barnes was general superintendent for the Raymond Concrete Pile Company.

Aerial Wire-Rope Conveyors to Feed Railways and Ships

IN SPEAKING on the value of "Aërial Wire Rope Conveyors as Feeders for Railway and Ship Lines," before the engineering section of the Pan-American Commercial Conference, Walter C. Kretz dwelt on their ability in developing regions at present inaccessible, on the west coast of South America. In his opinion they will solve many difficult and, in fact, otherwise unsolvable problems of transportation in that region.

After giving a description of the various types of aërial cableway, together with the limitations of each, he cited examples of their successful use under South American conditions.

One advantage of cableways over other means of transportation is that they can operate over very steep grades. An installation in Africa was mentioned which is operating over an 86% grade. Principal among the examples described is one in the Argentine Republic. It extends from the end of the railway line at Chilicito to Upulungos, a mining town 34.67 km. (21.5 miles) away, and 3510 m. (11,513 ft.) higher in elevation. On the down trip it carries chiefly ore, at the rate of 40 tons per hour. Passengers, miscellaneous supplies, machinery, etc., are also transported in both directions.

According to Mr. Kertz, this installation is at present the longest aërial cableway in operation in the world. It has nine separate sections, with intermediate terminals where transfer from one section to the other is made automatically.

Ship loading and unloading in open roadsteads, by means of building an island pier well out and transferring the passengers and freight by means of cableways, were also touched upon.

The speaker said that it must not be thought, because the installation is cableway, that it can be built for the mere cost of the cable and engines. It is doubtful if any such installation can be made for less than \$10 per meter (3.28 feet).

Labor Turnover High on Two War-Time Contract Jobs

Short Average Stay of Both Skilled and Unskilled Laborers Decreased Efficiency and Increased Cost of Work

By Sidney G. Koon
Walter B. Snow and Staff, Boston, Mass.

FLOATING labor undoubtedly contributed much to the difficulties of war-time construction noted by H. C. Turner in his article in *Engineering News-Record*, of Apr. 24, 1919, p. 815, if the experiences of most contractors was the same as that of the Aberthaw Construction Co., of Boston, on two large Government contracts, as well as their experience through 1917, on work of which none was done for the Government. All of these jobs, Government and otherwise, were done on the cost-plus basis.

An analysis of the labor situation on 15 jobs (in three states), which were started and completed in 1917, shows a total of 7179 men hired; while the sum of the 15 separate peaks, showing the maximum number of men on a job, was only 2812. The ratio between the number of men hired and the sum of the 15 peaks is 2.54 to 1—or, in other words, five men were hired for every two men at time of greatest employment. More than two-thirds of all the men who left of their own accord simply quit without giving any reason.

Taking the whole experiences of the year in connection with the length of time during which individual men worked on a job, it is found that 18.9% of the men worked three days or less; 32.4% (practically one-third) worked not more than one week. More than two-thirds of the total, 68.3%, were on the job less than one month. Of the total number employed, the "exits" were distributed as follows:

Transferred to other jobs		1882
Quit, no reason given	2174	
Left for another job	321	
Left because of sickness	139	
Left for family reasons	91	
Dissatisfied with job	78	
Leaving town	120	
Gave notice	51	
Dissatisfied with pay	38	
Enlisted or drafted	103	
All other reasons	91	
Total resigned		3206
Dismissed as incompetent	415	
Refused to obey	95	
Trouble-makers	23	
Drunk	14	
Not adapted to work	17	
Refused to work	73	
Struck for higher wages	12	
All other reasons	148	
Total dismissed		797
Laid off on reducing force	290	
Laid off, no stock	10	
Laid off, job finished	994	
Total laid off		1294
		7179

Divided according to length of service on the job, the men were grouped as follows:

3 days or under	1351
4 to 6 days	980
7 days to 2 weeks	1359
2 to 4 weeks	1219
4 to 6 weeks	750
6 to 8 weeks	458
More than 2 months	1062
Total	7179

A more detailed analysis has been made of the work at the two jobs listed below, both of which were for the Government and both carried on under high pressure.

At the Squantum works of the Bethlehem Shipbuilding Corporation, Ltd., where the Aberthaw Construction Co. erected in record time the largest destroyer-building plant in the world, the job was started in the second week of October, 1917, and was practically finished in June, 1918. About $13,000,000 was spent in providing a complete plant with 10 building ways. There was no war construction work going on in Boston, and the district had an excellent labor supply. For the first 10 weeks the men had to walk from 15 to 25 minutes from the nearest railroad or trolley line to get to the job. This was during the early part of an exceptionally severe winter, the daily mean temperature during January never going above the freezing point. A total of 10,300 men was hired on this job. The employment peak, Jan. 12, was 4200 men, showing a relation of the total number to the peak of 2.48 to 1. It will be noted that this is almost identical with the experience of the company on the 15 non-war contracts of 1917.

Of the total number of men employed, 3050 (29.6%) quit in one week or less; 2078 (20.2%) quit in seven days to one month; 1600 (15.5%) quit during the second month of employment; 1209 (11.7%) during the third month, and smaller numbers during succeeding months. These figures show that 77% of all the men hired for the job were gone in three months.

Of the total number of men hired 6219 were laborers; 31% of these, or 1936 men, worked one week or less, and nearly 55% (3344) worked not to exceed one month. The record of the laborers is thus seen to be somewhat worse than that of the men as a whole. In fact, if we deduct the number of laborers from the total number of men, we find that 1114 of the 4081 other men quit during the first week, this being 27.4% as compared with 31% for the laborers. Similarly, 43.6% of the higher-grade men had left the job inside of the first month of employment, as compared with 54.8% of the laborers.

Maryland Shipyard Had Worst Labor Turnover

The $3,000,000 job at Sparrows Point, also built by Aberthaw, 14 miles out of Baltimore, showed a radical difference in turnover of labor. The total number of men hired was 5245, of whom 3562, or 67.9%, had quit at the end of the first week of employment. Additional men to the number of 1070 left before the first month elapsed. This total is no less than 88.3%, by far the worst labor mortality in the history of the Aberthaw company. The number of men on the day of the peak was 836. The ratio of the total number hired to the peak number was 6.27 to 1, practically double the highest of any figure reached among the 1917 contracts.

The Sparrows Point job was started in June, 1918, and ended in February, 1919. It was in a district in which war contracts totaling many millions were under way, and was at the extreme end of the railroad line running out from Baltimore, which passed seven other large contract jobs. Camp Holabird was the nearest to Baltimore; in succession a munitions plant, a large sewer, water and gas contract, two Government housing projects and two Government shipyards were passed before the Sparrows Point job was reached. On the last-named four contracts, free transportation to and from Baltimore was furnished; but this was not the case on the Aberthaw job. Consequently a barracks was built and a restaurant established on the job to take care of the men who were not residents of Baltimore.

The Baltimore district reported a constant shortage of labor because of the large number of projects under way in the vicinity, and the United States Employment Service, from which the laborers for the Aberthaw job were obtained, had to serve the insistent demands of all. By the time laborers reached Sparrows Point they had made the rounds of every construction job in the district.

From the above cases it will be noted that the work at Squantum, with bad transportation and exceptionally severe weather conditions, was a little better than the average job with regard to labor turnover. This was unquestionably due to an adequate supply of common labor in a populous district where there was little emergency call for labor. Sparrows Point, on the other hand, with much better transportation conditions and better weather, but with an extremely deficient labor market, both as to quantity and quality, produced an exceptionally poor record. The laborers obtained on this job (with the exception of two gangs aggregating 264 picked men who were shipped to the job from Boston direct) were obtained through the Government employment service. Addresses on the employment cards showed that they came from six foreign nations and all but eight of the states of the Union. There is no reason to suppose that any other condition would have obtained had this job been on a lump-sum basis instead of the cost-plus which prevailed.

Influenza in Families Made Men Quit

Less than 19% of the men taken to the job from Boston had quit at the end of the first month of employment, as compared with 93% of the total laborers hired on the job. Even this 19% was higher than would normally have been the case, because a considerable number of men left for home on account of the influenza epidemic in Boston, which affected many of their families.

In tabular form the experience of the Aberthaw Construction Co. on these two jobs may be set down as follows:

Job	Total Number Hired	Men at Employment Peak	Ratio	Per Cent. Quit in— Not Over One Week	Not Over One Month
Squantum	10,300	4,200	2.48	29.6	49.8
Sparrows Point	5,245	836	6.27	67.9	88.3

Job	Total Laborers Hired	Laborers on Day of Peak	Ratio	Per Cent. Quit in— Not Over One Week	Not Over One Month
Squantum	6,219	2,688	2 31	31.0	54 8
Sparrows Point	3,017	334	9 03	77.0	93 0

It must not be imagined that these employment figures at Sparrows Point were in any degree due to neglect or lack of adequate supervision. The superintendence, office men and foremen, all were the pick of the organization, and no effort was spared to make the work go smoothly. But the men available were simply "not there." The superintendent estimated the general average efficiency of the men on the job at less than 40%, as compared with 80% for the average on a good pre-war contract, both based on the observed qualities of the best men on the work.

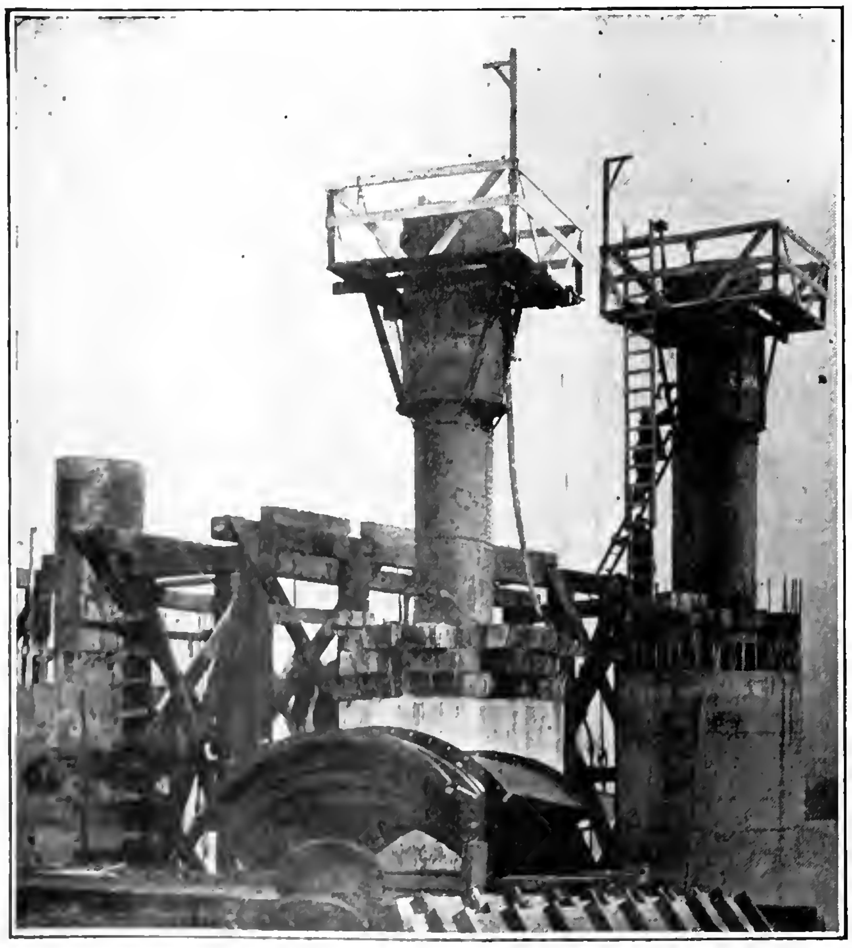
On the basis of an analysis which is as yet incomplete, no marked difference is shown in the percentage of men quitting, whether they are single or married. The question of family responsibility seems to have had little effect, probably because there was always a superabundance of work of one sort or another to which a man could turn any time he had a grouch or felt inclined to wander.

The problem is a very acute one, which will well repay the closest attention and most careful investigation of all employment managers, in hopes of finding some means of overcoming the evil of having constantly to train new men to a job for which an adequate number of men had already been trained. It is a problem which is never so prominent in times when labor is plentiful and jobs are relatively scarce, but it has such a large bearing on costs that anything which can be done to ameliorate the condition will be highly welcome. Once the main causes of dissatisfaction are localized and the proper remedy applied, there should follow quickly a more stable labor condition, with consequent benefit both in costs and in time of construction. This would help everybody alike, laborer, contractor, and owner, but the task of finding the answer is peculiarly one for the contractor alone.

Pneumatic Caissons Sunk Through Moving Ground

Constant Movement of the Earth Necessitates Suspension of Tower Foundation Piers From Overhead Timber Frames

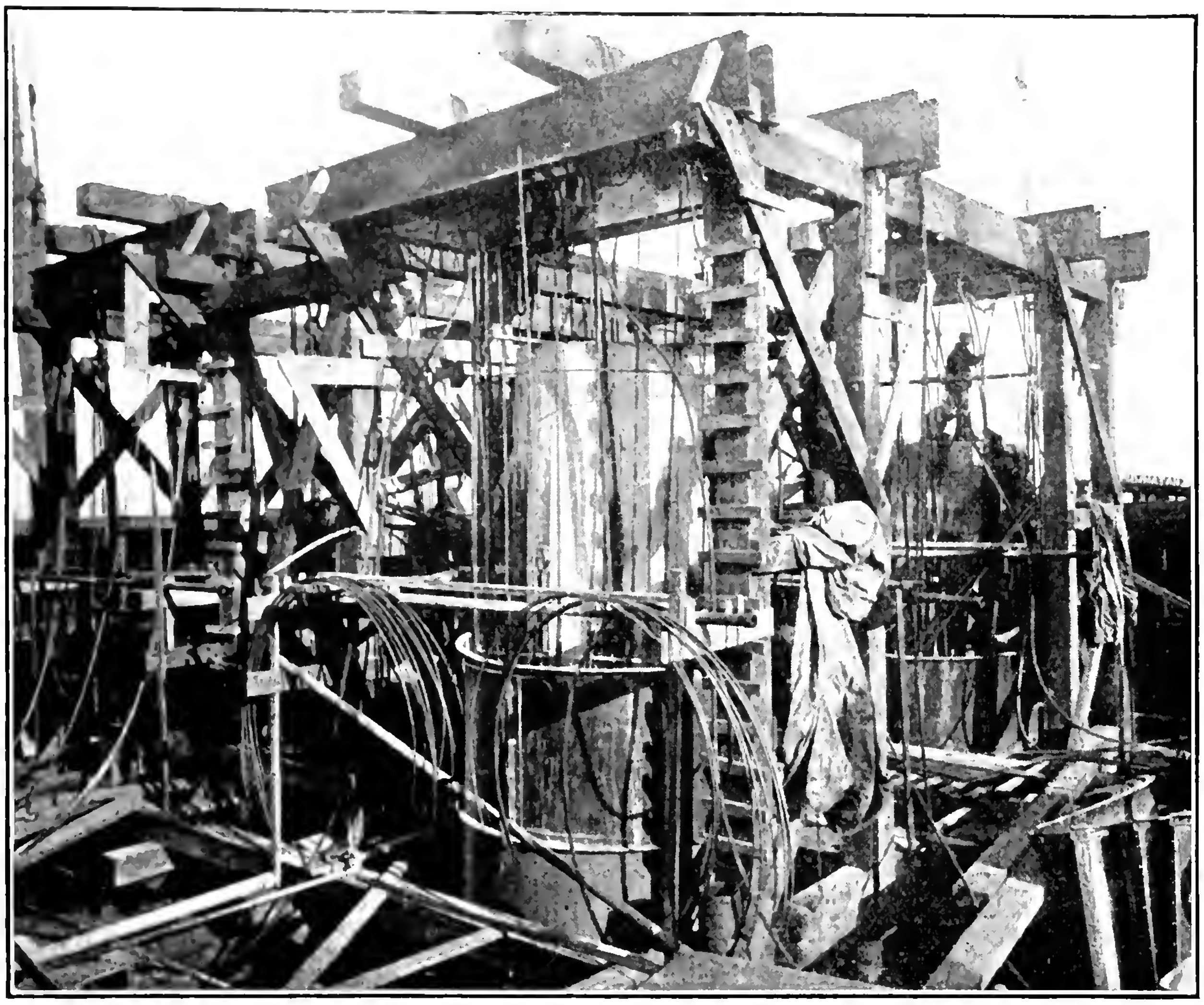
PECULIAR ground conditions in the foundations of the new hoisting tower being constructed near Baltimore for the Consolidated Power Co. forced the contractor to face the problem of sinking pneumatic caissons in such a way that allowance could be made for possible movement of the ground through which they were to be lowered. The solution finally adopted required the construction of an overhead timber frame large enough to support four caissons, one at each corner of a rectangle, from the top of which wire cables in pairs were connected with the bottom of the caissons. These



PNEUMATIC CAISSONS SUNK THROUGH SHIFTING GROUND TO SOLID BEARING

cables were then adjusted as desired during the sinking in order to keep the caissons tilted at the proper angle to allow for the effect of movement in the upper layers of earth. The caissons were sunk by their own weight until solid ground was reached, and from that point carried down about 20 ft. to hard bottom 68 ft. below water level.

The Westport station of the Consolidated Gas, Electric Light & Power Co. is located about 200 ft. from the bank of the Patapsco River, near Baltimore, Md., and the space between the power house and the river is used for the storage of coal brought up the river in barges and unloaded by a tower hoist, which is connected with the power house by a steel bridge. A 1000-ft. cableway extends from the bridge over the storage space, so that coal may either be carried directly to the bunkers in the power house or transferred to the cableway and deposited in the storage pile. The cableway is used, also, to remove coal from the storage pile when it is required to supply the power house.



FOUR PAIRS OF WIRE CABLES SUPPORT EACH CAISSON

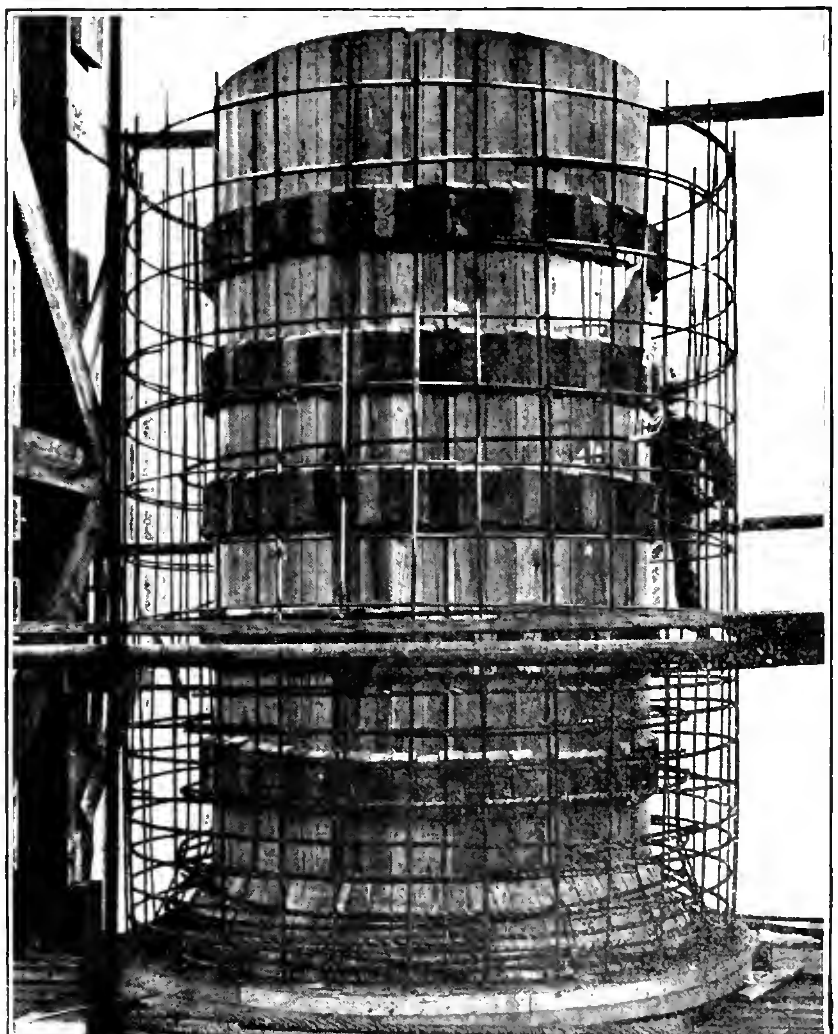
New Hoisting Tower—Last autumn the power company decided to add a second hoisting tower and a bridge, for handling coal. The company expected that it would be difficult to build a foundation for the tower, however, because the weight of the coal stored between the power house and the waterfront had started a movement of the ground toward the river which had been sufficient to throw the discharge tunnels from the power house badly out of line. Accordingly, the Foundation Co., of New York, was engaged to design and construct the necessary piers.

Borings showed that, under about 50 ft. of soft material, there was a stratum of compact sand. It was evidently necessary to sink the foundation piers far enough into this hard stratum to permit them to withstand the flow of the soft material above.

The design finally adopted consisted of four cylindrical piers, 10 ft. in diameter, centered at the corners of a 24 x 25-ft. rectangle. These piers were built with concrete walls, 18 in. thick, reinforced as indicated in one of the photographs, and were sunk by their own weight until they reached solid ground. Air was then applied, and the rest of the sinking was done by the usual pneumatic method. The piers were carried down about 20 ft. to hard bottom, making the total depth 68 ft. below water level.

Contractor's Problem—During the first stages of the operation the contractor was faced by the problem not only of keeping the caissons from sinking too rapidly, but also of holding them in alignment until they were solidly grounded. Four lines of piles were driven at right angles to the river; that is, parallel to the direction of movement of the ground. These piles were capped with 12 x 12-in. timbers and pairs of 24-in. 80-lb. I-beams laid across from one line to the next over each of the four caissons.

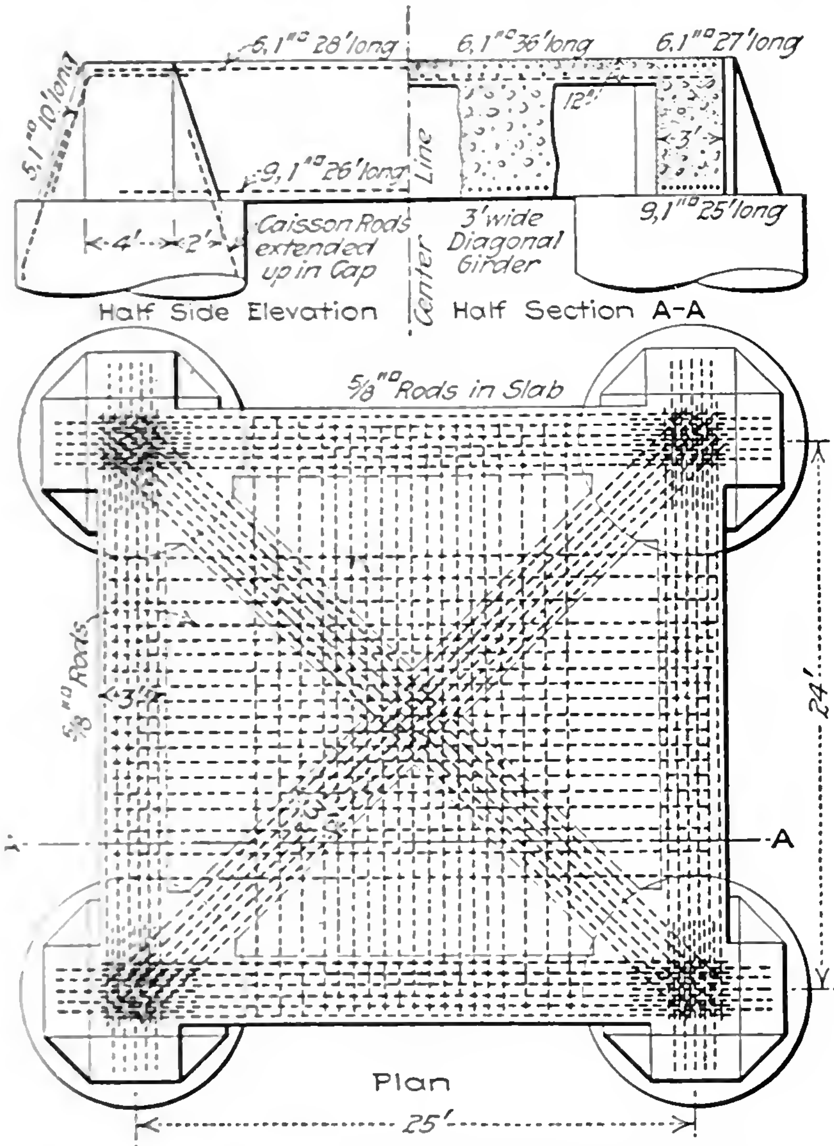
Each caisson was suspended from these I-beams by four pairs of wire cables attached to the cutting edge and extending up through the walls as they were con-



INSIDE FORMS PROVIDE KEYS FOR BONDING

creted. Each cable passed up between the pair of I-beams, made a half turn over an oak block, and was fastened to itself with three ordinary clips. One cable in each pair actually supported the load while the companion cable was held in reserve for safety.

In order that the cutting edge might be in correct position when it reached solid bottom, it was necessary to counteract the movement of the soil, by sinking the caisson out of plumb. The caisson was kept at this



REINFORCED-CONCRETE CAP FOR PIERS, BUILT OF SLAB AND BEAMS

angle by adjustment of the supporting cables. When it was necessary to throw the caissons further out of plumb, the cables on the river side were slacked off, throwing most of the load to the cables on the power-house side and causing the caisson to tilt accordingly.

It was the contractor's original intention to have each cable pass through pairs of blocks, so that it could be more easily adjusted, but as these blocks were delayed in transit, the lowering was done merely by loosening the clamps and allowing the cable to slip by itself. The safety cable in each pair was slacked off first the proper amount, and the clamps were tightened so that the motion of the caisson would be stopped at the proper point when the supporting cables were loosened.

After the caisson had been sunk 20 or 30 ft. it was necessary to shore against the side of the power house to hold it in the proper inclined position. When the cutting edge had been grounded securely, however, these shores were removed and the caisson was allowed to right itself.

After all four piers have been completed, they will be tied together at the top by deep concrete girders, which will stiffen them against the movement of the ground. Details of this cap and its reinforcement are shown in the diagram. The caissons are to be filled with a concrete core about 12 ft. thick at the bottom, with sand filling above it.

A. S. Loizeaux, electrical engineer, is in charge of construction for the Consolidated Gas, Electric Light & Power Co., and E. D. Edmonston is general superintendent of the Westport plant. The job was handled by C. B. Kowenhoven, superintendent, and William J. O'Neill, general foreman, under the direction of W. B. Taylor, district manager of the Foundation Company.

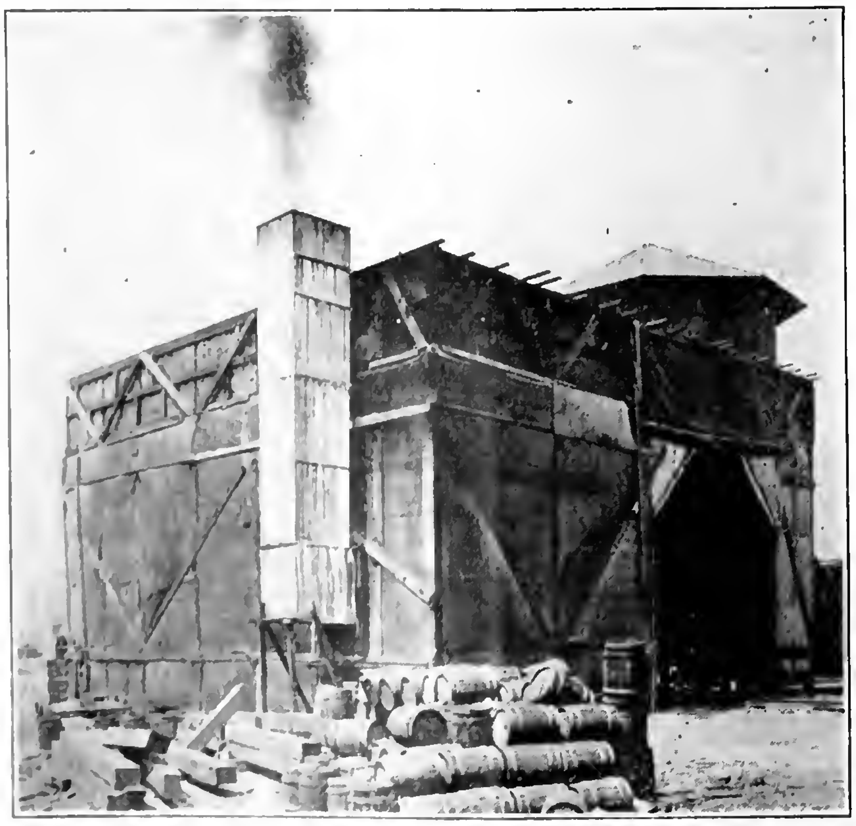
Tests to Free Under Side of Railroad Viaducts From Smoke

Special Arrangement of Ducts, Air Chambers and Fans Promises To Solve Problem of Low Headroom

BY ROBERT H. MOULTON
Chicago

EXPERIMENTS were recently conducted by the engineers of the new Union Station at Chicago to do away with the smoke nuisance created by locomotives under the viaducts. Limited headroom indicated the need for a special arrangement of ducts, air chambers and fans. A test structure was built and adjustments were made of sizes of openings, angles of baffle plates and the like, until the best combination was obtained.

Early in the designing of the station it became apparent that some artificial means would have to be employed to ventilate properly the under side of viaducts at Van Buren St., Jackson Boulevard, Adams St., Monroe St., and the structural portion of Canal St. overhanging the station tracks between Washington and Harrison Sts., a distance of ten blocks. These viaducts pass over depressed tracks and the train-shed of the station, and the use of high platforms made it obvious that smoke and gases could not be permitted to accumulate under these viaducts without seriously inconveniencing passengers and hindering operations of the station. The situation was doubly serious at the Jackson Boulevard and Adams St. viaducts, as these



TEST STRUCTURE—SMOKE ESCAPING AT LEFT

structures practically abut the concourse, and if smoke and gases were permitted to accumulate under these viaducts it would quite likely sift into the concourse and produce an extremely undesirable condition in one of the most used and important spaces in the entire station layout.

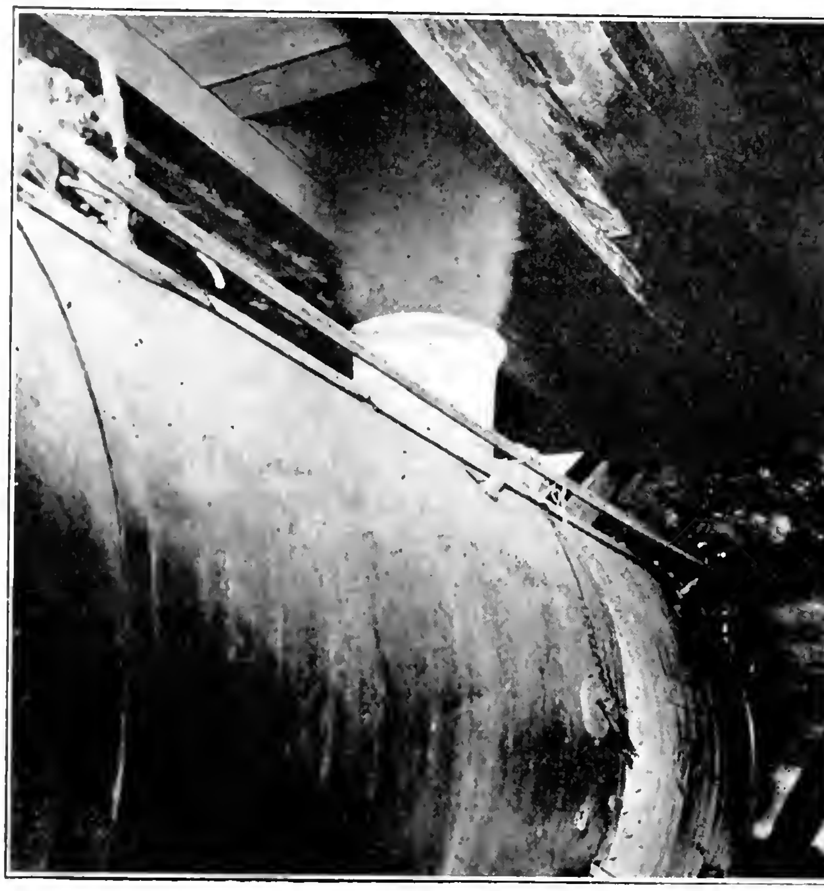
This situation prompted a thorough investigation of other stations, with a view to learning what had been done to relieve such situations. No analogous conditions were found; the situation at the Back Bay Station of the New York, New Haven & Hartford R.R., at Boston partly resembled that in Chicago, although in the main the conditions were dissimilar. At Back Bay the smoke is allowed to remain at or near the ceiling until drawn away through a number of small openings from which a system of ducts leads to ventilating fans. On account of this station having a great deal of headroom the above described method is fairly satisfactory, but it would not suffice at the Chicago Union Station, because if the smoke were handled in the restricted headroom there it would have to be dealt with on a plane only about 6 ft. above the proposed high platforms, or at about the level of a person's head.

Independent Study Solves Problem

Unable to discover anything that might lend assistance to the proper solution of the Chicago Union Station problem, the engineers began an independent and exhaustive study of their needs. After discarding as impracticable schemes which required special devices on locomotives, mechanically operated smoke ducts and one operated by the blast from the locomotives, they decided that the only device that would be entirely satisfactory would be one that could perform its functions entirely independent of the locomotive under all conditions of standing and running, and which also could be installed in a manner that would not require any structural changes in the viaduct design. A design was made of a system of open slots in the ceilings of the viaducts over the track center line. These slots were continuous in length, except where broken by the bottom flange of the viaduct girders, and were first made 30 in. wide at the bottom and 12 in. at the top, the space under the floor of the viaduct and above the ceiling being used as a gas or smoke chamber, and these chambers in turn being connected to a series of flues and ducts leading to ventilating fans.

A complete structure representing a two-track section of Jackson Boulevard was designed and erected, in order that a number of tests could be made as to the volume of smoke to be handled, the necessary air velocities and various other details, such as drainage and cleaning out soot and cinder deposits.

At the first trial of the device it was found that it worked successfully, except that when the locomotive was laboring very hard the smoke and gases had such great velocity that they would slightly overcome the suction pressure of the fan, and this caused a small amount of smoke to escape down through the smoke duct over the next track. It was not desirable to increase the power to overcome this condition, as it was found possible to do, or to construct a separate chamber for each track, on account of the expense of the extra suction flue and additional openings in the web of the viaduct girder much closer to the shearing point. Furthermore, the greater the storage capacity of these chambers the less the fan capacity. After some study



CLOSE VIEW OF ENGINE AND ARRANGEMENT OF SLOTS

of the situation a suction flue was designed with the opening continuous in the form of a slot at the top and a baffle arranged to stop the smoke and gases from passing this point, at the same time guiding them into a slot, the space below the flue being entirely closed. This arrangement operated excellently from the start, and it was not found necessary to make any radical changes throughout the rest of the experiments.

The next question was the adjustment of the angle of the baffle plates which formed the smoke duct. It was found necessary to have a width of about 30 in. at the bottom of the slot in order to catch all of the smoke from the locomotive stack. On the other hand, if the opening at the top of the baffle plates, where the smoke passed into the smoke chamber, was made too narrow, the smoke, due to its high velocity, would flare back. It was desired to make the slot opening into the smoke chamber as small as possible, as it is obvious that with a given velocity through the slot the total slot area would determine the necessary size and power required at the fan. If it were required to take care only of the gases and smoke from the locomotives while standing, or running light, a smoke slot 6 in. wide and an air velocity of 125 to 150 ft. per minute could be used. It was found, however, that to take care of all conditions, particularly an engine working hard, with the drivers slipping, it was necessary to make the smoke slot opening 9 in. and to keep the air velocity at 300 ft. per minute.

The baffle plates in the smoke ducts will be made of cast iron, as they come directly in contact with the locomotive blast. A protection plate of cast iron will be erected on the ceiling of the smoke chamber over the opening in the smoke slot.

The baffle plates will be provided with weep holes to drain the bottom surface of the smoke chamber when necessary. This undoubtedly will be seldom, as in all large experiments the smoke chambers were very dry, because of the large volume of air passing through them, absorbing all moisture and leaving a dry deposit of soot. All cinders were carried away by the fan

and were expelled into the outside atmosphere with the smoke.

While the tests have shown that the smoke chambers are very dry, it is possible that in very cold weather there may be some condensation. This, however, will be taken care of, as explained before, by weep holes in the baffle plates, allowing any moisture to drop to the floor of the track and thus be carried away by the track drains.

Viaduct Divided Into Small Units to Obtain Best Load Conditions

It was first proposed to treat each half of one viaduct as one unit of the system, but as it soon became evident that there was no economy in such a proceeding, it was decided to divide the viaducts into small units, and thus obtain the best load conditions that it is possible to put into effect at the power house.

It is intended to operate the fan motor by remote control switches at some central point, manipulated by some person from the station master's office—in all probability the same attendant that will look after the platform lights and train indicators. Automatic switches for the fan motors were considered, but were eliminated on account of their complications and their cost. The test structure was built under a contract which specified that all of the material was to become the property of the contractor when the structure was dismantled. The total amount of money that was expended on the experiment was $2500.

The engineers believe that the device is practical in every way, and they found, after a series of tests covering a period of three months, that the operation was very satisfactory and all that could be desired. This opinion was shared by outside engineers who observed the working of the device.

Safety Records in Building Construction in San Francisco

To show that safety precautions on building construction need not be costly, the California Industrial Accident Commission has compiled statistics covering work supervised by its safety engineers. An example is made of three large buildings recently completed in San Francisco, on which a particularly good record is reported. These are the California Theater and the Santa Fé and the Southern Pacific Buildings. The 10-story Southern Pacific Building, said to be the largest office structure west of Chicago, cost $1,500,000. On this job the cost of safeguarding 300 workers for a period of 12 months was $3952.50, or $13.15 for each worker employed.

On the 12-story Santa Fé Building, costing $350,000, the safety expense was $1032.35. This covered 175 workers for a period of six months, the cost per worker being $5.89. On the California Theater, which cost $500,000, thirty men were protected for 38 days for a total of $420, of which $240 was spent for nets. These were practically as good as new when the work was finished, and a salvage value of $200 is deducted from the cost of the nets, making the total cost of the safety provisions only $220. On none of these buildings was there loss of life or serious injury above the foundation level. One man was killed during the piledriving on the Southern Pacific Building.

Overhead and Time Cost to Erect Elevated Railway

Nine Hours per Ton Required to Haul, Erect, Rivet and Paint 13,500-Ton Structure—Overhead 30 Per Cent. of Total

By A. P. Roscoe
Ozone Park, New York

It cost nine labor hours per ton and $11 per ton to haul, erect, rivet and paint 13,500 tons of steel elevated-railway structure in New York City in 1916-1918. The precise costs were 9.21 hours and $10.95. Standard methods were employed, but delays of various kinds about doubled the time which would ordinarily have been required for the work. Overhead expenses ran from 19% to 37% of the total cost of the work. Stress was laid on recording overhead, and, in particular, on itemizing the labor hours expended.

Erection operations covered 11,190 ft. of three-track elevated railway, including five stations. The route was along an unpaved street with a two-track overhead-trolley electric railway. Crossing streets were about 700 ft. apart. Traffic was light and the street was only partially built up. Obstacles to erection operations consisted principally of electric trains and trolley cars operating below the structure and of live trolley wires and feeder cables which necessitated special precautions in handling steel.

Unloading and Hauling Steel

All of the steel, 13,394 tons, and the castings, 154 tons, were delivered in the original cars to a storage yard where they were unloaded by a 15-ton steel stiff-leg derrick. Some 640 tons, made up of especially large or heavy members, were hauled to the point of erection on flat-cars and there unloaded by the erection traveler. The remainder, 12,900 tons, was hauled by a fleet of three-ton motor trucks and trailers and was unloaded onto the street by hand. The largest pieces hauled by motor truck were 15-ton 90 x 7-ft. track stringers and 26-ton 63 x 7-ft. cross-girders. The average haul was 2200 ft., and the average piece was handled three times. The hours of labor per ton unloaded and hauled were:

Item	Hours per Ton
Foreman	0.228
Hoisting engineer	0.202
Bridgeman	0.456
Laborers	0.203
Motor truck and driver	0.408
Total	1.497

The money cost of hauling and handling is of importance chiefly because it shows the proportions of overhead expenses. These are divided into general overhead and special overhead, as explained and discussed in a separate summary and discussion of overhead below. The following tabulation gives the exact figures:

Item	Loading and Unloading	Hauling	Total
Direct labor	$0.596	$0.568	$1.164
Insurance	.133	.128	.261
Meneral overhead	246	.234	.480
Special overhead	.269	.015	.284
Total	$1.244	$0.945	$2.189

Erecting Steel—The steel erection included 211 bents, 453 columns and one express and four local stations aggregating 12,665 tons of riveted steel, 546 tons of beam steel and 87 tons of steel footing slabs. The bents

were 50 ft. apart, on an average; each consisted of two columns spaced 26 ft. apart carrying a 6-ft. cross-girder. The columns were made up of one 15-in. I-beam and two 15-in. channels with cover plates where necessary. Six 5-ft. plate girders were framed between the bents and braced laterally and for traction, to carry the three tracks.

At stations, street intersections, surface-railroad turnouts, curves, etc., this standard construction was modified to meet the conditions. Station platforms 500 ft. long consisted of two 3½-ft. plate-girder stringers supported on the cantilever ends of the cross-girders, with bracing and platform beams and a cantilever canopy. There is a mezzanine floor at each end of the station; this consists of shallow plate girders and I-beams suspended from the girders by double-angle hangers. The tracks are 13 ft. on centers except at the island express station, where they are 27 ft. 4 in. on centers.

A gantry traveler rolling on trucks on the center track stringers erected the steel. This traveler consisted of a timber platform, an 18 x 18-in. timber mast with a 16-ft. bull wheel, a 16 x 16-in. timber A-frame supporting the mast, two 14 x 16-in. timber backstays, and an 80-ft. lattice steel boom rated at 25 tons at 25-ft. radius and at 12 tons with flat boom. Hoisting was done with an 8 x 12-in. steam hoist equipped with swing gear.

The overall dimensions of the traveler were: Length 52 ft., width at front A-frame 32 ft., height from top of stringer to top of mast 47 ft. When raising steel the traveler was dogged down to the center track stringers in the rear and to one outside track stringer at each end of the front outriggers. It was hauled ahead by a set of falls attached to the cross-girder ahead and operated from the traveler winch head.

Erection of Steel

Steel was usually raised from the street surface, occasionally from motor trucks or flat-cars. The main steel was erected with the traveler falls. Cross-frames and canopy steel were erected with the boom runner line. Laterals were raised by the traveler and put in place by the fitting-up gang. At eight points the span length exceeded the reach of the boom, these spans being 80, 90, 88, 100, 85 and 90 ft. The columns and cross-girders at the 80- and 85-ft. spans were erected by the traveler boom by outhauling with a runner line reeved through a block anchored ahead of the bent being erected. The cross-girders for the longer spans were set by a steel ginpole using the traveler falls and topping lift to supply power. The heaviest piece raised by the boom was a 30-ton cross-girder.

In standard construction the average weights of pieces were as follows: Columns, two tons; cross-girders between stations, five tons; cross-girders in stations, 10 tons; track stringers, six tons; platform stringers, 3½ tons; through girders over mezzanines, 19 tons. The heaviest piece was a through girder of 91½ ft. span, weighing 36.7 tons. The longest piece was a 110-ft. platform girder weighing 12½ tons. The average panel weight was 62.9 tons and the average weight per foot of structure was 1.18 tons, or 2360 pounds.

The erection gang contained 19 men, as follows: Raising main steel, one foreman, one engineer, six bridgemen, two apprentices and one flagman; fitting up small steel, one pusher, five bridgemen and two apprentices. The hours of labor per ton of steel erected were:

Item	Hours per Ton
Foreman	0.162
Pusher	0.143
Engineer	0.158
Bridgeman	1.381
Apprentice	0.495
Team	0.091
Laborer	0.134
Total	2.564

The money cost, based on 13,300 tons, was as follows:

Item	Per Ton
Direct labor	$1.635
Insurance	.367
General overhead	.684
Special overhead	.481
Total	$3.167

Field Riveting—The total tonnage riveted was 13,211 tons, of which 546 tons were beam steel. A total of 265,800 rivets was driven by air hammers. A gasoline-driven compressor on the street supplied air to an average of 5 four-man gangs. No scaffolds were required except at column brackets. All rivets were ⅞-in. button-head, except in columns and canopies, where ¾-in. rivets were used. Labor time costs include blacksmith work, operating the compressor, laying and removing the air pipe, reaming, placing scaffolds and riveting, and in hours per ton were as follows:

Item	Hours per Ton
Foreman or pusher	0.119
Engineer	0.154
Bridgeman	2.187
Apprentice	0.245
Blacksmith	0.071
Blacksmith helper	0.041
Total	2.817

The average number of rivets driven per gang per day was 294. The cost per ton and also per 10 rivets driven was as follows:

Item	Per Ton	Per Ten Rivets
Direct labor	$1.925	$0.958
Insurance	.433	.215
General overhead	.802	.399
Special overhead	.208	.103
Totals	$3.368	$1.675

Painting—A total of 13,211 tons of steel was painted. All structural steel had received one coat of red lead before leaving the shop. After erection, all rusted or otherwise damaged portions of the shop coat were scraped and repainted. The shop coat was in good condition except for three subsections, comprising 3700 tons, which had been stored exposed to the weather for more than a year. Here the shop coat was badly damaged and required extensive renewal. The first field coat was black, the pigment being 50% red lead, 25% lampblack and 25% magnesium silicate and silica. The second field coat was olive green in color, the pigment being red lead 10%, lampblack 3%, magnesium silicate 10%, yellow ocher 67% and chrome green 10%. The vehicle for both field coats was raw linseed oil, with 5% and 6% of driers, respectively. All painting was done with flat brushes. The labor costs in hours per ton were as follows:

Coat	Hours per Ton Foreman	Hours per Ton Painters
Shop coat renewal	0.109	0.850
First field coat	0.111	0.644
Second field coat	0.078	0.540
First and second field coat	0.189	0.184
All painting	0.298	2.034

The money costs, based on 13,211 tons of steel, were

as shown in the table which is reproduced herewith:

Item	Cost per Ton: Renewal of Shop Coat	First Field Coat	Second Field Coat	All Painting
Direct labor	$0.375	$0.304	$0.250	$0.929
Insurance	.071	.058	.047	.176
Material	.328	.199	.176	.703
General overhead	.151	.125	.102	.378
Special overhead	.016	.014	.011	.041
Total	$0.941	$0.700	$0.586	$2.227

Overhead Expenses—Separation was made of overhead expenses, as shown by the tabulations, into general and special overhead. Included in general overhead are: Bond premium, interest on invested capital, lost interest on retained percentages, proportionate part of main-office salaries and expenses, field supervision, field-office rent and expenses, rent of yards, construction shanties, and legal expenses. Special overhead includes tools and supplies, plant depreciation and repairs, watchman, water boy, etc., particular to the individual operation.

The total of the general overhead items was distributed among the items of the work, first in proportion to the money value of the work and, second, in the ratio of the direct labor cost on each item. The amount charged as general overhead on any item of work was the mean of these two figures. The percentages of overhead in the various items of erection work are given by the following tabulation:

Item	Direct Labor	Labor and Material	Total
Unloading and hauling	65.5	53.6	34.8
Erecting	71.2	58.3	36.8
Riveting	52.5	42.8	30.0
Painting	45.1	23.2	18.8
Total	59.5	44.2	30.7

The cost of the steel itself f.o.b. yard is not included in "Material" in the above tabulation. If the cost of the steel is included at $40 a ton the percentage of overhead on labor insurance and material would be seven per cent.

Irrigation for Soldiers' Lands in Kansas

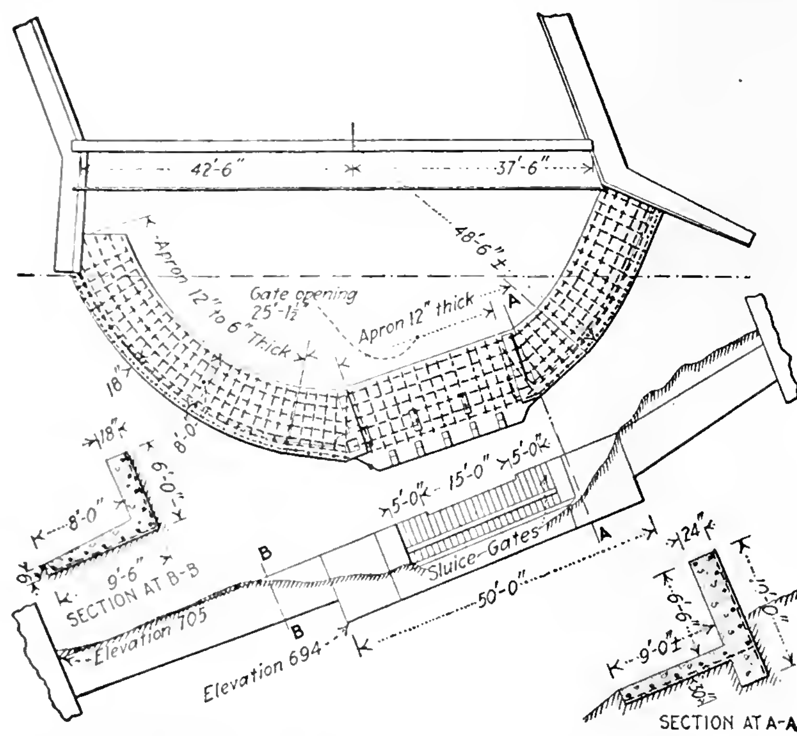
Study of the area of land irrigated and possible of irrigation in western Kansas has been made as part of an investigation concerning homes for returning soldiers. Rainfall in Kansas averages 30 to 40 in. per year in the eastern third of the state, 20 to 30 in the middle and less than 20 in. in the western third. Reports from 17 of 39 counties in the last named section showed 73,626 acres under irrigation by both ditch and pump methods, or an average of 4331 acres per county, exclusive of truck gardens. Applying this figure to the other counties and including the land which is irrigated only occasionally, the total area under irrigation is estimated at about 100,000 acres. Estimates of acreage possible of irrigation totaled 1,404,480 acres for 18 counties, or over 60,000 per county. The estimate of such land for the entire section is 1,876,080 acres. Inquiry made concerning supplemental irrigation of crops, employed only during periods when rainfall is abnormally light, showed good results from this practice.

These investigations were made by J. B. Marcellus, drainage and irrigation engineer for the division of college extension at the Kansas State Agricultural College, Manhattan.

Balanced Automatic Sluice Gate for Park Dam

In Central Spillway of Concrete Dam the Movable Timber Section Drops When Flood Height Tops Main Crest

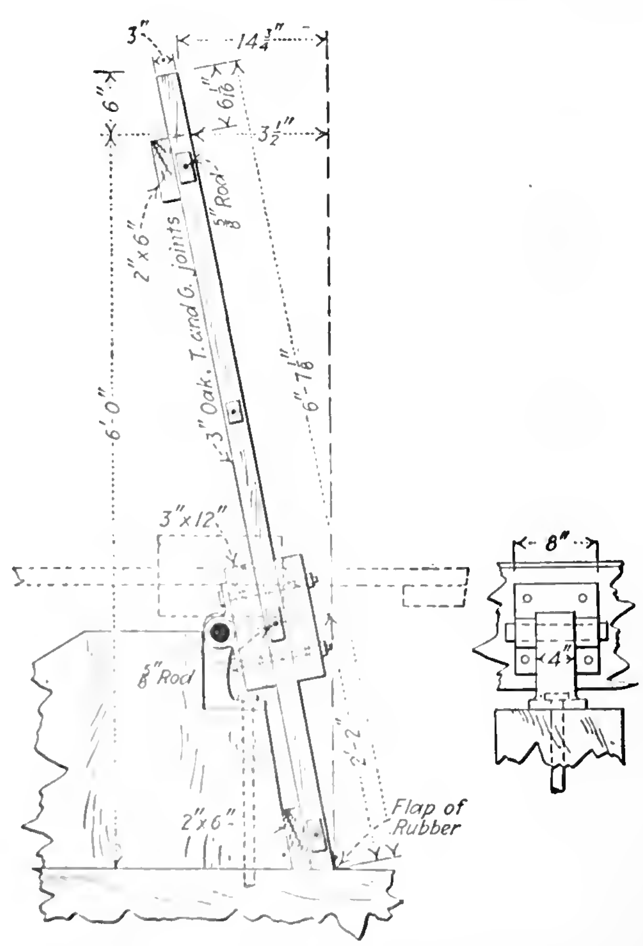
IN ORDER to provide spillway space during floods and reduce the deposition of sediment in the pool, an automatic sluice gate was designed and built for a dam in Harmon Park, Lebanon, Ohio. The dam itself is roughly semi-circular in plan, as shown in the drawing,



PARK DAM WITH MIDDLE AUTOMATIC SLUICE GATE

and consists of an L-shaped concrete main section with a central spillway section in which is placed the automatic wooden sluice gate.

This sluice gate, as shown in the detailed drawing, is in effect a shutter 25 ft. long and 6½ ft. deep, made

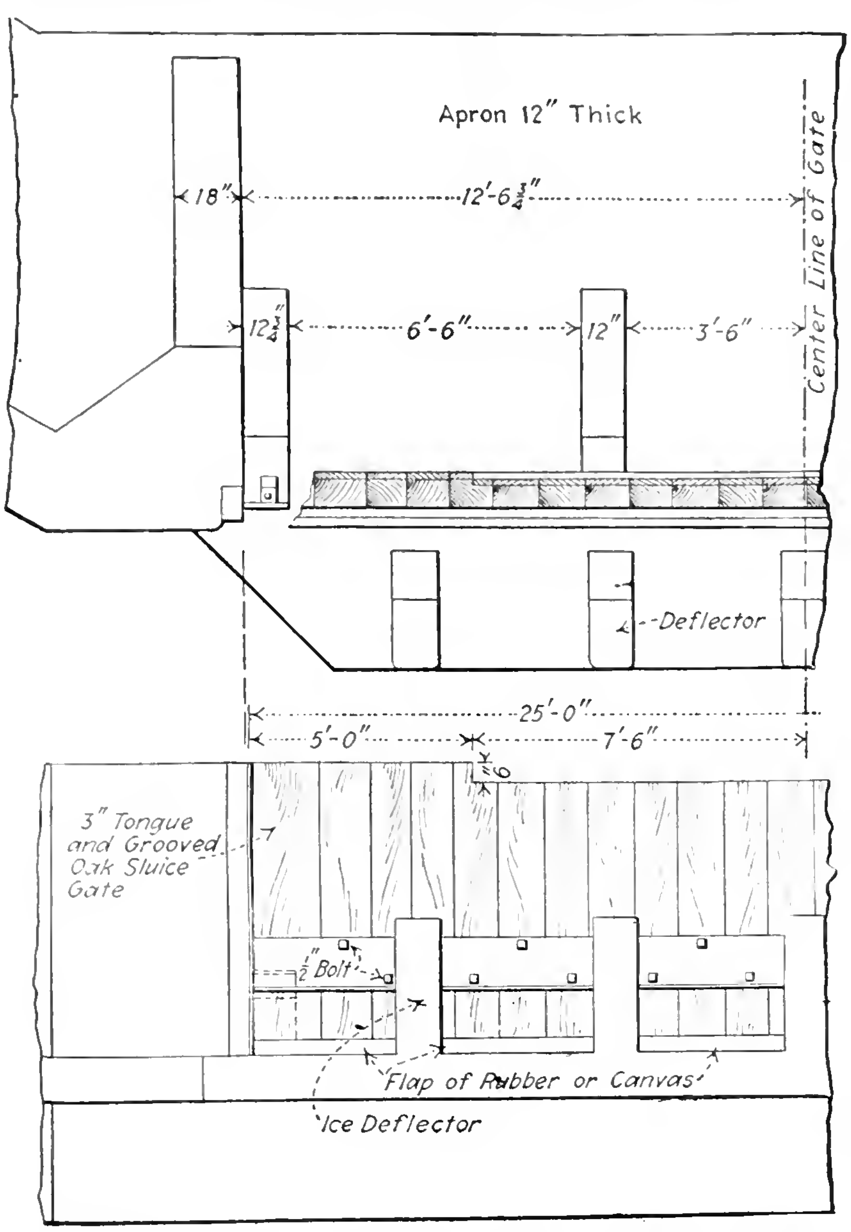


END ELEVATION OF SLUICE GATE

up of 3-in. tongue-and-groove oak plank placed vertically on a transverse 3 x 6-in. sill. This sill, which is at the lower third point of the gate, bears against hinges on concrete counterforts raised from the concrete apron

AUTOMATIC SLUICE GATE AT LEBANON, OHIO, WITH FLOOD JUST PASSING OVER ITS FULL HEIGHT

of the spillway. When the water reaches such a height that the overturning moment is greater than the resisting moment of the water head, the gate turns until it becomes horizontal and allows the flood to pass over.



ELEVATION, SOUTH HALF, LOOKING DOWNSTREAM

Small deflectors of concrete in front of the sluice gate are made of concrete walls integral with the concrete base of the apron.

The dam has now been in place about 18 months and has passed one spring freshet successfully. It was designed by Frank A. Bone & Son of Cincinnati, Ohio.

Trade-Waste Treatment Studies in Wisconsin

Wide Range of Investigations Made to Help Lessen Water Pollution—Treatment Methods—Test Plant at Milwaukee

By E. J. Tully
State Sanitary Engineer, Madison, Wis.

THE Division of Sanitary Engineering of the Wisconsin State Board of Health has devoted particular attention for some time to the prevention of water pollution by industrial wastes. Investigations have been conducted in every section of the state. The aim in selecting the system of treatment has been to combine effectiveness with simplicity of construction, reasonableness in cost and simplicity of operation, to eliminate technical supervision and to include recovery or partial recovery of waste products, as this is the ideal solution, when feasible. These investigations have included examination and small-scale experimental studies of creamery, cheese-factory, casein, canning-plant, gas-plant, brewery, tannery, rendering, glue, woolen, starch, iron and steel plant, paper and pulp mill, both sulphite and sulphate, coke-oven, chemical and dye, and explosives-plant wastes. In every instance, local sanitary requirements are the prime factors in deciding on the degree of treatment. The main purpose is to effect satisfactory reduction—depending on circumstances—in concentration of organic matter, and thereby to produce an effluent of such character that disposal by dilution may be satisfactorily accomplished, utilizing as fully as conditions permit the dilution method of purification, since it is our opinion that if a water course can receive and satisfactorily dispose of partially treated rather than completely purified wastes, without offense or detriment to riparian owners, it would be unwise and uneconomical not to take advantage of the opportunity to make the most reasonable use of the purification factors of dilution.

It has been found desirable to outline in blueprint form, after local investigation, the type of treatment unit or system believed to be adequate to accomplish the degree of purification deemed sufficient to meet local sanitary requirements. Instructions are given in constructional features and operation and care of the system. The necessity for supervision is emphasized. A wooden plank cover for the unit is specified. Considerable attention has been devoted to creamery and cheese-factory wastes, and wastes of canning factories, gas plants, tanneries and paper mills.

The procedure in the treatment of creamery and cheese-factory wastes, as these are comparable in character, includes discharge of cooling and boiler waters directly, where this is feasible; disposal of chemical wastes in excavation, and treatment of industrial waste proper, and of sewage, in case a public sewer system is not available, in a combination unit comprising two or three retention chambers. The first one contains a liming trough below the inlet or a section filled with crushed limestone, and the last is followed by a contact coke continuous chamber, and a gravel sand filtration chamber. A filtration trench is sometimes substituted for the type of filter. The disposal of casein waste is accomplished in somewhat similar manner, neutralization of the acid waste being effected by soda-ash before sedimentation, which is followed by gravel and sand

filtration. Disposal of these wastes by subsurface filtration, where the geological formation is gravel or sand, is resorted to, after preliminary treatment, when dilution is not feasible.

The canning industry is quite an important one. Wastes from this type of industry include, besides cooling waters, sewage and industrial waste proper, comprising pea and corn washings, plant washings and silage juice. Effective disposition includes direct discharge of cooling waters, discharge of domestic sewage by connection with the public sewer system, when available, conveying, after coarse screening, corn, pea, and plant washings, silage juice effluent, and sewage, when necessary, to a single point, and subjecting them to sedimentation in a three-section settling basin, and straining in a roughing filter, contact or direct, according to conditions. Preliminary treatment of silage juice is effected in a small three-section unit combining filtration through crushed limestone to accomplish partial neutralization, coke contact filtration and gravel filtration. In some instances, preliminary treatment in a single unit includes sedimentation after neutralization with soda-ash, applied from a barrel equipped with a faucet, coke contact filtration and gravel filtration. When a water course is not available or is relatively distant and a gravel formation is at hand, disposal by natural filtration in a series of excavations, after preliminary treatment, is an indicated procedure. Recovery of waste products and substances of fertilizing value is accomplished.

Tannery waste, because of its volume, usually requires large-scale treatment, the plan of disposal including differential screening in a long conduit prior to sedimentation in a two-section unit, each section comprising two chambers, and coke contact or direct filtration. Recovery of byproducts, hair and products of fertilizing value, is effected.

The plan of treating gas-plant waste consists of discharge into concrete tar-retention chambers and treatment of the effluent in a unit composed of four chambers, the first a sedimentation section containing a liming trough below the inlet, the two following chambers functioning as coke contact filters, the fourth and last a gravel-sand filter. The heavy tars recovered have been used for road work.

The relatively great volume of paper-mill wastes presents an element of difficulty in attempting to deal satisfactorily with this type of discharge. The procedure as to disposal includes the recovery of byproducts, woody suspended matter and pulp, and comprises differential screening for removal of woody suspended matters; the final screen or save-all being 80-mesh, the discharge from the screen passing into a box of adequate area containing a perforated flooring over which is laid o double layer of rope netting, which functions as a strainer or filter; sedimentation and pressing of mineral suspended material, reduction being effected before pressing by admixture with sewage, if necessary; and coke filtration, either contact or direct, or a combination of both, depending upon conditions, of "blow liquor," liquid waste proper.

Coke byproduct and chemical wastes are treated by a plan comprising chemical application, sedimentation, and aëration by discharge over shallow beds of stone, or filtration through a system comprising contact or direct coke beds, or both, and a gravel-sand bed.

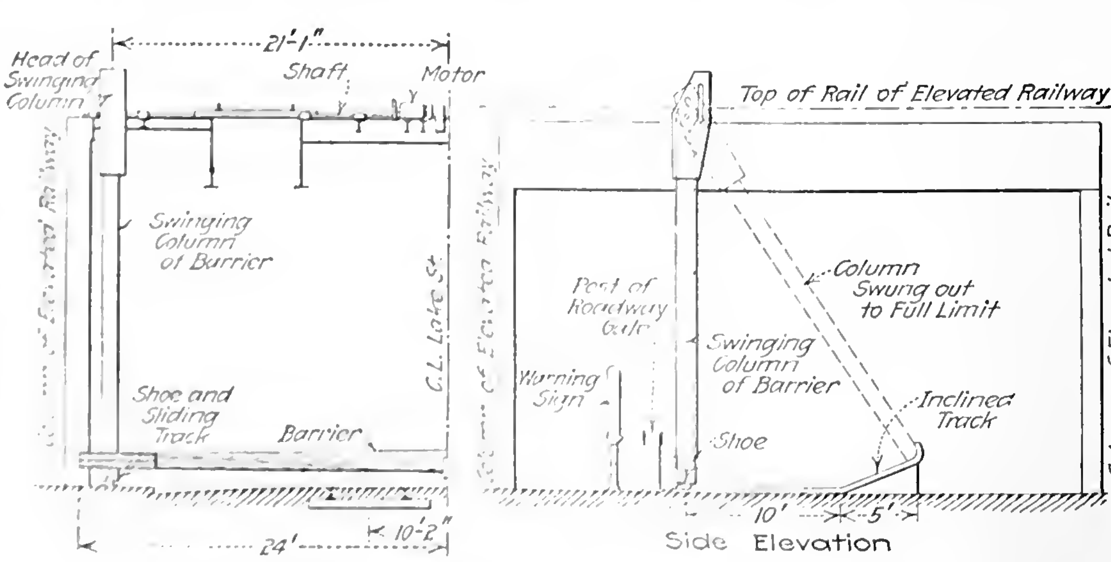
The Division of Sanitary Engineering has designed a fairly large experimental plant of wooden construction to treat, at a Milwaukee plant, chemical discharges, ammonia liquors, coke quenching waters, etc. The system comprises a sedimentation basin 15 x 4 ft. in plan and 5 ft. deep, a coke contact filter, 6 x 6 x 5 ft. deep, using 1-in. medium; a coke filter 6 x 6 x 5 ft. deep, using coke breeze as the upper layer of the filtering medium, distribution being effected by a wooden trough equipped with lateral, triangular boards, 6 in. at base and cut to a point at the end, and attached at openings of the trough; and a gravel-course sand filter, 6 x 6 ft. in plan, containing about 3 ft. of sand medium supported by coarse aggregate, with distribution as in a coke filter. The system is now in operation, and it is intended to experiment with the raw waste and to try coagulants and admixtures with sewage. A progress report will be submitted soon.

Yielding Barriers Close Roads at Drawbridges

Impact of Vehicles Absorbed by Traveling Gate to Stop Motor Trucks, and by Cables to Stop Automobiles

ESSENTIALLY different types of barriers to close the approaches to open drawbridges are represented by recent installations in Chicago and at Salem, Mass. The former, which is designed to stop the heaviest vehicles, consists of a rigid pole carried on traveling supports which move backward against sliding frictional resistance. The latter is designed only to stop automobiles, and is composed to cables attached to the pistons of oil-filled cylinders which form hydraulic brakes. Two other yielding barriers, both of the flexible or deflecting type, were described in *Engineering News-Record* of May 23, 1918, p. 1008.

For the protection of vehicles on the approaches to the Lake St. bascule bridge in Chicago there are provided yielding barriers which are designed to stop even electric cars and heavy motor trucks that may disregard the warning signals. This is a double-deck bridge, with an elevated railway on the upper deck; when it is open the roadway on either approach ends at the edge of



RIGID BARRIER AT LAKE STREET BRIDGE, CHICAGO, SWINGS BACK AGAINST FRICTIONAL RESISTANCE WHEN STRUCK

a large open tailpit 45 ft. deep, so that it was necessary to provide some sure method of stopping vehicles approaching out of control. The barrier is placed 8 ft. beyond the usual swinging-arm gate, leaving a 20-ft. space between the barrier and the pit.

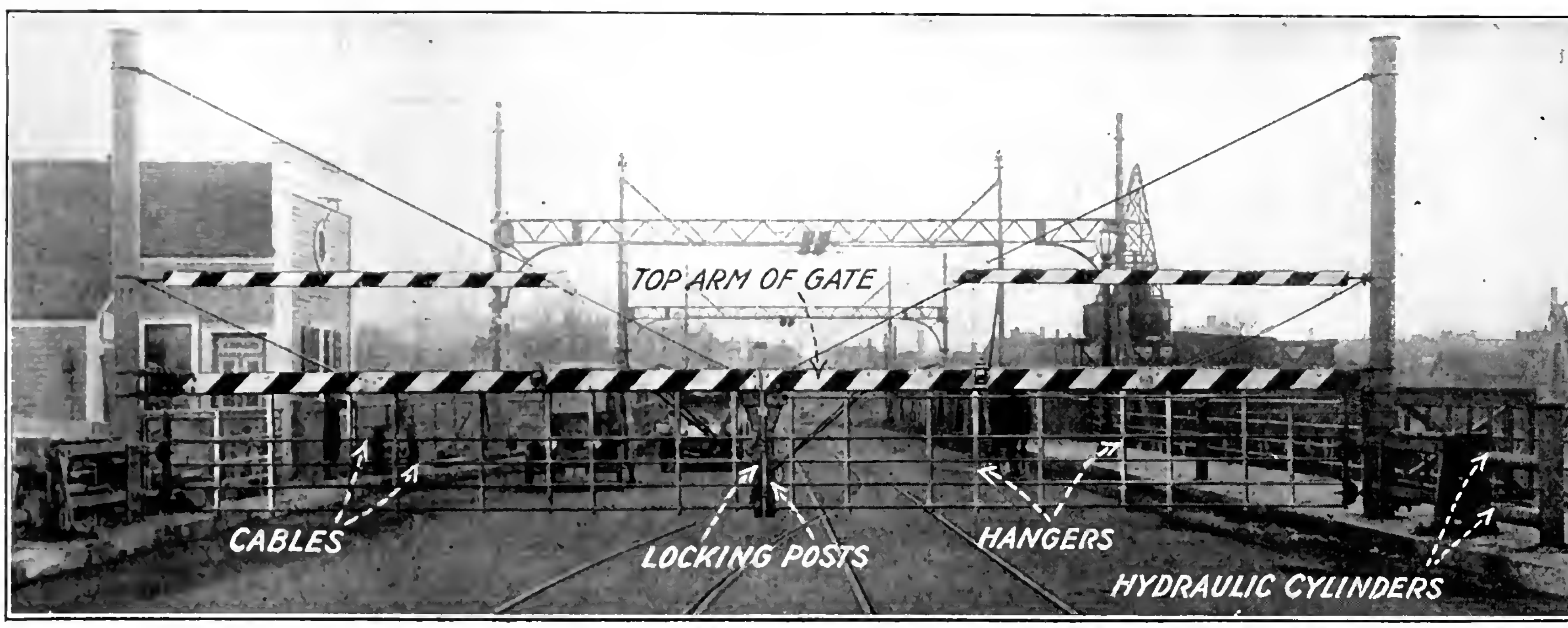
The barrier itself is a Douglas fir stick about 42 ft. long, turned to a diameter of 16 in. at the middle and having ends 10 in. square fitted to steel forks or guides. Truss rods on each side add rigidity to the timber. The forked ends engage vertical columns of 12-in. pipe which are seated on wheels and sliding shoes at the curb line and have their upper ends pivoted to a shaft carried by the girder framing of the elevated-railway approach. Each end of the barrier is attached to two ½-in. cables wound upon a drum in the structural steel head of the column, which drum also carries two similar cables for a cylindrical cast-iron counter-weight sliding inside the column. A 5-hp. motor operates the shaft and cable mechanism. The timber is housed normally beneath the girders of the elevated railway; when lowered, its center line is about 2 ft. above the roadway.

While the column has a rotating motion around the shaft it is not journaled to it, the shaft lying in a slot which permits vertical movement of the column. The foot of the column has a 10-in. wheel resting on track rails parallel with the curb, and outside of the wheel are shoes sliding on flat track plates so as to afford frictional resistance. The rails and the track plates are inclined, as shown in the drawing. When the barrier is struck the columns roll back on the wheels until the shoes engage the track plates and slide upon them. The steep incline of the end portions of these adds further resistance, and an end stop limits the total travel to 15 ft., with a vertical rise of about 2 ft. in that distance.

As a test, an old eight-ton electric car with front end reinforced against the shock was run against the barrier at a speed of 12 miles per hour, carrying the barrier to the full limit of its travel without injury to the barrier or the car. No unintentional test due to careless driving has occurred. To provide against street cars being held on the bridge by the lowering of the barriers, there is an automatic interlocking device which prevents operation of the barriers or the bridge while a car is between the gates.

This yielding barrier was designed by F. H. Avery, engineer of bridge construction and repairs, Department of Public Works, Chicago, who superintended the plans and construction under the direction of John Ericson, city engineer, and Thomas G. Pihlfeldt, engineer of bridges. The contractor was S. P. Harding.

Protection of automobiles on the approaches to the Essex drawbridge between Salem and Beverly, Mass., is afforded by flexible yielding barriers which are designed to stop light vehicles and which it is thought will check heavy trucks to such an extent that they can be stopped in the 75-ft. distance between the barrier and the draw opening. While a street car or heavy motor truck at high speed would probably break through the barriers, it was considered best not to attempt to make them strong enough to stop a truck, while the stopping of street cars was considered to be a matter for the electric-railway company.



FLEXIBLE BARRIER OF CABLES YIELDS UNDER IMPACT BY PULLING OUT PISTONS IN HYDRAULIC CYLINDERS

Each barrier is composed of two horizontally swinging gates or leaves which meet at the center of the roadway. Each leaf consists of a combined steel and wood arm placed 5 ft. above the roadway and carrying hangers through which are led four ⅝-in. wire cables 10 in. apart. At the outer end of each leaf the cables are attached to a vertical member hung from the top arm but free to disengage from it. When the gates are closed the locking mechanism on these members is engaged by levers, so that the cables form a continuous structure across the roadway.

At the hinged end of the leaf each pair of cables is looped around a stirrup to which is attached a ¾-in. cable passing over a horizontal guide sheave on the gate post and attached to the rod of a piston in an oil-filled cylinder. The two cylinders on each side are mounted in a frame placed parallel with the curb. Should the gate be struck by a vehicle it will yield, the pressure on the gate cables pulling out the four pistons against the resistance of the oil. The top arms are hinged at two points in each leaf and are not connected at the center, so that they are free to follow the curve of the cables without breaking. At the same time the hinges are so supported as to prevent vertical deflection of the arm.

Wrought-iron pipe of 5½-in. inside diameter is used for the cylinders, with a piston diameter $\frac{1}{16}$ in. less. Through the $\frac{1}{32}$-in. annular space the oil escapes as the piston is pulled forward. To prevent excessive pres-

sures and a too sudden stop to a light vehicle moving rapidly, a safety valve provides for escape of a portion of the oil when the pressure reaches 8000 lb., or about 500 lb. per square inch. The oil used is that employed in refrigerating machinery, which thickens only slightly even at a temperature of several degrees below zero. Under average conditions the resistance afforded by each cylinder is about 4000 lb. against a piston moving at the rate of 3 ft. per second. This means a total resistance of 16,000 lb. for the four cylinders of each gate. The gate posts are designed to withstand the reaction of the cylinders together with a downward pull on the gate arm. A travel of 4 ft. by the pistons allows for a 12-ft. deflection of the 42-ft. gate.

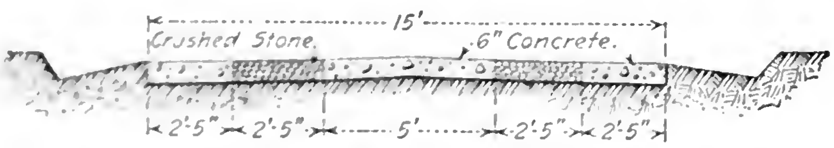
Interlocking the gate locks with the bridge-lock lever prevents operating the bridge until the gates are closed and locked, while the gates cannot be released and swung until the span is locked in its closed portion. The bridge locks are released by hand levers and the gates are swung by hand, being in charge of a bridge watchman. The 3 x 9-in. timber on the top arm of the gate is painted in diagonal stripes of black and white, and the gate is made still more conspicuous by a similarly painted plank carried above it by the gate post and a guy rod. On the top arm of each leaf is a lamp showing red toward the roadway and throwing a white light on each side to illuminate the painted arm. Warning signals are to be installed 300 ft. from the bridge.

No test, either intentional or accidental, has been made by moving vehicles. This bridge is opened only at long intervals, but is on a main highway which averages a traffic of over 3000 vehicles per day in summer, mainly automobiles. As the road is straight, most of these vehicles travel at considerable speed. The flexible yielding barrier was designed by Robert R. Evans, county engineer of Essex County, Salem, Mass.

Multiple-Strip Concrete Road to Conserve Material

BUILDING a concrete road in several strips requiring a minimum amount of material so placed that wheel-ways in both directions are provided, has been resorted to on a roadway leading to Lewis Point, St. Augustine, Fla. Duval County has since let a short stretch, and various other counties of Florida will advertise, in the near future, for a considerable mileage of this type of construction.

On the Lewis Point section, a view of which is shown, the specifications called for three strips 6 in. thick and with dimensions and arrangement as shown in the diagram. The concrete specifications call for Columbia granite in sizes from ½ to 1½ in. Lake Weir sand, which is considered one of the best sands in the state, was used. The proportions were 1 : 2 : 4. The slab was laid in one course, with ½-in. transverse-expansion joints



CROSS-SECTION OF MULTIPLE STRIP ROADWAY

every 15 ft. The concrete was thoroughly tamped and was finished by the canvas-belt method. All edges were rounded with a ½-in.-radius edging tool to obviate chipping under traffic.

The outside forms were set first in the usual way, the interior forms being left until the work was started, when they were placed in short lengths so as not to interfere with the concrete mixer. Setting the interior forms was accomplished very expeditiously by resting a templet cut to the proper crown upon the outside forms. They were set to line by means of the templet and spacers. The forms were of wood and were doweled together at the ends. When the forms are removed the space between the strips of concrete can be filled with gravel, crushed stone or other suitable material.

In normal times this road can be built in Florida for \$2.50 per square yard of concrete. A contract for 850 sq.yd. was recently let by Duval County at the rate of \$2.82. This would naturally be reduced on a larger contract. Where only single-track road is required it may be constructed of two strips from 2 to 3 ft. wide and about 8 ft. out to out.

In addition to the securing of a 15-ft. roadway with 10 ft. of concrete, another advantage is that traffic is distributed and is forced to keep to the right. It is

COMPLETED MULTIPLE-STRIP DOUBLE-TRACK ROADWAY

thought that this distribution will tend to reduce accidents and increase the life of the pavement.

The work shown was laid under the supervision of E. M. Wellman, construction engineer, of St. Augustine, and the plans and specifications were prepared by S. N. Cornwall of the National Highway Corporation, Jacksonville, Fla., who holds a patent on this type of road.

Tests of Wrapped Airplane Struts

Compression tests of wrapped and cloth-covered airplane struts made of cross-grained Sitka spruce and Douglas fir, in comparison with struts not covered, have shown that the wrapping and covering are of very little value. The Forest Products Laboratory, which carried out the tests, states that wrapping with cotton tape had no appreciable effect on strength. Governing with Bakelized canvas increased the buckling load and the deflection at time of failure; in other words, it increased both the strength and the resilience or shock-resisting capacity of the strut. However, the strength per unit of weight was decreased. The conclusion reached is that all the coverings tested have less value than the same volume of wood.

Precast Plates Form Shell of Concrete Barge

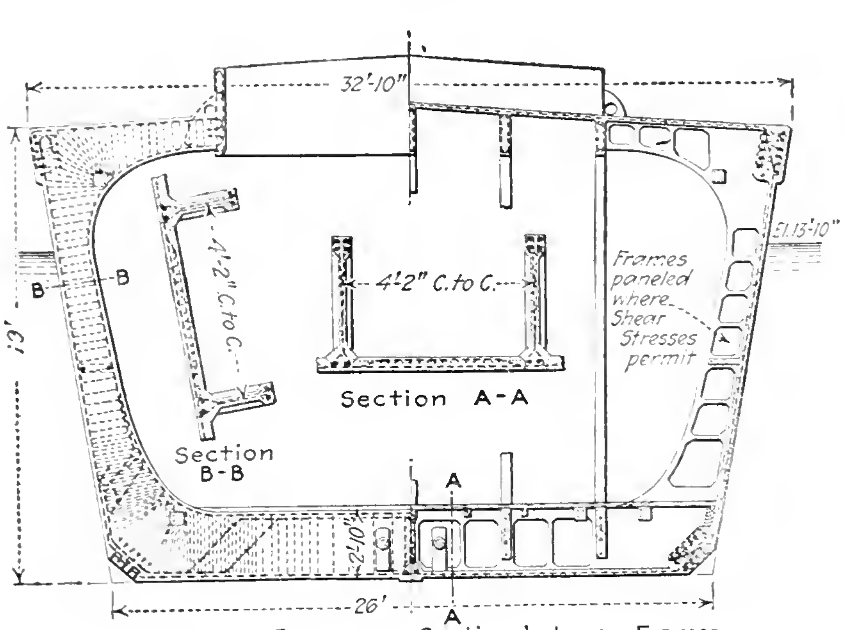
Bottom and Sides of Experimental Boat Built in British Yard Are Tied Into Frames Poured Inside of Forms

CONCRETE barges being built in a new yard in England have sides and bottoms made up of precast concrete plates fitting between the frames, which are cast in place according to the usual methods in concrete-barge construction in this country. An article by W. N. Twelvetrees in a recent issue of London *Engineering* describes the yard and the method of construction, devised by Capt. J. H. Waller, now with the British Army, but recently a civil engineer in Dublin.

The first barge built was in general accordance with the plans and specifications of the British Department of Merchant Shipbuilding. It measures 187½ ft. in length overall, 32 ft. 10 in. breadth at deck level, and 19 ft. in depth. The cross-section herewith shows the general type of design. The frames, continuous across the boat, are reinforced as shown. Longitudinal stability is insured by gunwale and bilge girders and a center keelson. All of these are poured in place at the same time as are the frames.

The bottom of the barge is formed of two rows of plates 3 in. thick, each plate being 11 ft. long by 2½ ft. wide, the end joints occurring at the bilges and center keelson, and the side joints are successive transverse frames—that is, every 4 ft. 2 in. The sides are formed of plates about 15½ ft. long by 3½ ft. wide and 3 in. thick, the end joints being at the gunwales and bilges and the side joints at successive transverse frames. The deck plates are only 2 in. thick and are jointed at the gunwales and hatch coamings. All the joints are in planes at right angles ~~to the~~ longitudinal axis of the vessel, and the edges of the plates are chamfered so as to permit the additional bond of the poured joint concrete. Rods project from the precast plates along all sides, and are bent perpendicular to the plates and twined around the bars inside the frame forms.

The plates are cast in a special yard connected by industrial track to the shipways, and are handled to the ways by derrick cars. In construction, the first work is to place the bottom plates on timbers laid across the shipways. These form the bottom of the ship, and the forms for the bottom and side frames are erected between and alongside of the bottom plates. After the side forms are up, the side plates are slipped in place, with the steel protruding and the frames poured. The deck plates are then erected, and the deck forms for the poured concrete are put in place, after which the boat is finished up.

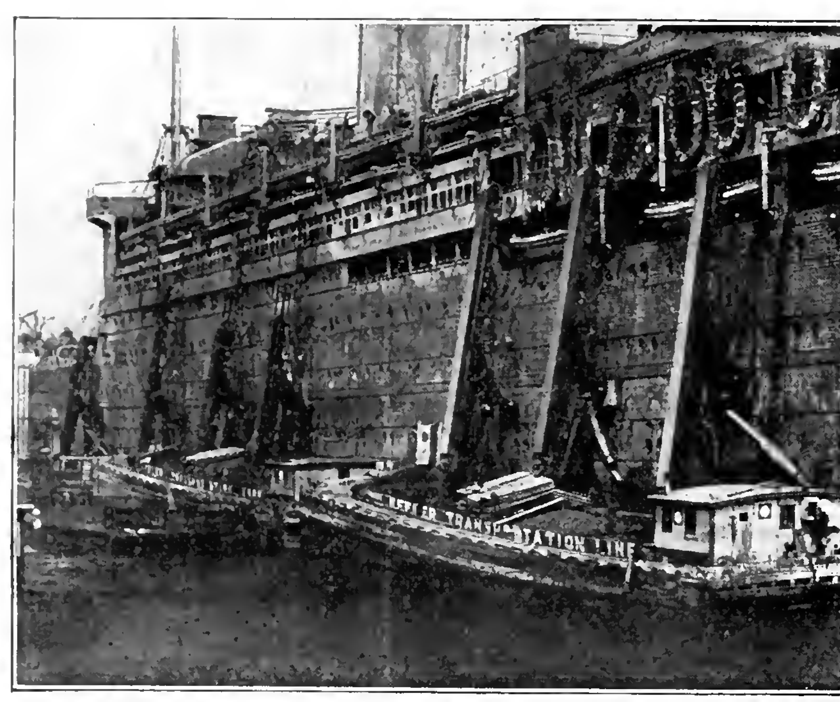


CROSS-SECTION OF BRITISH CONCRETE BARGE WITH SHELL OF PRECAST PLATES

Bucket Chain Conveyors Coal Transports

RAPID turn-around of the United States transports is being materially helped by the use of a mechanical coaling system which speeds up the filling of the coal bunkers. This apparatus has been used regularly at the Army transport bases at Hoboken, N. J., and Newport News, Va. While exact figures are not available, it is stated that the time in port has been reduced at both terminals.

The device consists of an endless-chain inclosed bucket elevator which is suspended by tackle from the side of the ship and which discharges into side ports of the vessel.



COALING THE "LEVIATHAN" WITH MECHANICAL CONVEYORS DISCHARGING INTO SIDE PORTS

When not in use the units are disposed on the adjacent pier. The elevator consists of two main members: The head, in which is installed an electric driving motor, and the leg, which slants vertically to the head and is raised and lowered as desired. The coal conveyor, of the endless-chain and bucket type, engages the coal at the boot of the leg.

When all is ready for operation the leg is raised sufficiently to allow the barge to move under it and is then lowered into the coal. The buckets lift the coal up only to the head and not to the top of the conveyor, and there permit the coal to be discharged into chutes which can be turned so that the slope will carry the coal into side ports. The view herewith shows the machine in operation on the U. S. A. transport "Leviathan" at Hoboken. The elevator is controlled by the Michener Stowage Co., New York City.

Heavy Shop Framing for 250-Ton Traveling Crane

Columns Carry Double-Deck Runways With T-Section Girders for Overhead Crane Handling Locomotives — Wood Paving

SPECIALLY heavy structural steel work is required in the repair shop now being built for the Pennsylvania Lines at Logansport, Ind., in order to carry what is believed to be the largest and most powerful electric traveling crane yet built for handling locomotives. Plate girders 5 ft. deep with 22-in. stiffening chords are supported on the H-section flanges of columns 48 in. wide. The crane has a lifting capacity of 250 tons and a span of nearly 86 ft. between the runway rails. It will pick up the heaviest locomotive and carry it over other engines to any one of the repair tracks. In addition, there are 10-ton traveling cranes of nearly 83-ft. span, which operate on runway girders below those of the larger crane.

The repair shop is 420 x 195 ft. and has its width divided into three bays: A 90-ft. erecting shop with 54 ft. clear height, a 73-ft. heavy machine shop 34 ft. high, and a 30-ft. light machine shop with a mezzanine floor for tool room, toilet rooms and the smaller classes of machines. The columns are spaced 24 ft. on centers, except that in the two end panels the spacing is 30 ft. Trusses carry the roofs of the two larger bays. In the 75-ft. bay each third panel of the roof has the purlins carried by the bottom instead of the top chords of the trusses, thus forming a series of transverse monitors which provide for light and ventilation. In the 30-ft. bay the roof is carried by I-beams. The upper floor in this bay has steel framing incased in concrete and covered with a concrete slab on which is laid wood-block paving. This floor is designed for 300-lb. live load and 100-lb. dead load.

A T-section is used for the columns of the erecting shop. It consists of a 48-in. web plate with flange angles, and a heavy inner flange composed of one 18-in. I-beam and two 15-in. channels, as represented in Fig. 3. This flange carries the runway for the 250-ton crane, while the rest of the column section, narrowing to 24-in. width, extends up to carry the roof trusses. Separate columns are provided for the runway girders of the 10-ton cranes; these are 12-in. I-beams, placed just inside the main columns and tied to the latter by diaphragms. These posts rest on the same bedplates and footings as the main columns, but have separate shoes and anchor bolts.

The runway girders for the 250-ton crane are 60½ in. deep, and are of the section sketched in Fig. 3. (See next page). The top flange is a horizontal girder composed of a 22-in. plate with four flange angles, the 150-lb. crane rail being laid on this web plate and secured by horizontal bolts which pass through the web of the rail and the upper flange angles on the plate. The flange is capable of taking a side thrust equal to 10% of the lifting capacity of the crane. In the design of the girders 25% was added to the live road to allow for impact. The wide top chord provides resistance for

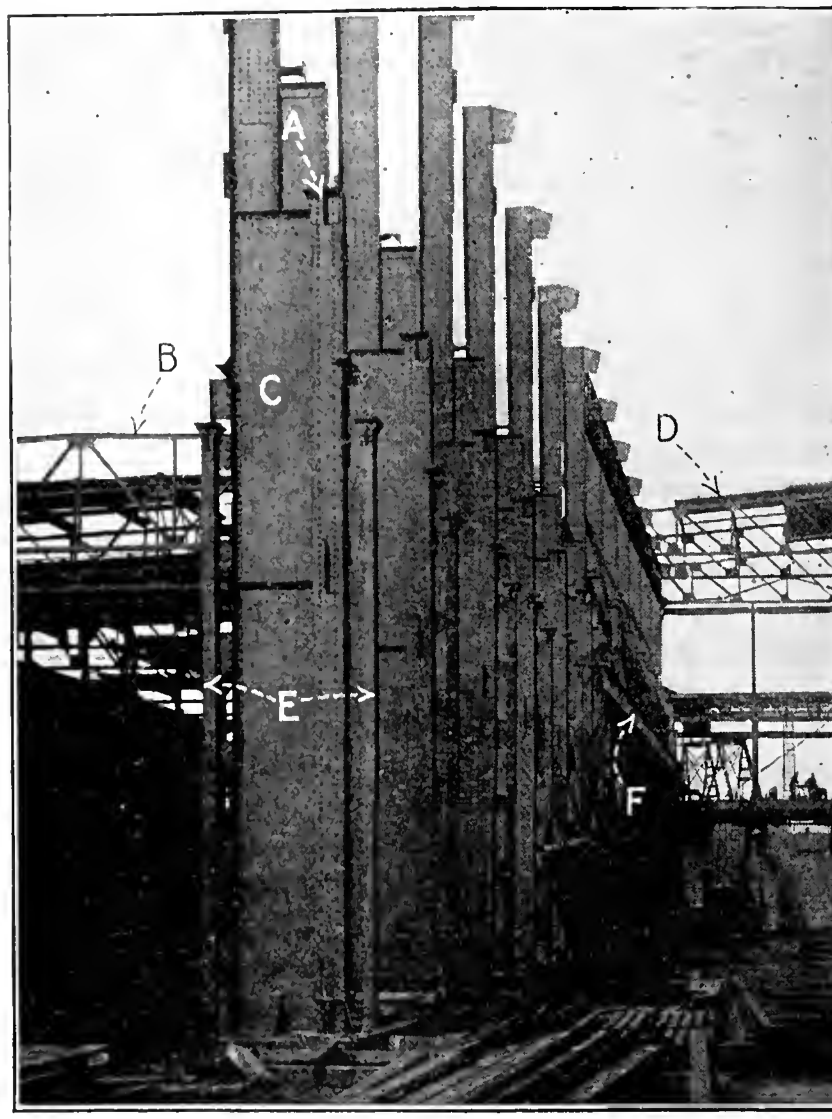


FIG. 1. HEAVY COLUMNS FOR 250-TON 86-FOOT CRANE IN RAILROAD REPAIR SHOP

A. Seat for runway girder of 250-ton crane. B. 75-foot machine shop. C. 48-inch main column. D. 90-foot erecting shop. E. Columns for runways of 10-ton cranes. F. Longitudinal strut

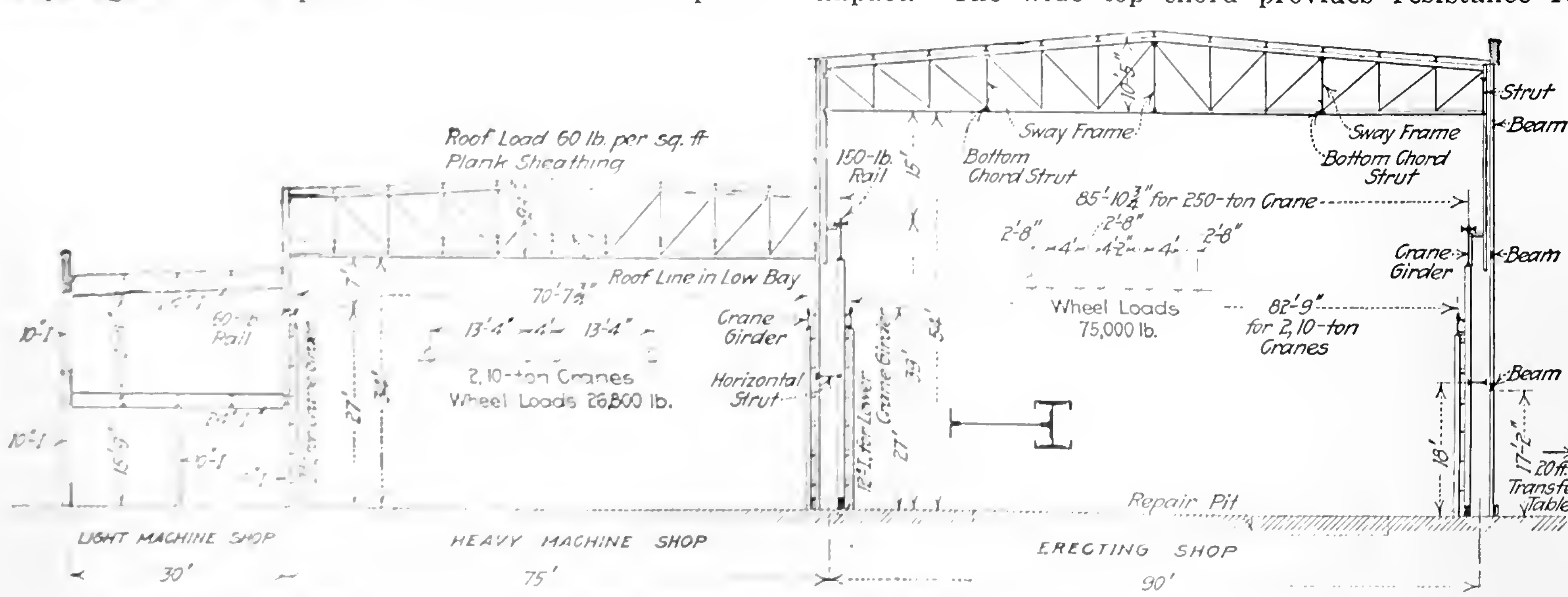


FIG. 2. CROSS-SECTION OF LOCOMOTIVE SHOP, SHOWING WHEEL ARRANGEMENT OF 250-TON CRANE

a side thrust equal to 10% of the lifting capacity.

In the case of the 28-in. I-beam runways for the 10-ton cranes, lateral stiffening was provided by riveting a horizontal 10-in. channel to the upper part of the web; this channel bears against the face of the column. The

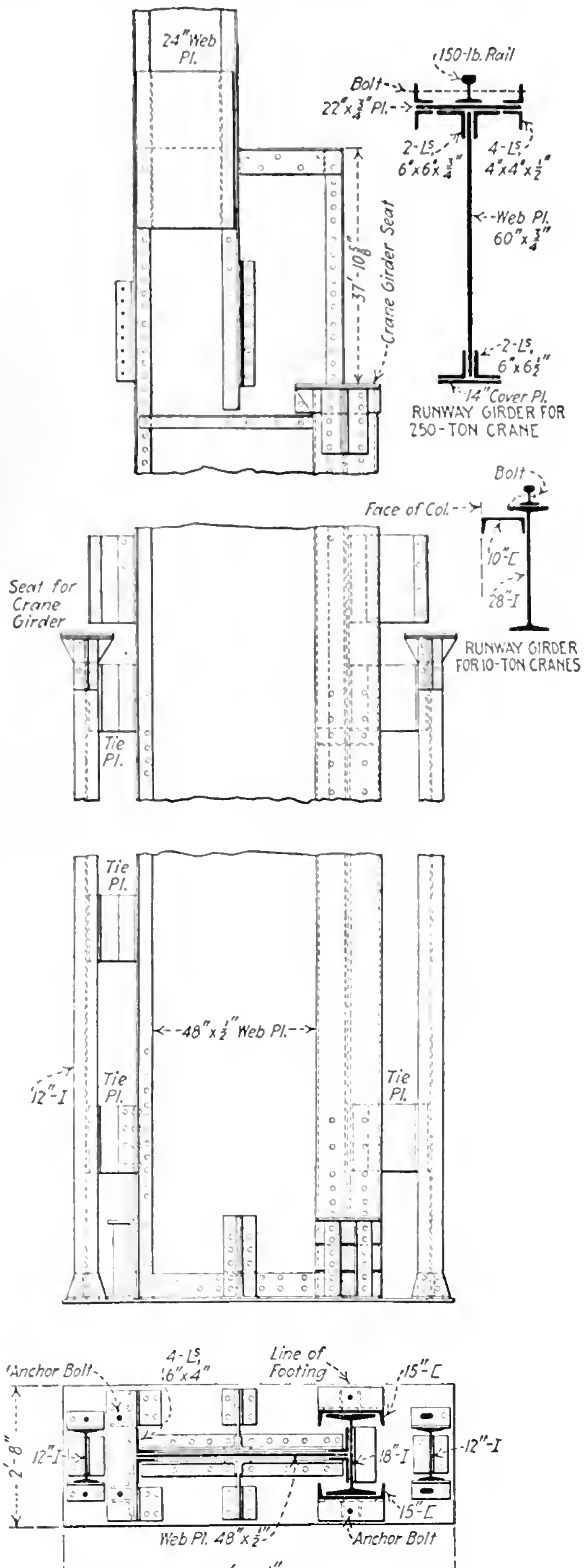


FIG. 3. CRANE COLUMNS AND GIRDERS

60-lb. crane rail is secured at 48-in. intervals by bent hook-bolts, alternating on opposite sides of the rail, engaging the edge of the I-beam flange.

Concrete sills are used in the brick walls, being found considerably cheaper than the stone ordinarily used. Wood-block paving $3\frac{1}{2}$ in. thick, laid with tar cushion on a concrete base, covers the entire area of the first floor, except that the concrete walls of the pits in the erecting shop are capped with 5 x 9-in. oak timbers to form supports for the jacks used in raising or blocking up the engines.

For lifting locomotives the large crane has two hoisting trolleys, each of 125 tons capacity, which are normally spaced about 45 ft. on centers and pick up the engine by both ends. Each trolley has also a 10-ton auxiliary hoist. Magnetic control is employed throughout, with dynamic control on each hoist. The crane has each end of its bridge carried by a group of eight wheels mounted in double compensating trucks and equipped with an electric motor, so that each group of wheels is driven independently.

Across the floor of the erecting shop are 17 parallel transverse stub tracks, three of which extend into the machine shop and each of which has a 56-ft. repair pit. These tracks are spaced 24 ft. on centers and are at right angles to the crane runways. They extend 20 ft. outside the building to the pit of a 60-ft. transfer table of 250-ton carrying capacity, and having a 75-hp. electric motor which operates it at a high speed of 100 ft. per minute when carrying an engine. This table has a travel of 540 ft., running beyond the ends of the building so as to connect with yard tracks on which engines are moved to and from the transfer table.

This new shop was built by the Austin Co., Cleveland, Ohio, which also made the plans for it, subject to the requirements of the engineering and mechanical departments of the railway. J. E. Anderson was the company's superintendent of construction. All work is under the direction of Robert Trimble, chief engineer of construction, Pennsylvania Lines. W. E. Guignon is division engineer at Logansport, with T. L. Doyle as assistant division engineer.

Some Engineering Problems of Regional Planning

By Morris Knowles

Chief Engineer, Housing Department, Emergency Fleet Corporation, United States Shipping Board

Abstract of paper read before the National Conference on City Planning, held two weeks ago at Niagara Falls and Buffalo—Solution requires comprehensive planning of all features with consideration of their relation to one another, for greatest good at lowest cost.

TOWN planning as a conscious art had its birth in the desire to add beauty and attractiveness to towns for which, it was at first assumed, the problems of convenience, sanitation and amenity had already been reasonably well solved. Therefore many town planners, enthusiastic in their quest for "the city beautiful," lost sight at times of the engineering problems of town planning. But all this is changed now, for experience has proved the interdependence, in city building, of beauty, convenience, sanitation, amenity and economy. And so, from being a question of art, town planning has become more and more one of engineering.

Regional planning is still newer as a conscious art. Born from the efforts of neighboring towns to coöperate in the solution of their joint engineering and utility problems, it has developed until today its ideals, as applied to regions, are as broad as are those of town planning.

The origin of this new art guarantees from the start that its dependence upon engineering will be recognized. Beauty is as vitally necessary in regions as in towns;

but, as the region is a little more remote from the individual than is the town, it is easier to see that the prerequisites of beauty are sanitation, convenience, amenity and economy, and that many of the most important problems of regional planning are engineering problems.

Among the problems to be studied are those associated with the geographical and industrial characteristics of the region; the development and interconnection of steam, electric and water transportation; the arrangement and construction of main highways; joint water and sewerage systems; the regulation of streams; the supply and distribution of light and power; the organization of regional utilities, and the apportionment of the cost of regional works.

Survey—The first requisite of a regional plan is a comprehensive survey of the topography, geography, population, natural resources, agriculture, industry and trade of the region, much of which is an engineering study. And one result of such study should be a complete topographic map of the area, which may serve as a base map for the regional plan. Not only should this map show the topography, and locations of the towns, railroads, streams, canals and other natural and structural features, but the data on natural resources, agriculture and industry should be correlated with the map in such manner that maps may be prepared showing the relative distribution of all the factors affecting the life of the region.

Steam and Electric Transportation—Steam railroads are the arteries through which the life-blood of our country's trade flows. Regional planning must take into account the fact that steam railroads are best adapted for long-haul, through traffic. It must, of course, be based upon the existing railroad systems, and must provide yards and terminal facilities, both for facilitating through movement and for transfer to local, short-haul roads and to electric and water transportation routes. The study of electrification must be continued in connection with the elimination of noise and dirt from our cities, and with the general power program for the region in which the railroad is located. And a new type of organization and regulation must be found which will at the same time protect the public interest and encourage growth sufficiently to serve the needs of industry. The electric roads are the natural complements of the steam railroads.

Regional planning will recognize more clearly than ever before the necessity for interconnecting the various types of transportation routes, for building joint terminals, with adequate wharves, docks, warehouses, railroad yards, cranes and electric facilities, so that the transfer and transshipment of passengers and freight may be accomplished most economically and most efficiently, and so as to secure the greatest usefulness from the transportation system as a whole.

Main Highways—If the railroads are the arteries of trade, then the highways are the vessels through which the individuals engaged in commerce receive the blood which quickens their lives. But regional planning cannot permit the location and construction of the highways of the future as have been many of those of the past. Main roads will no longer be located with reference to section or property lines, but with reference to topography, the distribution of products creating traffic streams, and the coordination of the highway system with the railroads, electric lines and waterways; and types of construction will be carefully adapted to traffic needs—not only as to road widths, but also as to gradients, surfacing and drainage.

The regional plan, therefore, should provide a program harmonious with the programs for the solutions of the other problems of the region, which may serve as a guide for the construction of main highways during years to come.

Water and Sewerage Systems—The advantages of regional water and sewerage systems are often particularly striking, and serve excellently to illustrate the value of the regional plan. Water-supply problems depend for their solution more upon the source of supply than upon any other consideration. Sewerage is strictly a drainage-area problem, and unnecessary expense as well as mutual damages of many kinds result from attempts to solve it with respect to political boundaries alone.

Stream Regulation—Another problem for which satisfactory local solutions are obviously impossible and drainage-area solutions absolutely indispensable is that of stream regulation and water conservation. Navigation requires a uniform, sufficient depth of water throughout the navigable length of the stream. Local flood-protection works may actually increase flood heights above or below them. The interdependence of the water and sewerage problems of communities within a region has already been pointed out. The best utilization of water-power requires that its development and distribution be based on regional, and not on local, considerations. It is of great importance that stream regulation be based upon the consideration of all the uses of water, and not on one of the above.

Light and Power—The type and the locations of regional sources of light and power will depend largely upon the characteristics of the region with respect to availability and location of coal, natural gas and hydroelectric power. But the economic advantages of power generation in large central station need no demonstration in these days of efficient, large-capacity generators and of high-tension transmission. Enlightened self-interest has long recognized this, and the results may be seen in the unification of the gas-supply systems in the neighborhood of every field of natural gas, and in the huge electric central stations and the network of electric-supply and distribution lines which characterize every one of our large urban districts.

Organization—Organization for carrying out the works of a regional plan is not solely an engineering problem. Existing political organizations must, of course, be the basis of it, and intricate legal and organization problems must be solved to build up the group of related organizations (for each problem may require separate organization), required to secure the results desired. But the selection of desirable types of organization is so closely tied up with the planning and use of the public works involved in a regional plan that no consideration of its engineering problems would be complete without reference to it.

The type of organization depends in each case not only upon the existing political organization and upon the area and density of population of the region, but also upon the particular purpose or combination of purposes to be accomplished. Dependent upon these factors, examples of community coöperation can be found,

varying through a wide range with respect to the functions involved, the degree of centralization of control, and the methods used in financing and apportioning cost.

Most of the important cases, however, can be classified under one or another of six heads, as follows: (1) Extension of municipal limits, and consolidation or annexation; (2) extension of municipal jurisdiction; (3) contracts between municipalities; (4) county administration; (5) private enterprise and (6) district organization.

Within a given region, each of these types of organization may be represented. But the conception of regional planning contemplates the direction and guidance of all of them by the regional plan—that the plan shall be a kind of regional constitution with which the subsidiary organizations of the same region must not conflict.

Apportionment of Cost—Like the problem of organization, apportionment of cost is in large degree a financial, legal and political problem, but, like the selection of organization types also, it is so closely bound up with the use of public works that it is largely an engineering problem, too. In most cases, the method used may be classified under one of four headings, or as a combination of more than one of them, as follows: (1) General taxation; (2) regional general taxation; (3) special assessment, and (4) rates based upon quantity of service used.

Conclusion—The great engineering problem of regional planning is the comprehensive planning of all of the features with consideration of their relation to one another, so as to secure the greatest good at the lowest possible cost. Steam transportation must not be developed without references to or in unnecessary competition with electric and water transportation. Main highways must not be planned solely with a view to carrying through traffic—if, for example, a slight modification of the location of a boulevard would provide a right-of-way for a trunk sewer and avoid the condemnation of expensive additional property, it would be indefensible to fail to consider it. Sewage outlets must not be located without reference to water intakes. Stream regulation must not be studied for one purpose, but consideration must be given to water transportation, flood prevention, water-supply, sewage dilution and power development, so as to secure that combination of results which represents the greatest good per dollar spent for the entire region.

If this broad engineering conception of regional planning can be kept before us, all of the inherent advantages can be realized and its future will hold for mankind a store of benefits as much greater than those which have come from town planning as its field is more extended.

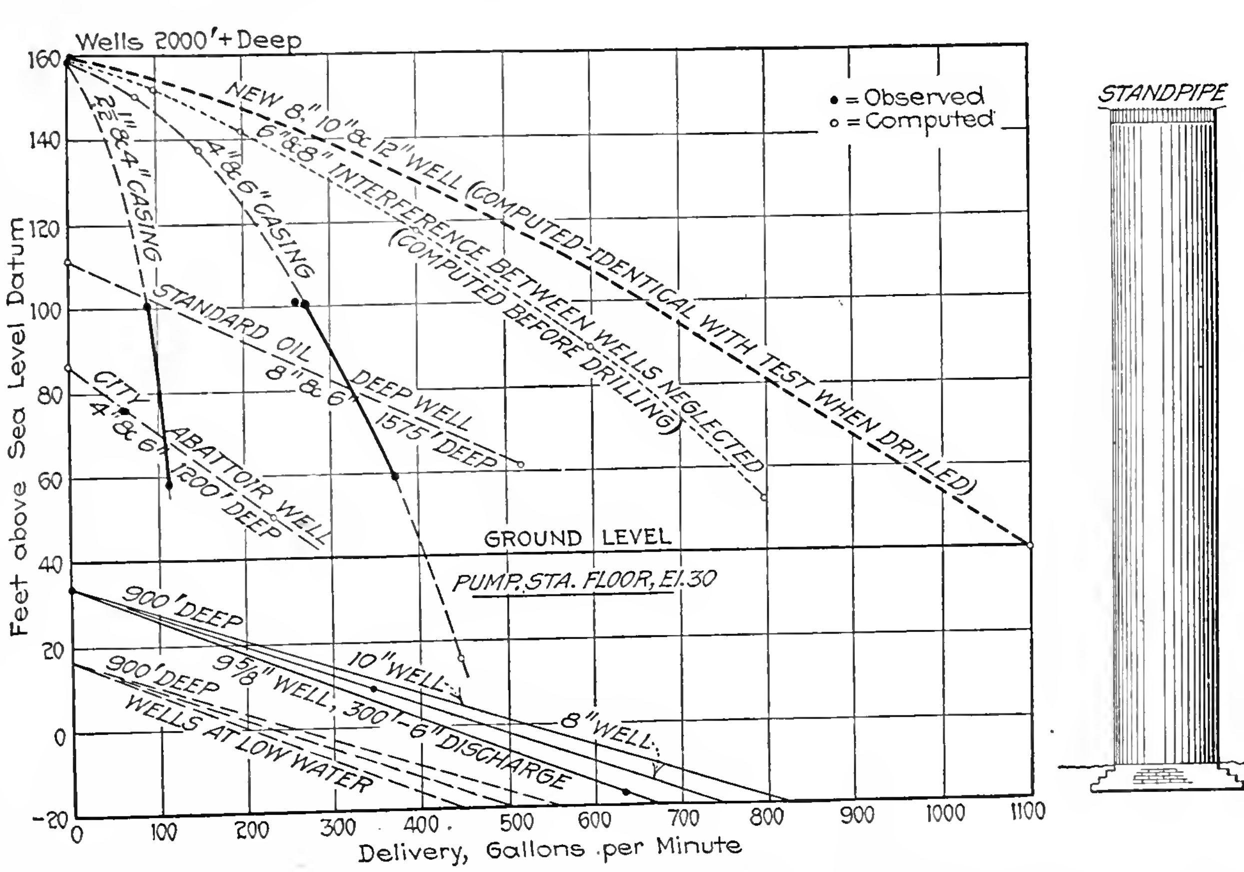
Artesian Well Experience at Baton Rouge, Louisiana

Larger Well Casing Gives Increased Flow — Temperature a Factor in Yield — Well Sunk About 2000 Feet in 62 Days

FOURTEEN artesian water-bearing strata 5 to 194 ft. in thickness, all of which are separated by thick layers of tough blue clay, underlie the City of Baton Rouge, La. A report by Alvord & Burdick, following exhaustive exploration tests to various depths for the Baton Rouge Water Co., indicated that at the 2000-ft. level a suitable soft water under high head would be obtained. L. R. Howson, of the firm, described certain features of the unusual ground water-supply conditions, at a recent meeting of the Illinois Section of the American Water-Works Association. Salient points in his paper are given in the following abstract:

As no rock is encountered and the holes must be cased the entire depth through the many strata, some of which cave badly into the larger holes, it was thought that the largest casing that could be successfully lowered into place, on account of the great length to be supported, would be 8 in. for the top 1300 ft. and 6 in. for the remainder of the depth. It was estimated that such a well would yield 840 gal. per minute free flow at the ground surface, since the static head is 120 ft. above the ground level. When the well was sunk, however, the contractor, W. M. Eberhart, was persuaded by the water company, despite the fact that he was not to be paid according to yield, to attempt a larger casing than had been used heretofore in the vicinity. Accordingly, he placed 915 ft. of 12-in., 934 ft. of 10-in., 44 ft. of 8-in. casing, and a 70-ft. strainer consisting of perforated well casing wound with brass gauze.

A flow of 1100 gal. per minute at the ground surface was secured, the increase over that expected with the 8- and 6-in. sizes originally proposed being due to the smaller friction losses in the larger casing. When the



RELATION BETWEEN YIELD OF WELLS AND LOWERING OF STATIC WATER LEVELS

large well is delivering at the 1100 gal. per minute rate approximately 50% of the total head loss is due to actual lowering of the water level, and the remainder to frictional resistance in the well casing. With the 6- and 4-in. well flowing at the ground surface the total head lost is consumed in the ratio of 25% for the draw-down and 75% for friction, the large pipes giving more than double the amount of water under similar conditions. At 2050 ft. a 60-ft. sand layer was penetrated, which produced a well having specific capacities, or yield for each foot the static level is lowered, of from 12 to 15 gal. per minute and a temperature of 92° F. The static water level is 160 ft. above sea level, or 120 ft. above the ground surface.

Tests on existing wells of the company gave the following data: From wells 200 to 400 ft. deep the static elevation of the water is near sea level, and the temperature is 64° F. Baton Rouge is 40 ft. above sea level. Wells 800 to 900 ft. deep penetrate a 50-ft. sand layer, yielding 10 to 12 gal. per minute per foot of draw-down from 6- to 12-in. walls. The temperature is 72°, and the static level is 35 ft. above sea level. From a sand layer at the 1320 to 1350-ft. depth a water of 85° temperature rises 110 ft. above sea level, but the specific capacity is only from 1 to 2 from a well of the water company and 6½ from a city well recently drilled.

The various gravel and clay strata under Baton Rouge dip to the south 20 ft. to the mile, so that a porous stratum outcropping near Jackson, Miss., is penetrated at Baton Rouge, 125 miles to the south, at 2050 ft. below sea level. Over an area of 20,000 square miles just south of the Louisiana-Mississippi line the surface becomes rolling and rises rapidly to from 200 to 400 ft. above sea level. Above 100 ft. it is gravelly and presents an excellent collector.

The gravel strata are separated by light, impervious material which prevents interconnection and accounts for the variation in static pressures. The variation in temperature is important because well yields depend upon the rate of flow through the sand, and water at the 92° of the 2000-ft. depth passes through sand, of the character and size encountered, 175% faster than would water at 50 degrees.

The diagram indicates the relation between the yield of the wells tapping the various strata and the lowering of the static water levels. It also shows the effect of friction in cutting down yield very materially when the water must rise through two-fifths of a mile of 4- and 6-in. casing, as compared with the larger sizes.

The well was drilled by the rotary process and tested, all in 62 days, or at an average rate of nearly 34 ft. per day. The contractor first ran a 10-in. fishtail drill until he located a suitable foundation in tough blue clay for the 12-in. casing at a depth of 915 ft.; then reamed the hole to a 16-in. size, "slushed" the hole to insure its standing open, and inserted the 12-in. casing. This "slushing" is accomplished by pumping a mixture of clay and water to the bottom of the hole. As it passes upward outside of the pipe the clay particles seal up the sides of the well and hole, and by their cohesive properties preserve the hole until the casing can be inserted and lowered to position.

The assembling and lowering of 915 ft. of 12-in. pipe required 7½ hours. Four days' time was allowed for the sand to set around this casing before drilling for the 10-in. casing was started. Similar methods were followed for the 10-in. and 8-in. casing and the 70-ft. strainer.

A large number of wells have been drilled in and near Baton Rouge in addition to that of the water company, the most important being the group of 14 wells drilled by the Standard Oil Co. to supply cooling and condensing water for its oil refinery. These wells furnish nearly 5,000,000 gal. per day. This water is, of course, air-cooled, but all the city water must be iced before using.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

More English, Not Greek and Latin

Sir—Anent the discussion of Latin and Greek for engineers, I wonder that it has never occurred to the people who criticise the engineer for his narrowness of training and outlook that there are others. An experience of a good many years of association with educated people in other lines leads me to the conclusion that the engineer is not peculiar in having a somewhat narrow outlook and that, indeed, he is less of an offender, if this be an offence, then a good many other persons presumed to be of at least equal training. True it is that the engineer is more familiar with the doing of things than with the telling about things. True it is that he has what perhaps may be called a geometric imagination, an imagination that sees great constructions rather than one that hears beautiful music, conceives of beautiful thoughts, or sees the results of the application of political or business principles; and I am disposed to agree that his training in verbal expression in the schools is not what it should be.

With what seems to me to be a characteristic engineering habit, I would go directly rather than in a roundabout way to the cure of the difficulty. It is more and better English that we want. The study of Latin and Greek will undoubtedly help in securing facility in the use of English, but would it do this to the same degree that an equivalent time spent on the study of English would do?

By all means let us do everything possible in school to give breadth of vision and facility of expression to all students of all professions, but let us not try to make teachers, orators, poets, or story tellers out of those people who, because of their peculiar type of mind, are intended to do the constructional work of the world.

And let us not make too much of the narrowness of vision of the engineer. A considerable experience as an engineer-witness leads me to the conclusion that the average lawyer is not a more logical thinker than the engineer; and long experience in mixing with teachers of language, economics, philosophy, mathematics and all other subjects that are sometimes called cultural leads me to the conclusion that the average teacher of these subjects has a not appreciably greater breadth of vision than the average engineering teacher; and a fortunately limited experience with healers of our bodies and a more or less extended acquaintance with the curers of our souls leads me to the conclusion that neither physi-

cians nor ministers as a class have a much greater breadth of vision than the engineer.

I think we are inclined to magnify our faults because we are of an analytical type of mind, and it is well that we should see our faults, but let us in characteristic engineering fashion proceed to cure these in the most direct manner.

WILLIAM G. RAYMOND,
Dean, College of Applied Science, State University of Iowa.
Iowa City, Iowa.

Flue Lining Would Protect Faulty Chimney

Sir—The fire in the officers' quarters at the United States Army General Hospital No. 3, Colonia, N. J., which is reported in *Engineering News-Record* of May 8, 1919, p. 929, is very much like the reports of a large percentage of the residence fires that are reported from day to day in the daily newspapers: "It started from the chimney." The National Board of Underwriters' reports show from year to year that a larger number of fires, entailing an enormous loss, are caused by defective chimney construction than from any other one known cause.

The materials which this expert brick mason used, in the construction of this particular chimney, would have made a thoroughly safe and satisfactory chimney had the mason looked around a little more and found a few pieces of fireclay flue lining to line the chimney. In all probability, the material was there, because the Government specified such lining in all flue construction at the cantonments. It makes a chimney fireproof and foolproof. The unvoiced criticism of the engineers that the medical officers should not undertake to build a chimney is thoroughly justified, for any of the engineers in the service would undoubtedly have lined the chimneys.

G. H. TEFFT,
Secretary and General Manager,
Chicago, Ill. Clay Products Association.

Special Stadia Methods Used in Florida

Sir—On reading the description of the methods used in the stadia survey at Columbus, Ohio, in *Engineering News-Record* of Apr. 17, 1919, p. 776, it occurred to the writer that the methods used by Cunningham and Hallowes, chief engineers of the North St. Lucie River Drainage District, might be of interest to the profession. This district covers 75,000 acres, being approximately 9 x 14 miles in area. As a topographical map was desired on which to base a plan of reclamation, the first move was to run transit and level lines along the section lines the long way of the district, to be used as base lines for the topographical work. Topography parties were made up of five men each: Instrument man, recorder, and three boardmen, it being found that with a party so balanced all hands were kept busy. By working back and forth between base lines, it was not necessary to try for as great a degree of accuracy as would otherwise have been necessary on long traverses.

With this fact in view, instead of setting over the last hub established and continuing the line ahead, the transitman skipped the hub and proceeded to such point as he might select for the next set-up. As azimuths were worked on the full circle, he then set the vernier at zero, dropped the needle, clamped the instrument in meridian, took a back sight reading the azimuth on the "B" vernier, which caused his notes to read as if he had actually set up on the hub and projected the line ahead. This saved the time of one set-up; or, in other words, he made just half as many set-ups as under the old methods, which amounted to a considerable saving in time and expense on a job of this size.

The stadia boards were 14 ft. long and 3 in. wide and were made of cedar at a local boat yard. They consisted of two 7-ft. sections connected with two light strap hinges—two hinges were necessary to overcome a tendency toward side sway. A fish or splice 2 ft. in length was fastened with screws on the back of the top of the bottom section of the rod, in such shape that it extended 1 ft. above and formed a ridged connection when the rod was opened out and fastened with a wing nut.

The first rods tried were graduated in figures the same as ordinary level rods, but on account of low visibility this was abandoned in favor of a character design of yellow, white and black. For the fifth and eleventh foot marks, the white was omitted, the graduations being made in yellow and black for quick identification.

The back of the rod was divided into feet of alternate yellow and black, the fifth and eleventh foot marks being black with a yellow diamond inclosed. It was only used when the sight was obscured or blurred for some reason. Sights of 2000 ft. were frequently made with this rod. This same equipment and methods were used in investigating the drainage outside the district, with very satisfactory results. Considerably more care was taken with the instrumental work, however, and sights were usually confined to about 1400 or 1500 ft. While some of these outside traverses were several miles in length there was no trouble in obtaining proper closures.

The notes were plotted with a universal drafting machine, only the turning points and instrument points being plotted first, to check the closure. As the azimuths were all based on magnetic north, the draftsman set off the variation on his machine and then plotted direct from the notes. After a little practice he was able to transfer the notes to his map about as fast as an assistant could read them.

Fort Pierce, Fla. A. D. CUNNINGHAM.

Chart for Solution of Manning Formula

Sir—Unfortunately, I find that the instructions for the use of my chart for the solution of the Manning formula, reproduced on p. 1126 of your issue of June 5, 1919, were not reproduced. The method of using the chart is as follows:

Starting from the proper value of the hydraulic radius, move vertically to the intersection with the roughness-factor line, then horizontally to the slope line, and vertically to the resultant value of the velocity on the upper scale.

If the desired velocity is known, but not the slope, find the intersections of a vertical line through the proper velocity with a horizonal line through the intersection of the hydraulic radius and roughness-factor lines, and read off the desired slope on the chart.

The following correction should be made: Slope line s, numbered 0.00003 on the chart, should be numbered 0.00002.

MORTIMER F. SAYRE,
Assistant Professor of Applied Mechanics, Union College.
Schenectady, N. Y.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Flood-Basin Wood Lots Logged For Construction Timber

MODERN forestry, as well as the engineering construction of dams and river channels, is one of the operations which are to make the Miami River Valley of Ohio safe from floods. When 2 x 2 x 24-ft. spuds were wanted for the scows to carry the 200-ton dragline excavators which are widening and deepening the river channel at Dayton, the trees were cut from the wood lots of the conservancy district. This is merely an example. Altogether, some 350,000 ft. b.m. of lumber used in construction, besides over 50,000 lin.ft. of piling and cribbing, have been provided from the same source. In addition, a great amount of timber on the stump has been sold to manufacturers who use mature, high-grade hardwoods in the making of their products. Only matured timber has been cut.

Other Articles in This Issue of Interest to Contractors:

There are about 120 wood lots, varying in area from one acre to 100 acres, in the five large flood-detention basins of the Miami Conservancy District. These wood lots are quite generally distributed, but the greatest amount of timber is in the Huffman and Englewood basins. The Germantown and Taylorsville basins rank next, and the Lockington basin is fifth. All the basins contain about 6,000,000 ft. b.m. of merchantable timber. Nearly all of the timber is hardwood. About 37% is oak and 14% is maple, and there are from 5 to 9% each of ash, birch, elm and hickory. Many of the trees are finely matured specimens of their kinds.

Upon assuming control of the wood lots, the directors of the flood-protection works had careful surveys made and, on the information obtained, a plan of conservation, planting and cutting was mapped out. The theory adopted was that timber was a crop to be harvested when ripe and disposed of for gain. Being a crop, only mature timber, that which would never be worth more than at present, was to be cut. Trees which had not reached maturity were to be left to grow, and growth and quality were to be encouraged by proper thinning out and by the removal of underbrush. In brief, modern, scientific forestry practice was to be applied to the district's woodland properties. This development is making progress, and is to be followed in time by proper planting and reforestation operations suited to the circumstances.

Utilization of the matured timber is the operation of chief interest to the engineer and contractor. Only matured trees, as stated, will be cut. An exception is made to this rule in the cases of wood lots that are on low ground and located not far up-stream from the dams. As a flood which would partly fill the basins would cover these woods and, if the water remained a few days, would probably kill the trees, these low-lying

LOGGING WHITE OAK FOR 24 x 24 INCH x 24-FOOT SPUDS FOR DREDGE SCOW ON DAYTON CHANNEL EXCAVATION

woods will be cleared completely. But the utilization will, nevertheless, be thorough. Each size and kind of timber will be turned into the sort and dimensions of lumber for which it is best suited, and the waste of proper size will be prepared and disposed of for fuel. Only the absolutely unmarketable trash will be destroyed by burning.

Specific examples illustrate best the manner of handling the timber crop in the wood lots which will be preserved. Surveys of the wood lots disclosed some 400 or more matured walnut trees; these were sold to a firm manufacturing gun-stocks and to another which makes churns. In the same manner, some 130,000 ft. b.m. of white and blue ash were sold to a firm manufacturing shovel and hoe handles. In all cases, the trees were cut and shipped in the log to be sawed at the factories. For use in constructing the flood-protection works the trees are cut by the district and hauled to conveniently situated commercial sawmills, to be sawed according to orders. For example, the large timbers for scow spuds were hauled to Dayton, where the timber was to be used and where it happened, also, there was the only nearby mill equipped to saw pieces of such large size. The trees were cut by the conservancy logging crew, were loaded onto wagons in the woods and were hauled by a 10-horse team, one log to a load, to a yard on the main road. At the yard the logs were loaded one at a time onto a motor truck and trailer and hauled to the mill. Timber cut from the conservancy woodlands for the conservancy work is charged against the item for which it is used, on the basis of a stumpage price plus the labor cost of producing the lumber. This is, of course, a purely bookkeeping charge.

The forestry work of the conservancy district is directed by J. W. Calland, on leave of absence from the Ohio Forestry Department. S. Graham Smith is director of the district farm lands on which the wood lots are located.

Job Labor Records Kept on Two Forms

TWO card forms kept by the foremen and the job clerk are used for recording time, labor and cost distribution, and payroll disbursements, on concrete-bridge construction at Columbus, Ohio. The bridge is a seven-span arch structure involving the placing of about 18,000 cu.yd. of concrete, with excavation and cofferdam, and also the wrecking of an old bridge structure.

The foreman's card is filled out and turned in daily.

Time Record of John Doe

No. 12 Address 73 [illegible] St.

WEEK ENDING	S.	S.	M.	T.	W.	T.	F.	TOTAL HOURS	WAGE Per Hour	AMOUNT PAID	
Exc	4½	0	3				0	7½	40	3	00
CHev	0	0	6	9	4½	9	0	28½	40	11	40
Equip					4½			4½	40	3	60
May 24 '19										$18	00

WORKMAN'S TIME AND PAYROLL BLANK, USED ON BRIDGE CONSTRUCTION WORK

Besides the spaces shown for equipment and excavation there are similar spaces for "Concrete, Class A," "Concrete, Class B," "Cofferdam," "Wrecking Old Bridge," "Screening Gravel," and three blank spaces. The workman's card is kept by the job clerk, who enters the figures from the foreman's daily report, as indicated by the sample. From these two original records, cost sheets can be made up and all needed bookkeeping entries made.

The contractors for this work are the Olson-Magee Co. & O. H. Olson, of Kansas City, Mo.

Tractor Pumps Oil from Cars to Tank

By Albert S. Fry
Morgan Engineering Co., Memphis, Tenn.

FIELD tanks which store the fuel oil for the walking dragline excavators which are building levee for the Inter River Drainage District in Missouri are filled by pumping from tank cars by a centrifugal pump operated by a tractor.

To have installed an engine to run a pump to unload tank cars would have been costly. Instead, a small centrifugal pump was set up and, whenever a car is to be unloaded, a tractor is disengaged from some other part of the work and is used to furnish power for the pump. One tractor is used to serve two of the tanks on this work, so this method of operation has been particularly efficient.

The unloading of the oil takes only a small part of the tractor's total time, the greater part being spent in general hauling and right-of-way clearing. On the latter work the tractor has proved its worth in dragging logs out of the cleared area.

OLSON-MAGEE CO. & O. H. OLSON

....Foreman ....19........

	Laborer's No.																		
EQUIPMENT	Hours																		
	Laborer's No.																		
EXCAVATION	Hours																		

DAILY REPORT BLANK WHICH IS USED BY THE FOREMAN

News of the Week

New York, June 12, 1919

Townsend Highway Bill Reintroduced in Congress

The Townsend highway bill, introduced in the last session of Congress and described in *Engineering News-Record* of Feb. 27, p. 446, has been introduced in the present Congress in slightly modified form. The bill has been considerably shortened, and provisions which were in the Federal-aid highway provisions of the Postoffice appropriation bill in the last session have been omitted.

Among the principal changes is the reduction of the number of commissioners from five to three, decreasing their terms from seven to six years. The bill provides that not more than two of the commissioners may be of the same political party. In cases where states have so framed their highway laws that they can take advantage of Federal aid only through the Secretary of Agriculture, he shall act jointly with the proposed Federal Highway Commission in administering the Federal-aid law in those states.

All present Governmental road agencies, with the exception of those pertaining to the War and Navy Departments, are transferred to the proposed new commission.

The officers and salaries provided for in the previous bill are left practically unchanged, as are the appropriations, with the exception that those appropriations for Federal aid provided in the last bill are omitted. All appointees such as clerical or other official assistants, with the exception of the chief engineer, secretary and attorney, shall be taken from the classified civil service; provided, however, that Army engineers may be employed by the commission without civil service procedure. The plan of distribution among the various states, prescribed in the previous bill, is also omitted.

United States Sells Ships at High Prices

Several steel steamers have recently been sold by the U. S. Shipping Board at prices of $210 per dead-weight ton, according to an announcement made by Chairman E. N. Hurley last Friday. A 7500-ton freighter went to the National Shipping Corporation at New York at this figure, and a 5075-ton vessel to the Omega Steamship Co. of the same place; offers for four other ships at the same price have also been received. The Skinner & Eddy Shipbuilding Corporation has offered to buy at present construction costs four 8000-ton freighters being built at the yards of that corporation.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Pittsburgh Asks Architects' Aid in Designing Bridges

Three achitects have been engaged by the county commissioners of Allegheny County (Pittsburgh) to act as advisers to County Engineer J. G. Chalfant in the design of three new river bridges which the county is preparing to build. Benno Janssen, of Pittsburgh, will deal with the design of the 40th St. bridge over the Allegheny River (replacing the existing 43rd St. bridge). Alden & Harlow, of Pittsburgh, will serve in connection with the Monongahela River bridge connecting Wilson and Glassport, while Warren & Wetmore, of New York, are retained for the new 16th St. bridge over the Allegheny River. This action follows the recommendation of the Art Commission, concurred in by the planning commission recently appointed by the county commissioners.

Study Missouri River Water-Power in South Dakota

A hydro-electric commission has been appointed in South Dakota, under an act of the legislature, for the purpose of investigating the water-power resources of the Missouri River in that state. This commission has engaged Daniel W. Mead and Charles V. Seastone, consulting engineers, Madison, Wis., to investigate and report.

Trouble With Bascule Bridge in Buffalo

Partial dropping of a bascule bridge in Buffalo recently, which blocked the span for a time, was caused by the operating gearing getting out of mesh. George H. Norton, city engineer, describes the circumstances as follows:

The South Michigan Ave. bridge over the city ship canal is a rolling-lift span of 110 ft., erected in 1904. The rolling girders or segments have shoe plates of 2-in. rolled steel which were bent and turned in a lathe to 20-ft. radius and have mortise holes which engage with lugs on the cast-steel track plates on the foundation girders. These rolled shoe plates had cracked and broken out around the lugs so as to allow the structure to shift in position.

Endeavor was made to have new plates constructed for this purpose, but, as this type of bridge is now using cast-steel segmental shoes for this purpose, after consideration it was decided to repair the plates by the electric welding process. This work is now under way. The shifting of the span on its track plates somewhat racked the operating machinery so as to allow the operating gear to slip, allowing the span to drop a short distance, but without injury to the span itself. The shifting in position made it impossible to land the span for a time and also impossible to operate it until the machinery gearing had again been placed in mesh. The most serious difficulty has been from delay to navigation for several short periods in the adjustment of the operating machinery.

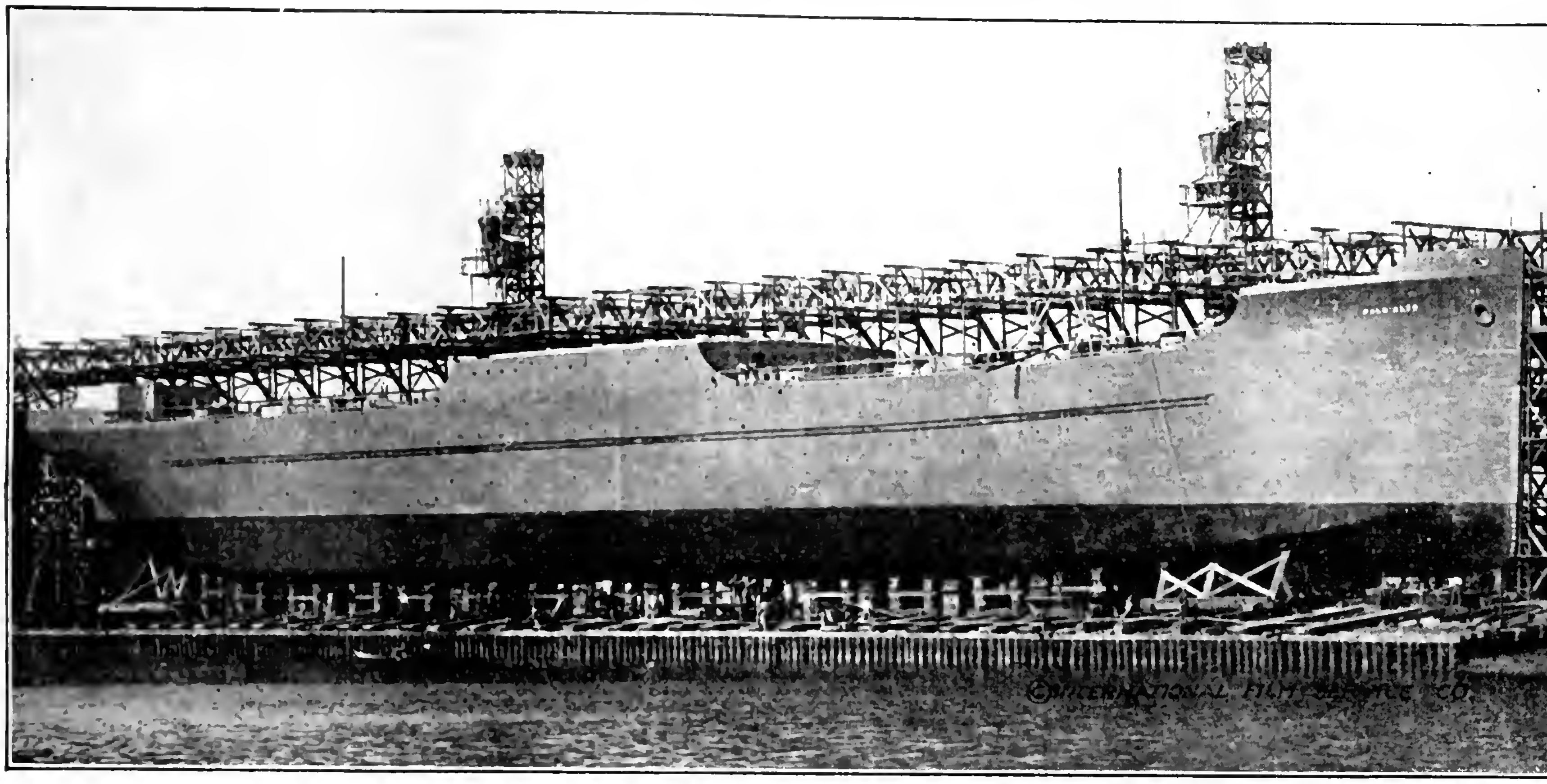
First Iowa Road-Bond Vote Under New Law Favorable

As a result of the favorable vote, June 3, on a $1,500,000 bond issue, the entire primary road system of Black Hawk County, Iowa, consisting of 84 miles, is to be paved. Black Hawk, in which Waterloo is situated, is the first county to hold an election under the new law. The fact that Iowa roads have been practically impassable this spring is reported to have had its effect on the vote.

Combined Dues Plan Operative

The Cleveland Engineering Society has approved the proposal that there be a reduction in the combined dues of members of the Cleveland Engineering Society and the American Society of Mechanical Engineers. The governing board of the latter body had already approved the plan, so it is now operative.

Largest Concrete Ship Launched at San Francisco



7500-TON CONCRETE OIL TANKER LAUNCHED SIDEWAYS AT SAN FRANCISCO MAY 29

The first of the Government's 7500-ton reinforced-concrete oil tankers, the largest concrete vessels ever attempted, was launched May 29 from the Government Island yard of the United States Shipping Board, on San Francisco Bay. The vessel was launched 90% complete and was put in 94 days after the date of the first concrete pouring. The actual pouring of the concrete was completed in about two weeks. The vessel's dimensions are: Length, 435 ft.; beam, 54 ft.; depth, 36 ft. The design was described in *Engineering News-Record* of Nov. 28, 1918, p. 986. R. J. Wig, chief of the concrete division of the United States Shipping Board, was present at the launching and Mrs. Wig christened the ship, which has been named "Palo Alto."

New State Highway Engineer Appointed by Kansas Commission

Appointment of a new state highway engineer has been announced by the Kansas Highway Commission. He is M. W. Watson, who has served as acting state highway engineer since July 15, 1918, in the absence of W. S. Gearhart in Army service. A large amount of road construction is in progress and more is planned, which will be directly under the supervision of Mr. Watson.

Before entering the service of the state, Mr. Watson practiced engineering in connection with coal mining, railroad work and municipal work in southeastern Ohio. He also served in the civilian branch of the United States Army in connection with the improvement of the Ohio River. For five years previous to entering the service of the Kansas Highway Commission as road engineer, in 1917, he served with the Illinois State Highway Department. He is a graduate in civil engineering from the Ohio State University.

Semi-Annual Meeting of Chemical Engineers

At the 11th semi-annual meeting of the American Institute of Chemical Engineers, to be held at the Hotel Lenox in Boston, June 18-21, a symposium on electric furnaces is planned for practically the whole of the opening day. Moving pictures of the operation of the furnaces are to be shown. A symposium on the registration of chemists will be held, and on the last day of the meeting the textile mills in Lawrence will be visited.

May Shipbuilding a New Record

Deliveries of completed ships in May passed all previous records, according to figures made public by J. L. Ackerson, vice-president of the Emergency Fleet Corporation. Moreover, for the first time since the beginning of the corporation's work deliveries exceeded launchings. Diminution of ship production in the early future is indicated by the fact that, considering steel construction only, fewer keels were laid than hulls launched or vessels delivered during the month.

During May, 136 ships totalling 768,025 dead-weight tons were delivered, completed, as against 111 ships of 543,720 tons in April. In both months the largest part of the tonnage was made up of steel ships, of which 87 (594,425 tons) were delivered in May, and 76 (423,320 tons) in April. The launchings for the two months were: May, 137 vessels (including 82 steel) of 705,958 tons; April, 118 vessels (including 74 steel) of 586,266 tons. Keel-layings amounted to 80 (all steel) in May, and 84 in April (including three wood), but the tonnage represented by these keels is 12% larger for May than for April.

Hurley Gives Average Cost of Shipbuilding

Gross Cost, Excluding Plant Extension and Housing Is Further Reduced by Profit Tax Payments

Shipbuilding cost figures for the vessels under construction by the Emergency Fleet Corporation were presented to the public during the past week, for the first time. In a published letter to Representative James W. Good of the House Appropriations Committee, Chairman Edward N. Hurley of the Shipping Board gives the net cost of the Fleet Corporation's ships at about $180 per ton.

In all, Congress has authorized the appropriation for shipbuilding purposes of $3,671,000,000, but of this only $2,625,451,000 has actually been appropriated. The board will require $673,368,301 additional, making a total ultimate expenditure of $3,298,819,301. Of this sum, a total of $202,853,456 should be charged off as representing not the cost of completed ships, but the loss involved in canceling contracts for 754 ships (which would have cost $797,564,276 to complete). Furthermore, shipyard plant extensions, shipworkers' housing and transportation costs amounted to $189,210,275, which is not a direct shipbuilding cost. Similarly, the administration cost of the board and the Fleet Corporation, amounting to $35,000,000, is not to be charged

against the ships. Thus, a total deduction from the gross expenditure should be made in the amount of $437,063,731, leaving the actual money spent for ships $2,861,755,570. This represents the construction of 2434 vessels aggregating 13,885,106 dead-weight tons, the ships thus averaging 5700 dead-weight tons carrying capacity and a cost of $1,175,000, or $206 per dead-weight ton.

As an offset against this cost Mr. Hurley cites the large income and excess profits taxes paid by shipbuilders on the profits of ship construction. Some shipbuilders, he says, have paid such taxes to the amount of $40 per ton; he estimates $25 a ton as the average tax payment of this kind by all shipbuilders, which indicates that very large profits were made by the yards. As far as the Government account is concerned, he reckons this $25 a ton as a deduction which, however, should still further be increased by the taxes paid by the many concerns that supplied steel, boilers, engines and other ship equipment, the amount of these taxes not being known. He concludes that, deducting $25 from $206, the balance of about $180 per ton is an outside figure for the actual cost to the Government of the Emergency Fleet Corporation's ships.

Southern Asphalt Association Formed by Contractors

The Southern Asphalt Association, comprising the principal public-works contractors engaged in laying asphalt pavement in the South Atlantic states, on June 1, opened offices in Atlanta, in the Healey Building. The association will be conducted in the interest of the construction of asphalt roads and pavements in the South Atlantic states.

The following officers have been elected: President, Walter Ely, of the Ely Construction Co., Augusta, Ga., and vice-president, W. R. Mayrant, general manager of the Simmons-Mayrant Co., Charleston, S. C. J. M. Woodruff, who resigned recently as manager of the advertising and paving department of the Standard Asphalt & Refining Co., of Chicago, is general manager.

Propose 385-Foot Concrete Arch

Tentative plans for a bridge across the Willamette River at Oregon City, prepared by the Oregon State Highway Department, show a main crossing consisting of a concrete and steel arch of about 385 ft. clear span, with a 120-ft. rise, flanked by reinforced-concrete approach spans, the entire structure being about 1000 ft. in length. According to a statement just issued, it is contemplated using in the main span a fabricated structural steel rib incased in a protective coating of concrete. In one of the drawings the approaches are of a Roman-arch viaduct type; that is, with multiple arches in vertical elevation. The bridge has been designed by C. B. McCullough, state highway bridge engineer, under the direction of Herbert Nunn, state highway engineer.

Second Pan-American Commercial Conference Meets

Necessary Action to Produce Closer Coöperation Discussed—Bearing of Engineering Considered

A commercial conference of the Pan-American countries was held in Washington, D. C., June 2-6, for the purpose of producing closer commercial relations among the various American countries. Many addresses were made in advocacy of better lines of communication and better commercial relations, and emphasizing the trade opportunities in South America. The afternoon of June 5 was devoted to the discussion of "Engineering and Its Significance and Relation to Commercial Developments."

William C. Redfield, secretary of commerce, in addressing the conference, announced that he had recommended to the United States Shipping Board the establishment of two new trade shipping routes to South America, one along the eastern and northeastern coasts, the other along the northern coast. He stated that these would serve to provide intercommunication among the South American countries as well as to carry American commerce. The Chilean ambassador, Señor Don Beltram Mathieu, called attention to the necessity for firm commercial ties as a means of building up sound diplomacy. He declared that the security of justice, of good order, of good faith in the observance of agreements are as indispensable as cheap production, transportation or credit. The Bolivian minister, Señor Don Ignatio Calderon, emphasized the need of South America for North American capital to develop its resources. In speaking of Mexico, Speaker Gillett of the House of Representatives laid stress upon the production of better conditions in Mexico as an essential to the best interests of all the American countries and of greatest interest to Mexico herself.

Chairman Edward N. Hurley of the United States Shipping Board aroused great interest while explaining the plans of the board to develop better shipping facilities to South America. Many questions were asked, and he stated that an initial trip is proposed for about Nov. 1. He assured the audience that no country would be neglected in the program, which would be developed for the best interests of all.

The engineering session was presided over by H. C. Parmelee, editor of *Chemical and Metallurgical Engineering*, and the session considered railways, highways, aërial tramways, light railways, and sanitation.

The railway discussion was introduced by Percival Farquhar, of New York, who devoted himself to a broad consideration of the question. Charles F. Lang, of Cleveland, Ohio, sent a paper on light railway transportation systems. Charles Whiting Baker, consulting editor of *Engineering News-Record*, New York, presented the subject of highways, and indicated their importance as railway feeders when arranged as systems radiating from railway stations. Dr. Walter C. Kretz, of New York, spoke on the use of the aërial tramway systems, pointing out the fundamental limitations of transportation with such methods and the conditions under which they might be constructed with profit.

The subject of irrigation and its relation to economic development was discussed by C. W. Sutton, of New York. The need for agreement on a number of technical engineering ideas now expressed in different Latin-American countries by a variety of words was brought out by V. L. Havens, editor of *Ingenieria Internacional.* Maj. George A. Soper, Sanitary Corps, U. S. A., advocated a definite plan to be adopted by municipalities in their program for community sanitation.

The principal proposals of the conference may be summarized as follows:

1. Immediate establishment of abundant freight, mail and passenger steamship facilities between the United States and Latin America.

2. Making of every effort by both governments and individuals to develop thorough reciprocity and mutual coöperation.

3. Meeting of the unavoidable and pressing financial needs of the Latin American governments and legitimate private undertakings, and also the protection and enlargement of the United States-Latin America trade.

4. A well defined program for the protection of the patents, trade-marks and copyrights of each country in all the other twenty countries.

5. Making of the parcel post beneficial alike to the United States and Latin American peoples, through the removal of unnecessary restrictions and regulations.

6. Improvement in the administration of the consular services.

7. Undertaking, without delay, all over Latin America, of extensive railway and highway construction.

8. Better credit facilities for Latin American buyers, closer study of Latin American trade, and the extension of United States banking connections.

9. Improvement and extension of news and commercial intelligence service.

The discussions will appear in English in the proceedings of the Pan-American Commercial Conference soon to be published by the Pan-American Union. The papers read at the engineering session will appear in Spanish in the July number of *Ingenieria Internacional.*

Lack Material for Economical Road Construction in Texas

With large amounts of money appropriated and the material plants in Texas working now at full capacity, there are insufficient aggregates in the state to carry on road work in an advantageous manner, according to R. J.

Windrow, state highway engineer. It is asserted that there are not over five quarries and 15 gravel pits operating that can deliver materials in large quantities. If it were not for local materials the outlook in the state would be discouraging.

Materials are plentiful in the state, according to the engineer, but capital seems unwilling to invest in plant equipment. Already the counties of the state have voted about $50,000,000 in bonds, with $22,000,000 more pending, the Federal Government has allotted $16,000,000 in Federal aid, to which the State Highway Department will add $2,800,000, and a constitutional amendment authorizing $75,000,000 for road purposes will be voted on in the autumn.

The highway department believes that the material business should be profitable, considering these large amounts of construction.

Commerce and Engineering Colleges Merged in Cincinnati

It is officially announced by the University of Cincinnati that the College of Commerce has been merged with the College of Engineering, under Dean Herman Schneider. Beginning next autumn a five-year coöperative course in commerce and administration will be offered. This course is planned to meet the demand for men trained both in the production and the commercial sides of business enterprises.

Dean Schneider thus describes the new course:

"The general plan is the same in detail and operation as in the coöperative course in engineering—that is to say, students will work alternating biweekly periods at practical work in business concerns and theoretical work in the university.

"The practical work during the first year will be in certain carefully selected departments of production, in the shipping departments of large concerns, in the traffic departments of railroads, and in the planning departments of factories.

"The work will cover a period of about 2½ years, after which the student will be transferred to the commercial side of business for the next two and a half years."

Enormous Increase in Exports

April exports passed the previous high record by nearly $100,000,000, according to a report issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. The figures given for exports and imports are as follows:

Exports	
January, 1919	$623,000,000
March, 1919	605,000,000
April, 1918	501,000,000
April, 1919	715,000,000
Past 10 months	5,705,000,000
Similar period 1918	4,844,000,000
Imports	
April, 1919	273,000,000
March, 1919	268,000,000
April, 1918	279,000,000
Past 10 months	2,474,0000,00
Similar period 1918	2,362,0000,00

Engineering Educators to Meet

At the annual meeting of the Society for the Promotion of Engineering Education to be held at Johns Hopkins University, Baltimore, Md., June 25-28, each half day's session will be devoted to some special topic, as follows:

At the first session, report of a special committee on the Mann report of the Joint Committee on Engineering Education; also papers on the "Case System for the Study of Law" and "Mental Tests for Engineering Students." At the second session, symposium on the effect of war on engineering education, opened by Anson Marston, dean of Iowa State College, also a paper on "The Unconscious Plagiarist," by G. I. Mitchell of the University of Pittsburgh. At the third session, military training in engineering schools, introduced by Col. W. S. Morrow, and by President Charles S. Howe of the Case School of Applied Science. At the session Friday morning the past and future of the society will be discussed by George R. Chatburn, past president, and in the afternoon the United States Naval Academy and Engineering Experiment Station at Annapolis will be inspected. At the last session there will be a symposium on changes in engineering courses, introduced by Dean Gardner C. Anthony, Tufts College, who will speak on the new course at that institution.

Protest Against Fishing in Water-Supply Reservoirs

Members of the New England Water-Works Association, called together on short notice, held a conference in Boston, recently, to discuss measures for opposing the passage of a bill which would make it lawful to fish in ponds used for water-supply in Massachusetts. Letters were prepared to be sent to all water boards in the state.

Civil Service Examinations

California.—Civil engineer, grade IV, $2700 to $3900 per year; examination in Sacramento, San Francisco and Los Angeles as soon after June 14 as possible. File applications with State Civil Service Commission at Sacramento before June 14.

California. — Construction engineer (civil engineer, grade III), $2100 to $2700 per year; examination in Sacramento, San Francisco and Los Angeles, June 20. File applications with State Civil Service Commission at Sacramento before June 14.

California.—Civil engineer, grade II, $1500 to $2100 per year; examination in Sacramento, San Francisco and Los Angeles, June 20. File applications with State Civil Service Commission at Sacramento before June 14.

California. — Senior engineering draftsman, grade II, $1500 to $2100 per year; examination in Sacramento, San Francisco and Los Angeles, June 20-21. File applications with State Civil Service Commission before June 14th.

New York.—Heating and ventilating engineer, office of state architect, $1500 to $2500 per year, June 28, apply to State Civil Service Commission at Albany for application forms before June 16.

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Senior engineer and senior architect, Interstate Commerce Commission, $1800-$2700 per year, June 10. File application before June 10.

Assistant designing engineer, Naval Ordnance Plant, South Charleston, W. Va., $9.20 per diem. July 8. File applications before July 8.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

Assistant inspector of engineering material (aircraft), $5.92 per diem, July 15. File applications before July 15.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York; June 16-19, Detroit.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

The San Francisco Association of Members of the American Society of Civil Engineers held a meeting May 26 which was devoted to considering the work of the Committee on Development. Four committees had previously been appointed, each assigned to one of the four subjects given to subcommittees of the Committee on Development, and the reports of these four committees were printed and sent to members of the San Francisco Association, so that all might be prepared

to pass on the recommendations of the several committees. To expedite matters, each of the four committee chairman was made chairman of the meeting pro tem, during the discussion of the report of his committee. These men were Edwin Duryea, subcommittee No. 1; C. J. Rhodin, subcommittee No. 2; C. E. Grunsky, subcommittee No. 3; George L. Dillman, subcommittee No. 4. There was a lively discussion, which considered the subjects from many angles and served to provide H. L. Haehl, the association's delegate to the Committee on Development, with a comprehensive idea of the members' viewpoints. A stenographic report of the discussion was taken for reference.

The Colorado Association of Members of the American Society of Civil Engineers will hold its annual meeting at the Shirley Hotel, Denver, June 14. The regular business of this meeting, such as the election of officers, hearing the president's annual address, and reports of the various officers, will be taken up. In addition, there will be an address by E. A. Moritz, engineer, United States Reclamation Service, on "A Public-Works Department for the Federal Government." The usual informal dinner will precede the meeting.

The Rochester, N. Y., Society of Technical Draftsmen will hold its annual meeting and election of officers at its rooms in the Sibley Block, 328 Main St., East, on June 26, 1919. Among the addresses will be one entitled "Some Experiences in Construction Work in the Tropics," by Leslie S. Wood, of the Eastman Kodak Company.

The Houston Engineers' Club and local members of the American Association of Engineers held a joint meeting May 26 at which C. E. Drayer, national secretary of the association, explained its principles and work. Officers of the club asked for a proposal under which it might become a part of the association. The club is one year old and has one hundred members, the number of engineers in its district being three hundred. In a discussion on licensing, J. M. Howe stated that an effort would be made to have a law passed at a special session of the legislature which meets this month. Maj. J. A. Rossiter suggested that the club direct the formation of a city-planning commission. A plan will be the subject discussed June 12. J. C. McVea, city engineer, is president of the club.

The Southwestern Society of Engineers held a convention at El Paso, Tex., on May 29-31, 1919, at which topics of general interest to engineers were discussed. Among the addresses and speakers were: "Oil Geology," by G. M. Butler, dean of the School of Engineering, University of Arizona; "Licensing of Engineers," by C. E. Drayer, secretary of the American Association of Engineers, of Chicago; "The Concrete Ship," by C. E. Barglebaugh, former engineer, Emergency Fleet Corporation, and "Modern Wireless Telegraphy and Telephony," by R. W. Goddard, in charge of the school of radio engineering, New Mexico Agricultural and Mechanical College. The officers for the previous year were reëlected.

The Rochester, N. Y., Engineering Society will hold its annual meeting June 13, 1919, at the Hotel Seneca. This will be the last get-together meeting of the season. An informal dinner at the Hotel Seneca will be followed by the election of officers and committee reports, and by an address by J. Y. McClintock, superintendent of highways, Monroe County, on "The Finger Lakes Road Project and the Roosevelt Road."

The Associated Engineering Societies of St. Louis held a joint meeting at the Engineers' Club, under the auspices of the St. Louis Section of the American Society of Mechanical Engineers, June 5. Wallace C. Capen, St. Louis manager, the White Co., gave a talk on "Certain New Developments in Rear Axle Construction." Motion pictures and lantern slides of motor-truck performance in Mexico and France were shown.

The Canadian Society of Domestic, Santiary and Heating Engineers held its annual convention at Montreal June 4-5, 1919. Reports were presented concerning the laws regarding plumbing and sanitation in the various provinces, with the object of formulating model laws to regulate these matters. The following officers were elected: President, F. R. Maxwell, of Toronto; secretary, G. F. Frankland, of Toronto.

The Louisiana Engineering Society held its regular meeting in the library room of the State Museum Building, New Orleans, June 9, 1919. Among the addresses was a paper by Thomas L. Willis on "Garbage Disposal."

Personal Notes

E. C. EARLE, designing engineer, Bureau of Public Works, Manila, P. I., has been appointed chief designing engineer of the bureau and is now engaged in carrying out the design and construction of a new ocean terminal pier and the enlargement and alteration of several of the older structures at the port of Manila.

C. C. THOMAS, formerly sales engineer of the Denby Motor Truck Co., has been appointed chief engineer of the Fields Manufacturing Co., Owosso, Mich. Mr. Thomas has been identified with several branches of work in the automotive industry, being successively in the experimental engineering department, service manager and sales engineer.

MAJ. THOMAS G. HAMILTON, formerly a construction engineer at Gary, Ind., who has been a member of the general staff of the American Expeditionary Forces, has been promoted to the rank of lieutenant colonel and has received the decoration of the Cross of the Legion of Honor from the French Government. He expects to return to Gary in July, upon his release from the service, and resume his work with the T. G. Hamilton Construction Company.

DAVID MACNAUGHTON has opened a consulting engineering office at 528 Lincoln Life Bldg., Fort Wayne, Ind., for the practice of industrial engineering, including the making of illumination surveys, valuations, reports and rate investigations of electric light and power companies. Mr. MacNaughton has been engaged in public utility engineering for the past 12 years for large companies operating in Indiana, Illinois, Michigan, Ohio and Wisconsin. He has also had wide experience in valuation work, making reports and analyzing rate charges for electric light and power service.

P. B. MCDONALD, who has been head of the department of engineering English at the University of Colorado for the past two years, has been appointed assistant professor of English in the engineering college of New York University.

H. F. HARMON and J. H. SLUSS, of Graham, Va., have formed a partnership and will carry on the construction work formerly handled by the J. H. Sluss Construction Co., of Graham, Va., and Huntington, W. Va. Mr. Harmon has had long experience in the construction business, as superintendent and manager of large construction companies, while Mr. Sluss is a civil engineer with varied construction experience, particularly in railway construction.

B. H. FRASER, formerly assistant chief engineer of the Department of Marine, Ottawa, Canada, has been appointed chief engineer, succeeding COL. WILLIAM P. ANDERSON, retired.

W. J. KRULL, HOWARD T. KRULL and HOMER B. GRADLE, of Hobart, Ind., have organized a construction company, to be known as the TRIANGLE CONSTRUCTION CO., with offices in the American Trust & Savings Bank Building. They will both make plans as architects and do construction work.

ERNEST P. GOODRICH, consulting engineer, announces the removal of his office to 140 Nassau St., New York City.

HOLLIS LIBBY, county surveyor of Lane County, Oregon, has resigned to accept a position as engineer with the State Highway Commission. Mr. Libby has served as county surveyor for the past six years, with the exception of the past nine months, while he was in the Army service.

PAUL SUMMY, city engineer of Warsaw, Ind., has resigned to devote his entire time to his business interests.

P. F. WHITTIER has resigned as engineer for the Whittier Mills Co.,

Chattahoochee, Ga., to accept the position as assistant to the State Highway Engineer, W. R. NEEL. He will take charge of the excess War Department equipment allotted to Georgia for Federal-aid highways.

LIEUT. COL. ARTHUR H. PARKER, of Cody, Wyo., who has recently returned from overseas service with the Quartermaster Corps of the 32nd Division, has been appointed assistant engineer, State Highway Department.

A. W. MOSELEY, of Kansas City, Mo., has been appointed by Col. E. M. STAYTON as his assistant in building the road system of Clay County, Missouri.

G. SYVERSEN and C. KRUSE, New York City, severed recently their connection with the ROBINS CONVEYING BELT Co., and sailed, June 9, for Christiania, Norway, where they will form a partnership to practice industrial engineering They will also represent the company in Norway.

T. R. SPENCE, formerly with the engineering department of the Army, has been appointed by the State Highway Department as superintendent of the surplus Federal equipment allotted to the State of Texas for Federal-aid road work.

CAPT. RICHARD SCHERMERHORN, of New York, of the Engineering Section, Sanitary Corps, American Expeditionary Forces, has received his discharge from the service and has resumed his practice as landscape architect and civil engineer at 363 Lexington Ave., New York City.

CHARLES CURRY, Kansas City, Mo., who served as a lieutenant with the 110th Engineers in France, has been appointed assistant city engineer of Kansas City, Mo. Before entering the service he was assistant in the sewer-engineering division of the city.

COL. E. M. STAYTON, of the 110th Engineers, has received his discharge from the service and has been engaged by Clay County, Missouri, to supervise building of its road system. Colonel Stayton was formerly highway engineer for Jackson County, Missouri.

CAPT. J. H. BONNER, Engineers, U. S. A., has received his discharge from the service and has been appointed chief engineer of the Montana Railroad and Utility Commission, Helena, Mont. Before entering the service Captain Bonner was a member of the staff of the College of Engineering, University of Montan

TAYLOR A. BORRADAILE, of Charleston, W. Va., has been appointed city chemist, and will take charge of the chemical and bacteriological research department of the city government. For the past two years he has been with the chemical department of the Warner-Klipstein Chemical Co., of South Charleston.

FRANK E. BAKER, engineer in charge of construction for Methodist Episcopal projects in Europe and North Africa, left, June 5, for France to begin work on the 11 towns of the Chateau-Thierry battlefield which have been assigned to the Methodist Episcopalians foi reconstruction. He will supervise a five-year building program, which will include the erection of sixty permanent buildings in France and about the same number in Italy.

H. H. ESSELSTYN, commissioner of public works of Detroit, Mich., has resigned, to take effect June 30, to return to the firm of ESSELSTYN, MURPHY & HANFORD, engineers and architects, 810 Marquette Building, Detroit. His resignation was made necessary by the increased scope of the work of the company

H. H. FILLMORE, formerly resident engineer with the Los Angeles, Calif., Highway Commission, has been appointed district engineer in charge of the Los Angeles office of the Portland Cement Association, in the Merchants' National Bank Building. He will have charge of the association's activities in Southern California and Arizona.

HERBERT J. FLAGG, Coast Artillery, U. S. A., has recently received his discharge from the service and has returned to his former position as assistant engineer, Public Service Commission of the State of Washington, at Olympia, Wash.

LIEUT. C. B. LEWIS, recently discharged from command of Co. C, 217th Engineers, has accepted a position as sales engineer with the Northwestern Expanded Metal Co., of Chicago. Before the war he was superintendent with Albert Kahn, architect, of Detroit.

J. R. ROBERTS has been appointed chief engineer of the Central Illinois Public Service Co., with headquarters at Mattoon, Ill.

O. B. KERCHER, formerly assistant to D. MOOMAW, county road engineer of St. Josephs' County, Indiana, has resigned to join the forces of the Indiana State Highway Commission.

LIEUT. COL. AMOS A. FRIES, Engineers, U. S. A., who was a brigadier general in charge of the Chemical Warfare Service of the American Expeditionary Forces, has been made a Commander of the Legion of Honor by the French Government.

CHARLES F. O'HAGAN, formerly chief engineer of the William B. Scaife & Sons Co., Pittsburgh, has been appointed resident engineer and manager of the Chicago office of the company, at 38 S. Dearborn Street.

JAMES W. TOWNSEND has opened an office at 709 Empire Bldg., Detroit, Mich., for practice as a designing and construction engineer. He is at present building a theater at River Rouge, Mich.

JOHN H. BRINGHURST, associate professor of civil engineering, Johns Hopkins University, has accepted the position of dean of the faculty and professor of engineering design at the Drexel Institute, Philadelphia. Professor Bringhurst is a graduate of the University of Michigan, and since graduation has had a varied experience in structural engineering. He has been associated with Johns Hopkins University since the autumn of 1916.

HENRY B. SEAMAN, supervising engineer, Navy emergency plant extensions, Bureau of Yards and Docks, terminates his connection with the bureau June 15. While with the bureau Mr. Seaman has had general supervision, under Admiral Rousseau, of construction work at 35 shipbuilding and accessory plants throughout the country. The work supervised has cost more than $55,000,000. Mr. Seaman was formerly chief engineer of the New York Public Service Commission, First District. He will return to New York, and his temporary address will be 363 Grand Ave., Brooklyn, N. Y.

E. J. TESKEY, of South Bend, Ind., has been appointed assistant to D. MOOMAW, county road engineer of St. Joseph's County, Indiana, with office in South Bend.

C. J. RENNER, of Mount Vernon, N. Y., has been appointed city engineer of Ellwood City, Penn., succeeding ALEXANDER MAINES, who has resigned.

FRED G. SIMMONS and JOHN C. DAVIS have formed a partnership as consulting engineers, with offices at 811 Majestic Building, Milwaukee, Wis., for the carrying on of a general engineering business. Mr. Simmons was formerly commissioner of public works of the City of Milwaukee and engineer of construction and maintenance for the Milwaukee Electric Railway & Light Co. Mr. Davis was dean of the College of Applied Science and Engineering at Marquette University and director of the Bureau of Municipal Research of the City of Milwaukee.

OBITUARY

FREDERIC A. BIGGI, highway contractor and civil engineer, of Albany, N. Y., died in that city, May 31. He was graduated from the Massachusetts Institute of Technology in 1904, and was connected with work for the Public Service Commission, First District, New York State Barge Canal, and New York State Highway Department for a number of years. For the past four years he was engaged in the construction and repair of highways.

EDWARD F. MULLANEY, an assistant engineer in the city engineering department of Minneapolis, Minn., died in that city, May 21, at the age of 64. He had been in the service of the city for the past 34 years.

Corrugated-Iron Manhole Sand-traps for Tile Drains

A new form of corrugated-iron combination manhole and sand-trap, for use in tile drainage on irrigation work and elsewhere, was described by L. E. Thompson, irrigation expert, in the June issue of the *Highway Magazine*. This method of access to the underdrainage system is formed by joining convenient-sized sections of circular corrugated-iron pipe. Many desirable features of this device are mentioned by the writer; some of them are as follows:

COMBINED MANHOLE AND SAND-TRAP

Combination manhole and sand-traps, extending about 1 ft. below the drains, serve as a settling basin for any sand or silt which may pass through the pipe; provision can always be made for flushing the drain, which is an important feature; the sizable opening at the top provides a means for operating a root-cutting or drain-cleaning device; and the manhole may be utilized to carry off surface water, thus serving a double drainage purpose.

The device as described by Mr. Thompson is about 10 ft. deep, 2 ft. wide in the neck, 4 ft. at the bottom and made of "Armco" pipe. An iron top is provided, as shown in the cut, and the device can be supplied with or without an iron bottom.

Good Roads Show and Exposition To Be Held in South Carolina

The Southeastern Good Roads Show and Agricultural Implement and Tractor Exposition will be held at Greenville, S. C., July 14-19, 1919. In addition to addresses by prominent road officials and highway transportation enthusiasts, there will be a complete exhibit of all kinds of roadbuilding and agricultural implements and machinery. The general manager is F. M. Burnett, of Greenville, S. C.

Large Weld Repairs Stern Frame of "Northern Pacific"

Welding of the large stern frame of the U. S. A. transport "Northern Pacific," which was broken just above the rudder lug when the steamer went upon the beach off Fire Island, New York, last January, has been accomplished by the Metal & Thermit Corporation, of New York. The section welded was entirely broken through as a result of the severe strain when the boat went aground with its load of homeward-bound troops.

The weld required 1400 lb. of thermit for the production of the necessary amount of molten metal, and the operation was performed without removing the casting from the ship. This obviated the delay and expense which would have been entailed by the only alternative of purchasing an enormous new casting and installing it in the "Northern Pacific."

Business Notes

THE LEHIGH PORTLAND CEMENT CO., of Chicago, announces the appointment of C. B. Rogers as assistant treasurer and credit manager in place of W. E. Viets, who has resigned.

THE MASSEY CONCRETE PRODUCTS CORPORATION, Peoples' Gas Building, Chicago, announces the appointment of P. E. Longstreet as resident manager of the Western district, in charge of all sales in that territory. His headquarters will be at 925 S. 6th St., West, Salt Lake City, Utah.

L. V. ESTES, INC., industrial engineers and accountants, have removed their offices from the McCormick Bldg., to the Century Bldg., 202 S. State St., Chicago, Ill., where they will occupy the entire fifteenth floor.

THE STARK ROLLING MILL CO., of Canton, Ohio, announces the appointment of George W. Scott as district manager for the Chicago territory, with headquarters at 1119 Marquette Bldg. Mr. Scott was formerly Chicago representative of the Pittsburgh Steel Co. The company also announces the appointment of Thomas F. Murphy as district manager for the Canton, Ohio, territory. Mr. Murphy was formerly connected with the American Sheet & Tin Plate Company.

THE MANUFACTURERS' CO., of San Francisco, has opened an office at 811 Lumber Exchange Bldg., Chicago. B. F. Wade, formerly chief engineer of the Redwood Manufacturers' Co., now represents the company in the Chicago office.

THE AMERICAN BLUEPRINT CO., of Chicago, Ill., announces that Vernon T. Brauns, for the past four years salesman for the company, has been made manager. Mr. Brauns has been active in the American Association of Engineers and the Western Efficiency Society, and is well known among railroad valuation engineers for his promotion of a process for reproducing tracings for presentation to the Interstate Commerce Commission.

THE VAN DORN & DUTTON CO., of Cleveland, Ohio, manufacturers of gears and pinions for electrical work, has opened branch offices in New York and Chicago. Harry S. Keegan, formerly with the Chicago surface lines, will manage the Chicago branch, with offices at 1241 First National Bank Building. John Keegan, formerly with the Interborough Rapid Transit Co., of New York, will manage the New York office, which will be at Room 313, 30 Church Street.

THE DAYTON INSULATING DIE CO., U. B. Building, Dayton, Ohio, manufacturers of molded insulation products and dies for the same, has bought the Edgemont Die Castings Co., of Dayton, Ohio, and will consolidate it with its other plants, operating under a new name. E. A. Kurz will be president. A new plant, 60 x 120 ft., and two stories high, will be immediately erected at Edgemont, Ohio.

Trade Publications

The following companies have issued trade publications:

THE IRVING IRON WORKS CO., of Long Island City, N. Y.; catalog, 4½ x 8½ in., 36 pages, illustrated; descriptive of "Irving Subway Fireproof Ventilating Flooring."

THE BELMONT IRON WORKS, 22nd St. and Washington Ave., Philadelphia, Penn.; catalog, 14 x 8½ in., 16 pages, illustrated; an export catalog printed in three languages, English, French and Spanish; describes the plants and products of the works and gives weights and dimensions of various steel sections.

THE GENERAL FIREPROOFING CO., Youngstown, Ohio; pamphlet, 8 x 11 in., 16 pages, illustrated; gives data on waterproofings, damp-proofings and technical paints.

THE AMERICAN SPIRAL PIPE WORKS, Chicago, Ill.; catalog, 8 x 10½ in., 87 pages, illustrated; describes and illustrates the advancement in the manufacture of corrugated-steel furnaces, large-diameter lap-welded steel pipe, spiral-riveted pipe, forged-steel flanges, and forged-steel boiler nozzles.

THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis.; booklet, 5 x 8½ in., 61 pages, illustrated; describes the works and products of the company.

THE COREY MFG. CO., Marshfield, Ore.; folder, 3¾ x 6¾ in., eight pages, illustrated; describes the Corey banding tool for placing large wire bands around wood-stave or metal pipe.

THE CEMENT GUN CONSTRUCTION CO., of 900 S. Michigan Ave., Chicago; pamphlet, 6 x 9 in., 24 pages; illustrated; shows views of numerous structures built up by or covered protectively by the cement gun.

THE AMERICAN CEMENT MACHINE CO., INC., of Keokuk, Iowa; catalog, 8½ x 11 in., 9 pages, illustrated; describes "Boss" concrete mixers.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

CHARLES WHITING BAKER *Consulting Editor*

Volume 82 NEW YORK, THURSDAY, JUNE 19, 1919 Number 25

The Development Committee Speaks

MUCH food for thought is contained in the progress report of the Development Committee of the American Society of Civil Engineers submitted at Minneapolis this week and printed on p. 1229. The many recommendations which the committee offers as a tentative outline of its final report deserve the earnest consideration and full discussion which the committee desires. If these are given, as we trust they will be, crystallization of opinion may be expected that will go far toward putting the society and the whole engineering profession where they belong among the forces of twentieth-century technical and civic progress.

Across the Atlantic

NOT because it is a matter of news to anyone who reads this, but because it is a record in transportation history, it should be set down that on June 14-15, with Capt. John Alcock, an Englishman, as pilot, and Lieut. A. W. Brown, an American, as navigator, a Vimy-Vickers biplane made the first nonstop flight across the Atlantic, a voyage of 1930 miles from Newfoundland to Ireland in 16 hours and 12 minutes. Adventure though it was, the flight marks one more step forward in air navigation, not only as it testifies to the solid engineering background of the plane and its engine, but because of the unerring direction through sleet and fog and starless night straight to the big wireless station on the Irish coast.

New Pumping Engine Promised

RECIPROCATING pumping engines have been so far displaced by rotating types of late that no little interest was created by Mr. Decrow's paper on the "Unaflow" pumping engine read at the Buffalo water-works convention last week (p. 1193). The interest was heightened and the hope for an early placing on the market of the new machine increased by the working unit seen in operation at the local water-works. Proposed tests of this 3,000,000-gal. unit will be awaited with interest.

Machines Instead of Laborers

DRUDGERY is becoming unpopular in the world. The hewers of wood and drawers of water are more scarce than they were before the war decimated their numbers and educated to less tiring and irksome labor many that were spared. In this country especially, the effect is clear. The increased cost of unskilled labor has far surpassed the universal increase in cost of all things. Mechanics' wages have gone up 30, 40, and in a few cases 100% over pre-war standards. Common labor today costs two and three times what it did five years ago, and in most construction work, particularly in heavy construction, common labor makes up the bulk of labor costs. What is to be done? The answer is obvious. Machinery to supplant unskilled labor must be provided. Too much of the inventiveness of mankind has been devoted to reproducing mechanically the skill of man. More must in the future go to relieve the drudgery, and in so doing to reduce the cost of production and of construction. If the material-handling machinery men who met in New York City last week can, through the joint effectiveness of their machines and their propaganda, spread this gospel, their reward will be commensurate with the great service rendered.

Buffalo Should Save Still More Water

MARKED has been the reduction of water waste in Buffalo by pitometer surveys and house-to-house inspection. There can be no doubt of the wisdom of continuing work along both lines, but do not Mr. Andrews' own statements (p. 1196), that the good results of house-to-house inspection seem likely to disappear in two or three years, indicate that at most only local conditions can justify the postponement of universal metering in Buffalo? True, the plan is to install meters where most needed. True, also, that in a city where consumption and waste once reached the enormous figure of 339 gal. per capita wholesale metering cannot be instituted over night. Time for educational leaven to work is often necessary in such cases. Mr. Andrews' educational bulletins (see *Engineering News-Record* of June 5, 1919, p. 1094) and the pressing need for reducing consumption so as to make filtration possible at a reasonable outlay, combined with the transient results from house-to-house inspection, will doubtless quicken Buffalo's speed in metering.

Labor Opposed to Radicalism

DURING the war there was constant fear that the socialistic element in the American Federation of Labor would get the upper hand. In fact, there were surprising demonstrations of its strength. It appears, however, from the convention of the federation in session last week in Atlantic City, that this element has either been very largely eliminated or, coming to its senses, has realized that true progress lies along the lines that the federation has pursued for many a year. At Atlantic City the determination has been clear to stamp out anything that savors of the revolutionary doctrine or action. Such assurance is encouraging at the present time, though anyone who has followed the federation's activities knew that it could be counted on to oppose radicalism if the Gompers element remained in power. The fact that the federation will oppose revolutionary doctrine and methods, however, is not assurance of speedy adjustment of the labor phase of our industrial problem. But it does warrant the hope that we can go about the task of stabilizing our industries without the fear that there will be lacking the coöperation of the strongest factor in the labor field.

Useless to Postpone Construction

THE consensus of opinion at the convention of the American Water Works Association in Buffalo last week was that the present high level of prices will continue, with little downward change, so it will be useless to postpone construction longer for the sake of less outlay. Prices of some materials may fall, but since labor cost is bound to keep up or even increase, and because labor enters so largely into water-works materials and construction, there seems no hope of any considerable reduction in water-works costs. The vital importance of water-works upkeep and extension, coupled with the fact that this is a revenue-producing utility, adds strength to the argument for going ahead with much-needed water-works operations.

Coöperative Course in Commercial Engineering

THE departure by Dean Herman Schneider at the University of Cincinnati in inaugurating, through the merged College of Engineering and Commerce, a coöperative course in commercial engineering, is an epoch-making venture. Judged from the standpoint of need for such a course, which was announced in our news pages last week, its success can be predicated beforehand—business men have been clamoring for applied scientists who could also think in terms of commercial values. And while courses in which engineering and business training have been combined already exist in various institutions, this is the first in which the coöperative system is applied. With the great advantages of first-hand contact with commercial problems such as results from the coöperative principle, the effectiveness of the new course, especially in the experienced hands of Dean Schneider, can be assumed from the start. It seems not unlikely that this new departure will mean a slowly developing element in the profession which should help mightily in raising its status in the business world.

Building Activity and Mortgages

COMPLAINT has been general that the revival of building construction has been delayed because of the difficulty of getting mortgage money from insurance companies, savings banks and trust companies. The matter has come up for public discussion at New York in connection with an inquiry on the raising of rents. The insurance companies recently made their defense. They admitted that their building loans had been heavily curtailed, but maintained that that had been done in order that they might invest in Liberty Bonds. The Government's necessity, they contended, took precedence over the housing demand. The unfortunate part of the situation, however, is that with the signing of the armistice large funds did not become available immediately for building loans because the companies had subscribed on their credit and even now have large payments to make. Probably the investment situation of the savings banks and trust companies is similar. In that case the building field cannot expect a heavy supply of mortgage money until the fall. That funds will be made available as quickly as the institutions can divert them to mortgages seems probable, for the return is lower on Government securities. Of course, one may expect on long-term mortgages a demand for a higher security margin than in the past, due to the present high construction costs. In any event, judicious pressure should help hasten progress in the matter of building loans, for at New York the companies concluded, as a result of the discussions, that they could find some $30,000,000 of mortgage money. The thought is worth passing on to the many other communities faced with housing shortage. The situation is one "affected with a public interest," an angle that the controllers of the public's funds as accumulated in the insurance and savings companies are not slow to grasp.

Partial Government Ownership of Railroads in Canada

GOVERNMENT ownership and operation of a large portion of Canada's transportation system are to be carried out under the terms of the bill providing for the incorporation of the Canadian National Railway Co. to take over and operate the properties of the Canadian Northern System, passed by the Canadian Senate May 27, as noted in the news section of this journal June 5. The fact that the passage of the bill has caused little comment may be ascribed to its being a natural outcome, although but a partial solution, of Canada's railroad problem, which has been brought about by the previous riot of ill-advised construction and by extravagant public gifts and guarantees, supported on an unsound financial structure.

Briefly, it is provided that the Canadian National Railway Co. shall be incorporated, with a board of directors nominated by the Governor General in Council, to take over and operate the properties of the bankrupt Canadian National System. Any deficits or surplus earnings from the operation of the lines will be paid out of or accredited to the national treasury. The capital stock of the company is to be vested with the Minister of Finance. Opportunity is provided for the indefinite extension of Government ownership and operation of public utilities through the insertion of a clause providing for the transfer to the control of the Canadian National Railway Co. of "any railway company, or of any other company having corporate powers or properties which may be conveniently exercised or operated by the company," in which the Canadian Government may have acquired the controlling interest. It may reasonably be assumed that the clause is destined to be applied to the Government-financed National Transcontinental and the Intercolonial Lines.

A little over two years ago the Royal Commission, composed of Sir Henry L. Drayton, W. M. Acworth and A. H. Smith, appointed to investigate Canada's desperate railroad situation, rendered its report. The Drayton-Acworth report, which recommended the virtual taking over into Government ownership of the Grand Trunk, the Grand Trunk Pacific, the Canadian Northern, the National Transcontinental, and the Intercolonial Lines, is partly carried out under the terms of the present bill. The minority report of A. H. Smith—to retain private operation and ownership of the lines, dividing the business into definite geographical sections and distributing the physical properties among the companies accordingly—has evidently been flatly rejected. The alternate plan of W. F. Tye, previously chief engineer of the Canadian Pacific, recommended that all of the railroad lines in Canada, with the exception of the Canadian Pacific, be unified, so that there would be created a transcontinental system which would be a worthy competitor of the strong Canadian Pacific. As

expressed by this journal editorially (May 7, 1917, p. 370), the Tye plan seemed more commendable than either of the others. It now appears that it is likely to be carried out, although under Government ownership, through the provision of the bill which permits indefinite extension of the control of the new company.

We can find no parallel between the railroad situation in Canada and that in the United States. Canada's railroad troubles were at first brought about by ill advised expenditures for new construction and the founding of companies on shadowy financial bases, backed by Government guarantees. The result was inevitable. In this country, the vast majority of railroad properties are in sound financial condition, granting that many, previous to rental by the Government, were living from hand to mouth, due to the persistent refusal of the Interstate Commerce Commission to grant increases in rates sufficient to meet increasing operating expenses and give an adequate return on the investment. While Canada has been oversupplied with transportation and her railroad troubles started with unwise expenditures for capital account, the United States has been under-supplied, and its chief difficulties lie in ever-increasing operating expenses, with gross revenues insufficient to operate the lines and pay rental to the owners.

The United States should be keenly interested in the railroad situation in Canada, not only for the reason that its railroads connect with Canada's, are physically like them and are in competition with them, but also because Canada's participation in railroad ventures has not proved fortunate, and holds lessons for us in the railroad settlement we must soon undertake.

The American Water Works Association

WITH 7500 water-works to draw upon, besides engineers, chemists and bacteriologists in private practice and a thousand or more water-works manufacturers and contractors, the American Water Works Association attained some 1400 members at high-water mark. Its membership should be at least 5000. The recent slight decline in membership may be attributed to war conditions; otherwise it would be discouraging, as perhaps it is, anyway. The falling off in technical-committee work during the past few years may also be laid to war conditions in large part, but this does not seem to be the sole cause.

Whatever may have retarded growth in membership and committee work in the past, and kept the association from entering that larger field of usefulness to be expected from a national organization of water-works men, should not hold in the future. That members having the advancement of the association at heart feel this was evident at the Buffalo convention of the association last week. Official measures proposed for meeting the situation, or at least for increasing and holding the membership, were: (1) Publishing the *Journal* six instead of four times a year and continuing the recent practice of including a considerable number of original contributions; (2) organizing sections in each state where the membership is 20 or more. Budget provision was made for greater frequency of publication, and approval was also given to the use of original contributions. It would be hard indeed to argue successfully against either of the branches of the first proposal. The second proposition is also good so far as it goes, but a hard drive for additional members, and doing more than is now being done for the membership, for the water-works fraternity in general and for the country at large, are two great needs and duties of the association.

More members and more service should be the slogan. Service alone would do almost as well, for nothing would bring new members so fast and hold them so long as increased service to them, the interests they represent and the general public.

Additional members would bring increased income but how provide funds for the added service which is essential to gaining and holding members? One means is directly at hand. In recent years the association has not only made good a deficit but it has also created an "investment fund." This fund totals $13,000. It is proposed either to draw somewhat upon this fund, or lessen additions to it, for useful current work of immediate benefit to the members. This appears to be so wise a policy that it seems strange that it was not adopted earlier. If the *Journal* be made a more frequent and helpful visitor, the association would get and keep a stronger hold on its members. Then, if in addition to this a material increase could be made in the small sum appropriated for committee work, the association might expect to make rapid progress.

The need for more money for committee work seems to be forcibly illustrated by the position of the association in relation to the American Electrolysis Committee. The association's members of this committee seem to be handicapped for funds, as compared with the representatives of the other utilities on the committee. The peculiar and almost isolated position of the American Water Works Association in this electrolysis matter—most of the other utilities being in more or less close affiliation with the utility creating the electrolysis problem—makes it particularly desirable that the association be able to take a strong stand. To do this funds for its members on the joint committee are needed.

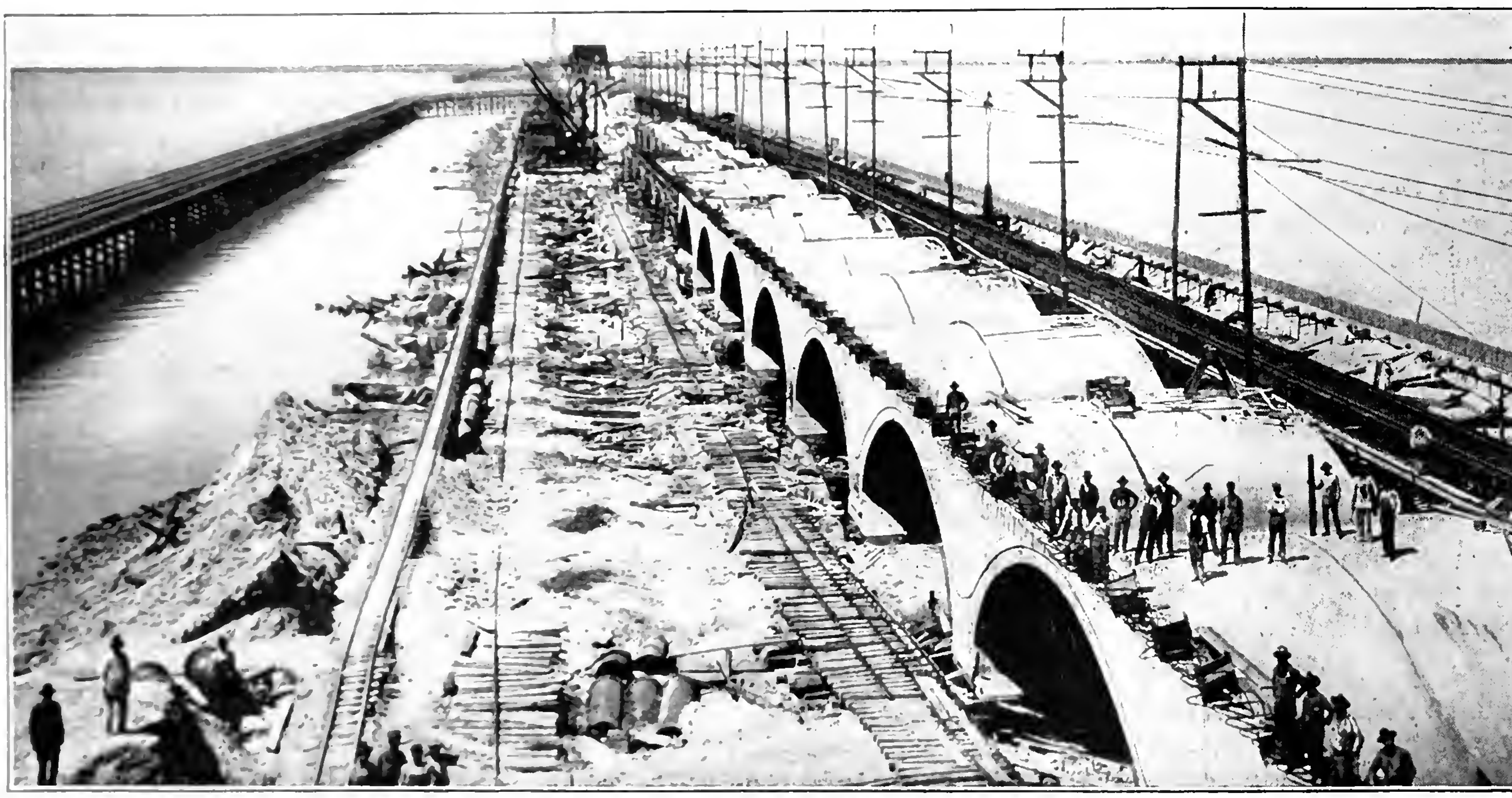
An unofficial proposal for promoting the association discussed at Buffalo was an increase in membership dues. This might strengthen the association in some respects, but it would tend to decrease the membership, or retard its rate of growth, and thus might pull down income. The members who dropped out and the prospective members kept out by higher dues need what the association has to give. Conceivably, they might be served by relatively low-priced membership in state sections, which would cover subscription to the *Journal*. Probably a rather high membership fee in the parent association would be necessary under a plan for local-section membership carrying with it receipt of the *Journal*. An extension of corporate membership, under which a city or water company joins the association, might help solve the problem of increased dues.

Finally, as has long been evident, what the association must come to, if it is to do its full duty, is to have one or more full-time officials. At the start a secretary-editor would do very well. Such an official, with a moderate amount of clerical help, could be an ex officio member of all committees that need to carry on correspondence. He could also do a certain amount of research work for some of the committees. Until some such plan is put into effect the American Water Works Association is not likely to grow as rapidly as it should and, failing to adopt it, actual decline may come.

Construction of New Arch Section of Galveston Causeway

Centrifugal and Jet Pumps Mounted on Derrick Platforms—Permanently Lagged Steel Arch Centers—Old Causeway Walls Used for Cofferdam

OF MORE than a mile of earth fill which formed about two-thirds of the Galveston causeway prior to the storm of August, 1915, only the low concrete walls and the concrete sheet piling below them remained after that catastrophe. As communication with the mainland was then possible only by altogether inadequate ferries, two temporary trestles of wooden piles were built immediately—a highway structure several hundred feet distant to avoid interference in rebuilding the causeway, and a railway trestle along the old line of track which is still in use for the main portion of Galveston's railway traffic and by the Houston interurban electric line. Location of the highway trestle too far away to be of use for construction purposes, and constant service required of the railway trestle, combined with the fact that the bay was too shallow for water craft along the causeway, made necessary the use of the bottom of the bay along the structure for location of equipment and for transportation of material.



REBUILDING CONCRETE ARCH SECTION OF CAUSEWAY, USING OLD SHEET PILING TO FORM COFFERDAM

The old sheet piles and walls were well situated for forming a wide cofferdam to make this possible and allow the use of wide-gage derricks to handle the work on the new arches. Concrete plants at either end receive material either by railway or by barges passing through the deeper water at the southern end and a channel dredged from deep water to the northern end. Centrifugal pumps on the ground and on the platforms of the movable derricks, which also contained jet pumps, and two reciprocating pumps drawing water from several pumps, emptied the cofferdam. The portable steel arch centers were permanently lagged and moved ahead in halves by a derrick and a wide-gage car inside the cofferdam.

All the sand for the 80,000 cu.yd. of concrete and the 10,500 concrete piles came to the job in barges, while the stone came by rail, as did the 6,000,000 lb. of reinforcing steel. The 40,000 cu.yd. of excavation and the 53,000 cu.yd. of fill were handled by the derricks directly to and from the bottom of the bay. At the north end of the work, where the railway track facilities are better, a sand-unloading plant and a pile-concreting plant consisting of a mixer outfit and a form yard 300 ft. long, with storage for curing the piles, have been constructed in addition to the regular mixing plant. Three main construction tracks lead along the viaduct from this end. A narrow-gage track is used for moving the concrete piles and for general utility work. A 30-ft.-gage track is laid for the stiff-leg derricks. Outside of this is a narrow-gage track with switches, which is used for transportation of the concrete in four 1-cu.yd. bucket trains. For a part of the work a track on brackets along the railroad trestle carried the concrete for the foundations. At other places

REINFORCED CONCRETE PILE CASTING YARD AND PLANT FOR CONSTRUCTING GALVESTON CAUSEWAY

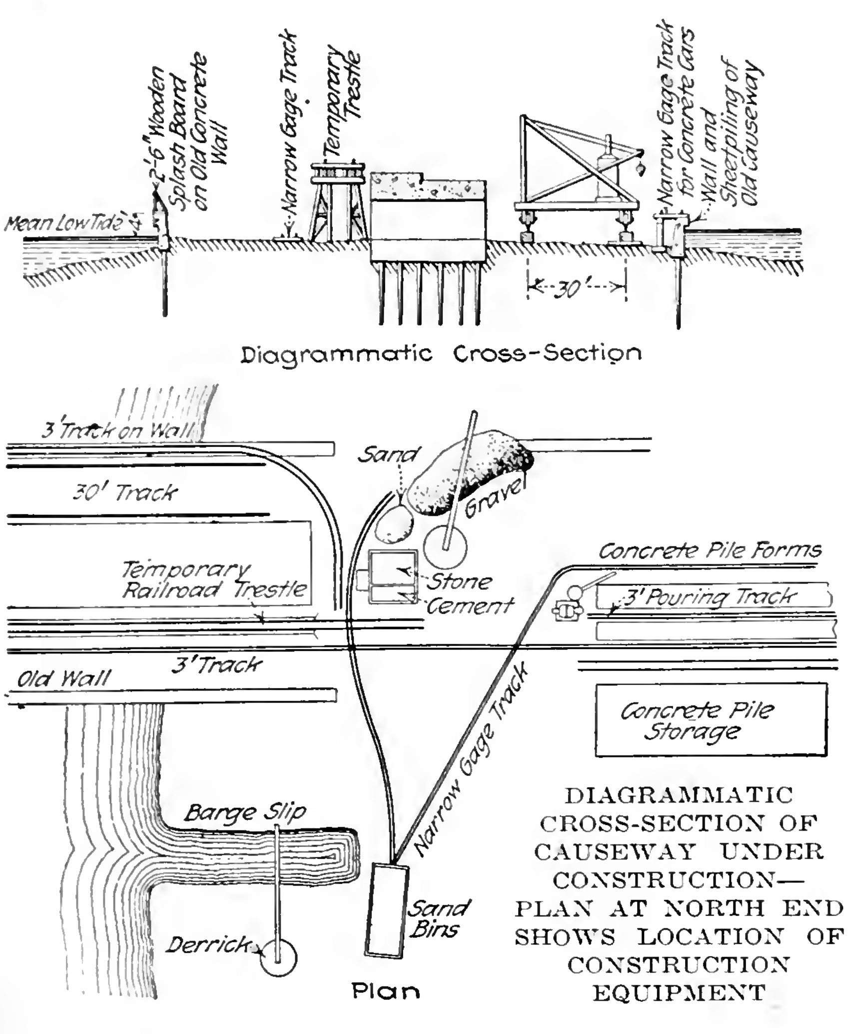
a narrow-gage track was placed on the near side of the derrick track, for convenience in moving material ahead.

The concrete sheetpiles and the walls surmounting them which retained the earth fill of the old causeway are far enough apart to allow working space between them and the new arches. In the construction of the new work these old walls are used as cofferdams and are found very tight. They are about 4 ft. above mean low tide, high enough to keep the water out except under strong winds. A 30-in. splash wall of boards has been built on the east wall to catch the ordinary spray of the waves. This is not water-tight, but throws the spray back and saves a great deal of pumping.

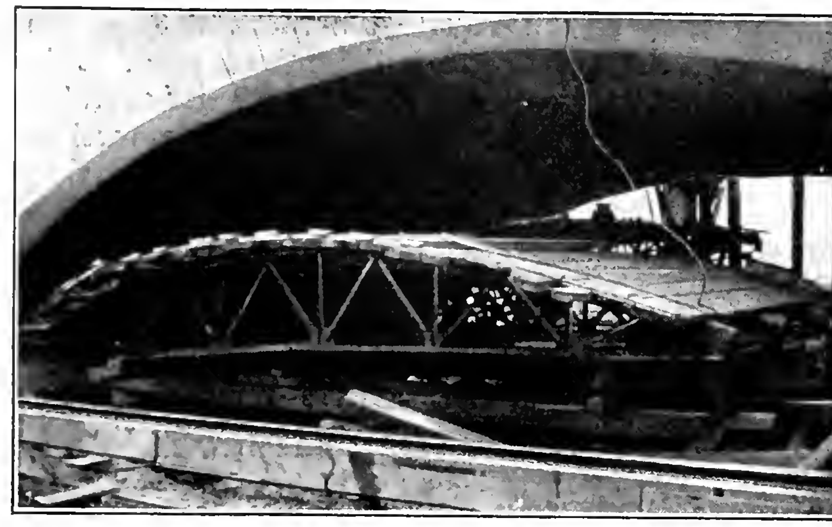
Most of the pumping is done by pumps mounted on the derricks. An 8- and a 10-in. centrifugal pump are used ahead of pier construction. A "line pump" system, composed of a locomotive-type boiler and two reciprocating pumps hitched in parallel, pumps from a pipe line with branches into the several sumps for 400 ft. each way from the power plant. By care in making the joints of this section line, it has been made to produce good results, and it is valuable in keeping the water down in holes behind pier construction and where other pumps are not available. Most of the derricks are equipped with 5- or 8-in. centrifugal pumps and with 3-in. duplex pumps for jetting. By moving several derricks into a desired section after a storm, it is possible to unwater it without much loss of time.

Both excavation and piledriving are done by the stiff-leg derricks—the former chiefly by clamshell. The piles are of concrete, varying from 19 to 35 ft. in length, according to the penetration which the soil will allow. They are driven with swinging leads hung from the ends of the derrick boom. A four-ton steam hammer of a medium quick-hitting type, with a special follower and double live-oak striking cushion, drives the piles with very little shattering of the concrete. When shattering occurs it is found always to be most severe at the top, and disappears completely in a foot or two.

Movable Steel Centers—Steel trusses with wooden lagging are used for the arch centers. The lagging is fastened to the trusses and moved with them. The trusses are of the three-hinged type, with a pin at the crown and jacks at either end. A tie-rod is provided about one-third of the way up to hold the trusses during erection. This is loosened before the concrete is poured. These trusses are removed after the concrete has set for 30 days. To strike them, the jacks are removed and the whole form is rolled part way out on rollers which replace the vertical jacks. Where the pins at the crown are within reach of the derrick they are removed, and the forms are lifted in halves and placed on a 30-ft.-gage truck for the removal to the next set-up.



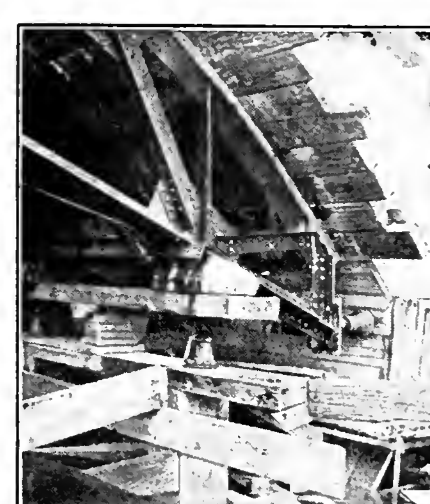
DIAGRAMMATIC CROSS-SECTION OF CAUSEWAY UNDER CONSTRUCTION—PLAN AT NORTH END SHOWS LOCATION OF CONSTRUCTION EQUIPMENT



STEEL ARCH FORM WITH LAGGING ATTACHED

During the latter part of the work narrow sections have been used, the railroad portion being poured first and then the highway, the lateral movement of the forms being accomplished without taking the trusses down. In setting up the forms the horizontal jacks are not placed until a day or two after the umbrella section over the pier has been poured.

The concrete plant at the north end of the work consists of a 1-yd. mixer with stationary measuring bins fed from wooden hoppers. These in turn are filled by a clamshell from car or storage piles of gravel and from piles of sand. This sand comes to the job in barges, and is unloaded by a derrick several hundred feet from the concrete plant into hoppers from which it is taken as required into side-dump cars. An endless cable operated by a reversible engine pulls the cars of sand up an incline, where they are dumped beside the mixer derrick. The mixer is arranged to dump into concrete buckets on flat-cars. One train is filled while the dinkey hauls one out and takes back the empties.

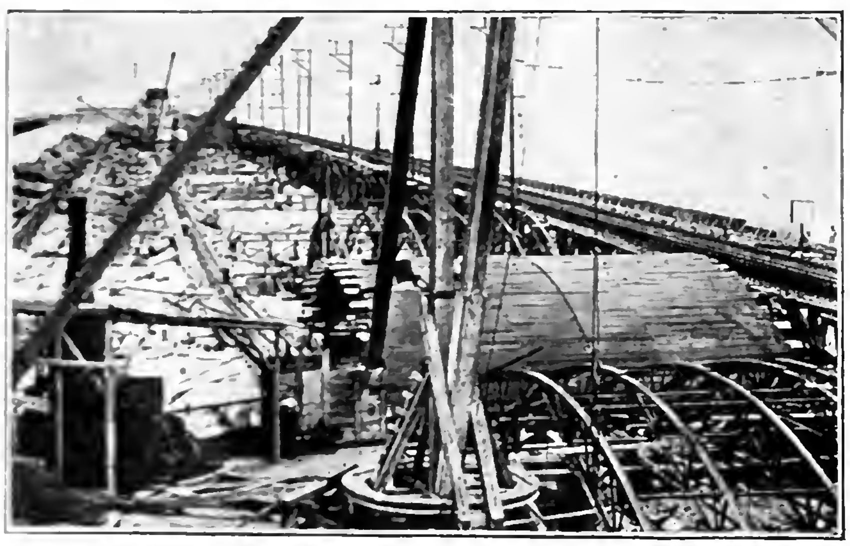


JACKING DETAILS AT ENDS

The reinforced-concrete piles used in the foundation work were made near the job in a special yard at the Virginia Point end. This concrete-pile plant had a mixer of its own and three tracks. The center one of these tracks was 3-ft.-gage and was used by the concrete car carrying the concrete to the forms. On either side of this, and between it and the standard-gage

tracks, were the forms for the piles. The standard-gage tracks were for the locomotive crane which handled the piles. The mixer plant consisted of an ordinary bin plant with a ¾-yd. mixer. It had a small tower high enough to dump into the concrete car. This concrete car was of peculiar construction, being nearly 20 ft. high and having a concrete hopper at the very top. The reason for locating the hopper so high was to allow the concrete to be chuted as far as possible from the car. From the concrete car the mixed concrete is chuted some 25 ft. to either side. This car was operated by an endless cable which was attached to a reversible engine.

The space for the concrete forms was a wooden platform on either side of the inner track. The bottom portions of the pile form were nailed permanently to this platform. The sides were of 2-in. material, as were the bottoms. They were movable. One day was required before the side forms were removed. Four days were required before the piles themselves were removed, and the total curing required 45 days.



PROGRESS IN ERECTION OF STEEL ARCH FORMS

As the length of the piles depended upon the depth of the sand stratum encountered at the site, an estimate was made from the borings at the foundation sites as to how many of each length would be required. About 75% of the piles were made from this estimate, with a few changes from time to time as foundations were put down.

As the second half of the railroad portion of the viaduct is yet to be built, any extra piles can be used there. After four days, the piles were picked up by a locomotive crane which handled them by means of two steel loops from the piles which were made a part of the reinforcing. After four to five days the piles were ready for driving.

With the exception of the handling of concrete materials, most of the crane work of the job was done by the wide-gage traveling derricks. Fourteen of these were single derricks with a platform 32 ft. square running on a track of 30-ft. gage. The boom was 65 ft. long.

A fifteenth derrick was double, being a little longer and having two booms, on opposite corners. Each derrick was equipped with one three-drum engine. Each platform or derrick outfit had a swinging engine, a 5- to 8-in. centrifugal pump, and a 3-in. duplex pump. Forge and work bench were also provided. These derricks were not equipped for rapid moving. They were moved by a line from the engine to a point at which it could be hitched ahead. This was entirely satisfactory, as they were often left in one place for a considerable time and very seldom required quick movement. For doing particularly heavy work, or when left a long time in one place, the frames for the derricks were blocked up to save the tracks and wheels.

WIDE-GAGE TRAVELING STIFF-LEG DERRICKS WERE MOVED BY LINE FROM ENGINE

H. F. Jonas is supervising engineer on the present construction work, which is being done on a cost-plus-fixed-sum basis by Larkin & Sangster, Inc., contractors of Buffalo, N. Y. A. A. Sangster is in active charge of the work for the contractors, with R. B. Norris as his general superintendent. Thomas A. Lowe was general superintendent at the beginning of the present work.

Water-Works Labor Prices in Boston District

Prices paid for labor in April, 1919, by 17 water-works in and near Boston, Mass., with information as to holiday and vacation allowances, are shown in the accompanying table, taken from a paper on the effect of the war on water-works, by Leonard Metcalf, consulting engineer, Boston. The paper was read before the meeting of the American Water Works Association in Buffalo, June 10, 1919.

LABOR PRICES PAID BY WATER-WORKS IN THE VICINITY OF BOSTON, APRIL, 1919

Place	Common Labor Per Day	Common Labor Per Hour Cents	Pipe Layers and Calkers Per Day	Pipe Layers and Calkers Per Hour, Cents	Hours per Week	Holidays	Vacation Two Weeks Paid
Boston	$3.00	41.0	$3.25–$3.50	44.4–47.8	44	Not paid	Yes
Somerville	3.25	44.3	3.35	45.6	44	Not paid	Yes
Newton	3.25	44.3	3.50	47.7	44	Not paid	No
Lexington	3.25	40.6	3.50	43.7	48	Not paid	No
Waltham	3.25	44.3	3.50– 4.50	47.7–61.3	44	Not paid	Yes
Everett*	3.75	51.1	4.25– 4.50	57.9–61.3	44	Paid	Yes
Malden	3.50	47.7	4.00	54.3	44	½ time	Yes
Chelsea	3.25	40.6	3.75	46.8	48	Paid	Yes
Quincy†	4.00	54.3	4.50	61.3	44	Paid	Yes
Medford	3.50	47.7	3.75	51.1	44	Paid	Yes
Melrose	3.50	47.7	4.00	54.3	44	Paid	Yes
Revere	3.50	47.7	3.75	51.1	44	Paid	Yes
Watertown‡	3.50	47.7	3.75	51.1	44	....	....
Arlington	3.75	51.1	4.25	57.9	44	6 out of 10	Yes
Milton	3.50	47.7	3.93	53.5	44	Paid	Yes
Winthrop	3.50	43.7	3.75	46.8	48	Paid	Yes
Cambridge	3.50	47.7	3.75– 4.00	51.1–54.3	44	Paid	Yes
Brookline	3.50	47.7	4.17	56.8	44	Paid	Yes
Marlboro	3.50	43.7	3.75	46.8	48	Not paid	No
Hudson	3.50	43.7	3.75	46.8	48	Not paid	No
Fitchburg	3.36 3.60 3.92	42.0 45.0 49.0	....	....	48	Not paid	Yes
Average		46.1					

16 allow two weeks vacation;
11 pay for holidays;
15 allow Saturday half-holiday under full pay.

* In Highway Dept., $3.50—47.7c. per hour.
† High on account of Government activities
‡ 50c. bonus per day for those who work one year.

Progress and Problems in the Field of City Water-Supply

Abstracts of papers before the American Water Works Association at Buffalo—New reciprocating pumping engine, chlorination and typhoid reduction, effect of war on water-works finances, pitometer survey and house-to-house inspection at Buffalo, need for standardization of flanges for light cast-iron pipe

The "Unaflow" Pumping Engine

By D. A. Decrow

Chief Engineer, Worthington Pump & Machinery Company, Harrison, N. J.

THE "Unaflow" steam engine derives its name from the fact that the steam travels into and through the steam cylinder in one direction; it does not counterflow or return over its own path. It is not particularly new in principle, but its development as a practical and economical commercial machine is quite recent, and its adaptation to reciprocating pumping engine practice is new. After much experimental work by various inventors Prof. J. Stumpf overcame previous difficulties, and to him undoubtedly falls the honor of making the first practical and commercially successful application of its principles to modern steam-engine practice.

The general principle of the "Unaflow" reciprocating steam engine is that of utilizing the heat energy of the steam in the cylinder during the period of its admission, expansion and flow in one direction, the expanded steam being released or exhausted through ports or openings uncovered by the travel of the cylinder piston at that period of its stroke most remote from the point of admission.

In the accompanying sketch of a typical "Unaflow" engine the piston is at one end of the stroke with the exhaust ports uncovered. The arrow indicates the path of the steam through the cylinder. The indicator diagram shows that steam is admitted into the cylinder for only a very minor portion of the stroke and is then cut off, the work performed during the remainder of the stroke being due to the expansion of the steam after the inlet valve closes. The exhaust opens when the piston, which is much longer than the ordinary steam-engine piston, travels past and uncovers the exhaust ports midway between the two ends of the cylinder.

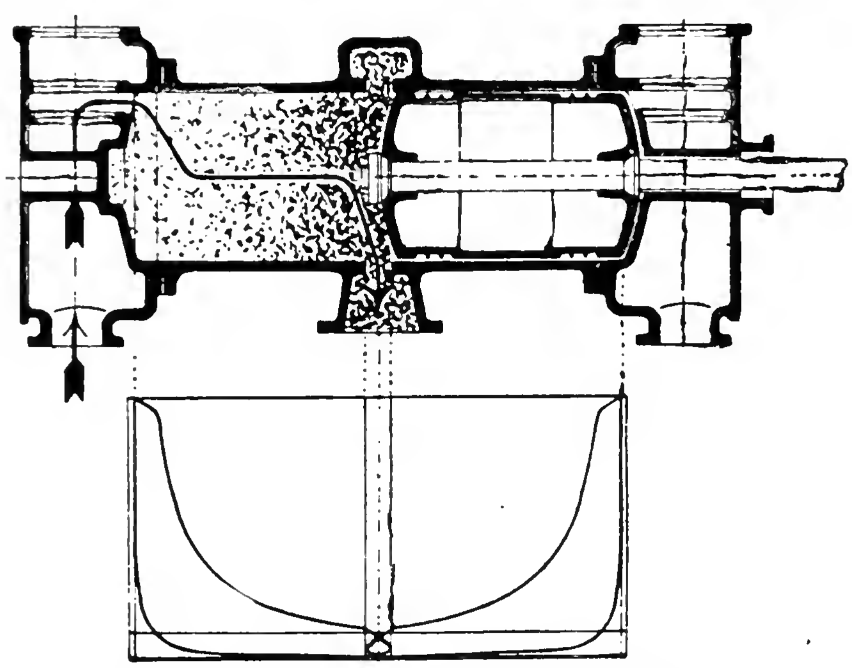
Beginning with the steam in the cylinder, there is practically no change of temperature until the point of cut-off. After cut-off, expansion takes place with a consequent drop in temperature and at this time condensation begins, due to the changing of heat into work. As the cylinder head is jacketed with high steam, no condensation takes place on the walls of the head, but the condensation is on the wall of the piston, which is comparatively cool and adjacent thereto, so that at the end of the stroke, when the piston uncovers the exhaust ports, the moisture of condensation is mostly at the exhaust end of the cylinder, and as the steam expanding away from the cylinder head rushes out through the exhaust port, it carries the moisture with it.

At this time there is a sudden drop of temperature in the cylinder due to the sudden drop of pressure, but as the inlet end of the cylinder is dry it does not lose its temperature. The exhaust port is covered by the piston on the return stroke, trapping in the cylinder comparatively dry steam partially superheated. As the walls of the cylinders have retained their heat, the heat of compression is not absorbed either by moisture or by cold walls, as in the case of a counterflow engine, and the steam remaining in the clearance is heated by compression to a temperature above the temperature of the initial steam. When the valve is opened to start the next stroke, the live steam rushing in goes into a clearance space in which the steam entrapped is hotter than the entering steam, hence there is no initial condensation. Owing to the complete removal of all the mixture of each stroke, the well known heat losses that are caused by the presence of water in the counterflow engines are avoided.

Eliminating initial condensation permits an economically high ratio of expansion in one cylinder. For normal working conditions about 16 expansions have been found to give best results.

It is also evident that, with the use of exhaust ports in the cylinder instead of the usual exhaust valves, leakage losses at the exhaust valves and of all of the added clearance space and surfaces, which losses necessarily follow from the use of a special exhaust valve, are eliminated. It has been found practical to reduce the clearance space in condensing engines to 3% of the swept volume of the piston.

Some of our manufacturers of "Unaflow" steam power engines have guaranteed as low as 10 lb. of steam per

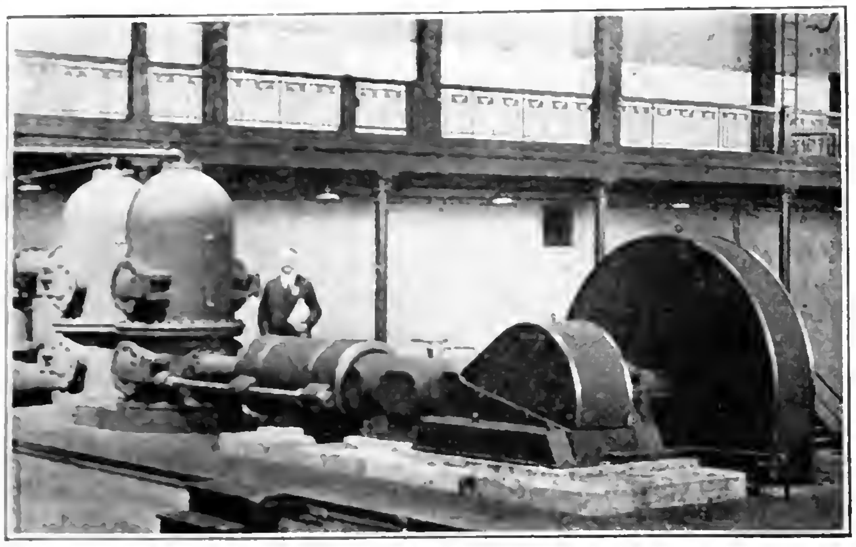


TYPICAL "UNAFLOW" STEAM CYLINDER AND INDICATOR CARD

indicated horsepower per hour, and some of the tests of European built engines have shown well under nine pounds.

Taking into consideration its simplicity—for with a single cylinder substantially the same economy is obtained as with the best types of compound- or triple-expansion steam engines—the "Unaflow" engine marks a distinct step in advance of the other types of reciprocating engines. These advantageous features have attracted attention to its desirability as a motive power for reciprocating pumping engines.

To develop a pump that could be combined with and utilize the advantageous features of the "Unaflow" engine requires that due consideration be given to proper



"UNAFLOW" TEST PUMPING ENGINE AT BUFFALO

channels for passing the desired amount of water to and through the pump with the least practicable amount of deflection and disturbance of the flow. This can best be attained by incorporating the "Unaflow" principle in so far as it will apply to a pump. The pump should be provided with passages ample and direct, so there will be no reversal of flow, with plungers properly proportioned and formed to cause a minimum disturbance, with suitable suction and discharge air chambers properly located with pump valves that will deflect the direction of flow as little as possible, that will operate quickly and quietly at all pressures and economic speeds of the engine, and, furthermore, that will be durable and lasting in operation.

One of our pumping engine manufacturers has designed, constructed, erected and will operate in the Porter Ave. water-works pumping station of the City of Buffalo, especially for the inspection and information of the members of this convention, a complete "Unaflow" high-duty condensing pumping engine of about 3,000,000-gal. daily capacity. Tests of this machine will be made later and the results published. It is anticipated that the tests will show a duty of 180,000,000 ft.-lb. of steam.

This engine is of the horizontal extended type (so-called), having one steam cylinder and one double-acting plunger pump. Its normal working water pressure is 100 lb. per square inch; the suction left is approximately 15 lb. plus the friction in about 60 ft. of suction pipe. The normal steam pressure at the Porter Ave. station is 235 lb. per square inch with 100° F. superheat.

Advance in Chlorination and Its Effect on Typhoid Fever

By John Kienle
Sanitary Engineer, Electro-Bleaching Gas Company, New York City

Chlorination of public water-supplies has been the most noteworthy single contribution to the art of water purification in recent years. The effect of this method of water treatment in reducing the typhoid mortality of the country at large is attested not only by the statistics but by the increasing demand of public health authorities for this method of protection.

Chlorination of water by the hypochlorite of lime method was first carried out successfully in the United States by George Johnson at the Union Stock Yards at Chicago in 1907, and almost immediately followed by the treatment of the Jersey City supply at Boonton. By the end of 1911 approximately 500 water plants had been equipped with hypochlorite installation. In 1912 the use of liquid chlorine was announced at the Minneapolis convention of this association. Although the increase in the use of hypochlorite was quite rapid following its appearance at Boonton, the rate of growth of the liquid-chlorine process was even more remarkable. From only one water plant (Niagara Falls), equipped at the end of 1912, the number at the end of 1918 had jumped to approximately 2500.

In 1907, the United States Census Bureau tells us, the typhoid-fever death rate in the registration area, with a population of 41,758,000, was 30.3 per 100,000, and the estimated number of deaths within the year for the entire country was approximately 30,000. There were then no chlorinated water-supplies. In 1917, according to the United States Public Health Service, the rate had dropped to 12.3 per 100,000, with the estimated number of deaths stated at 13,000, and in this year there were at least 2000 public water-supplies that were chlorinated. Thus 17,000 lives were saved from death by typhoid in one year. This is a saving of over $125,000,000 annually.

It has been aptly stated that the chlorination of public water-supplies is the cheapest municipal insurance that can be obtained, the average annual premium amounting to not more than 40c. per 1,000,000 gal. of water treated, or, for a municipality of 5000 or less, an annual expense of $150 per annum ($36.50 operating, and $120,000 depreciation at the rate of 20%) or a cost of 3c. per capita, based on the same figure of 5000 population.

Effect of the War Upon Water-Works Revenues and Expenses

By Leonard Metcalf
Consulting Engineer, Boston, Mass.

The situation with regard to the water-works of the United States is probably fairly shown by the accompanying comparative records of about 50 plants with aggregate annual revenue of about $35,000,000 and supplying a total population of upwards of 9,000,000 persons, or nearly 9% of the entire population of the United States. The data for 1914-17 were presented to the association a year ago by its committee on war burdens of water-works. The 1918 figures have been collected and added by the writer. These records indicate that:

1. The annual revenues with such increase in rate schedules as were granted by the regulatory authorities

TABLE I. COMPARATIVE WATER-WORKS REVENUE AND EXPENSE, 1914-1918, IN PERCENTAGES OF 1915

Group	1914	1915	1916	1917	1918
Percentage Gross Annual Revenue					
Eastern	95.7	100	110.1	112.8	120.6
Central	98.3	100	109.1	111.4	126.4
Southern	97.7	100	107.5	120.3	126.3
Western	101.7	100	107.3	109.5	117.5
Average	98.3	100	108.5	113.5	122.7
Percentage Operating Expenses, Including Taxes					
Eastern	99.7	100	121.9	141.1	149.7
Central	100.9	100	109.3	137.3	162.3
Southern	97.0	100	109.7	134.6	165.9
Western	98.6	100	109.9	117.4	128.0
Average	99.0	100	112.7	132.6	151.5
Net Revenue Applicable to Depreciation, Interest, Dividends and Surplus					
Eastern	90.9	100	103.0	90.4	105.8
Central	97.3	100	110.0	98.5	106.5
Southern	97.9	100	96.3	104.0	89.1
Western	103.6	100	104.3	105.3	114.4
Average	97.4	100	103.4	99.6	104.0

and put into effect by the plants, have increased at an average rate of approximately 7% per annum, slightly less than a normal amount.

2. The operating expenses, including taxes where taxes are paid, and excluding them where none is paid, have increased over the year 1915 abnormally, by 13% in the year 1916, 33% in the year 1917 and 52% in the year 1918.

3. The net (operating) revenues applicable to depreciation, interest, dividends and surplus, have substantially stood still since the year 1915.

The average increase in population in this country has been at the rate of approximately 1.9%, compounded annually, and of the cities supplied by these 50 typical water-works, about 3.1 per cent.

The net revenue of water-works usually increases at the rate of from 4% to 5%, compounded annually. Yet the total increase in the three-year period from 1915 to 1918 is but 4%, against a normal amount of from 12% to 15%, in spite of increases granted by the commissions.

The records gathered indicate further that the increases in rates granted to water-works by the commissions seem to have amounted on the average to about 10%, serving thus to decrease the loss in net revenue in the year 1918, from 20%, more or less, to 10% or thereabouts. If this inference is sound, the loss in operation was divided equally between the works and their consumers.

It is clear, however, that the burden of increased operating expenses, plus the interest upon the new investment put into these properties during the war period, has been *borne by their owners*, in larger measure than by the public, except in the case of publicly owned works.

Unskilled Labor Costs, in cents per hour (see Table II) did not generally feel the influence of the war until the middle of the year 1916. As compared with pre-war conditions, reflected by the prices prevailing in 1915, they increased one-eighth in 1916, one-fourth in 1917, and nearly three-fourths in 1918. The increase was felt most markedly in the South and upon the Eastern seaboard, being nearly doubled in the first, and increased by three-fourths in the latter district. The wages paid upon the Pacific coast before the war, which were much higher, have advanced relatively less than elsewhere, so that at the present time the Eastern and Western unskilled labor prices are about the same. Thus the average rate in the Western group increased from 27c. per hour in 1915 to 42c. in 1918; while the Southern rate increased from 18c. to 34c.; the Central group from 22c. to 37c.; and the Eastern group from 23c. to 40 cents.

In spite of the general business uncertainty and resulting depression, wages paid to unskilled labor, by water-works in the vicinity of Boston, have advanced from approximately 41c. per hour, under date of Sept. 14, 1918, to approximately 46c. per hour in April, 1919, without allowance for the effect of vacations and holidays under pay, granted by some works. Present (June, 1919) conditions give little if any indication of reduction in prices this year, or hope for any marked reduction in the future.

Cast-Iron Pipe Prices (Table II) which had about trebled at their maximum point, have now receded to about twice pre-war figures. *Valves, Hydrants and Pumps*, which had more than doubled in price, are now to be had at an advance of something over seven-eighths of pre-war prices. *Coal and Fuel Oil Prices*, which more than doubled, have receded somewhat. *Chemicals* used in the purification of water, which, by reason of outstanding contracts showed an average advance of but one-third, though the market price had increased approximately three-fourths, have decreased so that the present excess cost is about one-half over pre-war prices.

Future Prices—Engineers prefer the rôle of interpreter of facts to that of prophet. It is desirable, however, to note here probable future price tendencies. First, with respect to unskilled labor, no marked change is to be looked for; and with respect to the rates paid to water-works employees, it is believed that the prices now paid are likely to continue in most cases, and to increase rather than to decrease in the remaining cases.

TABLE II. INCREASE IN COST OF LABOR AND MATERIALS TO WATER-WORKS IN THE UNITED STATES, AS REPORTED TO THE EXECUTIVE COMMITTEE OF THE AMERICAN WATER WORKS ASSOCIATION, MAY, 1918, AND REVISED, APRIL, 1919, BY LEONARD METCALF

		Prices per Unit				Per Cent. Increase Over 1915			Year 1918		
Item	Number of Records	1915	1916	1917	3 Mos. 1918	1916	1917	3 Mos. 1918	No. of Records	Unit Price	Per Cent Increase Over 1915
Unskilled labor* in cents per hour:											
(a) Western Group	7	27.0c.	28.5c.	31.4c.	Still	5.0	16.0	Still	8	41.8c.	54.7
(b) Central Group	12	21.7	25.3	26.9	increasing	17.0	24.0	increasing	10	37.2	71.3
(c) Eastern Group	15	23.0	26.7	30.4	in 40.6%	16.0	32.0	in	18	40.2	74.7
(d) Southern Group	10	17.9	20.6	24.5	of all	15.0	37.0	all	12	34.3	91.6
(e) Average of Groups (4)	..	22.4	25.3	28.3	groups	13.0	27.0	groups	4	38.4	71.2
(f) Average of all	44	22.1	25.2	28.3	......	14.0	28.0	.....	48	38.4	73.2
Cast-iron pipe, per 2000 lb.	21	$24.23	$30.70	$51.60	......	26.7	112.9	.....	..	$67.74	179.0
6-inch valves	11	11.18	12.64	19.13	$23.20	13.1	71.1	107.6	23	19.13	71.0
12-inch valves	3	34.78	41.53	65.22	69.00	19.4	87.6	98.7	10	65.02	87.0
Two-way hydrants	6	26.69	32.04	43.13	53.90	20.1	61.6	102.0	38	5.80	94.0
Coal, per 2000 lb.:											
(a) Eastern Group	13	$2.98	$3.80	$5.96	$7.04	27.5	100.0	136.3	16	6.00	101.0
(b) Central Group	11	2.41	2.77	3.75	6.38	14.9	56.4	164.7	10	4.53	88.0
(c) Southern Group	12	1.92	2.01	3.03	4.02	4.7	57.8	109.4	10	3.89	102.0
(d) Western Group	5	3.97	4.37	6.31	7.89	10.1	58.9	98.7	6	7.92	99.0
(e) Average of Groups (4)	..	2.82	3.24	4.77	6.33	14.9	69.2	124.4	4	5.57	97.0
(f) Average of all	41	$2.62	$3.04	$4.52	$5.69	5.3	73.7	117.1	42	$5.42	107.0
Fuel oil, cents per gallon—South	1	1.80c.	1.80c.	2.00c.	4.50c.	0.0	11.1	150.0	1	4.28	138.0
Fuel oil, cents per gallon—West	1	1.38	1.50	2.57	3.55	8.7	86.2	157.3	4	4.05	193.0
Alum, cents per pound											
(a) Western Group	2	1.14c.	1.21c.	1.51c.	......	6.1	41.4	.....	3	1.53c.	34.0
(b) Central Group	5	0.91	0.91	1.25	......	0.0	37.0	.....	6	1.50	65.0
(c) Eastern Group	9	1.12	1.72	1.48	......	54.0	32.7	.....	8	1.45	29.0
(d) Southern Group	9	1.08	1.38	1.48	......	28.0	37.0	.....	9	1.78	65.0
(e) Average of Groups (4)	..	1.06	1.30	1.43	......	23.3	35.1	.....	4	1.56	47.0
(f) Average of all	25	1.07	1.40	1.44	......	30.6	34.4	.....	27	1.59	49.0
(g) New York market price†	Average of Monthly Prices	2.08	4.63	3.57	5 Months 3.15	123.0	71.6	51.4	..	......	.. ..

* Note. It was generally reported that there has been also a marked decrease in efficiency of labor since 1914, variously estimated at between 20% and 50%; and that the increase in wages paid to labor by water-works had not kept pace with contract prices, owing probably to the advantage of continuity of service.

† See *Journal of Industrial and Engineering Chemistry*. Note that 1915 price was an advance of 34% over the 1914 average price before the advances listed went into effect.

Unless Bolshevism runs its course in this country, or industrial depression should follow the war—neither of which seems likely—an active demand for labor is to be looked for in the near future. It is to be remembered that, despite the war, the population of this country has been increasing at a rapid rate. Immigration has been at a standstill, and in the light of home demand for labor abroad, does not seem likely to be active for some time to come. Many employers, contractors and labor leaders believe that in the not distant future this country is sure to feel the competition for available labor and that this will stimulate yet higher wage scales.

NECESSARY IMPROVEMENTS SHOULD GO FORWARD

Second, with respect to materials of construction, there is greater hope for relief. Nevertheless, no substantial reduction in the price of cast-iron pipe, valves and hydrants seems likely for the present year, and but a gradual reduction is to be looked for in the future. In spite of the increased facilities for production, the labor, transportation and money conditions involved seem likely to make themselves adversely felt for some time, and the losses resulting from the war seem likely to be permanent.

Third, the materials of operation—coal, fuel oil, and chemicals—do not appear likely to decline markedly in cost, and such tendency toward decrease as there may be will probably cause the making of short-time, rather than long-time, contracts for such supplies.

The Future—The conclusion to be drawn from the present physical and financial condition of water-works in the United States seems clearly to be that *necessary improvements should go forward as rapidly as possible.* It is desirable to restore public confidence and further the Government's wise wish to give employment to idle labor. More important yet, *improvements are seriously needed to restore our normal high standard of water service, to safeguard adequately the public health.*

While city officials and water-works men are hesitating, the large manufacturing interests, dominated by shrewd, farsighted business men, are going ahead with their construction work, with their plant extensions and housing projects, confident that postponement will at best offset increased cost in small measure; will probably involve loss in service or profit far exceeding any saving in construction cost; and at worst will involve yet higher costs, coupled with increasing difficulties due to a vanishing labor surplus.

The public is far more vitally interested in thoroughly good and adequate present service than in any probable saving to be effected by delaying construction to a later date, in anticipation of further, more or less problematical, decline in costs.

Reduction of Water Consumption By Pitometer and Inspection

BY GEORGE C. ANDREWS
Water Commissioner, Buffalo, N. Y.

IN 1897 the Buffalo common council decided it would be more advantageous to its citizens to install additional pumps and give practically an unlimited supply of water than to control consumption by means of meters. It would be interesting to speculate on what that decision has cost the citizens of Buffalo in the past 22 years. Suffice it to say that in 1903 the Bureau of Water had a bonded debt of $3,699,382 while it was $12,141,524 in 1917. In 1903 there was one pumping station, with a daily capacity of 183,000,000 gal. In 1917 there were two pumping stations, with a combined daily capacity of 330,000,000 gal. Coincident with the increased pumping capacity large distributing mains were laid. During this period the per capita consumption ranged between 302 and 339 gal. per day. Of this practically 100 gal. was for industrial use.

In 1916 a commission of five men was selected to govern the city. One of its early efforts was an investigation of means to reduce the water consumption by the city.

As all water used must be pumped from Lake Erie against a head of 140 to 204 ft., a reduction in pumpage would make an immense saving in coal for fuel. In the spring of 1917 it was decided to start a pitometer survey. This was supplemented by house-to-house inspection. Metering was considered, but was rejected on various grounds, some of which were the following: Popular local predjudice against metering; length of time to meter the city completely, there being over 76,000 unmetered and active services, while the pitometer method promised early results; extensive changes in plumbing required should meters be installed in many of the poorer types of dwellings; heavy initial investment required for meters.

To make the survey, an engineer in charge and four assistants were employed. Three trucks with gangs of four were constantly engaged, and one clerk was assigned to this work to keep the records. Twelve of the regular city inspectors made the house-to-house inspections. Later, as more of the city was covered, 20 temporary inspectors were engaged. One of the assistant engineers made the district measurements, and two were constantly engaged on subdivision. An assistant engineer tested the meters and fire lines. During the winter months two men worked in the office.

BUREAU INTENDS TO CONTINUE PITOMETER WORK

As work was completed in each division, a permanent map was filed in the office, showing gaging points for instrument and valves on boundary points. On this map are recorded the date of the first measurement, 24-hour consumption and minimum night rate, and same record of second measurement. It is the intent of the bureau of water to continue the pitometer work as a special department. Regular measurements will be taken at varied intervals, and these maps will facilitate the work greatly. All inspectors' reports are filed by streets and can be referred to instantly. As soon as a section was completed, a full report on it was submitted by the engineer-in-charge. This report gave a general summary of the work, with certain specific recommendations to meet the conditions for the sections. These reports are filed so as to be available for future reference.

Our first section was surveyed in 1917, and this year remeasurements have been taken. These show that there is a more or less gradual return of the waste first eliminated, depending wholly on the character of dwellings. In all sections the consumption was less than it was two years ago, at the time of the first measurement. I estimate that effects of the result of the survey will be from one to three years as far as house waste is concerned. All underground leaks stopped are a permanent saving.

Nine-tenths of the city has now been covered by the survey, with the following results:

	House waste stopped, 18,000,000 gal. (estimated)
	Underground waste stopped, 12,000,000 gal., actual measurement
33,278	leaky fixtures reported and repaired
1860	leaky services reported and repaired
52	unfinished supplies found wasting 3,587,000 gal. per day
	Broken mains and leaky joints wasting 4,376,000 gal. per day found and repaired

The pumpage has been reduced, except in times of extremely hot or cold weather, to less than 125,000,000 gal. per day, as compared with over 160,000,000 gal. per day in 1917. Figuring the cost of pumping at $6.24 per 1,000,000 gal., the average cost for the past three years, the annual saving is $68,328. Against this is the estimated charge of $25,000 per year to maintain the pitometer division of the bureau. To date the survey has cost $96,931, much of which represents permanent investment in equipment and records, or for professional services. Including the pay of temporary inspectors, who will be employed each spring, it is estimated that the annual cost of continuing the work will be $25,000 per year.

From the survey made and the results obtained, it is evident that to a certain extent the house waste can be greatly reduced by house inspection controlled by pitometer measurements. When these measures are used in conjunction with selective metering, the most flagrant house waste can be eliminated and the consumption reduced nearly to that obtained by universal metering, and done at less expense. The pumpage can be reduced at least 20,000,000 gal. by the installation of 10,000 meters on house services where tremendous waste has been found by the survey. The installation of these meters is now proposed. A further reduction is not deemed advisable until a filtration plant is built.

A comparison between the cost of universal metering and the elimination and control of waste by the pitometer and selective metering is, briefly, as follows:

Control by pitometer and selective metering:	
Annual cost of inspection	$25,000
Installation of 10,000 meters, investment in meters, $100,000	
Annual charge on meters, interest at 4½%	4,500
Depreciation	4,000
Cost of reading and maintenance	6,000
Total annual cost	$39,500
Universal metering:	
Installation of 75,000 meters, investment in meters, $750,000	
Annual charges on meters, interest at 4½%	33,750
Depreciation, 4%	30,000
Cost of reading and maintenance	45,000
Total cost	$108,750
Annual saving in favor of pitometer control	$69,250

It is true that universal metering would reduce the consumption considerably more than the other method, but even if the reduction amounted to 20,000,000 gal. per day the saving in operation costs would not equal $69,250 per year.

Need for Standardization of Flanges for Light Cast-Iron Pipe

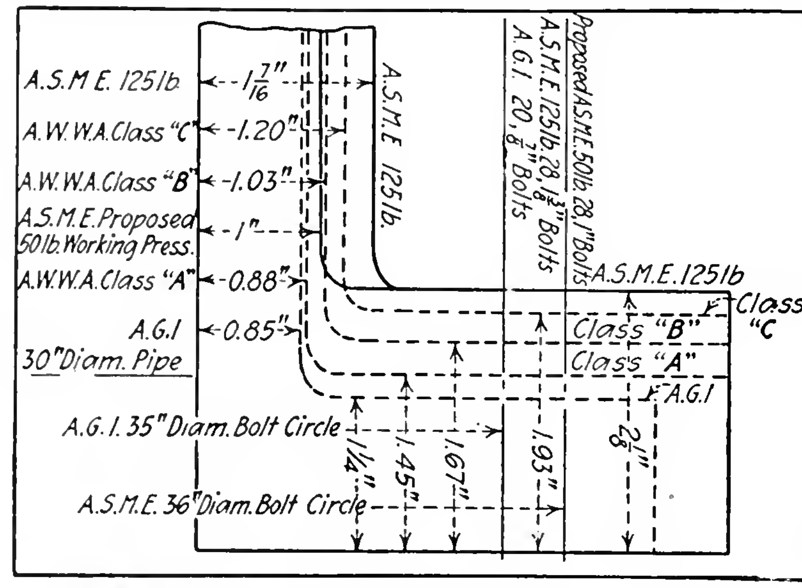
By John Knickerbocker
President of the Eddy Valve Company, Waterford, N. Y.

The question of flanges for light cast-iron pipe has come up for discussion at various times, but up to now no final action has been taken. Early standardization is desirable.

To bring this subject to the attention of this association and all others interested, an illustration is presented showing the thicknesses of pipe, and thicknesses of flanges for American Water Works Association Class A, B and C pipe, the flanges for these pipes being calculated by the formula, thickness of flanges equals 1½ times the thickness of pipe, plus ⅛ in.; the thicknesses of pipe of the American Gas Institute, and the thicknesses of flanges and bolt circles adopted by them; the A. S. M. E. proposed standard for 50-lb. working pressure, and the American Standard [also A. S. M. E.] for 125-lb. steam working pressure.

It is a serious question whether the standard flange suggested by the American Society of Mechanical Engineers for pipe for 50-lb. working pressure is not too heavy and would cause casting strains and shrinkage where the flange meets the pipe. Or take the 30-in. pipe, Class A, American Water Works Association pipe, which is 0.88 in. thick. Would it be good foundry practice to cast a flange measuring 2⅛ in. thick to this thin pipe, and if the pipe were increased to 1 in. thick, the thickness proposed by the American Society of Mechanical Engineers for 50-lb. working pressure, would not the flanges 2⅛ in. thick be too heavy for the pipe?

The American Gas Institute pipe thickness for 30-in. pipe is 0.85 in. Taking the inside diameter of the



COMPARATIVE DATA OF FLANGES FOR LIGHT CAST-IRON PIPE

The proposed A. S. M. E. 50-pound working pressure and the American Standard have the same diameter bolt circle

flange at 31.7 in. (the outside diameter of the pipe), the weight of the American Gas Institute flange is 102.4 lb. and the flange proposed by the American Society of Mechanical Engineers for light pipe is 215.5 lb., which is over twice as much as the American Gas Institute 30-in. flange. If the American Gas Institute flange is heavy enough for Class A pipe, then for each flange 113.1 lb. would be wasted if the American Standard flange were used; besides the poor casting that might result from casting so heavy a flange on a light pipe.

If a flange 1.67 in. thick were used on a 30-in. Class B pipe, taking the outside diameter of the pipe as the inside diameter of the flange, it would weigh 169.38 lb. The American standard flange on this pipe would weigh 215.5 lb., showing a saving of 46.12 pounds per flange.

If it were possible to use the American Gas Institute flange for the Class A pipe, and a flange of the diameter of the American Standard, but between the thickness shown for the flanges for Class A and Class B pipe, as calculated by the formula already given, it might be a good solution of the question.

Would it not be well for the committee of this association which has this matter in charge to endeavor to take it up with like committees from the New England Water Works Association, the American Society

of Mechanical Engineers, the American Gas Institute, the Cast Iron Pipe Manufacturers, the Committee of Manufacturers on Standardization of Fittings and Valves, and such other organizations as might wish to be represented?

Progress by Engineering Council's Compensation Committee

Seriousness of Situation Considered and Principles for Classification and Salary Schedule Are Proposed

REPORTING at the recent regular meeting of Engineering Council, the committee on classification and compensation of engineers presented the following analysis of the situation and suggested the lines of its future action. Reports from separate sections of the committee are also briefly abstracted herewith:

In attempting to formulate standard rates of compensation for professional engineers, the first task is to find what rates are actually in force, especially in those fields where attempts at standardization have been made. The second task is to inquire what adjustment should be made to correspond to the great change which has taken place in the cost of living, or, in other words, in the value of the dollar. How great this change has been during the past 20 years is realized by few. Fortunately, an accurate determination is available in the statistical records of average prices which for many years have been gathered and published by leading commercial organizations.

A record of average prices of the necessaries of life kept by R. G. Dun & Co. shows that prices have increased continuously for 22 years. A certain quantity of staple necessaries could have been purchased July 1, 1897, for $72.45. By Jan. 1, 1905, the same quantity cost $100.32. On Jan. 1, 1914, before the outbreak of the war, the cost had risen to $124.53; May 1, 1917, to $208.43, and Oct. 1, 1918, to the maximum of $233.23.

Salaried Worker Has Had No Such Increase as Wage Worker

This enormous increase in prices of the necessaries of life has been accompanied by an increase in wages, especially among workers organized in unions which had the power to compel attention to their demands. In the unskilled labor market the relations of supply and demand raised wages during the war to points in some cases exceeding the increase in the cost of living. No such increase has taken place in the compensation of salaried workers in the professions. It has been assumed that these workers, living in a different social environment, had a margin of compensation sufficient to enable them to meet the increased cost of living. This assumption is not justified by the facts. Where salaries have been increased during the past three years, there are few cases in which the increase has been at all commensurate with the increase in prices of the necessaries of life, which the salaried worker, like the wage worker, has to purchase. That this is a correct statement is amply proved by many direct comparisons which have been made of the wages of the workers in various skilled trades and the salaries of the rank and file of technical and professional workers.

There is little doubt that an unprejudiced investigation would show that a large proportion of the salaried workers in professional occupations during the past three years have been unable to pay their living expenses from their earnings and have been obliged to rely on income from property owned or to use up savings of other years in order to maintain themselves.

A serious question is whether the present scale of prices is here to stay. There has been a general belief that with the coming of peace and the resumption of productive industries a heavy fall would occur. It has been assumed that the salaried worker would have to wait for this so that he could again live within his income. It now appears, however, to be the opinion of many financiers and economists that the present high prices of necessaries are likely to continue for a long time, probably for several years. The salary of $2000 a year which a man received from 1902 to 1905 will now buy less than $1000 worth of necessaries. This has been the case for two years. If this is to continue for two, three or four years to come, then surely the salaried worker, in a professional or any other occupation, has an equitable claim to have his compensation brought back in purchasing power to where it was fifteen years ago.

There is another aspect of the compensation of the professional worker which has been frequently misunderstood, but which, with present knowledge, ought no longer to deceive. The pay of professional engineers has for many years been influenced by the idea that a young man in the earlier years of his work should expect moderate compensation because of the future to which he might look forward. In Great Britain this idea found expression for many years in the custom of the young engineer paying a premium during a number of years' service in order to learn the business. There was justification for this idea during the period when the development of engineering was so rapid that a large proportion of the men who were turned out from the few engineering schools or the engineering workshops were able eventually to rise to positions of large responsibility and importance, commanding high salaries.

That condition has been altered. Of the men who begin technical engineering work today, only a very few selected ones can rise to positions of responsibility commandnig high salaries. The rank and file must inevitably be ten times as numerous as the captains and lieutenants, and a hundred times as many as the majors and generals.

The man of exceptional ability, indeed, may find it worth his while to work for low compensation because of the future awaiting him. But to hold up to the rank and file of technical workers the idea that they can afford to work for insufficient salaries for the sake of some future high position, which they have not one chance in twenty or fifty of attaining, is a gross deception.

In Public Interest That Engineers Be Well Paid

The committee believes, therefore, that in adopting standards for the compensation of workers in all technical fields due consideration must be given to the great increase in the cost of living which has taken place. The dollar of salary must be considered with regard to what it will purchase today and is likely to purchase next year, and not with regard to the value of the dollar ten or fifteen years ago.

This increase in compensation is necessary not merely as a matter of justice to the engineer, but in order that engineering work may be maintained on the plane that it must be to secure economical and efficient work. Not only the leaders but the rank and file of technical workers often have it in their power largely to affect the cost of the work in their charge by the quality of the effort they exert.

There is no economy in paying such men at rates inadequate for their support, for this leaves their minds burdened with anxieties, when they should be free to give their best efforts to the work in hand. Moreover, such a rate automatically tends to drive the abler men into other occupations and to leave in charge of the work only those of less ability, who are unable to make a change.

The municipal and state section of the committee, Arthur S. Tuttle, chairman, reported that it was formulating a standard classification of positions and duties, and a schedule of titles and qualifications has been prepared to be incorporated in a questionnaire for circulation among engineers of all states and the more important cities.

The Federal Government section, John C. Hoyt, chairman, reported that a survey of Government activities shows 28 offices that employ Government engineers. A letter was sent to each member of the Cabinet requesting a list of engineering bureaus in his depart-

ment, and favorable responses were received from all except the Secretary of War.

The railroad section, Francis Lee Stuart, chairman, reported that a questionnaire had been prepared to be sent to the chief engineers of the railroads under Federal control, but after conference with Director General Hines it was decided to send it to members of the founder societies who are connected with railroads. A letter outlining the work of the committee and suggesting a simple general classification into eight groups accompanied the questionnaire. These eight groups of engineers are as follows:

(1) Chief administrative officer having full charge of organization, including determination of policy; (2) head of major subdivision in responsible charge of large unit; (3) head of intermediate subdivision in responsible charge; (4) head of minor subdivision; (5) on general duty under direction but requiring special education and special training and the use of initiative and originality; (6) on subordinate duty requiring special education or training but not requiring special originality; (7) on subordinate duty not requiring special education, training or originality; (8) on special duty of responsible character requiring particular qualifications and initiative.

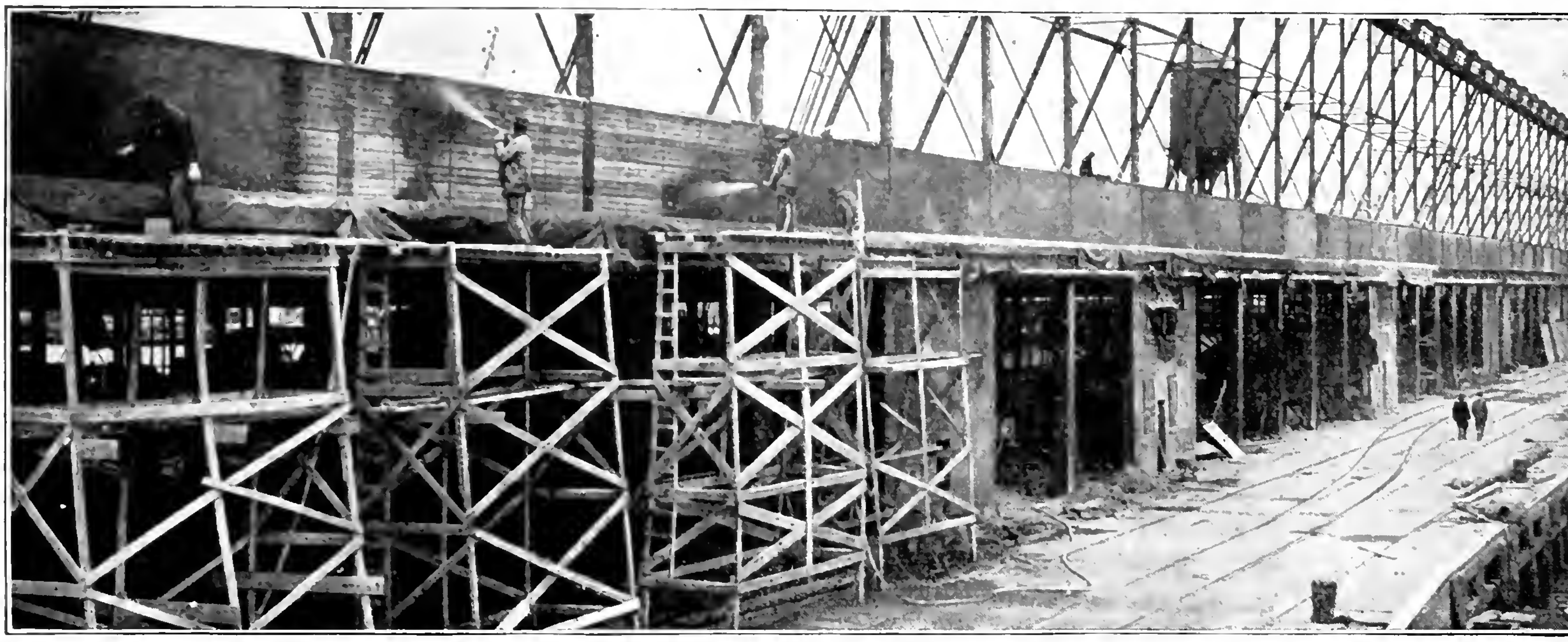
Michigan Is Active in Water Purification

There are now in Michigan 22 chlorination plants, besides 10 filter plants using chlorine, according to a statement by Edward C. Rich, state sanitary engineer. With few exceptions, each installation has a laboratory where daily analyses of the raw and the treated water are made and from which monthly reports are sent to the State Board of Health. Some trouble has been experienced in getting the appointment of competent analysts to take charge of the smaller plants, but the reports from the laboratories are mainly satisfactory. The results in protection of public health are considered to warrant fully the expense of equipping and maintaining these plants and laboratories. The methods recommended by the American Public Health Association are used in the laboratories, and the United States Treasury Department standards for drinking water on interstate carriers are used in interpreting results.

Cement Guns Built Walls and Roof of Army Warehouses

During the War Steel and Timber Framing Covered With Wire Was Coated With Gunite Shot in Place—Materials Transportation Reduced

CONCRETE walls and wide roofs were placed with the cement gun on timber and steel frame warehouses and pier sheds on the United States Army Base at Norfolk, Va., during the war, as was reported in an article in *Engineering News-Record* of Mar. 7, 1918, p. 462, although at that time the location of the port was not announced. Land being cheap as compared with that for Army bases in large cities, the warehouse facilities there are provided in the form of large one-story buildings, with a view to securing convenience and rapidity in making up cargoes. On the site of 640 acres there are eight warehouses, serving two piers, the former having nearly 2,500,000 sq. ft. of floor area and the latter having sufficient frontage for 12 large ocean steamers.



CONCRETE FOR SIDE WALLS AND PIER IS SHOT INTO PLACE—THE STEEL FRAMING ABOVE THE WALL IS FOR CARGO-HANDLING EQUIPMENT

Transportation difficulties at the time of construction made it imperative to use local material as far as possible. Sand being plentiful, it was decided to make the walls of 2-in. concrete, with the 1 : 3½ mixture as placed by the cement-gun process. This was employed for six warehouses, while one has brick and the other has tile walls, the latter being weatherproofed with a stucco coat applied by the cement gun. These buildings are 160 ft. wide and 1400 and 1680 ft. long, with transverse firewalls of brick 140 ft. apart.

Timber framing for the warehouses includes posts spaced 10 ft. on centers, carrying girts and caps and roof joists, the posts having 3-in. plank sheathing with tar and gravel roof. Wire netting of triangular mesh was secured to the posts and girts by wire nails and by wire chairs which kept the netting about ½ in. away from the wood, as described in *Engineering News-Record* of Apr. 25, 1918, p. 819. On the inside of the building are placed wood-form panels about ½ in. behind the wire, and the gunite is shot in place from the outside to build up a wall about 2 in. thick. After 24 hours the panels may be removed and set up for the next section of the work.

ARMY WAREHOUSES HAVE TIMBER FRAME WITH GUNITE SIDE WALLS AND BRICK FIRE WALLS

Each of the 1280-ft. piers has a steel frame shed in three bays, the middle bay being the higher and forming a monitor. On the outside is a wall extending down about 11 ft. from the roof to the continuous line of doorways, except that at the offices and toilet rooms this wall extends to the bottom of the building. In the side bays every eighth roof truss is cased in concrete to form a firestop. Between the upper ends of the interior columns are longitudinal concrete curtain walls or screens 12 ft. deep, so that smoke from locomotives in the middle bay will not escape into the side bays but will be diverted up to the openings in the monitor. Roof construction of the side bays is similar to that of the warehouses.

Roof construction of an unusual type, for the 42-ft. middle bay, consists of a $2\frac{1}{2}$-in. slab of concrete or gunite on I-beam purlins spaced 7 ft. on centers. Forms were placed close against the upper flanges, and wire netting was stretched from side to side, being supported clear of the beams by wire chairs. The concrete was then shot into place from above, as shown in one of the views. A test panel 11 days old, under a uniformly distributed load of 164 lb. per square foot, showed a deflection of $\frac{5}{8}$ in., with slight cracks on the underside. At 209 lb. the deflection increased to $1\frac{3}{8}$ in. and the cracks opened. On removal of the load the slab returned to normal position and showed no sign of injury on the top surface.

This work was done by the Cement-Gun Construction Co., of Chicago, which used not only its own equipment but some of that owned by the Dewey Cement-Gun Construction Co., in order to have ample capacity for keeping up with the framing of the building. Sometimes as many as 12 cement guns were at work.

CONCRETE ROOF OF MIDDLE BAY OF PIER IS BUILT WITH CEMENT GUNS

Operation Costs of Municipal Asphalt Plant

Portland, Oregon, Effects Large Saving Over Contract Methods—Plant Pays for Its Cost Three Times in Seven Months

CONSTRUCTING and repairing asphalt pavements with a municipal asphalt plant, during a seven-month working period, from Apr. 27, 1918, has saved the City of Portland, Ore., three times the first cost of the plant, according to the annual report of the city paving department. Comparison of itemized cost with the prevailing contract prices for such work shows a saving to the city of \$27,500 from an \$8800 investment. While there were some factors, such as advantageous contracts for aggregates which were highly favorable, so large a saving in a time of high wages and high prices for the other materials is thought to indicate considerable saving over other methods at all times. The following data are abstracted from the annual report mentioned above:

Conditions due to the war and high prices for paving work done by contract induced the City of Portland to build an asphalt plant of its own, and specifications were prepared for a plant with a capacity of at least 1000 sq. yd. of 2-in. wearing surface per eight-hour day. The installation of the plant, including the cost of machinery and remodeling and strengthening the dock so as to provide adequate foundation, required about \$8800. The plant as constructed has more than equaled the requirements, having turned out between 1000 and 1100 sq. yd. per day on several occasions.

Due to abnormal conditions, it was impossible to procure a new paving plant at a reasonable cost, so a plan was evolved to build it from several separate mechanical units, which could be obtained second-hand from contractors who had closed up their business because of the embargo on materials for public improvements. Care was taken in selecting this equipment to get it in good condition, and the plant as finally constituted is probably as good as a new plant would be, and has been obtained at less than half the cost.

The production of paving material at low cost was aided by several factors: First, on account of the central location of the plant and its proximity to water and rail facilities and sand and gravel bunkers from which these materials could be procured without hauling, cost for material was reduced to a minimum. Second, an annual contract had been made for sand and gravel at pre-war rates. Third, crushed gravel was substituted for crushed rock in the paving mixture, the former being about half the cost of the latter.

On the other hand, the war was responsible for several large increases in the cost of labor and material. The wages of the plant and street crews have increased about 33%, while the cost of asphaltic cement has been about 100% higher than before the plant began operation. It is felt that the conditions which have tended to the increase of the cost of production have heavily counterbalanced those tending toward cost reduction, and that the results obtained have demon-

TABLE I. SAVING TO CITY OF PORTLAND, OREGON, ON CONSTRUCTION ON NEW WORK DURING SEVEN-MONTH PERIOD

Location	Number of Square Yards Laid	Total Cost of Pavement	Cost per Square Yard of Pavement	What Cost per Square Yard Would Be by Contract	What Cost of Pavement Would Be by Contract	Actual Saving Over Contract Work
Terwilliger Blvd.	$22,464.00	$13,972.61	$0.622	$1.43	$32,123.52	$18,150 91
Nicolai Street....	1,584.20	1,351.32	0.858	1.43	2,265.41	914.09
Clinton Street.....	348.63	176.09	0.506	1.43	497.64	321.55
Mulberry Street..	628.00	567.09	0.903	1.43	898.04	330.96
Bridges.........	317.70	392.04	1.234	1.43	454.31	62.27
Crosswalks......	3,172.80	3,344.15	1.064	2.00	6,345.66	3,001.50
Totals	$28,514.70	$19,803.29	.....	....	$42,584.58	$22,781.28

strated that the prices charged for paving under the contract system now in vogue have been far in excess of the actual cost of such work.

An instance of this saving in cost is seen in the surfacing of Terwilliger Boulevard with a 2-in. wearing surface of asphaltic concrete. The contractors' estimate for laying this surface was $1.45 per square yard, exclusive of the cost of grading and scarifying the macadam foundation to a proper subgrade. The work as completed by the city cost $0.693 per square yard, which included not only the laying of the 2-in. asphaltic-concrete top, but also the scarifying and grading work, as well as the crushed rock used in rounding out foundation. The saving to the city on this one job of 22,464 sq.yd. was $18,150, or more than enough to pay the entire cost of two municipal plants of the type built. Table I shows the cost and saving to the city on new construction, during the period mentioned above.

Besides doing the work, the city repaired all cuts made in the pavements for public utilities and took on all maintenance work. On the maintenance work a saving of $3376 was effected, while on the repairing of cuts $1343 was saved. This made a total saving of $27,501 for the three classes of work. The cost of maintenance was reduced from contract prices of $2.87 per square yard to $1.44 per square yard.

The crew required to run the plant consisted of a foreman and three or four men, while the street force consisted of a foreman, a roller man, two rakers, and from three to six laborers. Table II gives itemized costs for the operation of the plant and laying of the pavement, which were under the direction of R. S. Dulin, engineer in charge of the paving department.

TABLE II. ITEMIZED COST FOR OPERATION OF MUNICIPAL ASPHALT PLANT AND PAVEMENT CONSTRUCTION

New Construction Work

	Total	Total per Square Item	Total per Yard Total
Plant Cost:			
Labor	$2,311.59	$0.081	
Fuel oil	632.51	0.0222	
Coal	99.25	0.0035	
Wood	61.68	0.0022	
Power	106.92	0.0038	
Paving materials	7,169.82	0.2514	
Total plant cost	$10,381.77	$0.3641	$0.3641
Hauling and transportation, including depreciation and interest and repair charge on trucks	2,990.71	......	0.1049
Street costs:			
Street labor	4,085.71	0.1433	
Street materials	976.68	0.0342	
Total street cost	5,062.39	0.1775	0.1775
Repairs	975.20	......	0.0342
Overhead: Capital invested in plant, interest on $8,800.00 at 4½%	199.60	......	0.007
Depreciation (5 years at 20%) ($0.0309 per sq.yd)	881.11	......	0.0309
Rent	342.17	......	0.012
Insurance	8.55	......	0.0003
Superintendence:			
Half time of Chief of Bureau of Standards.			
Full time General Foreman	770.78	......	0.0240
Miscellaneous charges ($0.0161)	458.24	......	0.0161
Total cost per square yard		......	0.7710

PATCHING UTILITY CUTS AND MAINTENANCE

	Cost per Square Yard Top Only	Cost per Square Yard Entire Pavement
Plant labor	$0.1980	$0.5757
Plant material	0.2200	0.6396
Fuel oil, coal, wood, power	0.0382	0.1116
Hauling and transportation	0.2220	0.6472
Street labor	0.3390	0.9880
Street material	0.0222	0.0645
Overhead	0.0600	0.1760
Superintendence	0.0850	0.2470
Total	$1.1844	$3.4496

Cement Joints for Cast-Iron Water and Gas Mains at Vallejo, California

SATISFACTORY experience with the use of cement instead of lead for joints in cast-iron water and gas mains on the Mare Island project of the United States Housing Corporation at Vallejo, Calif., is reported by Philip Schuyler, assistant engineer, in a communication to Stephen E. Kieffer, project engineer, San Francisco, May 26. For a copy of the report, given practically in full below, *Engineering News-Record* is indebted to L. K. Sherman, president of the United States Housing Corporation, Washington, D. C.

The decision to use cement instead of lead was arrived at only after careful investigation of the results obtained in various cities in California during the past decade. The City of Los Angeles, under the direction of Mr. Mulholland, water-works superintendent, was practically the pioneer in the use of cement joints. The Pacific Gas & Electric Co. is now using cement exclusively in place of lead in the laying of all cast-iron mains in various cities in this state, and incorporated its specification in the official specifications for the utilities contract, as follows:

Pipe Joints—Pipe shall first be firmly set and well braced against jar or movement of the joints by careful backfilling between joints and bracing where necessary. Joints shall be carefully wiped out clean and dry. One braid or strand of hemp yarn shall be inserted in joint and very carefully and securely calked. A cement filler, composed of portland cement, with the addition of about 30% of carefully selected, clean, sharp siliceous sand, made into a stiff paste by the addition of water, shall be tightly pressed into the bell to within ½ in. of the face of the bell. A braid or strand of hemp yarn shall then be placed around the pipe against the cement in the bell and calked until the cement filler is firmly packed in the bell. The joint will then be wiped with cement paste, leaving same on a 45° level. The proportion of cement and sand in making paste and its consistency shall be as directed by the engineer. No water shall be allowed in or around pipes until cement is thoroughly set, which shall be determined by the engineer.

The contractor will utilize the services of the employees of Pacific Gas & Electric Co. in the actual work of installing and testing all gas mains and service connections.

Oakum or jute not being satisfactory for use with cement, we decided to use hemp rope, and from the Mare Island Navy Yard obtained some discarded slings made from ½- and ¾-in. tarred rope. These were old, dried out and very stiff, and after being cut into required lengths for our use were unstranded and the strands loosely retwisted and rolled by hand, the thickness depending on the size of joint to be calked. This particular kind of hemp rope proved so satisfactory that the company obtained a quantity for its own use elsewhere.

Great care was taken to see that all pipes as laid were solidly blocked so that there should be no movement of the pipe line during and after the making of the cement joints, and earth was tamped around and over the pipes between joints.

One strand, and sometimes two strands, of the retwisted hemp rope were inserted in the bell of the pipe, and this was rammed in hard by calking. A mixture of two parts cement to one part clean, sharp sand, with enough water added to make a dry paste which when balled and squeezed in the hand would barely exude moisture, was then inserted in the ball, pressed in first by hand until the bell was about half filled, and then calked as a lead joint would be calked, until the calking tool would barely penetrate the cement and the joint would ring. More of the cement paste was then inserted and the calking repeated, leaving the joint filled to within ½ in. of the face of the bell. A strand of the retwisted hemp rope was then laid around the bell, and this was calked in flush with the face of the bell. The joint was then wiped with cement paste containing sufficient moisture to mold, and it was beveled off.

Each joint, after being made, was kept wet by covering with pieces of old sacks, for at least 36 hours, after which the pipe line was slowly filled and allowed to stand under normal pressure, which was never greater than 70 lb., for at least two days, before testing.

Practically All Joints Water-Tight

In the first test 2000 ft. of 10-in. water main and 400 ft. of 8-, 6- and 4-in. pipe were included, and 50% of the joints leaked after they were subjected to the normal pressure. These leaks ranged from a slight sweating to a steady drip which filled the bell holes and covered the pipe. During the following three days most of the leaks stopped, and we decided to cover and backfill the whole pipe line, as the character of the ground was such that any leak would come to the surface, and let the pipe line remain under normal pressure for a week or two before putting on the test pressure of 125 lb. The dry hemp rope undoubtedly absorbed moisture and swelled, thereby stopping all leakage. All leaky joints took up with two exceptions, both of which upon being cut out and examined were found to have been very carelessly made. These were remade, and the line when tested showed no leakage.

A total of 20,770 ft. of 4- to 12-in. cast-iron pipe was laid on this project for water and gas distribution and only six defective joints had to be cut out and remade. When the pipe line could be drained the joint was remade with cement, but a few joints were cut out and remade with lead wool in order not to delay progress.

As it was necessary to pave the streets immediately upon the completion of the sewer, water and gas mains and services, the pipe lines were subjected to a severe test on account of the heavy teaming and heavy steam roller working on the subgrade, but not a single leak developed. The paving was completed in January and the first leak has yet to develop.

To anyone familiar with pipe laying and maintenance, using lead joints, this record should appear remarkable.

So far as we were able to ascertain from observation and cost records, the labor cost using cement joints should be slightly less than for lead joints. The cost of cement and sand per lineal foot on small sizes of pipe is negligible, and the money saved on this project was considerable, as the price of pig lead when this work was started was almost at its highest peak.

Teaming Industries Improve Service by Adopting Motor Trucks

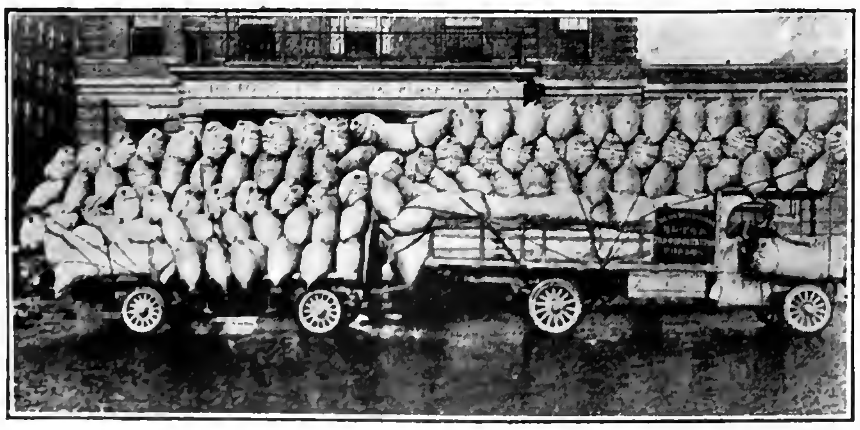
Large increases in business and much greater efficiency, both profitable to the teaming companies and more satisfactory to the merchants, have been effected in Boston, Mass., by the substitution of motor trucks and trailers for teams. In one case the tonnage handled by a teaming company was increased 300% in three years. Adaptation of the truck to hauling both heavy and light materials has also been demonstrated in this case.

An example of this expansion is seen in the business of the Youlden, Smith & Hopkins Co., which established its business in 1891 with two horses and a capital of $500. This business increased until, in 1916, five hundred tons of freight were handled daily within a radius of eight miles, an activity which required 150 horses and between 45 and 75 drivers.

In 1916 it was decided to substitute motor trucks and trailers for some of the horses, so as to increase the business by handling tonnage over a larger territory. A fleet of fifteen 5-ton trucks and three 5-ton trailers has been purchased to date, with the idea of supplanting 30 horses. The addition of the trucks has enabled the company to increase its activities so that, during the busy season, it now handles a daily average of approximately 1500 tons of freight within a radius of 30 miles. It is evident that the long-haul business would be impracticable with teams.

Not only has this change benefited the teaming company, but it is found that, due to greater efficiency, the service is more satisfactory to the merchant, who give preference to companies operating trucks. At the present time, only local hauling is done with horses; also, much of this is done with trucks. It is found that each truck purchased replaces four horses, besides increasing both the local and interurban business.

A specially designed Troy trailer, attached to a large truck for the economical hauling of bulky materials, is shown in the accompanying illustration. This trailer



MOTOR TRUCK AND TRAILER HAULING BULKY MATERIAL FOR BOSTON TEAMING COMPANY

has a chassis 16 ft. in length and a capacity of five tons. In the picture it is loaded with sacks of wool. The cab roof of the Mack truck is arranged with an upright so that it may be utilized, and the bags are securely bound on with ropes. While it would seem that in turning there would be trouble with the bags over the coupling, it is stated that no particular difficulty has been experienced, doubtless because there is a large amount of give in the sacks of wool.

Surface Aggregate or Fineness Modulus for Concrete

Professor Duff A. Abrams Defends the Fineness-Modulus Theory of Proportioning Concrete and Gives His Objections to the Surface-Area Theory Proposed by L. N. Edwards

Following the presentation in "Engineering News-Record," of Apr. 17, 1919, p. 758, of an abstract of Bulletin No. 1 of the Structural Materials Laboratory, Lewis Institute, which is an exposition of the fineness-modulus theory of concrete proportioning developed by Prof. Duff A. Abrams, L. N. Edwards, the proponent of the surface-area theory of concrete proportioning, submitted certain comments on Professor Abrams' remarks about the latter theory. This letter and a reply from Professor Abrams are given below. The reply contains some new data from the Structural Materials Research Laboratory, as well as definite criticism of the surface-area method—EDITOR.

Surface Area Method of Proportioning Concrete Is Defended

BY L. N. EDWARDS

Senior Highway Bridge Engineer, Bureau of Public Roads, Washington, D. C.

THE reference in Professor Abrams' article to the surface-area method of proportioning appears to the writer to be subject to question; more especially so, since his own investigations have shown its efficiency for both laboratory and field use.

It is not quite clear just what is meant by the statement, "Our studies have shown that surface area is not a satisfactory basis for proportioning aggregates," since the surface-area method is not confined to the proportioning of the aggregatés, but instead is adapted to the proportioning of all the ingredients of the mix, including the water content. Table II of the article above-mentioned does not appear to the writer to offer evidence tending to disprove the fundamental principles of the surface-area method, but rather to add emphasis to the important role of the water content of the mix in the determination of the ultimate strength of the concrete. Incidentally, Table II calls attention to a rather important detail of concrete making to which the fineness-modulus method gives scant consideration.

Granting for the present the correctness of the surface areas as recorded in Table II, then, since the quantities of cement and water were maintained as constants throughout the entire series of tests, it naturally follows that, by reason of the variations existing in the surface areas of the aggregates to be moistened, the quantity of water combining with the cement to form the cement matrix is correspondingly changed. Very small variations in the water content of the cement matrix, at the time of mixing, produce radical changes in its strength, and other physical properties when it has become fully set. "However, it is only the water which goes to the cement (that is, exclusive of absorbed water) which affects the concrete strength." Likewise, this change in the consistency (plasticity) of the concrete is fully recognized in Bulletin No. 1 of the Lewis Institute, but this portion also of the original paper was not incorporated in the *Engineering News-Record* article. Its importance appears to justify its inclusion here:

"The grading of the aggregate may vary over a wide range without producing any effect on concrete strength, so long as the cement and water remain unchanged. The consistency of the concrete will be changed, but this will not affect the concrete strength if all mixes are plastic." The requirement that the concrete be "plastic" when mixed will be referred to further on. However, it may be said here that the above quotation, together with the preceding one from the same source, contains the kernel of the cement-water ratio idea.

Concerning the surface areas recorded in Table II, the writer has endeavored to check about one-third of the entire list. For this purpose unit areas, adapted to Tyler standard sieves, were used. These areas were derived from the writer's tests, described fully in a paper, "Proportioning the Materials of Mortars and Concretes by Surface Areas of Aggregates." (See "Proceedings" of the American Society for Testing Materials, Vol. XVIII.) The fact that a very marked difference has been found between his results and the tabulated areas leads to the conclusion that the latter were determined by a somewhat different method.

For a proposed concrete structure, the consideration of possible sources of supply of aggregates frequently involves the laboratory examination of the concrete-making qualities of two or more different aggregates varying in their sieve analyses and other physical properties. The field condtions attending the mixing, handling, placing and finishing of the concrete, as well as ultimate strength, toughness, etc., of the concrete produceable from them, require that the relative merits of these aggregates be determined under the conditions characteristic of the surface-area method. Most assuredly, those conditions which tend to produce variations in the relative plasticity and the final strength of the cement matrix should be eliminated. In the tests described in Table II, uniformity of strength was the single object sought. Uniformity of plasticity and toughness were not considered.

The writer does not desire to create the impression that the fineness-modulus method is radically different from the surface-area method; on the contrary, he has failed to discover wherein these methods are at variance, although it may truly be said that they approach the problem of concrete design from quite different angles.

Tests Do Not Bear Out Surface-Aggregate Method

BY DUFF A. ABRAMS

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IN DESIGNING concrete mixtures, three elements must be kept in mind: (1) Workability; (2) strength, or other desirable property, and (3) cost. In usual circumstances, each of these three factors is an absolute limitation on the makeup of the concrete. If cost were no item, concrete of any desired strength and workability could be secured by using rich mixtures. In order to reduce the cost to a minimum, we use as much aggregate as feasible. The degree of workability required depends on the nature of the work and the methods used in handling and placing. The workability of concrete is one of its prime advantages and a certain degree of workability is absolutely essential. In order to reduce to a minimum the cost of handling and placing, a satis-

factory degree of workability may be secured by using a little more water than is necessary, and an aggregate of somewhat greater fineness than that known to produce maximum strength of concrete. In designing concrete mixtures, the engineer must work out a nice balance between the strength, cost and workability in order to secure an economical building material.

It has been pointed out that the function of water in concrete is twofold: (1) To hydrate the cement; (2) to form a plastic mass.

The quantity of water required to hydrate the cement has not been definitely determined; it is probable that not more than 25 to 40% of the water in ordinary concrete is necessary for this purpose.

Tests made in this laboratory have shown that with given materials and conditions of test the quantity of mixing water used determines the strength of the concrete so long as the following conditions are observed: (1) Concrete is plastic with the method of placing used; (2) aggregate not too coarse for quantity of cement used; (3) mixture not so wet that all water cannot be held by the concrete.

Regardless of the size or grading of the aggregate, the amount of cement or the consistency of the concrete, the "water-ratio" may be used as a measure of the strength of the concrete. In other words, it makes no difference *why* the water-ratio is changed; the fact that it *is* changed within the limits stated above produces a definite result. Other properties of concrete, such as wearing resistance, modulus of elasticity, etc., have been found to follow similar laws.

Captain Edwards has not given sufficient weight to the fundamental relation between the water content and the strength of concrete. He states in his original paper that "the surface-area method of proportioning concrete assumes as its basic principle that the physical properties are primarily dependent upon the relation of volume of cementing material to the surface areas of the aggregates." It seems to me that the tests reported fail to bear out this assumption. On the other hand, many different series of tests made in this laboratory have shown that the quantity of cement is *not* a criterion of the strength of the concrete unless at the same time we take into account the quantity of water used. A 1: 9 mix may be as strong as a 1: 2 mix. In other words, it is the *ratio of water to cement* that determines the strength of the concrete. Table III shows one way in which the quantity of cement may be varied 400 to 600% without producing any appreciable effect on strength so long as the water-ratio is constant. Much greater variations in cement content could have been made had it seemed desirable.

The "water formula" for concrete cannot be reduced to the simple form given by Captain Edwards, if it is to be of general application. The water formula given in Bulletin No. 1 takes account of the following six factors: (1) Relative consistency of concrete (workability factor); (2) normal consistency of cement; (3) the mix (volume of cement); (4) size and grading of aggregate (measured by the fineness modulus); (5) absorption of aggregate; (6) moisture contained in aggregate.

Another term is necessary when an admixture is used. The items, with the exception of (1) and (4) can be readily determined for given materials. The amount of water required under (1) will depend on the nature of the work, the method of placing the concrete, etc. Any method which will give a *proper* distribution of the water due to the size and grading of the aggregate should give satisfactory results. This Captain Edwards has endeavored to accomplish by means of the surface-area factor, while we have used the fineness modulus of the aggregate.

Where the Two Methods Differ

The fineness modulus is the sum of the percentages in the sieve analysis of the aggregate, divided by 100. Sieves from the Tyler standard screen scale are used. The percentages are expressed in terms of the quantity of aggregate by weight or volume *coarser* than each of the sieves. For a particle of a given size the surface area and the fineness modulus bear a direct relation to each other, since they are both simple functions of the diameter. The surface area varies as the square of the diameter, while the fineness modulus is a logarithmic function of the diameter. The relation is not so simple when we come to deal with graded aggregates. The discrepancy in this case becomes so great that both of these methods cannot be correct for a wide range of conditions.

A further discussion of the quantity of water required on the basis of the grading of aggregate may be of interest. The plasticity or workability of the finished concrete is the only criterion which can be used in comparing the water requirements of different mixes, gradings, etc. We have used the "slump" test for this purpose. This consists of molding the 6 x 12-in. cylinder in a smooth steel form by puddling the concrete in 4-in. layers with a ⅝-in. steel bar, leveling off with a bricklayer's trowel, then immediately removing the form, without opening it, by a steady, upward pull. The shortening of fresh concrete from its original length, measured in inches, is the "slump."

The water which must be added, due to the presence of the aggregate, aside from that absorbed, may be divided into two portions: (1) To form a surface film on aggregate; (2) to make a thin cement paste which will produce a plastic mix with the aggregate. The total quantity of water required for this purpose can be determined experimentally by measuring the additional water necessary to produce a given plasticity in a concrete mixture as compared with that required for neat cement. By using different quantities of aggregate and different sizes and grading we arrived at the term, $0.30/1.26^m$, in our water formula which takes account of this factor. (It will be noted that this term gives a relation between water and fineness modulus similar to the water-strength curve in Fig. 1 of Bulletin No. 1.) The total quantity of water required for this term in an ordinary concrete mixture is about 8% by volume of concrete, or 40 to 50% of the total. This quantity is known to give satisfactory results. There is no reason why the water necessary to thin the cement paste should not be charged to the cement instead of the aggregate; however, the latter method seems more logical, since it is the presence of the aggregate and its size and grading that necessitate the addition of water to produce a mix of the same plasticity.

How Much Water Does Aggregate Take?

Let us see how much the quantity of water which must be charged to the aggregate (aside from that absorbed) is dependent upon surface area. Earl Pettijohn has shown (*Jour. Am. Chem. Soc.*, April, 1919)

that the thickness of the surface film of standard Ottawa sand is 0.00003 in. at the point when free water begins to form. This means that 18 cc. (about 1/20 pint) of water would be required to produce the surface film on a cubic foot of standard sand and a much smaller quantity for ordinary concrete aggregates. The water required for this purpose is negligible. In other words, practically the entire quantity of water necessary on account of size and grading of aggregates must be charged to thinning the cement paste.

Ordinary mixes require water-ratios of 0.75 to 1.00; the value for neat cement with a normal consistency of 23% by weight is 0.35. In other words, the cement in concrete contains two to three times as much water as that required for normal consistency. It is the dispersion of the cement particles which results from the addition of water that is responsible for the rapid reduction in strength found in the wetter mixes.

How must the thinness of this paste be varied in order to produce a plastic mix with aggregate of different size and grading? Upon thinning the paste by adding water, we observe the following phenomena: (1) Increased plasticity; (2) change in volume.

The increased plasticity arising from adding water needs no demonstration. The volume of paste is first reduced, then increased as water is added to cement. Table I herewith shows the effect with a standard cement weighing 94 lb. per cubic foot:

TABLE I. VOLUME OF CEMENT PASTE

Water Added to One Volume of Dry Cement: Water-Ratio	In Terms of Normal Consistency	Volume of Cement Paste
0.35	1.00	0.87
0.40	1.14	0.89
0.50	1.43	0.98
0.60	1.71	1.06
0.75	2.14	1.20
1.00	2.90	1.42
1.50	4.3	1.93
2.00	5.7	2.40
3.00	8.6	3.20

That the *volume* of paste is an important factor in producing plasticity of mix can readily be seen from the fact that plasticity can be increased by increasing the quantity of cement and using relatively less water; in other words, a given degree of plasticity is produced by a low water-ratio for a rich mix and a high water-ratio with a lean mix. Just what effect the actual *quantities* of paste have on workability under the extreme conditions of mix, etc., has not been determined.

Current theories of concrete are generally based on the idea that the quantity of paste is dictated by the voids in the aggregate, with a certain surplus. Four weaknesses in this theory may be mentioned: (1) The voids in the aggregate can be varied widely without producing any change in the quality of concrete; (2) the grading of aggregate which gives greatest strength in concrete gives higher voids than are found in other gradings of lower strengths; (3) concrete of highest strength may contain visible voids; (4) the strength and other desirable properties of the concrete depend on the *quality* of the paste and is little affected by the *quantity*, so long as we have sufficient to produce a workable mix.

The influence of the cement-water mixture on the plasticity of concrete is, then, a function jointly of the plasticity and volume of the paste. We have seen that the strength is a function of the water-ratio (volume of water to volume of cement) and that the strength of concrete decreases as the water-ratio increases; hence, in order to secure the highest grade of concrete at the lowest cost it is necessary to secure a given condition of plasticity with a minimum water-ratio. What condition with reference to the size and grading of the aggregate will give the desired result? It is obvious that this is a most complex relation if we consider the almost infinite variety of sizes and gradings which may be made from a single aggregate. Captain Edwards has used the surface areas as a satisfactory measure. It seems to the writer that the radius of curvature of the particles and the number of points of contact (or near contact) between adjacent particles are the factors which are primarily responsible for the additional water which is necessary due to the presence of the aggregate. Both of these factors are functions of the diameter; the radius of curvature is one-half the diameter if we assume that aggregate of spherical form is being used. Since particles of all sizes are mixed at random, and there is no systematic arrangement, it is impossible to analyze the problem in a way that will enable us to compute the number of points of contact. The only practical method, then, is to determine the relation by trial. The fineness-modulus method was arrived at in this way. It was discovered from a study of mortar strength tests of about 1000 different sands mixed to a uniform plasticity, and stored and tested under uniform conditions.

The water formula given in our Bulletin No. 1 is of a rational form and can be applied to any combination of concrete materials. Its development was an evolution extending over several years. These formulas were numbered in the order of their derivation as they were modified from time to time on the basis of experience. The above formula is No. 11. It is based on the experience of many thousand tests. I do not mean to be understood as believing that this formula is exact and will require no further modification. On the other hand, subsequent experience may dictate certain changes.

The formula has been subjected to many severe tests by applying it to aggregates of the most diverse character. A recent series of tests using four different coarse aggregates (graded No. 4 sieve to 1½ in.) and the same sand gave the following results (Table II) for 1:4 mixes:

TABLE II. STRENGTH OF CONCRETE FROM FOUR AGGREGATES

Coarse Aggregate	Compressive Strength (Pounds per Square Inch)
Pebbles	3,620
Crushed limestone	3,830
Crushed slag	3,750
Crushed granite	3,850

Tests were made on 6 x 12-in. cylinders at the age of three months. Twenty-one different gradings were used for each coarse aggregate. Specimens were stored under two conditions. Each value given above is the average of 105 tests. The water for these concretes was proportioned by the formula given above. The fact that with similar gradings and water properly controlled we secure uniform plasticity and strength is a severe test of the formula, when it is considered that we are comparing spherical and crushed materials of widely different characteristics. The absorption of the aggregate was also different in each case. Many serious errors have been made by experimenters in comparing the concrete-making qualities of different aggregates. The wide variations reported in the strength of the concrete made from different materials can almost invari-

ably be traced to failure to take account of differences in size or grading, and to neglect of the absorption of aggregates.

The sand-mortar tests in Captain Edwards' paper, which were mixed with 1 volume of cement for each 13 sq.in. of calculated surface area of the sand, gave mortars of fairly uniform strengths at three different ages. These tests are interpreted as proving that the surface area of the aggregate is a proper basis for proportioning mortar and concrete mixtures. It is the writer's view that the uniformity in strength is due to an entirely different cause. Since both the water and cement were proportioned on the basis of the surface area of the aggregates, he obtained a uniform water-ratio, which is solely responsible for the uniform strength. This is the result to be expected so long as all of the mixtures were plastic and none of the aggregate gradings was too coarse for the quantity of cement used.

Tests Do Not Check Surface Method

It is unfortunate that it was not feasible to include in our Bulletin No. 1 all of the data on which the conclusions were based. It is the writer's belief, however, that the tests given in Table 2 of the bulletin bring out a fatal limitation of the surface-area method of dealing with proportioning of aggregates. Twenty-seven different gradings of the same aggregate were used. The gradings were made to vary over a wide range, but had one property in common; that is, the fineness modulus was uniform. They were mixed with the same proportions of cement and water. The strengths for two different consistencies showed a mean variation from the average of about 3%, and a maximum variation from the average of about 10%. The corresponding values for surface areas are 34% and 110%, respectively. If the water proportioning of these tests had been based on Captain Edwards' formula the water-ratios of the concrete would range from 0.39 to 0.57, an extreme variation of 69%, and would have made a very great difference in the plasticity of the concrete. It is true, as stated in Captain Edwards' letter, that these tests were made with a view to determining whether or not a uniform strength of concrete was obtained with such wide variations in the sieve analysis of the aggregates. However, the plasticity or workability of the concrete did not differ materially.

The surface-area values in our table were calculated from the diagrams given in Captain Edwards' paper. It was necessary to estimate the areas of the sand particles below the 100-mesh sieve, and wide variations may be due to this cause. In certain of the tests as much as 10% of the aggregate was sand finer than the 100-mesh sieve. The surface area of this portion which we must estimate or neglect entirely is probably considerably greater than the entire surface area of many other gradings in the same group. The quantities of water given by Captain Edwards' formula are only 60 to 70% of those required for the materials used in this laboratory. It was impossible to mix concrete using the water given by his formula.

Table III herewith gives the results from a portion of some recent tests in this laboratory. Two leaner and two richer groups of mixtures are omitted. The quantity of materials required for each specimen, beginning with the 0-1½ in. aggregate and a mix of 1:2½:5, 1:2:4, 1:1½:3, etc., was calculated. The coarser sizes of aggregate were dropped in turn, but we retained exactly the same quantity of cement and water. The final mixes in terms of volume of cement and total aggregate are given in Col. 2 of the table. It is obvious that the richer mixes in each group are much more plastic than the leaner ones, and that equal workability was not secured. As in all other tests in these investigations the concrete for each cylinder was mixed separately by hand. Each value is the average of five tests made on various days. The second series of tests is not yet completed; however, the tests which have been made show a greater uniformity in strength than those in Table III, due to slight readjustments of certain constants in the water formula. These tests confirm the conclusion based on many other series; Namely, that *the widest variations may be made in the mix, consistency, and size of aggregate without any change in strength so long as the water-ratio is unchanged,* and the above limitations are not violated.

It seems to the writer that any comparison of the surface-area and fineness-modulus methods must be reduced to the following two factors: (1) Which rests on the more sound experimental basis? (2) Which is the more simple to apply?

As stated above, the whole question of the comparison between the two methods resolves itself into that of determining which will give the better distribution of water in a mix, so far as the size and grading of the aggregates are concerned. Both of these methods make use of the sieve analysis of the aggregate. However, it seems to the writer that there is more variation in the underlying principles than that suggested in the last paragraph of Captain Edwards' letter.

It appears to the writer that the following disadvantages accompany the use of the surface-area method: (1) Areas of the finest particles of sand cannot be computed; (2) crushed aggregate requires a greater quantity of water for the same grading than pebbles of a spherical form; (3) if the surface-area method were strictly interpreted it would require separate treatment for practically each kind of aggregate; (4) the method requires laborious computation, with the resulting chance of error; (5) it is not clear how the method can be applied to the simplest problems which arise in the course of designing concrete mixtures; for instance, to determine the best proportions of given fine and coarse aggregates for a concrete mixture; (6) it has not been shown that there is any theoretical reason why the surface-area method gives more nearly correct results than other methods which have been proposed.

If the surface-area method is correct, it would seem to be a serious fault that the areas of the finest particles cannot be satisfactorily dealt with. It seems probable that in extreme cases the areas of the particles finer than the 100-mesh sieve would be in excess of the combined areas of the coarser sizes. Our experience indicates that the quantity of water required for these fine sands is not in proportion to the amount that would be suggested by the surface areas.

The area of a tetrahedron is 25 to 30% greater than that of a sphere of the same volume, or one having a diameter equal to the height of the tetrahedron. Our experience in testing concrete made of crushed aggregates as compared with rounded pebbles does not indicate that there is any discrepancy in the quantity of water required, as would be suggested by the surface-area method.

TABLE III. EFFECT OF SIZE AND GRADING OF AGGREGATE AND CONSISTENCY OF CONCRETE

Compression tests
Age at test, 28 days
Sand and pebble aggregate

Six by 12-in. cylinders, hand-mixed concrete
Stored in damp sand; tested damp
Each value is the average of five tests made on various days

		Water		Aggregate				Surface Area		Concrete			
Ref. No. (1)	Mix by Volume (2)	Relative Consistency (3)	Ratio to Cement (4)	Size, Inches (5)	F.M.* (6)	Weight, Pound per Cubic Foot (7)	Density (8)	Square Inches per Pound of Aggregate (9)	Square Inches per Pound of Cement (10)	Weight, Pound per Cubic Foot (11)	Density (12)	Yield† (13)	Compressive Strength Pounds per Square Inch (14)
					Nominal Mix for 0-1½-inch aggregate, 1:2½:5								
15	1:6.7	1.00	0.91	0-1½	5.67	125	0.755	923	8280	152	0.846	0.978	1640
16	1:5.4	1.05	0.91	0-¾	5.09	124	0.743	1052	7500	151	0.828	1.006	1800
17	1:3.7	1.13	0.91	0-⅜	4.10	121	0.725	1737	8300	145	0.768	1.115	1760
18	1:2.5	1.21	0.91	0-4	2.99	112	0.671	2601	7750	139	0.696	1.241	1950
19	1:2.2	1.23	0.91	0-8	2.58	108	0.648	3056	7730	136	0.669	1.299	1630
20	1:1.9	1.29	0.91	0-14	2.24	105	0.629	3695	7840	134	0.643	1.377	1940
21	1:1.2	1.50	0.91	0-28	1.81	102	0.611	4494	5860	135	0.603	1.685	2000
												Average	1820
					Nominal Mix for 0-1½-inch aggregate, 1:2:4								
22	1:5.4	1.00	0.80	0-1½	5.67	126	0.755	923	6680	152	0.842	1.003	2230
23	1:4.3	1.05	0.80	0-¾	5.09	124	0.743	1052	5980	150	0.814	1.050	2130
24	1:2.9	1.13	0.80	0-⅜	4.10	121	0.725	1737	6480	144	0.754	1.183	2550
25	1:2.0	1.20	0.80	0-4	3.00	112	0.671	2604	6210	139	0.690	1.322	2160
26	1:1.7	1.22	0.80	0-8	2.58	108	0.648	3056	5970	136	0.658	1.418	2280
27	1:1.5	1.26	0.80	0-14	2.24	105	0.629	3695	6180	132	0.625	1.522	2440
28	1:0.9	1.47	0.80	0-28	1.81	102	0.611	4494	4390	135	0.594	1.937	2400
												Average	2310
					Nominal Mix for 0-1½-inch aggregate, 1:1½:3								
29	1:4.0	1.00	0.69	0-1½	5.67	126	0.755	923	4950	152	0.832	1.054	3100
30	1:3.2	1.04	0.69	0-¾	5.09	124	0.743	1052	4450	149	0.799	1.120	2970
31	1:2.2	1.11	0.69	0-⅜	4.10	121	0.725	1737	4930	144	0.743	1.273	3390
32	1:1.5	1.16	0.69	0-4	3.00	112	0.671	2601	4650	139	0.679	1.463	3270
33	1:1.3	1.20	0.69	0-8	2.58	108	0.648	3056	4570	136	0.651	1.570	3220
34	1:1.1	1.22	0.69	1-14	2.24	105	0.629	3695	4540	132	0.615	1.740	3200
35	1:0.7	1.37	0.69	0-28	1.81	102	0.611	4494	3410	129	0.565	2.308	2930
36	1:0	1.92	0.69	....	Neat	...	....	....	....	132	0.467	.....	3230
												Average	3160

* Fineness modulus of aggregate.
† Yield was calculated on the basis of the original volume of dry aggregate.

The computation of surface-areas begins at practically the same point where the determination of the fineness modulus ends. There appears to be little room for question as to which of the proposed methods is the more simple in application.

No doubt, the surface-area method could be worked out so that it would apply over a limited range. In fact, almost any function of the size of particle could be used in this way. This would be equivalent to representing a portion of the curve by a line or by an arc of different curvature.

It is unfortunate that the wording in our Bulletin No. 1 was such as to permit the interpretation which is placed upon it by Captain Edwards in the third and fourth paragraphs of his letter. The thought the writer meant to convey was not at all the meaning that Captain Edwards finds in this report. The purpose was to indicate that the *size* of the aggregate may vary over a wide range without producing any effect on the concrete strength, so long as the concrete and water remain unchanged; for instance, as in Table III, herewith. The confusion arises from the use of the term *size* and *grading* interchangeably and to the use of both of them in a multitude of different senses. It was not intended that this statement should apply to the case of aggregates having the same fineness modulus, such as those given in Table 2, Bulletin No. 1.

Correction in Writer's Title

H. Y. Carson, lately captain and sanitary engineer, American Red Cross Commission, author of the article "Ancient, War-Time, and Present Water-Supply in Jerusalem," *Engineering News-Record* of June 5, 1919, p. 1092, is now with the American Cast Iron Pipe Co., Birmingham, Ala., and not with the Central Foundry Company, as indicated incorrectly at the head of the article.

New Etching Process for Studying Structure of Steel

Does Not Require Polished Surface, But May Be Used With Emery Finish—Prints Made by Ink and Copying Press

A USEFUL improvement in methods of etching sections of steel to study the quality and internal structure of the metal has been made by J. C. W. Humfrey of Sheffield, and is reported by him in a paper read last month before the Iron and Steel Institute, under the title "Macro-Etching and Macro-Printing." The value of the method lies in its ease of application; instead of requiring a finely polished surface to prepare for the etching (with present methods a coarser-grained surface is not adequate, in view of the delicacy of the etching) it can be applied to surfaces having an emery-paper finish only. Furthermore, the etching gives such a degree of relief that prints can be made by means of printer's ink and copying-press methods. Specimen prints included in the paper just mentioned show that the marks traced out by the impurities in the steel which give rise to the differences of etching are sufficient to portray the mechanical structure of the metal very perfectly. Thus, ingots, punched shell blanks and the like show clearly defined structure markings.

Humfrey's etching solution is a modification of Heyn's reagent (copper ammonium chloride) made by adding strong hydrochloric acid. The most satisfactory composition was found to be 120 g. of copper ammonium chloride, 50 cc. of concentrated hydrochloric acid and 1000 cc. of water. This solution is poured on the surface to be etched, which is placed horizontal, and is renewed frequently, so that a film of fresh solution is always in action. A satisfactory relief effect is obtained in from 20 min. to one hour.

It is preferable to start the etching with a neutral

solution and continue with it until the emery-paper scratches are all eaten away. Then, in successive applications of the acid solution, the acidity of the reagent is gradually increased up to the maximum. By starting with neutral solution, the copper which is thrown down on the iron is given a loose or flocculent nature, so that it can be wiped away, while the acid solution tends to produce an adherent plating of copper. For this reason, whenever the solution and the copper are wiped off for the purpose of examining whether a sufficiently deep etch has been obtained, the etching is started again with the neutral solution, subsequently acidified in successive stages.

When a surface so etched is inked with a printer's roller a print can be made from it in a copying press. Coated paper and a rather hard pad give the best result.

The effect of the acid solution is to attack most vigorously the purer parts of the metal, which solidified first. All areas containing marked amounts of impurity are more resistant to the reagent and show on the finished plate in high relief. The chief impurity having the effect of increasing the resistance of the steel to the etching fluid is phosphorus, and in a sense the prints obtained are maps of phosphorus distribution in the metal, just as bromide-paper prints give maps of the sulphur distribution.

Presidential Address at Convention of Civil Engineers

Fayette S. Curtis Outlines the Duties of the Engineer and Reviews Past Accomplishments—Promises for the Future

DIGRESSING somewhat from the trend of former addresses, Fayette S. Curtis, in his presidential address June 17 at Minneapolis, Minn., at the first convention of the American Society of Civil Engineers held after two years' interruption by the war, spoke of the duties of the engineer, what has been accomplished in the past by the society and what is to be accomplished in the future, the personal application necessary to make work successful, and the distinction to be gained through uprightness and honest labor. The address, practically in full, follows:

It is quite probable that some of you have often been asked the question, "Do you recommend civil engineering as a profession?" and I assume that generally an affirmative answer has been given. The civil engineer, when thoroughly fitted for his profession, immediately becomes useful to society and the world of materiality. He is prompted by the wants of society, and is constantly originating other wants by the improvements he introduces. He is also creative, and his profession is not mortgaged to power or influence, but stands firmly on its own foundation—encouraged by world-wide influences.

His duty consists in designing, arranging, and building structures or machines which require the immediate superintendence of those who are acquainted with not only the principles but the practice of construction; for engineering is a branch of knowledge that takes its place both among the sciences and the arts.

Therefore, to be eminent in his profession, or any branch of it, he should be able, not only to design and plan, but to supervise construction. Those who have only the knowledge of how to design and plan, and are unable to execute, become confused in meeting the many contingencies which arise.

Requires Acquaintance With Sciences

The profession, embracing as it does almost every kind of construction, requires a very extensive and general acquaintance with other sciences, in order that the engineer may be qualified to accomplish successfully the various works on which he may be engaged, and to overcome those difficulties which frequently arise unexpectedly in the progress of his work, and, but for that knowledge and talent, threaten its final success.

Thomas Telford, in his "Descriptive Narrative of his Professional Labours," has said:

"How can a man give judicious directions unless he possesses personal knowledge of the details requisite to effect his ultimate purpose in the best and cheapest manner? It has happened to me more than once, when taking opportunities of being useful to a young man of merit, that I have experienced opposition in taking him from his books and drawings, and placing a mallet, chisel or trowel in his hand, till, rendered confident by the solid knowledge which experience only can bestow, he was qualified to insist on the due performance of workmanship, and to judge of merit in the lower as well as the higher departments of a profession in which no kind or degree of practical knowledge is superfluous. For this reason I ever congratulate myself upon the circumstances which compelled me to begin by working with my own hands, and thus to acquire early experience of the habits and feelings of workmen; it being equally important to the civil engineer, as to naval or military commanders, to have passed through all the grades of their profession."

It is no doubt true that many men have gained prominence in their profession by individual effort—practicing and studying at the same time, with a view to acquiring a full knowledge of all necessary scientific principles. Students are required to spend a certain time in acquiring technical knowledge, but must not then think they are engineers in the broad meaning of the term, capable of constructing and being responsible for engineering work, as that is a false idea.

No one can doubt that the addition of the natural sciences to the old-time arts course has greatly enriched it, and the sciences are now undoubtedly the most important part of a liberal education; but there is another side, which we cannot ignore, and that is, that, after all, the great object of a good education is not so much the accumulation of knowledge as the development of mental power in the individual.

The tendency toward scientific and practical education is no new thing. Men have come to see that the first mental training can be made more effective by solving physical problems than by studying the dead languages, because as much true value can be obtained in the study of nature as in the study of man's conception of nature. First knowledge is more satisfactory to the best of minds.

Specialization Necessary

The profession has become so diversified that after having secured a good fundamental training it would be worth serious consideration to take up a single branch of engineering practice, as it can hardly be expected that the civil engineer will become proficient in every branch. He would be better able to give his best endeavors to attaining the highest proficiency in some particular line, and, at the same time, grasp or understand in a general way the subjects which may relate to the several kinds of works, as the whole subject is so broad that it would be vain to attempt to understand them all in all their details.

Ambition to obtain as great a knowledge as possible is to be admired and encouraged, but to attain the highest standard in one branch is more commendable than to attempt to reach special eminence in all, as the student will be apt to find himself oppressed with a weight which he is not capable of sustaining, and this will be very likely to result in utter failure.

The professional man should not make the mistake of thinking that he can reach the top in an unconcerned and idle manner, believing that by some easy process he will

reach and hold it. The structure on which he stands must be constructed by piece and parcel, every member thoroughly tested by a gradual and difficult process; he must experience all the difficulties, trials, and troubles to be met on the way, in order to support and sustain him at the higher elevation to which he aspires. To such the doors to success are open. Work seeks the best hands, as naturally as water runs down hill, but seldom seeks one whose only recommendation is that he needs it. If he is not willing to go slowly through the maturing process of time, through patient work, by steady application step by step preparing himself for the work ahead, which has made men prominent and efficient in their profession, then, alas, the result is doubtful. It is like the student who prepares his education for future advancement. He goes from grade to grade until he is master of the science on which he has to build, taking no upward step until the last has been tested and found not wanting in any characteristic which will sustain him and serve him to build on for the future.

Facing New Conditions

New problems are all the time arising. The tremendous growth of our complex industrialism means the facing of new conditions, that we may overcome new difficulties and enjoy new benefits. Therefore, there is only work to face, and it should be met with a spirit characteristic of the creator of science, and thereby much may be accomplished.

There is no success without hard and earnest labor. Never balk at a few obstacles, but hang on with all your might; this, in the end, will give success. It is true that many experiments will have to be made, but there can be no doubt of ultimate success if our aim is a determination to succeed and we do not become discouraged.

As we look back, even over a short time, how often have we said to ourselves, after completing some important structure, "This should last for many years—we have reached the limit;" but within a comparatively brief period have we not seen that structure replaced by another, larger and more expensive, which has been demanded by the growth of business? We have not stopped building, nor have we come to the time when we have built sufficiently for the future, and we never will, as long as the richness of this country is undeveloped and its physical and financial growth continues. To stop this great advancement, which the people continue to make, would be death. Then, does it look as though there was not a future for the engineer who has integrity and perseverance, as he is and must be the practical foundation or basis for all which we are to build, in order to accomplish a higher and nobler position in society?

The work of the engineer is the foundation on which rests the growth of this great republic, not only physically but financially. He is one of the prime factors, and could not by any possibility be dispensed with. We are not an organization which threatens to pull down and wreck or destroy what we have built, but an educational organization, and hope to get the necessary recognition of our rights through education. No doubt the engineer has often had his line of procedure curtailed by some power having authority to suspend or discharge at will, at the pleasure of some controlling power, ignorant, and with no understanding of the conditions or the difficulties the engineer may have to meet, and without the least knowledge of engineering subjects.

Civil engineering is ages old, but has always shown a steady progression, possibly not as to more substantial work, but certainly in the facilities provided in machinery to do its work. As to its beginning, I will not undertake to say, but will only refer back to those times of which we may have knowledge, and ask if the great work done is not a credit to the scientific ability of this profession? But what is the future to be? Does it depend on those who are coming into this society—educated, experienced—to show to the world that they can and will continue to build and improve the financial and social conditions? For a determination we must wait on time.

Is the engineer being benefited by his connection with this society? It has been said that the society is becoming less democratic and more conventional, or, in other words, is not taking sufficient interest in, or having proper regard for, its members, and, therefore, they are without the opportunities or advantages which they might gain in local societies. This society has grown to such an extent that contact personally with all its members is not possible, but the interest and devotion and brotherly love of its members are just as great as ever. The information in the different papers by the most prominent engineers of the country, presented and distributed, is of the greatest importance to the members of the society. As the society grows, this information increases, and the papers are more numerous and contain information and knowledge which cannot be obtained except through the parent society. If not, why are so many engineers anxious to affiliate themselves with this society? They know it gives them prestige the world over, and sets a standard which has been passed upon and approved by the highest of professional men. Our constitution requires that standard to be higher than that of any of the local societies.

The society has not only grown in numbers, the increase within the last ten years being 85%, but has increased in influence in the estimation of the public and the world at large; our members are looked up to as the leaders in the engineering profession. Then, who can say that it, as an engineering society, has depreciated, gone back, or fallen off one iota from its former standing? On the contrary, it has grown steadily stronger and stronger. Its members have become of such strength, in the material and financial upbuilding of the Government, that they are indispensable.

Therefore, we must not permit ourselves to forget the obligation we owe to the founders of this society, the men who gave their time and talent in creating an organization which has proved to be of untold benefit to the engineering profession. How, then, are we to repay them, if not by giving to the society our support and assistance, promoting good fellowship among its members, encouraging its officers, and giving a helping hand to the future engineer who comes into the society, passes up through the different grades of experience, and is seeking information? Let us all do something in the interest of the society, and thereby broaden its influence and add to its high standards of proficiency.

We certainly cannot help by creating dissensions among the members, or becoming dissatisfied with the earnest labors of those whom we select to bear its responsibilities, or in getting the idea that we are connected with this society wholly for what we can get out of it. No matter how much we give, we can never repay the society for the benefits we have received.

Future of High Honors Possible

The engineer has designed and built many a monument which will endure for ages as a testimonial to his proficiency and skill. We need not go back many years to find members who have won the highest engineering distinction and whose names are ineffaceably engraved on the enduring pages of history. We know who they are and what they have accomplished. Even before this society was organized, we find the names of engineers who achieved everlasting remembrance through their exceptional ability. Therefore, I would say to engineers, but more particularly to the younger members of the profession, that there is a future for them which, if taken advantage of, will insure the highest honors possible to be obtained.

By him who is in the prime of life and in the possession of health, strength, and knowledge of the arts and sciences, much may be accomplished. Therefore, never give up. Think, work and suffer, that in this life you may gain something which will place your name upon the highest pinnacle of fame.

Many of our members have been engaged in the late war, and their work, in the construction of yards, docks, cantonments, and the reconstruction and building of bridges, roads and equipment, both in this country and on the other side of the Atlantic, thus making it possible to take care of millions of troops, was the most important factor in bringing the war to a successful termination. All of this has been done in such short time as to bring out comment and praise from the whole world. Why should not the

engineer have his full due and credit for the ability he has shown, not only at critical moments during the war, but in the accomplishment of things at other times?

We are living in an age in which we possess all the information as to what has been done for many years, all of which we ought to profit by. The conditions change, the opportunities grow greater. This world is growing in its necessities almost beyond the imagination of the present generation. The country is being developed so that every state in the Union is increasing in wealth and prosperity. Greater facilities are needed to accommodate its growth. And yet some say there is no future!

Work of Other Societies

The work of other engineering societies or organizations should also be mentioned. They have all done their part in building and developing the great industries of the world. All are working toward the same purpose, creating, building, and improving the facilities on which the prosperity of the country depends. This is illustrated by the establishment of Engineering Council, composed at present of representatives of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials, for the purpose of giving more strength to the profession and obtaining greater recognition for the engineering arts and sciences.

Why should we not go farther, and even take our position in Governmental affairs? Is it the political cloud that casts a shadow over us, so that our practical ability does not get the proper recognition in Government affairs; or is it our modest, indifferent way of being satisfied with our present condition? We should rise to the occasion, demand our rights, and a proper recognition by the people generally, with the idea that we are not only to advance the engineering arts and sciences but to fill the positions under this general Government which require the knowledge of how to govern, each according to his ability.

The armistice having been signed, it is incumbent on us, as founders of prosperity, with the sciences and the arts, to become one of the greatest upbuilding factors in the future, to help reconstruct that which has been torn down and destroyed by the ravages of war, and to promote new ideas for the world's future prosperity.

Emerging from the greatest war the world has ever known, not only in the number of men engaged and the use of the most deadly weapons, but in the destruction of property, what does this mean for the future? The employment of many engineers to reconstruct, and to rebuild in an improved form.

In the future the names of many of you engineers will be enrolled among those who have attained high public standing through great achievements. Many in our profession have thought, done, and suffered much in former days. Childhood may seem to be at almost an immeasurable distance in the past, but something that we have accomplished on account of its overpowering vastness seems near. It is like a beacon light, far away but seemingly near.

It is said, "The schoolhouse of the world—human experience—however expensive, has something to teach." Shall we learn our lesson readily?

Snowslides Removed by Sluicing

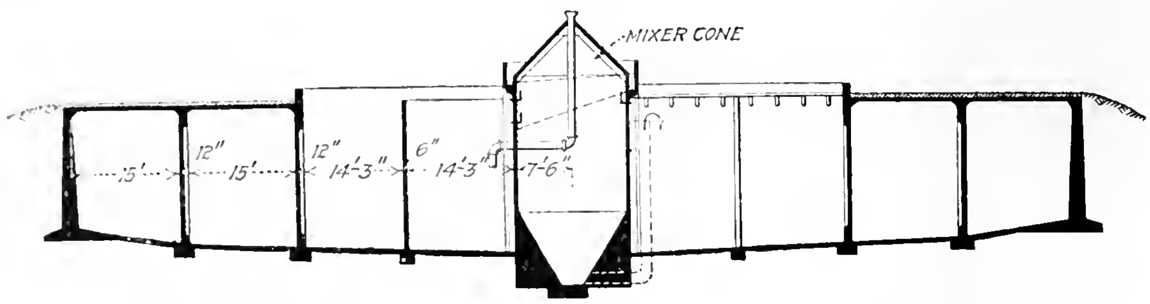
Three snowslides which blocked the line of the Government railroad in Alaska between Anchorage and Seward were to be removed by sluicing, according to the *Alaska Railroad Record*. One of the slides was 25 ft. deep over the track and the other two were 50 ft. in depth, the locations being at Mile 76½ and Mile 72, respectively. Nearby streams flowing only during the melting of snow in spring were available for removing blockades.

Combined Aërator and Mixer for Colloidal Water

Odor, Color, Taste and Turbidity in Underground Water From Cavernous Limestone Make Treatment Difficult

HIGH colloidal content and infrequent heavy turbidities are removed from the water-supply of Bloomington, Ind., by a combined aërator and mechanical mixer consisting of a conical concrete framework in which are embedded a series of short angles interrupting the flow.

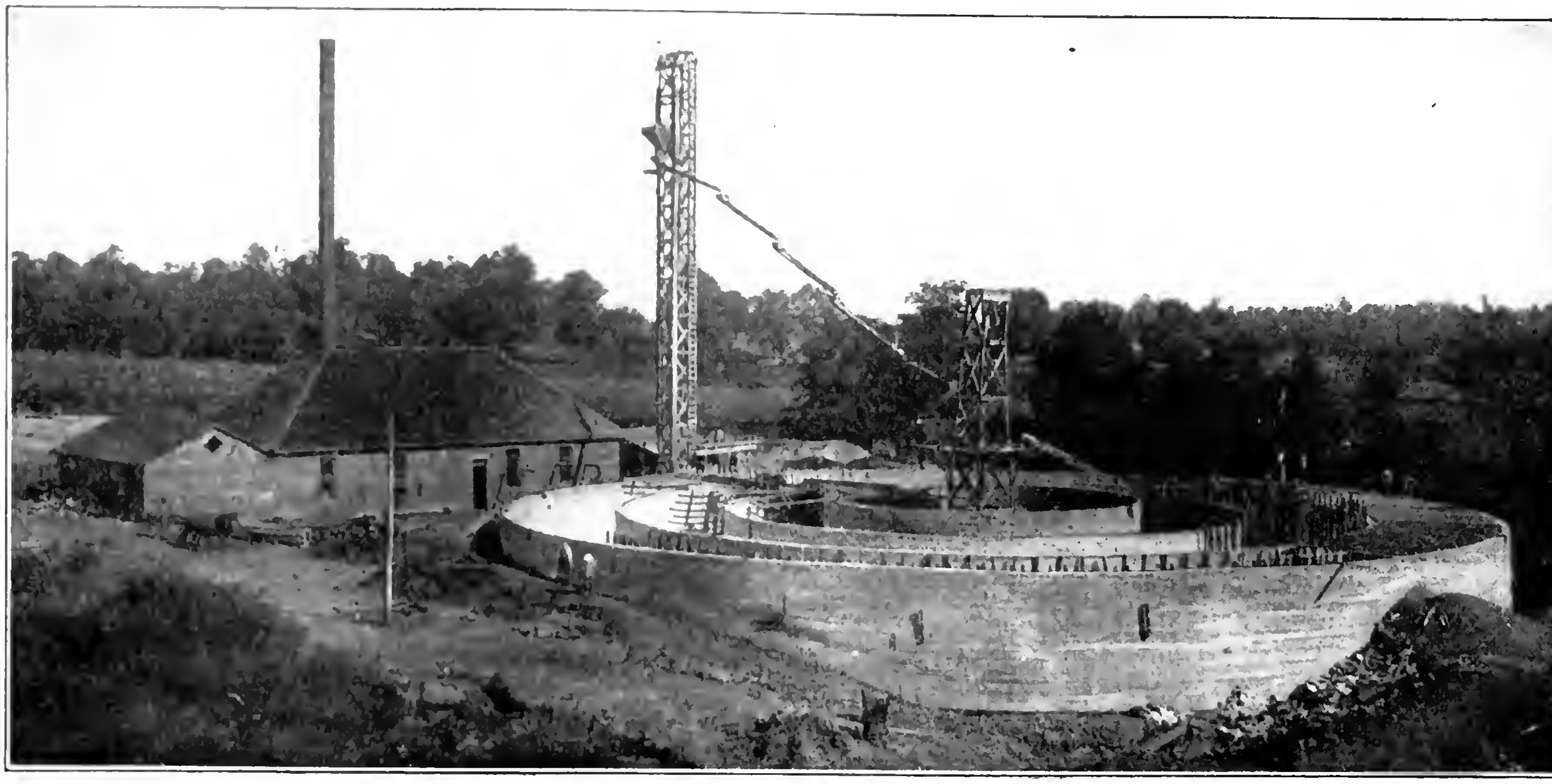
Geological conditions have made the water-supply problem particularly troublesome, the city being in the Mitchell limestone district, which is cavernous and underdrained to such an extent that deep rock wells are practically impossible, while the numerous fissures make the impounding of a sufficient supply difficult and uncertain. After numerous attempts to impound the water of several small streams in the vicinity, and after giving consideration to pumping water from White River, nine miles distant, a reservoir was constructed on a suitable site about three miles from the present pumping station. This reservoir is supplied entirely by springs and underground streams and has an approximate capacity of 1,500,000 gallons.



SECTION THROUGH BLOOMINGTON SETTLING RESERVOIR

The conditions in this reservoir, together with a high iron content in the water, favor the production of organic growths, which during certain seasons give objectionable odors and tastes. This feature, coupled with the fact that at times of extremely heavy rainfall the underground streams carry considerable turbidity, made it necessary to provide a purification system and means for the removal of the tastes and odors. Experiments showed that with complete aëration and the use of chlorine gas, followed by coagulation, a satisfactory effluent could be obtained. With the high colloidal matter and periodical heavy turbidities, it was considered advisable to provide not only the treatment just indicated but also to construct a specially designed sedimentation basin in connection with a small storage


CONE MIXER IN OPERATION



CIRCULAR BAFFLED RESERVOIR CONCRETED BY TOWER AND CHUTE

reservoir, having ample means, while in service, for removing settled solids. The combined reservoir and basin is of reinforced concrete, circular in form, 140 ft. in diameter, the outer ring, 30 ft. in width, being covered.

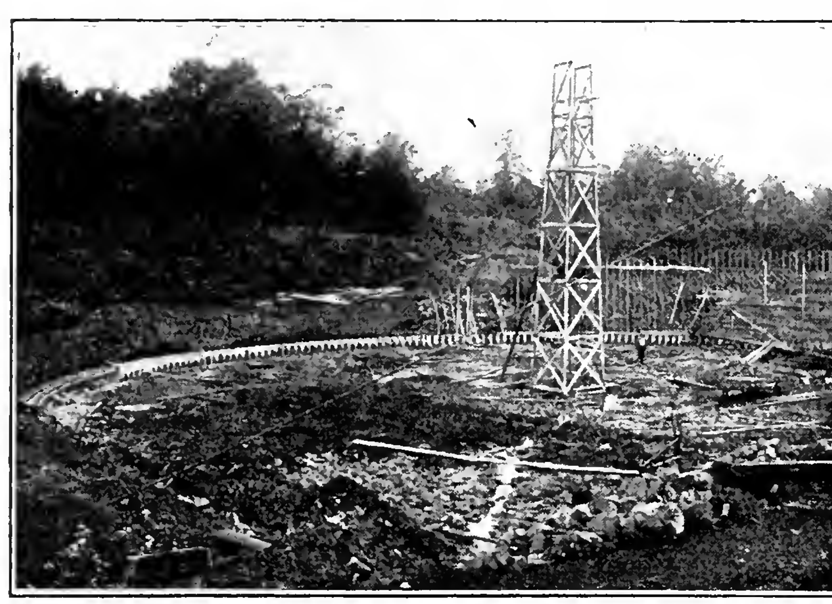
The combined aërator and mechanical mixing chamber is the special feature. The aërator, which is constructed of reinforced concrete, is formed in the roof of the circular mixing chamber. It is conical in shape, 16 ft. in diameter, and has a slope of 37½°. Water is discharged from a pipe rising just above the apex of the cone, and sprays down over the conical surface, in which are embedded a series of short angle irons which are set in such a way as to increase the splashing effect and to give the water a circular or spiral motion.

This additional length of travel not only gives a more complete mixing effect but considerably increases the contact period. The water falling over the edge of the conical surface flows into an inclined circular gutter or trough, to augment the circular motion as it passes into the water of the mixing chamber, which is located in the central compartment of the basin (see drawing). This arrangement, with the method of discharging the water from the chamber, creates a high velocity which gives a complete mechanical mixing of the coagulant, this being added in solution at the beginning of the operation. The contact period is from 16 to 24 min., depending upon the service demand. The water from the mixing chamber is delivered at or near the surface level in the second compartment, where a subsequent quick sedimentation is produced, due to complete distribution. Complete clarification takes place before the covered storage is reached. The chlorination treatment is provided for both before and after sedimentation and coagulation.

In the construction of the aërator, after the cone was cast and the angle irons were embedded in the concrete, the upper legs of the short angles were wrapped with wire and the entire surface was coated with a thin grout, to prevent oxidation and deterioration.

The cost of forms in the construction of the exterior reservoir wall was considerably reduced, and the placing of steel was facilitated, by the use of a series of concrete blocks that were cast in place radially and to an exact circle.

These blocks were entirely enveloped in the poured concrete and permitted the deposition of the concrete of the wall and footing section, which extended 2 ft. 4 in. outside and 6 ft. inside of the interior surface, at the same operation. Six per cent. of hydrated lime was added to the cement to increase plasticity in the depositing of the concrete for the outer wall. The usual tower method was used in placing the concrete, the mixture being chuted from the main tower to a central auxiliary tower from which continuous placing took place.



THIN CONCRETE FOOTING SLABS HOLD SUPPORT BARS AND FORMS

The entire work, including the pumping station at the lake and the transmission pipe line, was designed and constructed under the supervision of Charles H. Hurd, consulting engineer. R. J. Buck, of Mr. Hurd's staff, acted as resident engineer. D. E. Helfrich is superintendent of the plant.

Function of Corporate Contract Bonds—How Obtained

Great Care Must Be Exercised by Surety Companies in Issuing Them — Questions Asked by Bonding Companies — Many Rejections

By Harmon V. Swart
Specialist in Contract Bonds, New York City

A CONTRACT bond is a guarantee of the financial standing, moral integrity and practical ability of a contractor to perform the work which he contracts to do. It should, therefore, be seen easily that the many questions which the surety companies ask the contractor as to his standing are not idle. It is not a fact, as often stated, that any contractor can get bonds by paying the premium, but yearly large numbers are refused, and it is a mark of distinction to be able to procure one. With these facts in mind, an enumeration of the questions asked and the reasons therefor may aid in a better understanding of the time necessary to verify the contractor's answers, may induce him to make early application for his bond and so arrange his affairs that there will be no delays due to uncertainties as to his standing.

Years ago, during the early development of the contracting business, and before the days of such sizable contracts as a New York subway, a 2200-room hotel, a tunnel sewer running several miles, a cantonment, an industrial city, or a railroad tube under a great river, the contractor doing the work was not required to give a bond. The man who was having the work done knew the contractor personally, knew him to be honest and able to complete the work, and that was security enough. Later on, some sort of security was deemed necessary, and a personal bond was given by the contractor to guarantee that he would complete the work in the specified time and would do it according to the stipulations set forth in the specifications.

After experience proved that changes in the financial status of the contractor not infrequently made it difficult, if not impossible, to collect damages in the event of nonfulfillment of the contract, more dependable security for performance was found desirable. This brought into being companies organized under the banking and insurance laws, designed to furnish bonds for contractors to be given as a security or guarantee that their contracts would be performed in strict accordance with all agreements and stipulations. These bonds are called "corporate surety bonds"; they are commonly known as "corporate contract bonds."

Surety Company Assumes Real Responsibility

The companies themselves are known as bonding or surety companies and are required by the banking or insurance laws to carry and maintain unimpaired their capital and surplus, as well as a liquid reserve fund sufficient to pay any losses impending by reason of defaults of the contractors bonded. By issuing a contract bond, the surety company assumes a genuine responsibility, which makes it necessary for the surety to satisfy itself that the contractor is thoroughly reliable and abundantly able to execute the contract.

Because they overlook this necessity, many contractors, in obtaining their first bond, are inclined to feel that the surety company is entirely too inquisitive and too much inclined to ask questions intended to elicit information which, they feel, does not concern it and can have little or no bearing on the subject. The request for the information is neither idle nor foolishly inquisitive. Naturally, the underwriters, like all other busy men, care nothing about the financial standing and personal relations of any contractor, except in so far as this information is needed by them in judging whether or not he is a good or a hazardous risk. A dependable contractor, who has nothing in his record he needs to conceal, is perfectly willing to have his reputation and bank accounts thoroughly searched. Having been accepted after the rigid investigation that surety companies very properly make, he may well be proud that he is able to obtain contract bonds.

What the Surety Wants and Why

Surety companies ask from a contractor doing business as an individual sufficient pertinent information along certain lines to enable them to underwrite him; that is, to determine whether he is a proper man for whom they may, with reasonable safety, pledge their credit in the form of a bond to those with whom the contractor makes agreements. They ask the contractor how he has conducted his business in the past, in order to determine whether or not he takes advantage of every technicality in a contract and just keeps within its bounds and no more; or whether he is thoroughly conscientious and eager to do not only all the contract calls for, but possibly a little bit more, if necessary. They ask whether he has paid for material on note or invoice bases and whether he met payments promptly, because they want to know whether he is making wise use of his capital and borrowing capacity, or whether he is overreaching. The answer to this question has an obvious bearing on the question whether bonds should be issued for him. Financial embarrassment would be one of the first and surest causes of default on the part of the contractor.

The surety asks which type of subcontractors he employs, and the regard in which they hold him as a general contractor, in order to determine whether there is any likelihood of trouble arising between him and his subcontractors. It wants to know how he is regarded by architects, engineers and owners for whom he has done work, because such opinions afford valuable guidance, from an outside viewpoint, to his capacity and methods, both technical and business, and also to whether he is a man of his word, worthy of confidence and agreeable to deal with, or contentious, faultfinding and possessed of ability to deliver excuses rather than finished work. Similarly, the contractor's general reputation for honesty, integrity, reliability and dependability is inquired into. Why not? When you are asked to put your credit behind a man's promise to do something, it is natural to want to know something about the man who makes the promise.

Because the surety may become liable for the contractor's debts in case he defaults, it inquires as to his relations with banks on previous contracts; how his obligations were met; the line of credit that was extended by the bank and its inclinations as to future credit; as to his financial responsibility; cash in bank; whether he owns stocks and bonds and in which companies—whether old and established or new and unproved companies; as to any mortgages, and the property, and whether they are first or second mortgages. May the surety not also ask the contractor whether he

owns any real estate, and whether it is farm or city property, improved or not improved, income-producing or otherwise, free and clear of incumbrances and in his own name or in his wife's name? In some states the law prevents a wife from jeopardizing her property on behalf of her husband, so that property held in her name cannot well be considered an asset of the contractor.

Questions Regarding Equipment

After satisfying itself as to the character and financial responsibility of the contractor, the surety must also consider whether he is properly equipped to do the work and in a position to prosecute and expedite it. Hence, it asks full information as to plant and equipment and why it is suitable for the contract in question; the quantity of material on hand which is suitable for the contract in question; other contracts he has under way and their condition as regards completion; amounts of payments due and payable on work already under way, together with approximate due dates on future payments; whether any of these payments are assigned or tied up in any way by litigation, liens or differences of opinion. It needs particulars of each item.

For like reasons, it asks the amount of his loans from banks and other sources; the amount of accounts payable for materials and due to subcontractors for work under way or completed; a complete list of all other obligations, such as indorsements of notes, surety for others, etc.; whether the contractor has ever taken advantage of the bankruptcy laws; and, if so, it asks detailed information of the settlement with his creditors.

Is it not entirely natural and businesslike for one who is asked to assume financial responsibility for your debts to be interested in inquiries of this nature?

If the contractor is a corporation or a firm, the same lines of inquiry are pursued, also the assurance is required that each individual member of the corporation will back his company to the limit of his personal responsibility.

From this information a statement of assets and liabilities is made up, and, by a careful weighing of the value of the assets, a conservative net worth is shown. The balance of assets over liabilities must be real and based on sound assets in which slow assets and doubtful ones—such as equities in properties largely encumbered—are either disregarded or largely discounted. Apparent worth based on bookkeeping trial balances, until so analyzed and verified, carry little weight. The actual net worth is derived from real, available assets. Paper assets or slow assets that may have a financial value some day, if everything goes right and nothing untoward happens, receive little or no consideration.

Satisfied as to the contractor's financial responsibility, the board of underwriters then determines whether the contract on which a bond is sought is similar to the previous work handled by the contractor, or whether it is a line of work entirely or for the greater part new to him. Quite naturally, the surety company will issue a more substantial bond to a contractor doing familiar work, on which he has proved his ability, than on unfamiliar work where there is room to doubt his ability to handle it successfully.

For many years, contract bonds have been required on all municipal, county, state and Federal Government work, and it is fast becoming the custom to require the contractor to furnish a surety bond on private work of large volume. The latter condition seems to have created a misunderstanding on the part of some contractors, resulting in a mistaken belief that contract bonds are a necessary evil and are required only of contractors who are not financially and otherwise thoroughly reliable. As a matter of fact, a contract bond is a clean bill of health as to a contractor's financial and technical ability, his character, standing and record—a passport into the society of the elect. To be able to furnish such a bond is something of which the contractor has every reason to be extremely proud.

Moreover, the contractor who hesitates when asked to furnish a contract bond places himself immediately, and probably without realizing it, in the same category with the man who accepts as an insult any inquiry into his credit responsibility and refuses to buy, indulging the while the impulse of self-pity by fatuously declaring he will place his orders where his credit is good. Business and financial responsibility never shrinks from careful scrutiny, for the result of investigation is always additional good-will, an asset of the highest value. The contractor who fails to realize this is unwittingly doing himself a grave injustice; which, if inflicted by another, would be resented with no little zeal. A contract bond shows to the world that the acid test proves the contractor to be absolutely honest in action and intent as a man, thoroughly reliable and dependable as a contractor, and that he has the money to back up his reputation.

Contract Binds Owner Also

The contract bond also binds the owner, who is described in it as the obligee, to make payments at stated intervals in accordance with the terms of the contract, or run the risk of forfeiting the protection of the bond. The owner is ready and willing to carry out fully all his agreements, because the mere fact that the contractor is able to give bond is assurance that he has been looked up thoroughly, and his capability and responsibility have been verified from every possible angle—in short, he has been weighed in scales of minute accuracy and sensitiveness and found to be a plus unit, 100% pure.

There is still another point that should be cleared up in the minds of some contractors. No small number of them are not only under the impression that any contractor can get a bond by merely walking up and depositing the premium on the counter, but they fail utterly to take into consideration the element of time necessary to complete the transaction. I believe I have made it quite clear that every contractor cannot get a contract bond, but the realization that the matter cannot be unduly hurried is of equal importance.

From the kind of investigation made by surety companies and the reasons for it, given earlier in this article, it requires no great stretch of fancy to realize the importance that is placed on the answers made to inquiries; and, from the nature of the questions, it is equally easy to realize that a sufficient amount of time must be allowed to verify the information given. Here again the contractor suffers a self-inflicted injustice by not making application for the bond early enough, and thus lays himself open to the embarrass-

ment of having his application rejected. If contractors could be made to realize the large percentage of applications, from concerns of supposed good standing, that are rejected, they would allow more time for proper investigation, and fewer disappointments would result.

The best possible advice that can be given to the individual contractor is to "get his house in order," for in this period of reconstruction there will be an abundance of work for the man who is ready and able to take it.

The Engineer in Politics—By One Active Therein

W. A. Stinchcomb, Recent Candidate for Mayor of Cleveland, Explains Why Engineers Are Fitted for Solving Political Problems

ENGINEERS themselves are largely to blame for their present position and relatively inadequate compensation, according to W. A. Stinchcomb, county engineer of Cuyahoga County, Ohio, and recent candidate for mayor of Cleveland. In an address prepared for the recent meeting of the American Association of Engineers, reproduced below practically in full, he strongly advocates participation in politics both by the association as a body and by individual engineers. Even the problems of financing and taxation should be attacked by engineers, he asserts, because of their experience in the execution and organization of work on the basis of lowest unit costs, and engineers are urged to take a dominant part in civic life, not only as a right, but as a duty they owe to society. Mr. Stinchcomb said:

To say that the American Association of Engineers and its members shall not go into politics would be to deny to the country and the local communities within which the association has chapters the service of an organization of men who, by natural ability, by education, by training and by experience are most capable of serving the public and in directing and educating the voters on questions of public policy, and would deny to its members the fulfillment of their obligations as citizens of this republic.

Now, I know that a natural tendency exists among engineers not to take an active part in politics, but by this they evade their full responsibilities as citizens. Shall anyone say that the engineer's training and experience do not better fit him to solve the problems of government, as our civilization becomes more complex, than one trained in any of the other great professions?

Nature of Political Problems

In our cities practically all of our public problems are subject to scientific analysis. Is the subject one of developing the physical plan of the city, including the adequacy and location of its highways, the kind and strength of its pavements, the development of its parks and recreation facilities, the working out of proper drainage or the planning of its transportation facilities, either rail or water? Surely, the engineer is best qualified to solve such problems. He is now called on for advice in these matters, and in my opinion he should be the one to decide.

In matters of public health, as influenced by problems of sanitation such as sewage and garbage disposal, water-supply and building and housing regulations, he is best qualified. On questions affecting the control of public utilities such as transportation, electric or gas supply and telephone service, his engineering training best fits him to bargain with the trained mind representing the public-utility companies, and to know when the contract has been made that justice is done both public and service corporation.

As cities extend further into the realm of municipal ownership of these public utilities, the engineer's obligations to serve the public in an executive capacity increase.

Even in the welfare and social problems of the city his analytical training fits him to search out the cause of our social evils and ills, to relieve them rather than apply only palliative and preventive measures. Shall anyone say that he is less qualified to organize and direct the ordinary housekeeping affairs of a city because of his training and experience?

One of the most difficult and always present problems of all government is that of financing and taxation. It is the constant duty of the engineer in his practice so to design, execute and organize his work that in terms of unity cost that cost shall be as low as possible. All problems of public taxation must go back to a proper appraisal of the property taxed, whether that property be in a tangible or intangible form. Here again his experience and training fit him well to serve efficiently.

Our national government problems are best solved when the engineering mind influences their solution.

And so, in my opinion, the engineer should take a dominant part in politics, and this association as an organization should wield a forcible influence in determining the civic and governmental policies—not as a right only, but as an obligation which both the engineer and the association owe to society.

Political Activity Beneficial to the Association

"But," I hear some timid soul say, "what effect will that action have on the engineer and this assocation?" In my opinion, it cannot be anything but beneficial.

This convention has had its attention called to the inadequacy of the salaries paid engineers in public service. Various means will be discussed as to methods by which salaries may be properly and equitably increased. How better can this be done than by the members of this profession taking an active interest in the political questions of their communities?

We have noted the appointment of men fitted by neither education nor training to take charge of departments of public service which really require the services of the trained engineer. We have seen the engineer subordinated to such superiors. He has seemingly been content to let his "light shine under a bushel," and have the accomplishments of his brain and energy appropriated by those to whom they do not rightly belong. By a more active participation of the engineer in politics these injustices would be removed and credit would be bestowed where it rightfully belongs.

We have seen national organizations of other professions jealously guarding the business interests of the members of their professions. There is the national bar association and the various national organizations of the medical fraternity, whose efforts are used not only in maintaining a proper code of ethics in the profession, but in seeing that the members of that profession as a body are not discriminated against by the passage or operation of what they consider unjust laws. And so, in halls of legislatures their representatives are seen when measures affecting those professions are under discussion—and the professions referred to do not have to do with the public work of the state in any degree compared with the engineer.

It has always seemed to me that the engineer himself has been to blame for the position in which he is held by society and for the meagerness of the salaries paid by both public and private corporations for his services. He has been retiring in his nature, content in too large a degree to take his reward from the satisfaction growing out of difficult problems well solved and difficult work well performed.

We cannot in a democracy expect to maintain our Government for any length of time in advance of the intelligence of the voters. The intelligence of the voter is only expressed through the polls and is influenced by the kind of political education which the voter received. In elevating the standard of citizenship the engineer can and should be a leader in his community. To be anything less not only results generally to the disadvantage of the individual, but decidedly to the disadvantage of his profession, and is a direct evasion of the responsibilities of citizenship which his training and ability impose upon him.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Railway Development

EFFICIENT RAILWAY OPERATION—By Henry S. Haines, M. Am. Soc. C. E., M. Am. Soc. M. E., Formerly Vice-President and General Manager of the Plant System of Railroad and Steamship Lines; Also Commissioner of the Southern States Freight Association; Ex-President of the American Railway Association. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 709; illustrated. $4.

"Railway development" would seem a more appropriate title for this interesting book, since it deals only incidentally with railway operation—as this term is usually understood—but consists mainly of a summarized review of history and development and future prospects in the entire field of railway construction, equipment, organization and service.

Bridges, foundations, concrete, tunnels (ancient and modern), rails, track, signals, coal and water supply, freight yards, and passenger and freight stations, are covered in 100 pages. Locomotives, cars, brakes, couplers, car lighting and heating and various allied subjects occupy 100 pages. Traffic and transportation (100 pages) include accidents, train speed, train equipment, ticket and baggage methods, car interchange, tonnage rating, train resistance, dispatching and block system. Operation (34 pages) covers organization, personnel, engineering department and training for railway service.

Obviously, with such a wide and varied list of subjects in a limited space, the treatment touches mainly the high points and is necessarily incomplete in many respects. Some inaccuracies occur. For instance, the Belpaire boiler is attributed to France instead of to Belgium and is said to have radial stays, whereas its crown and top sheets are flat and the radial-stay boiler is an American type. Comparison of railway and water transportation is hardly illumined by the statement that a freight train "can" make the round trip from Buffalo to New York in five days while a barge "requires" six weeks. Probably the train does not make such trips, while the barge time includes waiting for a return cargo. Certainly, even a barge "can" make the trip in less than six weeks.

Special mention may be made of the 50-page chapter on military transportation, an unusual subject of direct interest at this time. It begins with the achievements of Xerxes the Persian, but gives considerable attention to the Civil War, modern foreign wars and the great war of 1914-1918. The material is somewhat disappointing in that it deals largely with specific events and operations and, although it gives a mass of miscellaneous information, it has comparatively little about principles, methods or systems of organization. In fact, this chapter, like many of the others, is suggestive or informative rather than instructive, although it is highly interesting.

One fundamental principle that is brought out is that while there should be close correlation between the military and the railway organizations, the latter should be in direct control of the transportation service between the points designated by the former. Where military officers are permitted to control train movements there is sure to be confusion and congestion. This has been proved in many instances, including our own very recent experiences. A more technical work on this subject would be of value to both military and railway authorities.

Electric traction appears to find little favor with the author, and he sees little prospect of extensive development for either main lines or interurban lines. Rather pessimistically, he seems to view the jitney motor car as a possible serious competitor of suburban lines, but a considerable part of his chapter on motive power deals with electric locomotives and service. Appendixes covering 165 pages include a variety of statistics, together with rail specifications, and lists of tunnels, yards and large terminals; also regulations for military railway organization. A bibliography, an index and lists of railways and persons mentioned cover 50 pages.

The above notice of this book is intended as explanatory of its scope and character rather than as a critical review. It is a pleasure to add that the book is written in an attractive and interesting manner, and that it includes a wealth of information that can hardly be indicated within the space here available. With the exception of some diagrams and rail sections there are no illustrations, but they are not needed and would add little to the value of the book.

Walker's Building Estimator's Book

THE BUILDING ESTIMATOR'S REFERENCE BOOK—By Frank R. Walker, Author of "Practical Cost Keeping for Contractors." Third Edition. Chicago, Ill.: Frank R. Walker Co. Leather; 5 x 7 in.; not consecutively paged. Illustrated. $10, including 12 monthly supplements.

The earlier editions of this work were reviewed in *Engineering Record* of Jan. 1, 1916, in *Engineering News* of Feb. 17, 1916, and *Engineering News-Record* of Sept. 20, 1917. Changes in the present edition consist of detail revisions to bring practice up to date. Furthermore, the author announces that hereafter there will be issued to purchasers of the book a monthly supplement, which will carry new unit prices as they develop during the reconstruction period. Assuming the user's ability to adjust other costs to his own problem, the book continues to be a valuable aid to the building estimator.

Highway Handbook Much Enlarged

HANDBOOK FOR HIGHWAY ENGINEERS: Containing Information Ordinarily Used in the Design and Construction of Rural Highways—By Wilson G. Harger, C.E., and Edmund A. Bonney, Supervising Engineer, N. Y. State Department of Highways. Third Edition. New York: McGraw-Hill Book Co. London: Hill Publishing Co., Ltd. Limp binding; 4 x 7 in.; pp. 986; illustrated. $4.

The first and second editions of this handbook were reviewed in *Engineering Record* of Sept. 28, 1912, and Sept. 2, 1916, and in *Engineering News* of Jan. 16, 1913, and Oct. 19, 1916, respectively. The present or third edition contains about 350 pages of new material. Chapters have been added on mountain sections for roads; earth, sand-clay and gravel roads; preliminary investigations; and photography, camp equipment, and camp

medicines. The subject of specifications has been much enlarged. In fact, additions have been made to practically all the chapters. Although the author still draws numerous examples and standards from practice in the New York State Highway Department, the criticism that the original book was too local in character has been largely removed by the addition of material taken from reliable sources of information from Maine to California and Alaska. An evident effort has been made to bring the book up to date and to cover all phases of design and construction.

Vital Statistics Made Easy

VITAL STATISTICS: An Introduction to the Science of Demography—By George Chandler Whipple, Professor of Sanitary Engineering in Harvard University Member of the Public Health Council, Massachusetts State Department of Health. New York John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible Cover; 5 x 7 in.; pp. 517; illustrated. $4.

Designed primarily for public health students, this volume promises to be of wide usefulness to health officers and sanitary engineers as well as in the classroom. The theory and practice of vital statistics are clearly and interestingly presented, with many useful observations on statistical presentation and the use of graphical methods in general. Enumeration and registration of population, population forecasts, the calculation of death and other rates used in vital statistics, and the other phases of the subject are taken up. The discussion extends to expectancy tables and the law of probabilities. Apt citations, with historical and statistical data, are given. The use of thin paper, flexible covers and a medium-sized page places the volume among the handiest of the many almost indispensable handbooks of the day.

More Efficient Municipal Government

A NEW MUNICIPAL PROGRAM—Edited by Clinton Rogers Woodruff New York and London: D. Appleton & Co. Cloth; 5 x 8 in; pp. 392. $2.25.

EXPERTS IN CITY GOVERNMENT—By Edward A. Fitzpatrick, Ph.D., Director, Society for the Promotion of Training for Public Service. Editor, "The Public Servant." Natoinal Municipal League Series. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 363; illustrated. $2.25.

The present century has brought marked betterment in municipal government. In hundreds of cities the old, cumbersome system of checks and balances, with its divided responsibility, has given way to a simple form of centralized responsibility in which the value of trained permanent public servants is recognized. In over a hundred cities still more progress has been made through centralization of responsibility in a single executive officer and by a fuller recognition of the value of expert service. The first of the two volumes under consideration, "The New Municipal Program," is devoted to the principles of city government as embodied in the commission-manager plan. The second deals primarily with the need for experts in city administration, how to get them and how to keep them.

Each volume is a work of collaboration. The "Program" is the more concrete of the two, because it embodies and contains supporting arguments for a model city charter of the commission-manager type, something based on the experience of scores of cities during the past few years. The volume on "Experts in City Government" is, perforce, largely academic. It seems rather discursive—if not excursive into fields that are not very closely related.

Chapters in the "Program" that may be specifically mentioned are "Experts in Municipal Government," by A. L. Lowell, president of Harvard University; "Civil Service and Efficiency," by W. D. Foulke; "Franchise Policy," by Delos F. Wilcox, formerly with the New York Public Service Commission and later deputy commissioner of water-supply, New York City; and "City Planning," by M. N. Baker, associate editor of *Engineering News-Record.*

President Lowell, Mr. Foulke and Mr. Wilcox also contribute to the volume on "Experts," and there are also many other contributors, including M. L. Cooke, formerly director of public works of Philadelphia; Charles A. Beard, director of the New York Training School for Public Service, and W. H. Allen, director of the Institute for Public Service. These and other contributors deal with the subject of municipal experts from a variety of viewpoints.

Both volumes deserve the attention of engineers in or in close contact with municipal or other branches of Government service.

Against Government Ownership

GOVERNMENT OWNERSHIP OF PUBLIC UTILITIES IN the United States—By Leon Cammen, M.A., Associate Editor of the *Journal of the American Society of Mechanical Engineers;* Member, New York Academy of Sciences, Etc. New York: McDevitt-Wilson's. Cloth; 6 x 9 in.; pp. 142. $1.50.

Perhaps no gloomier view of what would happen to this country were government ownership of utilities to come has ever been written than is presented in this volume. All other industries, according to the author, would come under government ownership with or following utility ownership. Not merely democratic institutions, but their very spirit would give place to "an autocracy of central government." Our 48 states would become "simple electral [sic] districts." Our great corporations would be forced into politics by government ownership. There would be a reinforcement of "the sinister cohorts of enemy and Bolshevist propaganda." It is some comfort to learn that the author does not mean to imply that advocates of government ownership intend to bring all these evils on the country.

For the most part, the author confines his discussion to railways. He marshals many arguments against their being taken over by the Government. Most of them merit consideration, but some of them seem to be aimed at men of straw. Toward the end the author proposes a regional scheme of private ownership under Federal control. The book seems to be an honest and earnest attempt to save the country from the disaster which the author believes would result from government ownership—a condition that seems more remote than when the book was written a few months ago.

Pollution of Boundary Waters

POLLUTION OF BOUNDARY WATERS REFERENCE: Final Report of the International Joint Commission, Washington-Ottawa. Washington, D. C.: The Commission. Paper; 7 x 10 in.; pp. 56.

POLLUTION OF BOUNDARY WATERS: Report of the Consulting Sanitary Engineer upon Remedial Measures, Mar. 8, 1916. International Joint Commission. Washington, D. C.: The Commission. Paper; 9 x 12 in.; pp. 159; illustrated.

After six years of consideration, the joint commission created to consider the pollution of the boundary waters of Canada and the United States rendered its report last August. The report (summarized in *Engineering News-Record* of Oct. 10, 1918, p. 660), has just appeared in printed form. It is accompanied by a large supplementary report, dated Mar. 8, 1916, by Earle B.

Phelps, consulting sanitary engineer, giving the results of detailed engineering studies and estimates for sewage-treatment plants at communities on the Detroit and St. Clair Rivers, made under Mr. Phelps' direction by H. C. McRae, district engineer, and I. P. Kane, assistant engineer, and like studies for places on the Niagara River by F. C. Tolles, district engineer. The final report is notable for its conclusions that no untreated sewage should be discharged into boundary waters; that the claim of use of these waters for sewage dilution is well founded; and that where city water-supplies are concerned the degree of sewage treatment should be calculated so as not to overload water-treatment plants. A tentative standard is set up, based on recommendations made by the advisory engineers to the commission, George W. Fuller, Mr. Phelps, Prof. George C. Whipple, W. S. Lea, T. J. Lafrenière and F. A. Dallyn.

Canadian Electric Light and Power Plants

ELECTRIC GENERATION AND DISTRIBUTION IN CANADA—By Leo. G. Denis, B.Sc., E.E., Hydro-Electric Engineer, Canadian Commission of Conservation. Ottawa, Can.: The Commission. Paper; 7 x 10 in.; pp. 296; illustrated.

After a brief general summary, the electric supply of each city and town of Canada is described textually, the municipalities being arranged alphabetically by provinces. In addition, there are tabular summaries of power plants, transmission lines, consumption and rates, capacity, ownership, prime movers and generators, load, service, etc., and transmission lines and distribution. The textual descriptions of power plants give much information in small compass. The volume is a credit to all concerned in its preparation. A similar one for the United States would be welcome.

New Monthly Technical Journal Appears

Starting with May, a new technical journal, devoted to highway engineering and contracting, has appeared under the name of *Highway Engineer and Contractor*. It is published monthly (Chicago: International & Trade Press; $2 per year). The initial issue contains articles covering the general highway situation, highway design, highway contracts, selection of materials, maintenance, and cost of roads.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES by the Slope Deflection Method—By W. M. Wilson, Assistant Professor of Civil Engineering, F. E. Richart, Instructor in Theoretical and Applied Mechanics, and Camillo Weiss, Instructor in Structural Engineering. University of Illinois. Urbana, Ill.: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 218; illustrated.

LES APPLICATIONS DE LA PHYSIQUE PENDANT LA Guerre—Par H. Vigneron, Paris, France: Masson et Cie, Editeurs. Paper; 5 x 8 in.; pp. 322; illustrated. 7 fr. net.

CLAY-WORKING INDUSTRIES AND BUILDING OPERATIONS in the Larger Cities in 1917 (Mineral Resources of the United States—Part II, pp. 521-582)—By Jefferson Middleton. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 61.

EFFECT OF CURING CONDITION ON THE WEAR AND Strength of Concrete—By Duff A. Abrams, Professor in Charge of Structural Materials Research Laboratory, Lewis Institute. Chicago, Ill.: The Institute. Paper; 6 x 9 in.; pp. 32; illustrated.

THE ENERGY RESOURCES OF THE UNITED STATES: A Field for Reconstruction—By Chester G. Gilbert and Joseph E. Pogue of the Division of Mineral Technology, U. S. National Museum. (The Mineral Industries of the United States.) U. S. National Museum, Smithsonian Institution. Washington, D. C. The Institution. Paper; 6 x 9 in.; pp. 165; illustrated.

THE EVAPORATION AND CONCENTRATION OF WATERS Associated with Petroleum and Natural Gas—By R. Van A. Mills and Roger C. Wells. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 104; illustrated. 20c. from Superintendent of Documents.

FOREIGN COMMERCE AND NAVIGATION OF THE UNITED States, 1918—Washington, D. C.; Bureau of Foreign and Domestic Commerce. Cloth; 9 x 12 in.; pp. 1031. $1.50 from Superintendent of Documents.

ILLINOIS MINING STATUTES ANNOTATED: Including all Illinois Mining Laws—By J. W. Thompson. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 594. 35c. from Superintendent of Documents.

THE GOLD SITUATION, Oct. 30, 1918—Report of a Joint Committee Appointed from the Bureau of Mines and the United States Geological Survey by the Secretary of the Interior—Washington, D. C.: Bureau of Mines, Department of the Interior. Paper; 6 x 9 in.; illustrated. 15c. from Superintendent of Documents.

INDUSTRIAL HEALTH AND EFFICIENCY: Final Report of the British Health of Munition Workers' Committee—Washington, D. C.: U. S. Department of Labor. Paper; 6 x 9 in.; pp. 374; illustrated. 35c. from Superintendent of Documents.

INTERNATIONAL ASSOCIATION OF INDUSTRIAL ACCIDENT BOARDS AND COMMISSIONS: Proceedings of the Fourth Annual Meeting, Aug. 21-25, 1917. Washington, D. C.: U. S. Department of Labor. Paper; 6 x 9 in.; pp. 306; illustrated. 30c. from Superintendent of Documents.

THE MEASUREMENT OF RAINFALL AND SNOW—By Robert E. Horton, Consulting Engineer, Albany, N. Y. Reprinted from *Journal of the New England Water-Works Association*, Vol. XXXIII, No. 1. Albany, N. Y.: The Author. Paper; 6 x 9 in.; pp. 71; illustrated.

A valuable review of methods of measuring precipitation from the earliest historical records up to the present day, by an engineer who has given the subject long and careful attention.

THE NENANA COAL FIELD, ALASKA—By G. C. Martin, Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 54; illustrated.

NEW YORK STATE CONSERVATION COMMISSION: Sixth Annual Report, 1916. Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 464; illustrated.

NUEVOS METODOS DE CALCULOS DEL HORMIGON ARmado—Por Aurelio Sandoval y Garcia, Professor de la Universidad de la Habana. Segunda Edicion. Habana, Cuba: The Author. Paper; 7 x 10 in.; pp. 11; illustrated.

PROBLEM OF REFUSE COLLECTION IN THE CITY OF ROCHESTER, N. Y.: Report Submitted to the Mayor and to the Commissioner of Public Works. Rochester, N. Y.: Rochester Bureau of Municipal Research, Inc. Paper; 6 x 9 in.; pp. 102, with appendixes; illustrated.

Gives results of a detailed study, with statistical tables, made by Carl C. Cooman, assistant engineer, under the direction of James W. Routh, then chief engineer and now director of the bureau named above.

PROVINCIAL HIGHWAYS BOARD: First Report, Mar. 1 to Dec. 31, 1918. Halifax, N. S.: The Board. Paper; 6 x 9 in.; pp. 195; illustrated.

A complete report of the status of roadbuilding in Nova Scotia from the time of organizing the Provincial Highway Board to date. Describes types of road and bridges used and gives detailed accounts of expenditures.

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE United States Coast and Geodetic Survey in 1918—By Daniel L. Hazard, Chief of the Division of the Terrestrial Magnetism. Washington, D. C.: U. S. Coast and Geodetic Survey. Paper; 6 x 9 in.; pp. 32. 5c. from Superintendent of Documents.

RULING GRADIENTS AND THE MINOR DETAILS OF ALIGNment: Calculations for Railways Projected in Burma—By C. Richards, Chief Engineer with the Simla Railway Board, Simla, India: The Author. Paper; 8 x 13 in.; pp. 54.

RURAL HOME SANITATION—By V. M. Ehlers and Louva G. Lenert, Sanitary Engineers. Texas State Board of Health. Austin, Texas: The Board. Paper; 6 x 9 in.; pp. 39; illustrated.

SANITARY OPERATIONS IN THE MISSISSIPPI COASTAL District: Final Report by the Mississippi State Board of Health and the United States Public Health Service, 1918-19; With Recommendations for the Permanent Continuation of the Work—By Leslie C. Frank, Associate Sanitary Engineer (Reserve), Director of Sanitation, Mississippi Coastal District. Gulfport, Miss.: The District. Paper; 6 x 9 in.; pp. 31; illustrated.

Besides Mr. Frank, there were four other sanitary engineers, a surveyor, a sanitary inspector, two physicians and a malarial microscopist on this work. The district embraced three counties and a large amount of ditching and oiling was done. Ditching cost figures are given.

THIRD INDUSTRIAL SAFETY CONGRESS OF NEW YORK State: Proceedings Held Under the Auspices of the State Industrial Commission, John Mitchell, Chairman. Albany, N. Y.: The Bureau of Statistics and Information. Paper; 6 x 9 in.; pp. 225.

TREATMENT OF INDUSTRIAL PROBLEMS BY CONSTRUCtive Methods—Washington, D. C.: U. S. Department of Labor. Paper; 6 x 9 in.; pp. 12.

WATER LAWS OF THE STATE OF OREGON: Compiled from Lord's Oregon Laws and Session Laws of 1911-13-15-17-19; Prepared in the Office of the State Water Board, Salem, Oregon, and Published by Authority of the Legislature of Oregon. Salem, Ore.: State Water Board. Paper; 6 x 9 in.; pp. 64.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Value of Engineering in Public Life

Sir—It is evident that your effort to arouse the engineer to his full sense of civic responsibility is whole-hearted. It is equally evident that you have entire confidence in his ability properly to function in public life, and you are to be commended for the endeavor to inspire him with the necessary self-confidence to undertake his important position in relation to his fellow men.

But in your enthusiasm it seems that at times you become somewhat radical. As I read some of your editorials it would seem that the engineer by temperament and training is peculiarly and particularly fitted better to function under most circumstances than the man of any other profession.

Now, I am an engineer. I believe in engineers. And I am in full accord with your sincere efforts to raise the standards of the profession and to arouse in the engineer a full sense of his civic duty and full confidence in his own ability. But I cannot believe he would prove a cure-all for every ailment of our political, economic, or social structure, nor can I believe he would prove most efficient in every position of responsibility or in every circumstance. Engineers, like men of every other profession, have limitations. But I think that I understand your point of view in regard to this and other matters. *Engineering News-Record* is edited by engineers for engineers. It is, therefore, but natural that you should exhibit some professional prejudice, as I choose to term it. Also, it is undoubtedly necessary to be somewhat overenthusiastic upon a particular object in order to have the desired influence upon a class of men who are inclined to be overmodest and ultraconservative. I believe, however, that a tendency might in time prove to develop into a hobby.

ENGINEER.

West Webster, N. Y.

Engineering Training Fits Men for Various Opportunities

Sir—I have just completed reading your issue of May 29, 1919, and on p. 1075 note two interesting references to an article in a recent number written by a young man expressing his doubts of a future in the engineering field being sufficiently remunerative to warrant his preliminary effort and expense in fitting himself with a technical education.

May I voice a thought which comes from my personal experience and which seems to be universal among men with whom I have talked on the subject; namely, that a technical education as a foundation fits a man to any job of ordinary proportions and demands, makes him flexible to meet and qualify in the countless opportunities that come preliminary and preparatory to the great big opportunity that becomes that man's lifework.

Since graduating from college in 1909 I have suffered and enjoyed a varied experience, which in the main has been a commercializing of my technical training. I found in the early days of this experience that if I followed the field career my results would be mediocre and my end untimely, and with a view to the future looked about for some means of capitalizing my engineering education. I became a sales-engineer and trust that my present employers consider me such today. At any rate I am supervising a district sales organization whose effort is directed along the lines of sales-engineering service to the field—or, better still, engineering-sales service, for the advisory engineering service comes first in all cases. The men in this organization are, with a few exceptions, technically and practically trained engineers, and I am frank to say receive a monthly stipend considerably in excess of the $160 obtained by Lucien Alter as a laborer. These men are all in the early and middle thirties, with families of varying dimensions, and I know of two that receive flattering dividend checks from investments made on past surplus bank accounts.

There are vast opportunities for the technically trained man, and I sincerely hope that Mr. Alter will read this article and if any further inspiration is needed will be glad to give him some personal history by correspondence.

WILLIAM S. MILLER,
District Manager, the Lakewood Engineering Company, Cleveland Branch Office.

Cleveland, Ohio.

Salary Schedule Proposed for Railway Engineers and Draftsmen

Sir—In view of the considerable discussion concerning economic and social phases of the life of engineers and draftsmen and the attempts to better the situation generally, it may be of interest to state that representatives of the International Federation of Engineers' and Draftsmen's Unions received a hearing at Washington by the Board of Railroad Wages and Working Conditions of the United States Railroad Administration, May 12-13. In behalf of engineering and architectural employees in all branches of railroad service, both in field and office, a brief was presented to the board, and testimony was given concerning its subject matter. This brief embodied four principal suggestions considered to be of prime importance, and requested their adoption by the board in recommendations to the Director General of Railroads.

One of these was the request that in case the widely rumored reduction of forces should occur (it *has* already begun) a system of pro-rata furloughs should be instituted, to affect all employees who are classed as permanent; making it possible for many men to tide over emergency periods and for some to use their off time to find permanent locations elsewhere. These latter would naturally be taken from the rolls and thus automatically reduce the pro-rata lay-off for the remainder. When this method was suggested in our organization for the shipyard draftsmen, it was approved by them almost without exception as being preferable either to flat discharge or practically enforced acceptance of lower ratings.

A further request was for the establishment of regulatory committees, to be composed of the more responsible technical supervisors and representatives of the managing officials. Such committees, by applying the schedule and budget principle to work which is to cover

somewhat lengthy periods, could greatly reduce the tendency of railroad work to go by fits and starts, and be of great value in breaking the disrupting force of periods of financial depression. The fact that projected railroad construction and the men at work on it usually feel the first effects in times of stringency hardly needs repeating, but the fact of continual danger in breaking up field and office organizations and throwing the men into the market, to compete against and undercut those left at work anywhere in the country, warrants frequent repetition.

Any abrupt and continued cessation of plan-making by engineers and architects is bound to have results reaching far out into labor and business fields.

The third point of the brief was the creation of office committees, similar to those in many industries, which will put into operation the classification of technical employees and the standardization of their positions, so far as these objects may be accomplished. It was suggested that machinery be adopted for this purpose similar to that instituted by the Macy board in the private and Government shipyards. In this way matters of classification and the adjustment of differences are taken up with supervisors and department heads or managing officials, and in rare cases, of special difficulty, with a regional examiner appointed by the board.

And, finally, there was presented the following salary schedule which we feel is very moderate and which is a minimum scale of monthly pay:

Chief draftsman	$300.00
Leading draftsman or squad-man	250.00
Draftsman, Class A	210.00
Draftsman, Class B	175.00
Draftsman, Class C	135.00
Tracer, Class A	125.00
Tracer, Class B	75.00
Assistant engineer (or engineer-inspector)	250.00
Assistant inspector, Class A	200.00
Assistant inspector, Class B	150.00
Instrumentman	210.00
Rodman, Class A	175.00
Rodman, Class B	150.00
Tapeman, Class A	125.00
Tapeman, Class B	100.00

Regular hours to be 7½ hours on five days of the week and four hours on Saturday, making 41½ hours per week; no overtime except where absolutely necessary, and at the option of the employees, and time and one-half for all overtime ordered or made necessary. All traveling and other expenses incurred for railroad business, and also expenses attached to moving headquarters, should be allowed. Civil service rules should apply regarding vacation, holiday and sick leaves. No salaries now in existence are to be reduced. This schedule is slightly lower than that of the Macy board award to marine draftsmen, and it is certainly small when compared with the more than 100% increase in living costs in the past five years.

The publication of the full record of this hearing, and also of a previous hearing of representatives of the American Association of Engineers, is contemplated by the International Federation of Engineers' and Draftsmen's Unions. It may be news to many of your readers that 28 locals were represented in the convention of our international in New York on Apr. 1. The president and secretary, respectively, of this federation are A. J. Oliver and A. H. Miller; the address of the latter is American Federation of Labor Building, Washington, D. C.

T. S. FORD,
Chairman, Publicity Committee, Draftsmen's and Designers' Union, Local 14.
Chicago.

Are Services Paid What They Are Worth?

Sir—I was surprised and just a little shocked to note the attitude expressed in the letter written by the president of the Rensselaer Polytechnic Institute, as printed in your issue of May 29, 1919, p. 1075. I certainly wish to take issue with his statement that "services, in the long run, receive the payment that they are worth." An advertisement in the *Literary Digest*, in its appeal for increased salaries for school teachers, but which holds good for engineers as well, contains the following:

> The men and women who are making the Americans of tomorrow are being treated with less consideration than the janitors who sweep out the buildings in which they are employed; they are earning on the average less than the wages given to scrubwomen employed in the public buildings of the United States Government. Normal-school graduates receive less salary than street sweepers; high-school principals and superintendents less than section foremen; country school teachers less for instructing the farmers' children than he pays his hired man to feed the hogs.
>
> In a certain town of Illinois, for instance, the average wage of 15 miners for one month was $217, while the average monthly salary of 15 teachers in the same town was $55. In another town a miner—who, by the way, was an enemy alien—drew more than $2700 last year, while the salary of the high school principal in the same town was $765. We welcome with all our hearts the long-belated recognition that is being given to the man who works with his hands. We believe that this same workingman will be the first to join with us in asking better pay for those who teach his children.

Unless the teachers of this country are not worth a living wage it would appear that Palmer C. Ricketts is clearly mistaken when he states that "services, in the long run, receive the payment that they are worth." That remark belongs to the class of commonly accepted generalities usually found, upon analysis, to have so many exceptions as to bear little relation to the facts. The basic idea that services should be paid what they are worth is far from being universally accepted as a general principle.

Bear in mind that $1500 per year provides bare subsistence at present-day prices for an average family of five, and that $2100 is required to maintain "security and citizenship level," according to a recent Federal wage inquiry. What does the average salary of thousands of ordinary engineers look like? Not members of the American Society, or presidents, managers, and chief engineers of corporations, but just average engineers?

Consider these instances: Railroad engineer, 13 years' experience, in charge of construction, $135 per month; four assistant engineers have salaries ranging from $96 to $124 per month, and from 3 to 17 years' experience. *On the same job*: Steam-shovel engineers, $200 per month; contractors' chief clerk, $150; team foreman, $150; fireman, $125.

On another job an assistant engineer, a graduate of exceptional ability, supervising the activities of several squads of survey parties, received $35 per week. One of his rodmen, 18 years of age, earning $20 per week, was given the job of carpenter foreman at $65 per week, *although totally inexperienced!* The chief engineer on this several million dollar construction job received $75 per week.

If engineers are being paid all that they are worth, and this amounts, as it does in so many instances, to less than is required to live decently, there should be only one of two courses open: Either teach engineers to earn more, or else get along without them.

I believe that most men who are in engineering are in the game because they love it. They have no longings for "royal salaries," and are really willing to devote their lives to service to humanity, but, first of all, they have to live to do it. How can engineers make progress when they cannot afford to buy the books and magazines which are necessary? What sort of work can we expect from the engineer with righteous discontent in his heart because he knows his family is suffering hardships while others producing much less receive a great deal more? Certainly, the engineer deserves a little more than the average mechanic or common laborer, if only because of the extra expenses due to societies and studies that will enable him to learn better methods and thus render higher and better service beneficial to all mankind.

Until our intellectual leaders become sufficiently progressive to advocate methods making for social justice, and a fair opportunity for everyone, there will always be a fertile ground in which Bolshevism or some similar symptom of economic protest may develop. America is far from being free from the taint of it.

The only positive remedy is *more production, more equitable distribution*, and the *elimination of unemployment*. The time and motion study of the industrial engineer, the social economist, the welfare worker, big business, labor, all thinking men, can, through intelligent coöperation, achieve in the short period of ten years any reasonable economic ideals. The misfortune is that our intellectual leaders dismiss such thoughts as these with the epithet of "paternalism," and our radicals cry that they are opposed to the spirit of democracy, or anarchy, or socialism, or unionism, or whatever cause they may happen to espouse, while misery, disease, and poverty remain at liberty to choose their victims.

E. N. GOLDSTINE,
Junior Member, Am. Soc. C. E.

Terre Haute, Ind.

Sir—In your issue of May 29, 1919, p. 1075, you print two letters commenting on a letter to you signed by one Lucien Alter. I feel somewhat presumptuous in taking issue with either the president of Rensselaer Polytechnic Institute or a man like Mr. Stierlin with his long years of experience. I shall have at them both, however, for I believe that both, while they sense in a vague way the undercurrent of unrest which is disturbing our profession, have either missed entirely or deliberately ignored the conditions which are causing it.

First, Mr. Ricketts: I feel sure that when one takes into consideration the dollars actually spent and the dollars a man could have earned if employed productively during the time he was busy at college, one would not be far from the truth in setting the expense of a college education at \$1500 a year.

The engineering education does not pay in money. It is an intangible something that seems to be part and parcel of the profession, a hope for the future and a certain measure of the idealism and professional pride which keep us in engineering work. This is particularly true of the young man—not the graduate of a year or two, but the man from five to ten years out of school.

What is a fair wage for such a man? Certainly, he has a right to expect to be able to support his wife and children decently. There are those who dare as far as a wife, but I maintain that the thought of possible children is a nightmare to most young engineers of my acquaintance.

Now, Mr. Stierlin: This gentleman writes of the very things I mentioned above. The idealism keeps us at our work, but it is the despised dollar that pays the butcher and baker—the fellow citizen for whom we are to create useful things. We aim not at an estate to leave behind us, but at a chance to live a full life cleanly and honestly, to pay our bills and look every man in the eye.

I feel certain that these gentlemen have written hastily. Do they know that local engineering clubs and societies the country over are affiliating with the American Federation of Labor? If they know that, do they realize what that means to our future professional life? Has either of them really endeavored to get first-hand information of social and economic conditions in the profession outside of the little section that comes under his personal observation?

I would commend to them the American Association of Engineers, which is spending time and money to seek out and cure the ills we suffer from as a profession. Knowledge of them may be had for the asking. The discontent is widespread and not at all confined to surveyors and draftsmen; even if it were, they are our engineers of tomorrow.

Let us not disagree among ourselves; that way lie confusion and defeat. Let us rather find the right solution by careful investigation, and then work together to bring about the better days. ERNEST R. TAYLOR.

Cleveland, Ohio.

Sir—It is evident from a letter appearing in your issue of May 29, 1919, p. 1075, that Palmer C. Ricketts, president of Rensselaer Polytechnic Institute, is greatly concerned over the effects that discussions relative to the compensation received by engineers, lately appearing in your journal, might have upon prospective students of the profession. This letter refers to a previous one published in your issue of May 8, 1919, p. 931, which is worthy of closer reading than that apparently given it by President Ricketts. In this connection, I desire to point out that young Alter did not state that he intended to spend \$1500 a year to obtain an engineering training, but spoke about an investment of \$1500 per annum, an entirely different matter.

I happened to be in Dayton last summer and came in frequent contact with young Alter, and it was I who gave him the estimate of the investment necessary to obtain an engineering education. After consultation of the catalogs of a great number of engineering schools, it was found that the average cost of one year's training would amount to about \$1000. To this was added \$500, the savings of a section hand for a period of ten months, at \$4 per day, thus making a total investment of \$1500 per annum. This figure (\$1000) agrees very closely with an estimate given by a member of the American Society of Civil Engineers in *Engineering News-Record* of Jan. 23, 1919, p. 201, and it is quite proper, in figuring the total investment in one year's education, to add to the amount that would actually be spent the amount that could have been saved had the student been engaged in manual labor.

President Ricketts also states that "the complaining letters are most frequently written by surveyors and draftsmen," but I find, in going over the files of *Engi-*

neering News-Record since Jan. 1, 1919, letters pertaining to the compensation received by engineers from the following: A member of the Am. Soc. C. E., a consulting engineer, a dean of an engineering college, a chief city engineer, a European student doing post graduate work in America; an employer of engineers; and a senior civil engineer in the Bureau of Valuation. In fact, only a few letters were written by draftsmen, and those pertained to the dispute with the Navy Department.

It is true that a young engineer is self-supporting from the start and through hard work "need not let the laborer pass him in the running." The remarkable thing is not that the engineer can hold his own and in the end pass the laborer, but that the laborer gives the engineer so good a race. It is almost unbelievable that the compensation paid for following the greatest of all professions is comparable with that received by a section hand.

In his comparison of engineering with the other professions, Professor Ricketts fails to see that while a doctor, dentist or lawyer can look forward to the time when he will have a practice of his own, over 90% of the engineering profession are forever doomed to work for someone else, by the inherent relation of the engineer to industry. That those at the bottom of the profession receive all they are worth is a subject open to much controversy; and that those at the top receive large compensation is not always true, unless they happen to be part owners of large corporations, in which case their large incomes are not the results of professional services rendered, but are the profits of business men. But what about the great bulk of the engineering profession who neither are at the very bottom nor yet have reached the top? What about the great multitude of assistant engineers, chief draftsmen, designers, detailers and checkers?

That a laborer remains a laborer is generally true, but that faithful service and hard work are invariably rewarded by adequate compensation is by no means the rule of the engineering trade. If it were, why should we see such phenomenal growth of an organization such as the American Association of Engineers, composed of men who rank from chief engineer down to the most humble draftsman, or the spectacle of those distinguished engineers and scientists employed by the Bureau of Standards affiliating with the American Federation of Labor, under the leadership of Dr. Edward B. Rosa? From my own experience, I know of assistant engineers employed by the Pennsylvania system, who were only earning $150 per month after 14 years of faithful service, while first assistants on the engineering corps were receiving $85 or perhaps $90 after 10 years. I worked under a chief draftsman of the bridge department of a large transcontinental line who only received $150 per month, and under another who was a graduate of a famous European university, and who after 12 years' bridge-engineering experience in America was getting the miserable pittance of $125 per month! Surely, these men are not mere draftsmen.

Engineering is essentially a question of service, and the engineer is, above all, an idealist. He is not in the profession for what he can get out of the world for himself, but for what he can put into it for others. However, this is no reason why he should be expected to support a wife and raise a family on $175 per month, which I find to be the average pay of the average engineering position. Surely, if the chief engineer of the Bureau of Public Roads can give up a big position to accept a smaller one for $1000 more a year, a prospective engineer has a right to inquire into the monetary remuneration he might receive from his profession, without being classed as a materialist. That engineering does not pay in the monetary sense, at least at the present time, is a fact to be attested by the sad experience of many. I do not wish to entice a youngster into the study of engineering under the pretext that it is a remunerative profession. Let him enter with his eyes open and realize that engineering is a "service that sweats for glory, not for meed." EDMUND FELDMAN.

Jefferson City, Mo.

Sir—Palmer C. Ricketts, in your issue of May 29, 1919, p. 1075, has answered the "invidious remarks" made by a young man concerning the opportunities for making money offered in engineering. He thinks that similar comments which have appeared in *Engineering News-Record* may have a serious effect on young readers who contemplate becoming engineers, and he makes a very positive assertion that an engineering education "pays in money if in no other way."

The trouble is that it usually pays in some *other* way. To illustrate this point we have Mr. Stierlin's letter on the same page with Mr. Ricketts', assuring us that to the real engineer the creation of things useful to mankind is compensation enough in itself, irrespective of worldly prosperity.

Historians or psychologists should make an investigation to discover who it was, or what it is, that is responsible for this suicidal conceit of the engineering profession. Others besides engineers create things useful to mankind, but few donate their services to society, or allow any discount for a laudable satisfaction to themselves from work well done.

Very little experience is required to disclose the fact that subordinate positions in engineering do not entail work so congenial, interesting and agreeable as to compensate for relatively inadequate salaries. It is precisely the pay for subordinate positions, drafting and surveying included, which has given rise to complaint. To what extent the promise of future highly remunerative positions can be considered compensation is a question deserving careful consideration. Some employers deliberately overemphasize this subject of future reward, but this despicable practice is by no means confined to engineering.

At least three factors should be considered before a proper appraisal can be made of Mr. Ricketts' remark that if a man "is able and continues to work very hard he is sure to rise in his profession and be well paid." How little pay can he afford to begin with? How long can he afford to make his apprenticeship? How certain can he be that his industry and ability will finally receive proper recognition?

Mr. Ricketts says, "the cold fact remains, that services in the long run receive the payment they are worth." If this means that all occupations are paid equitably in proportion to the effort involved, or the importance to the community, he is the first to announce that such an ideal state of society has been achieved. Mr. Ricketts does not mean this, and he does not mean that engineers' services (except young graduates') *now* receive the pay-

ment they are worth, or he would probably say so. What he does mean is not at once apparent.

Engineering News-Record has performed no greater service during the past few years than it has rendered by presenting to its readers a free discussion of this question of compensation for the rank and file of engineers. The law of supply and demand may "take care" of the common surveyor's pay and the pay of the ordinary draftsman, but the supply of young men whose ignorance of the situation with regard to engineering salaries is their best excuse for choosing this profession will certainly diminish when true conditions are understood.

It is unfortunate that in his letter Mr. Alter (he of the "invidious remarks") does not more clearly define the issue. He makes it seem that he is discussing the choice of becoming an unskilled laborer or an engineer, and Mr. Ricketts is led to remark that "the laborer generally has to remain a laborer," and has evidently taken it for granted that this is the only question involved. The real issue, for Mr. Alter and for most other young men who would contemplate becoming engineers, is not such a choice as this, which would easily be made. Properly interpreted, Mr. Alter's letter asks this question: If professional engineers after seven or eight years' apprenticeship (including four years in college) are not paid as much as common laborers, would common sense not indicate that it is wiser to choose some other profession, or some other line of business? There are others besides Mr. Alter who are asking this question.

JEROME FEE,
Assistant Engineer, Bay Cities Water Company
Coyote, Calif.

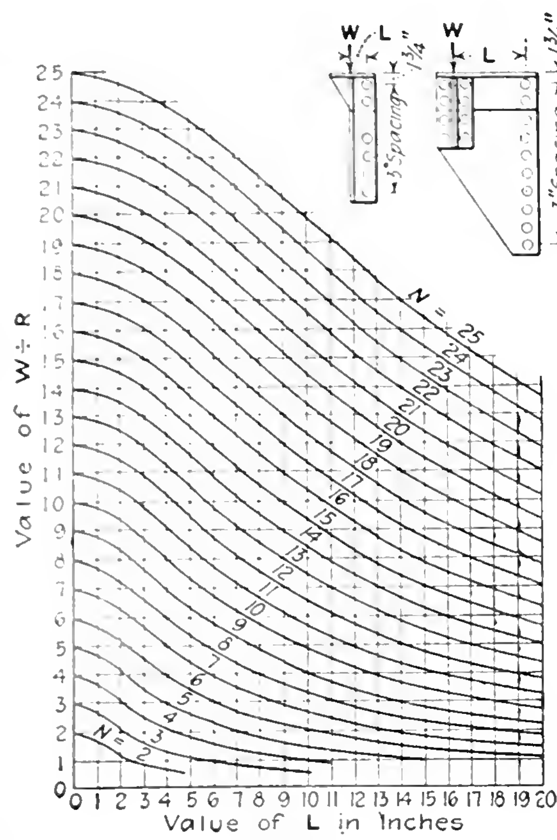


FIG. 1

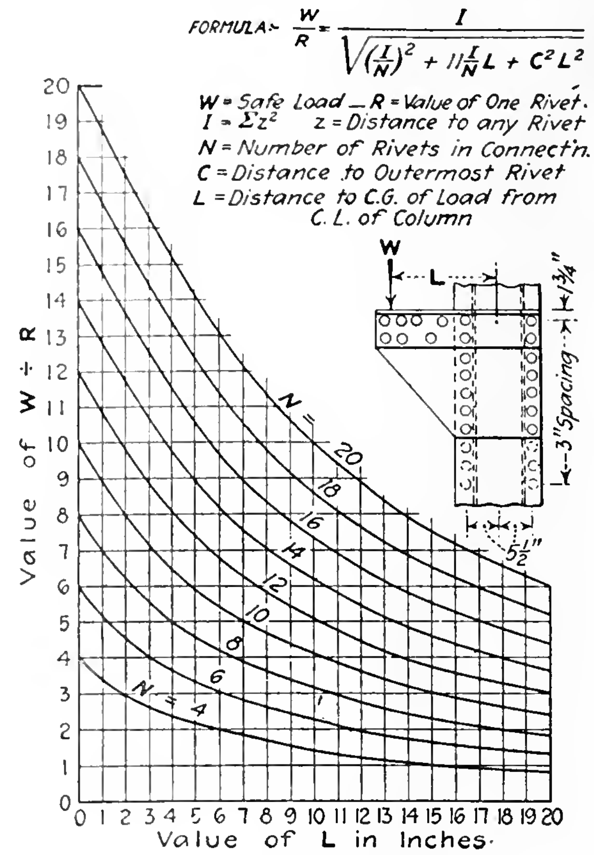


FIG. 2

DIAGRAMS FOR FINDING SAFE ECCENTRIC LOADS ON GUSSETS

Diagrams for Safe Bracket Loads

Sir—The accompanying diagrams for the safe load on gussets or brackets connected with one or two lines of rivets with 3-in. spacing have saved a lot of time and computation in our office. The method of using is probably self-evident. For spacing other than 3-in. the safe load is approximately proportional to the spacing, and for connections with a double line of rivets, where the distance between the center lines is between 10 and 12 in., the safe load is practically the same as for the 11-in. spacing given.

As an example, consider a two-line rivet connection as in Fig. 2, with 14 rivets of ⅞-in. diameter. To find the safe load W at a distance L of 8 in. from the center line: Find intersection of curve $N = 14$ with the vertical line 8 and trace horizontally to $W/R = 7$. Then, since the value of one rivet $R = 4400$ lb., the safe load $W = 7 \times 4400 = 30{,}800$ pounds.

Similarly, to find the size of the gusset connection required to carry a load of 25,000 lb. at 12 in. from center of column, using ⅞-in. rivets: $R = 6000$, and $W/R = 25{,}000/6000 = 4.17$; then, in Fig. 2, find 4.17 on left-hand scale, follow longitudinally to the vertical line for $L = 12$, and the intersection lies just below the curve $N = 12$. Hence a 12-rivet gusset is required.

The single-line rivet diagram, Fig. 1, is used in precisely the same manner.

Chicago, Ill. F. W. SEIDENSTICKER.

Water Hammer in Penstocks as Affecting Economy of Design

Sir—It seems to the writer that the penstock designer should specify the time of closing, T, before asking for bids on turbines or valves, rather than run the risk of a manufacturer's limit of T causing the use of tons of extra steel in the penstock. The designer can readily do this, since all the quantities except T in the following formula must be known even in a preliminary hydro-electric investigation. The term a, the velocity of vibration along the penstock, may accurately enough be taken at 2600 ft. per second, while h should be taken as a certain percentage of the maximum static head in feet, depending on the good judgment of the designer for its value. We have

$$T = \frac{\frac{LV}{h} + \frac{gL}{a}}{g} \text{ or approximately } T = \frac{L}{g}\left(\frac{V}{h} + 0.012\right)$$

in which

T = Time of closing of gate, in seconds.
L = Length of penstock, in feet.
V = Velocity of water in penstock, in feet per second, corresponding to Q. (Q is discharge in cubic feet per second before gate starts to close.)
h = Head due to water-hammer alone (in excess of static head) in feet.
g = Acceleration of gravity = 32.2 ft. per second.
a = Velocity of vibration along penstock, in feet per second.

The foregoing formula was obtained by solving for T in the equation $h = \frac{LV}{g\,(T - \frac{L}{a})}$ for ordinary water-hammer (T greater than $\frac{2L}{a}$), derived by Minton M. Warren in the "Transactions" of the American Society of Civil Engineers for 1915.

The justification for assuming the velocity of vibration equal to 2600 ft. per second and for thus making $g/a = 0.012$ in the above formula is that the value of T is not appreciably affected by even a few hundred feet or error in the value of a. V/h is readily determined with accuracy and since, in ordinary penstocks, it is several times greater than g/a, there is little use of wasting time in the computation of a value for a, at least during preliminary work.

However, unless a fairly accurate value of T is obtained by using the above formula, any preliminary estimate of the cost of a penstock may be greatly in error since, when T is less than $2L/a$, or when the closing is instantaneous, the stress due to water-hammer may become several times that due to the maximum static head.

It is customary to look into the most important things even in preliminary work, and the writer is inclined to believe that little attention is paid to the value of T until too late in the progress of many hydro-electric investigations.

Elmhurst, L. I. AUSTIN H. REEVES.

[Comments on Mr. Reeves' letter by Robert E. Horton, consulting engineer, and on both letters by Allan V. Garratt, of the Lombard Governor Co., follow.—EDITOR.]

Sir—There seems to me to be much more to the determination of the proper time of gate closing for turbines than appears from Mr. Reeves' letter. Considerations of economy of penstock construction do not wholly govern the time. The suddenness of load changes, the amount of fly-wheel effort in the rotating parts, the use or nonuse of surge tanks or pressure relief valves, and the allowable percentage of speed variation, must be taken into account in fixing the time of gate operation.

Albany, N. Y. ROBERT E. HORTON.

Sir—1. I have read with much interest the letters from Austin H. Reeves and Robert E. Horton.

2. The transposition of Minton M. Warren's formula, as suggested by Mr. Reeves, is interesting. It is in a little different form from that often employed by the present writer, which is

$$T = \frac{L\,V}{h\,g} + \frac{L}{a}; \qquad \text{(a)}$$

or, again, I sometimes write

$$T = V\left(\frac{L}{h\,g}\right) + \frac{L}{a}, \qquad \text{(b)}$$

which is very convenient for slide-rule work where you are chasing permissible values of V.

3. Mr. Reeves states that h "should be taken as a percentage of the maximum head." Has he not, in this, conveyed a different impression from what he intended, which may mislead some? If the static head is 50 ft., and it is intended that the pressure wave head shall be 100% of the static head, it must be used in Mr. Reeves' formula as 50, not 100.

4. Mr. Reeves' thesis, if I understand it aright, is that the designer of a penstock shall arbitrarily assume a value of h "depending upon his good judgment for its value," and then solve for T, and let it go at that, designing the thickness of the walls of the penstock on a convenient value of V and the sum of the static head which obtains and the value of h which he assumes on "his good judgment." It would seem that the above method leaves out of consideration some matters which will loom large when it comes to operating the plant; and the present writer is inclined to lean toward the opinion expressed by Mr. Horton that "the value of T cannot be determined from considerations of economy of penstock construction."

5. Perhaps the present writer's viewpoint may be made more clear by discussing an actual example: Let us assume a penstock 1000 ft. long, 10 ft. in diameter, with the water moving at a maximum velocity of 10 ft. per second, and with a static head of 50 feet.

6. By Mr. Reeves' method we should calculate the time, in seconds, less than which the water column should not be stopped, as follows:

$$T = \frac{\frac{1000 \times 10}{50} + \frac{32.2 \times 1000}{2600}}{32.2} = 6.6 \text{ seconds.} \qquad \text{(c)}$$

7. But, how about this 6.6 sec.? If the penstock is designed on that basis it is evident that the water-wheel gates must not be closed in a shorter interval of time. Now, with the full power that may be developed by this water column—which will be discussed later—it will be impossible to obtain a speed regulation, under commercial conditions, which will be tolerated by the electrical engineers of the plant, unless so large a fly-wheel effect is installed as to be very costly on a horizontal unit, and not only very costly, but also almost impossible to install, on a vertical unit.

8. Moreover, it should be remembered that there is absolutely no way of insuring that T may not be very much less than 6.6 sec. Some turbine gates are of such design that if liberated from control they will slam shut in a surprisingly short time. The critical time of a penstock, or that period of time of arresting the water column at which, or below which, the maximum pressure wave will occur is

$$T = \frac{2L}{a}; \text{ in our example, } \frac{2 \times 1000}{2600} = .769 \text{ second,} \qquad \text{(d)}$$

and the maximum pressure wave (for a rigid penstock) is

$$h = \frac{a\,V}{g}, \text{ or in our example, } \frac{2600 \times 10}{32.2} = 0.807 \text{ ft. head.} \qquad \text{(e)}$$

In practice it would be something less than that, depending upon the thickness and elasticity of the penstock walls, but the point I wish to make is that in our example the total head on the penstock, if the water-wheel gates slammed shut in 0.769 sec. or less, would approach 50 ft. static head plus 807 ft. wave-pressure head, a total of approximately 857 feet-head.

9. The supposition in the previous paragraph is by no means chimerical or fantastic. Just such an accident, resulting in the bursting of a wheel case and the flooding of the power house, very recently occurred in the Clinton dam power house of the Metropolitan waterworks in Massachusetts. The attendant lost control of the water-wheel gates in shifting from governor control to hand control. The wheel case was a perfectly good

one, and the ruptured iron was of ample thickness for normal conditions, and showed no flaw. If the wheel case had not let go, the penstock would have done so. It is always possible for the connections between the governor and the gate rigging to break, or for an attendant to lose control of the gates, resulting in a very rapid closure of the water-wheel gates. In the above plant the same operation of shifting from governor control to hand control had been performed safely for years, but at last the unexpected happened.

10. Where the penstock is long, is it not more conservative to provide means whereby the total pressure may be limited to a safe value rather than to rely upon predetermined arbitrary values of T and h which may not obtain under accidental conditions?

11. We should not forget that our penstock is full of water in motion. The water weighs 4,908,000 lb. When moving at a velocity of 10 ft. per second it contains 13,860 hp.-sec. of kinetic energy. This energy is a very real thing. You cannot destroy it. If you stop the water column you have got to expend this energy somewhere. There is only one place where it will be expended, and that is upon the water wheel. Even the small amount of this energy which will be expended in compressing the water and in stretching the penstock walls will very quickly reappear as power in the water wheel.

12. Our water column will develop, through a turbine of 80% efficiency, 3570 hp. If you throw off that amount of load from the turbine you have got to stop the water column as quickly as is feasible, otherwise the turbine will run away. But you are not only throwing off 3570 hp., of load, but at the same time you are supplying the turbine with 13,860 hp.-sec. of energy in addition to its rated capacity under normal head. How about the speed regulation under these conditions? It may be argued that the water column will not be completely arrested. Perhaps so; but that would only minimize the above troubles somewhat. To calculate it here would be beyond the scope of this letter, and would not modify the general argument.

13. Again, if you suddenly throw on a load of 3570 hp., with the water column at rest, the accelerating water has got to develop 13,860 hp.-sec. of energy upon itself before the water wheel can develop full power. If the turbine gates were opened wide instantly, the water column, starting from at rest, would acquire 10 ft. velocity in 6.2 sec., or, if starting from a velocity of 2 ft. per second (which might be velocity at friction load), in 5 sec. We cannot, of course, open the gates instantly. Here we are up against regulation and fly-wheel difficulties again, if the plant is to be subject to large and sudden load changes.

14. It begins to look like a surge-tank and fly-wheel proposition. The commercial load changes which will occur, the speed regulation which will be tolerated, and the permissible investment in surge-tank and fly-wheel effect, must all receive very careful consideration before the time of turbine-gate closure or opening (which may very well be different) can be established.

15. Possibly, therefore, we cannot establish the proper value of T from a simple formula based on V and h which may, perhaps, become of relatively small importance in comparison with more weighty matters.

16. But it must not be argued from the above facts that Mr. Reeves' formula is not valuable. It is valuable, very valuable, but chiefly to calculate quickly what not to do, rather than what to do. If engineers of design would make this formula, in the various forms in which it appears in this discussion, their familiar working tools, the engineers who provide turbines, generators and auxiliary apparatus would not so often be plunged in despair by "specified penstocks."

Ashland, Mass. **ALLAN V. GARRATT.**

Hard-Surface Road Specifications of the State of Illinois

Sir—In *Engineering News-Record* of May 8, 1919, p. 905, Clifford Older, chief highway engineer, Department of Public Works and Buildings, Illinois, outlines the adoption by the State of Illinois, as a basis for all its rigid surfacings, of a standard concrete slab 7 in. at the side and 8 in. at the center, for 16- to 18-ft. widths, and states that "the only other types considered suitable for the primary road system of Illinois are monolithic brick and bituminous concrete on a concrete base."

Is it possible that the great State of Illinois is retrograding so far from modern designs and constructions as to overlook the absolutely established supremacy of reinforced concrete over plain concrete?

The writer quotes from the article in question:

"It is fundamental that the load-supporting capacity of a rigid pavement is dependent upon its transverse strength, and its transverse strength is measured by its thickness and the modulus of rupture of the material of which the surface in tension is composed."

The modulus of rupture or the transverse fiber strength of *concrete*, which is the material in question, we know is of far less importance than the crushing strength. In fact, it is practically about one-eighth of the latter, and, for this reason, a reinforcement in the bottom of the slab has been introduced to make the modulus of rupture in tension at least equal to the crushing strength; by this means a far thinner and more elastic and resilient body is produced, with great economic results.

According to the conclusions of committee No. 9 of the National Conference on Concrete Roads, 1914, concrete highways are subject to the following six causes of failure or unnecessary deterioration: (1) Changes in temperature; (2) variations in the percentage of moisture in the concrete; (3) defective foundation; (4) improper drainage; (5) insufficient thickness of slab to carry the traffic; (6) faulty construction.

Then follows: "It is necessary, therefore, in a pavement properly designed and constructed, to minimize the cracks resulting from the above causes, by embedding a reinforcement in the concrete, which will so distribute the tensile stresses as to prevent formation of larger cracks."

The same committee further recommends, in general, that all reinforcement should be about 0.1%, which, in the 1916 conference, was further specified.

As an example of the efficiency of such construction, the writer will refer to H. B. Bushnell's article in *Engineering Record* of Mar. 24, 1917, p. 464, as follows: "Twelfth Street, Cook County, Illinois, east of Hillsdale, presents a striking example of the settlement of a rigid pavement laid on a yielding subgrade. At this point the road extends through a slough for 600 ft., and the maximum settlement at the time the last levels

were taken (after 16 months) was 1.74 in. It still is in a very good condition." This concrete was of course reinforced.

The experimental concrete roadways built at Riverbank, Calif., in 1912, have also amply proved the superiority of reinforced-concrete roads after seven years' service. The experience with the concrete roads in Wayne County, Michigan, Owosso, Mich., Iron River, Mich., Davenport, Iowa, Oakland, Calif., and scores of other locations, furthermore, is, as everybody knows, entirely in favor of reinforcement.

While the writer would use a reinforcement of 0.2% per foot width of a slab, we will compare the cost of adding 0.1% of reinforcing fabric to a 6-in. slab with the cost of an additional 2-in. thickness or an 8-in. slab, as follows: $0.1\% \times 6 \times 12 = 0.072$ sq. in. or, say, A. S. & W. Co. No. 068 weighing 35 lb. per 100 feet. At 5c. per pound, laid, this means $9 \times 0.35 \times 5 = 15\frac{3}{4}$c. per square yard of pavement or base laid in position. Two inches of concrete per square yard will cost not less than

$$\frac{2}{12} \times \frac{6.75}{27} \times 9 = 37\tfrac{1}{2}\text{c. per square yard.}$$

And as to the comparison of strength and resiliency between a 6-in. reinforced slab and an 8-in. plain concrete slab, there can be no doubt. Furthermore, the reinforced-concrete base or slab meets, to a large extent, *all* the six causes for failure laid down by the National Conference on Concrete Road Building, while the plain slab meets none.

H. W. Skidmore's article, "Defects in Surface of Bituminous Pavement Due to Concrete Base," in *Engineering News-Record* of May 1, 1919, p. 878, also criticizes the cement-concrete base and suggests "a bituminous-concrete base rather than a rigid one." Why not a thinner, richer, but reinforced-concrete base?

What can possibly induce engineers of the highest standing in highway engineering to ignore all precedents absolutely, as well as one of the most important improvements in building construction?

E. LEE HEIDENREICH,
Kansas City, Mo. Consulting Engineer.

Sir—I have read with much interest the article by Clifford Older, chief highway engineer of Illinois, on "Illinois Adopts a Uniform Basis of Design for All Types of Rigid Pavement," in your issue of May 8. The article is carefully written, and the position of the author gives his opinion great weight. If his premises are accepted as being the fundamental ones to be used in the design of a pavement, his logic cannot be disputed. It would seem, however, that he ignores some phases of the problem which, if fully taken into consideration, might modify the conclusions.

Mr. Older states first, "it is not the primary function of rigid pavements to span soft spots in the sub-grade." He also says, "it is fundamental that the load-supporting capacity of a rigid pavement is dependent upon its transverse strength." The first statement is not open to debate, but the second opens up a field of discussion. A logical formula based on the second assumption is developed, which is used to determine the thickness of the pavement. In other words, the pavement is designed not for its primary function, but for an incidental condition.

The soundness for this conclusion is the one questioned. A pavement is being designed, not a framed structure. Probably Mr. Older and the other able engineers who have concurred in his conclusions had other sound reasons for adopting as a standard the 8-in. ½-, 7-in. concrete slab, but these reasons are not set forth, and it would seem questionable whether the structural theory should be the sole basis for determining the thickness of foundations for all types of rigid pavements.

The thought which occurs after study of the article is that it attempts to cure a defect by covering it up rather than by eradicating the cause. Logically, if later experience shows that the 8-in. concrete is not enough, the thickness must be increased to 9, 10 or 11 in. Just as logically, the redesign of a bridge failure would only require that the members be made heavier. Such a course would excite only derision.

The items entering into the construction of a road are material and labor. The material in the case of a concrete roadway consists of sand, cement, stone and water. The labor consists of grading, ditching and mixing the concrete. The labor of transportation is really a material item, and may so be regarded. In an average job, labor consists of 50% and material of 50% of the cost of the completed work. In a mile of average 18-ft. pavement costing $27,000, the material and its manufacture into the road will represent two-thirds of the total. Each additional inch of concrete will amount to not less than $2500, or from 9 to 10% of the total.

This sum, or a part of it, spent on the labor of more completely preparing the road for its wearing surface, would work wonders. It would provide for 10,000 lin. ft. of drain tile in place, the deepening of the side ditches, the raising of shallow fills amounting to an average of 1 ft. for an eighth of a mile. In designing drainage for city pavements, the total cost rarely amounts to more than 15 or 20% of the cost of the improvement. This includes cement jointed pipe laid at considerable depths, of large size (in place of side ditches) many catchbasins and manholes and, frequently, rather lengthy outlets. It is certainly to be doubted that similarly adequate drainage for a country road would increase the total cost more than 5%, taking into consideration the amount of drainage which it is now customary to provide.

It seems to me that the money spent in this way will go farther toward making a first-class heavy-traffic highway than increasing the thickness of the concrete. Rarely in my experience have failures been caused by lack of depth of the foundation. Even when apparently so, investigation has shown some other primary reason, generally faults in the drainage, but often, also, because of careless mixing of concrete. Our materials are usually first-class, but labor items do not come up to the same standard. For this reason the adoption of the mechanical type of tamper is a long step in advance, and, of itself, reduces the necessity for increasing the thickness of the slab.

Mr. Older, it would appear, passes rather lightly over the necessity for wider roadway widths with the statement that, as a great number of heavy trucks will monopolize the roads, they must be thicker. If the traffic is so heavy, should not the question of greater widths receive more thought? True, a 4-ft. wider pavement would cost considerably more than a 1-in. increase in the thickness, but ordinary traffic is entitled to consideration. Because of heavy traffic and

inadequate revenue, the City of Chicago has for some years imposed a wheel tax, graduated on the size of the vehicle. Should not some such form of tax be equitably assessed on traffic of the kind he has in mind, thus creating a fund to be applied toward the correction of the evil? A highway on which the traffic is so heavy that the pavement requires 10 in. of foundation certainly needs a wide roadway, and would justify almost any expenditure for drainage. How many asphalt city pavements in our heaviest-traffic streets in our largest cities have such a foundation? States St. in Chicago has not, and it has teemed with heavy-truck traffic on an asphalt wearing surface for the past 15 years.

In this discussion much has necessarily been ignored, but the main thought has been to show that as far as the published reasons are concerned, sufficient data have not been submitted to justify the increase in the standard thickness of the concrete, in preference to other methods which may be suggested. A rather cursory study would also seem to indicate that other types of pavement suffer by the Illinois decision, which was not the intention of the department, I feel sure.

Chicago, Ill. PAUL E. GREEN.

[The foregoing letters were submitted to Mr. Older for comment, and his reply to the letters follows.—EDITOR.]

Sir—I have read carefully the accompanying letters commenting on my article on pavement design. E. L. Heidenreich criticizes the design because no reinforcing steel is used. For flexural effect it would be necessary to use such steel in both top and bottom of the slab, as both positive and negative moments occur in every road slab. The negative moment is particularly important adjacent to cracks or joints and the edges of the slab. Even in heavily reinforced pavements built by this department cracks were not avoided. The amount of steel recommended by Mr. Heidenreich would have but little effect so far as increasing the flexural strength is concerned.

The total maintenance cost of concrete and brick slabs from two to six years old in Illinois, including the maintenance of cracks, has not yet reached $40 per mile per year; nor is the maintenance cost of the oldest roads greater than those more recently constructed. Illinois has for years been a leader in the use of reinforced-concrete bridges, and the use of steel in roads has been carefully considered and experimental reinforced sections built, but the use of this material has not been deemed of sufficient benefit in reducing the first cost or maintenance cost, to justify the additional expense.

I am thoroughly in accord with Mr. Green's remarks concerning drainage. The importance of proper drainage cannot be overestimated. The design of the concrete slab adopted by the Mississippi Valley Association of State Highway Departments was, however, considered by the association as being that necessary to support the expected loads on a subgrade drained as thoroughly as a justifiable expenditure will permit. This matter, of course, represents the judgment of the engineers who adopted the design, based on their observation and study rather than upon any theoretical consideration.

In this connection, it should be held in mind that many states, Illinois, included, at the present writing, have absolutely no provisions restricting concentration of loads on their highways.

I also agree with Mr. Green that where the traffic is heavy, wide pavements would largely eliminate the necessity of traffic following distinct lines. The law providing for a bond-issue system of roads in Illinois, however, provides for a maximum width of 18 ft., and, having been approved by the people, is not only irrepealable but cannot be altered in any particular.

CLIFFORD OLDER.

Chief Highway Engineer, Department of Public Works and Buildings.

Springfield, Ill.

Concrete Coating for Steel Floor-Beams To Prevent Corrosion

Sir—In looking over your issue of May 29, I was very much interested in the article on "Scrapping Tons of Good Highway Bridge Metal Because of Local Corrosion." While, at first thought, it seems that the officials in charge of highway maintenance, who, as a rule are not trained engineers, are responsible for not keeping the steelwork properly protected with paint, yet we all know the unfortunate tendency in connection with public work to praise the official who spends whatever money his local board may allow him on the parts of the highway which show, rather than spend it on getting at and cleaning up inaccessible points. The neglect of these, after all is said and done, will not appear for five or ten years after the commissioner is out of office. Such being the case, would it not be wise, both from the engineer's standpoint and also from the standpoint of public economy, to coat the floor-beams thoroughly, and also all parts of highway bridges which are not easily accessible, with concrete? The first cost would be a trifle more, but the saving in expense of cleaning and painting would more than counterbalance this additional first cost, to say nothing of the greatly increased life of the bridge which it would give.

This matter, I understand, is receiving considerable thought from some of the railroad officials, and might, with considerable advantage, be adopted in connection with all road work. There are, of course, cases where this simple protection has been tried with unsatisfactory results, but in these cases the dropping of the concrete was undoubtedly due to faulty details of construction, rather than to any internal weakness in this system of bridge preservation.

I have not endeavored to go into the above in a technical way at all but simply wish to bring up the question, which is very important but of which one, nevertheless, hears very little. A. B. TAPPEN,

New York City. Mitchell-Tappen Company.

Why Not "The Profession of Engineering"?

Sir—In your issue of May 29, 1919, p. 1079, T. L. Condron, chairman of the license committee, Engineering Council, gives a definition of "professional engineering." While the definition in itself seems to meet the requirements of the case, the term "professional engineering" is decidedly objectionable. Why not substitute therefor "the profession of engineering," and begin the definition thus: "The profession of engineering embraces . . . ?" W. CHASE THOMSON,

Montreal, Can. Consulting Engineer.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Pipelaying Cost Is Influenced by Many Conditions on Each Job

CONSTRUCTION cost is influenced by so many local factors that each job must be considered in the light of its own conditions, according to a paper presented at the meeting of the Iowa Section of the American Water Works Association by W. A. Judd, superintendent of water-works at Mason City, Iowa.

For instance, in the laying of a one-half mile stretch of 10-in. pipe in good clay in 1915, the cost of pipelaying was only 5c. per foot, due partly to the fact that the ditch stood up well, and 500 to 600 ft. per day could be laid. Another job in the same year was scattered in short pieces, laying 6-in. pipe at intersections preparatory to paving. Here the cost was 7c. per foot, but excavation prices were lower on account of cooler weather and consequent higher labor efficiency.

On two jobs of laying 8-in. pipe in sandy clay, with an experienced gang in the first case and an inexperienced gang in the second, the costs were 32 and 40c. per yard for excavation, 13 and 16c. per yard for backfilling, and 3.7 and 7.7c. per foot for pipelaying. Weather and soil conditions influence such work, as is shown by records of 6-in. pipe laid behind a trenching machine. One job in wet, sticky clay cost 8.9c. per foot, bracing being needed close behind the machine, while with more favorable weather conditions on a similar job the cost was 6.4c. In good clay and with favorable weather the cost was 4c., but with the best weather of all the jobs, in a sandy trench, the cost was reduced to 3.2c. per foot.

For laying 6-in. pipe on all jobs during 1918 the average cost was 8½c. per foot, this reasonable rate, Mr. Judd explained, being due to the old and dependable emergency gang. On the other hand, earth excavation ranged from 42 to 66c. per yard, as compared with 32 to 40c. in previous years. In 1915 and 1916 labor was plentiful at 22½c. per hour. In 1914 and 1918 it was scarce at any price, and part of the time there was only the emergency crew of five men.

Other Articles in This Issue of Interest to Contractors:

Methods of Shifting Pontoons for Walking Dragline Excavators

By Albert S. Fry

Morgan Engineering Company, Memphis, Tenn.

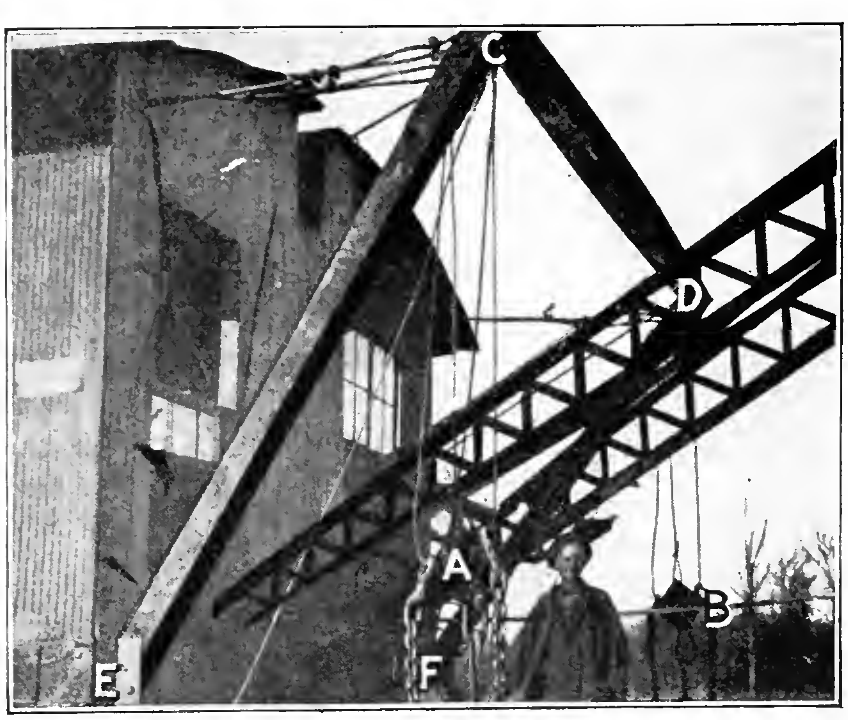
TWO successful methods of handling pontoons for walking dragline excavators were developed in the levee work for the Inter-River Drainage District in Missouri. Four excavators are being operated by the Callahan Construction Co., with J. W. Radford as foreman. The pontoons are 6 x 30 ft., and are built of 3 x 14-in. timbers.

The simpler method of shifting is to hook one end of the pontoon directly onto the bucket bridle. In this case, near one end of the pontoon there is a chain with a hook to be hooked to the bucket bridle. By the hoisting of the bucket the pontoon is raised from the ground, the machine is revolved, the drag cable tightened and the hoist line slacked until the pontoon is maneuvered into position on the opposite side of the machine. In shoving the pontoon up against the last one placed, the edge of the bucket is sometimes brought against the pontoon after it is unhooked and is resting on the ground.

The bucket is hauled in to the machine which pushes the pontoon up tightly against the last one. This practice is looked on with disfavor, however, as the bucket edge tends to damage the pontoon. Although a bit hard on the hoist cable, this method of handling pontoons is rapid and efficient.

An inclined gallows frame on the dragline is an essential feature of the second method. When this method is employed each pontoon is fitted with a U-bolt at each of its four corners.

Two blocks, which are shown herewith at A and B in the illustration, are triple-hitched to hoist cables which pass through sheaves at C and D, thence down to blocks at E and F and thence to a junction with each other in a common hook about midway between E and F. To lift a pontoon, bridle chains from A and B are hooked into the U-bolts. Then the common hook of the two hoist cables is connected to the bucket bridle. Tightening the bucket hoist line raises the pontoon, and the revo-



AUXILIARY FRAME ON DRAGLINE SHIFTS PONTOONS FOR WALKING DRAGLINE EXCAVATORS

lution of the excavator body carries the pontoon to the front of the machine. This method is much more cumbersome than the first and takes more time. After trying out the two methods, Mr. Radford has adopted the first method for all four machines.

In connection with the pontoons, it may be noted that one man is kept busy cleaning mud off the tops; if this is not done the tub of the machine will slip on the mud when the machine moves.

Concrete Used to Line Temporary Diversion Channel

By Glenn D. Holmes
Chief Engineer, Intercepting Sewer Board, Syracuse, N. Y.

Temporary diversion channels, for the unwatering of Onondaga Creek in the City of Syracuse, N. Y., in connection with the extensive improvements of the waterway being made by the Intercepting Sewer Board, are being constructed of concrete by John Young, the contractor. It was intended at first to construct these diversion channels of timber, but when excavation for them was opened up, well graded sand and gravel suitable for concrete was encountered, which led to the change in plan. The adoption of concrete resulted in a saving in width of excavation, and ordinary rather than skilled labor could be employed for the construction.

CONCRETE-LINED DIVERSION CHANNEL AT SYRACUSE

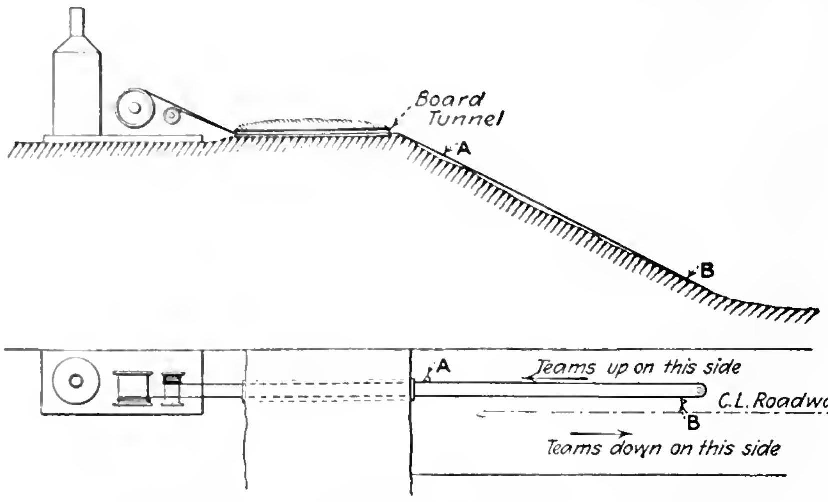
There are two of these channels, each about 1200 ft. in length. They will divert the water to the large storm sewer and around the work of construction. The larger of these channels is rectangular in section, 6 ft. wide and 3 ft. high, and has a capacity of about 250 sec.-ft. The smaller channel is U-shaped in section, 45 in. in height and top width, and has a capacity of about 50 second-feet.

Onondaga Creek has a drainage area of about 100 square miles. Its dry-weather flow reaches a minimum of about 50 sec.-ft. and its maximum dis charge has reached 5500 cu.ft. per second.

Snatch Cable Aids Teams on Steep Grade

Teams hauling earth from a portion of the river-channel widening work being done at Columbus, Ohio, are helped up a 15% grade by a snatch rope operated by a double drum hoist, as indicated by the accompanying diagrammatic sketch. From one drum the rope extends down the hill, and there makes a loop and returns to the other drum. By alternate forward and reverse operation of the drums the hitches at A and B see-saw up and down hill, one always being at the bottom when the other is at the top. From the drums the rope passes under the roadway through a small plank tunnel.

When a loaded team comes from the shovel to the bottom of the hill the driver makes a chain

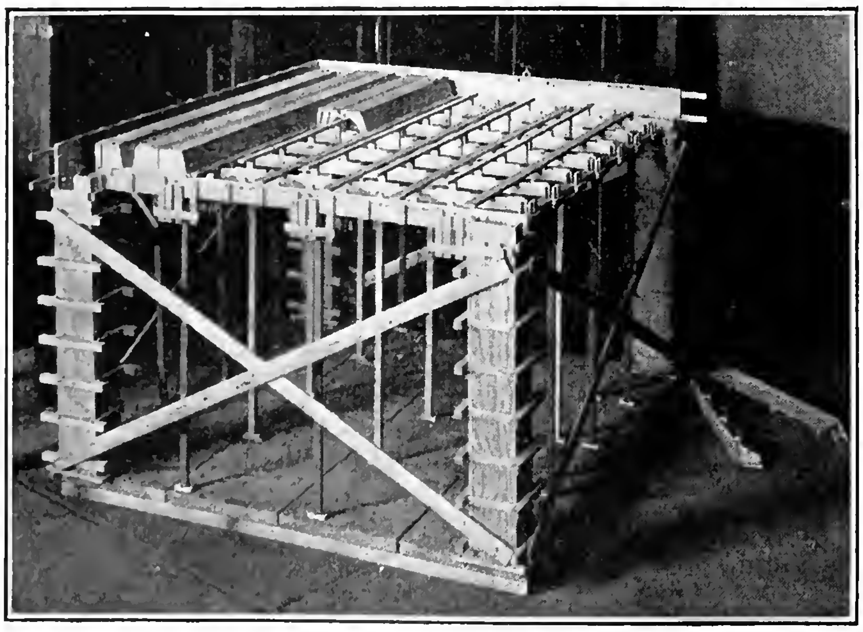


LOOPED CABLE HAULS WAGONS UP INCLINE

hitch from the cable to the rear axle and the load is snatched up the incline; the team is thus relieved of all work of pulling.

Model of Typical Concrete Form Section Helps Contractor

In building a new reinforced-concrete apartment house at Salt Lake City, Utah, Villadsen Brothers, Inc., the contractors, introduced a number of novelties in the design of the forms. Previous to the construction, the firm built the small-scale model of a typical form panel shown in the accompanying view. This was



MODEL ON SCALE OF 1½ INCHES PER FOOT

on a scale of 1½ in. to the foot and reproduced in precise detail the intended structure. The contractors state its cost was negligible compared with the total form cost, but that it has proved of great assistance to the form designers in studying the most economical connections and in forecasting the stripping of the forms.

It is also stated that the model has proved even more valuable, since the construction was completed, in the analysis of all suggestions and criticism following the actual work.

New York Wages Doubled in Four Years

A report issued by the New York State Industrial Commission states that during the four years since March, 1915, wages have increased on the average 107% and the number of employees 18%. In March, 1919, there were 9% fewer workers in the factories in the state than in the same month in 1917, but the payrolls were 27% larger.

Progress Report of Development Committee of American Society of Civil Engineers

Statement of Fundamentals on Which Views of Members Are Desired Includes Relations with Other Societies, Internal Relations and Local Associations, Technical Activities and Public Service

(By Wire from Minneapolis)

UNDER date of June 16, the development committee of the American Society of Civil Engineers, after a four-day session at Minneapolis, presented to the board of direction a report expressing certain fundamentals which the committee anticipates will form the basis of its ultimate report. The committee, desiring to learn the views of the membership on these fundamentals, suggested to the board that it take steps to secure these views. Accordingly, the board ordered the report printed for distribution at the business meeting of the society in Minneapolis the following day.

The report also carried the information that a committee of three, consisting of Gardner S. Williams, George G. Anderson, and Richard L. Humphrey, had been appointed to serve on a conference committee, with representatives of the development or aims committees of the national societies of mechanical, electrical and mining engineers.

The report in full follows:

The basis of the report herewith is the work of the four subcommittees which were appointed at the November meeting, and the main subdivisions represent approximately the scope of the subcommittee work.

A. Relations with Other National Societies and Related Organizations

It is the opinion of your committee that the identity of the four existing national societies should be preserved. The committee believes that the American Society of Civil Engineers should continue to pursue the objects for which it was formed as expressed in the constitution, namely, "the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members," and that it should devote its chief endeavors to the performance of these objects.

We feel, however, that the time has now come when this society should adopt the principle of becoming an active national force in economic, industrial and civic affairs.

This can only be done effectively, however, by active coöperation with other engineering organizations of the country. To this end the committee recommends that a comprehensive organization be formed embracing:

The local affiliation of the branches of the national technical societies and the local technical societies;

A state council composed of representatives from the local affiliations;

A national council consisting of representatives of the national technical societies and from the state council or state group organizations, in lieu thereof.

The object of the council shall be to increase the usefulness of the engineering profession, to bring about greater coöperation and to advance the welfare of engineers.

The council shall have an executive committee, shall maintain a central office and shall hold at least one meeting each year. It would be desirable that a bulletin of general engineering interest be published by the council. The council shall be supported by a per capita contribution or in such other manner as may be determined.

B. Internal Relations and Local Associations

Your committee makes the following recommendations:

Local Associations—That every member of the society be a member of a local association.

That there be created in each geographical district of the society an organization consisting of representatives of the local associations in that district.

That local associations and district organizations shall operate under uniform constitutional provisions to the extent only that the same are necessary or desirable to insure uniform relations with the society.

That the representatives of each district on the board of direction and the nominating committee of the society be elected by ballot by the corporate members resident in such district.

That it be the duty of each director to visit each local association in his district at least once during each calendar year.

That the nominating committee select candidates for the offices of president, vice-president, and treasurer, the election of which officers shall be by the ballots of the corporate members.

That there be an annual conference of representatives from the local associations for the purpose of discussing the welfare of the society and its members.

That there be allotted a percentage of the dues of the society to each district organization and each local association for the payment of their expenses.

That the board of direction refer for recommendation each application for membership to the local association in whose jurisdiction the applicant resides.

That the present provisions of the constitution relating to the discipline and expulsion of members be so revised as to make them more effective.

That it be the obligation of each local association to bring about within its territory a close affiliation of all branches of the national and of the local technical organizations for the purpose of advancing the status of the engineer.

That in communities where members are too few to form a local association, it be their obligation, in addition to that of their district local association, to affiliate with the resident members of other technical societies, and other engineers, where such affiliations will promote the organization of a local affiliate body.

That the local affiliations be the basis for comprehensive state and national organizations.

Rearrangement of Grades—That the grades of membership be more clearly defined and that changes be made in the grades of associate and fellow.

Student Societies—That it be the duty of the local associations to organize and assist student engineering societies in neighboring engineering schools, to provide carefully selected speakers, and to maintain personal contact with such societies.

(Note: The above is recommended in lieu of establishing the grade of student member and of establishing student branches.)

Young Men of the Profession—That it be the duty of the local associations to provide for the welfare of the younger members of the profession by:

1. Reasonable representation on the active committees.
2. Encouraging their discussion of the general problems of the society.
3. Arranging excursions to works of engineering interest.
4. Promoting social intercourse between them and the older members.

Personal Service—That a personal-service bureau be maintained by each local affiliation, so organized as to operate in connection with a central service bureau to be maintained by the national council.

American Engineers in Foreign Service—That it be the duty of members resident in foreign countries outside of North America to form associations and to promote an

affiliation with the resident members of other American technical societies.

That the board of direction consider the feasibility of keeping on record, and providing to American consuls abroad, the names, addresses and brief professional qualifications of members of the society resident abroad.

C. Technical Activities

Meetings—That local associations should hold not less than four stated meetings per year and encourage joint meetings with kindred societies.

That the fortnightly meetings of the parent society should be discontinued.

That the semi-annual meetings of the parent society should be supplemented by the addition of a spring and fall meeting held successively in different sections of the country under the auspices of a local association.

Papers—That the present system of securing papers depends wholly upon voluntary offers and results in a limited variety of subjects. Committees of the parent society and local associations should be formed and charged with the responsibility for promoting greater activity and discussions. Simultaneous discussions of important papers by local associations is desirable.

That the use of the monthly *Proceedings* should be extended to include editorial work, abstracting and reviewing important engineering articles and subjects of popular interest to the great majority of engineers.

Committees—That there be created advisory standing committees of the board to promote the study of important engineering subjects and charged with outlining and coördinating the work of like committees of the local associations. Three members of the board should constitute a standing advisory committee on each subject. Local associations should urge the younger members to identify themselves with local committee work.

That local associations should suggest names of volunteers possessing necessary qualifications for special committee service, and that tenure of committee membership shall terminate automatically on account of absence or inactivity.

That the society support an active program of research work, coöperating, if practicable, with existing research agencies.

That the chairmen of the standing advisory committees of the board should constitute the publication committee.

That to effectively carry out the intent of these recommendations a technical editorial staff under the direction of the publication committee should be established.

Sections or Divisions of the Society for Specialized Lines of Work—It is not recommended that the work either of the parent society or the local association be divided in this way. The object apparently sought by such divisions will be better met by the work of strong committees.

Coöperation With Specialized Engineering Societies and Other Organizations—Much of value has been accomplished in the past in this way and it is recommended that such work be continued and extended.

Standards in Engineering Practice—There exists at the present a committee known as the American Engineering Standards Committee, composed of representatives of the national engineering societies. This line of coöperation and advice is approved, and it is recommended that it be continued and extended, but the idea of developing this committee into another association is deprecated.

It is recommended that a book of recommended practice and standards be compiled which shall be revised periodically to follow the development of engineering.

D. Relation to Public Affairs

Definition of Engineering—That the three main ideas in a complete definition of engineering should be as follows:

1. A general and descriptive statement.
2. The content of the profession—the things that engineering does.
3. The aims and motives the profession should have.

Ethics—That a short code of ethics of broad scope, general character, and positive rather than negative injunction, be prepared.

Engineering Education—That a standing committee of seven be created to consider questions of educational policy, and offer advice and guidance in carrying out such policy. The aims of engineering education, fundamental requirements, changes in curricula indicated by changing social and industrial conditions, the qualifications of teachers, and the standardization of degrees, are a few of the topics which such a committee should rightly consider. Further, that local associations appoint similar committees of three or five to coöperate with educational institutions in their respective territories.

Licensing—That the society, in coöperation with the other founder societies, prepare a standard form of bill for the licensing or registration of engineers, to be used in the framing of legislation.

Arbitration and Expert Testimony—It is the belief of the committee that the present practice with regard to expert estimony and arbitration is not satisfactory, and it is recommended that a committee of the American Bar Association be asked to coöperate with the joint committee from the four founder societies, in order to develop better practice along these lines.

Publicity—It is recommended that the preparation of general articles on engineering subjects be encouraged and assisted by the profession, especially with a view toward having such articles published in the standard magazines.

Washington Agency Recommended

Legislation and Development of Natural Resources—It is recommended that the national council maintain an agency in Washington, D. C., or elsewhere, for the purpose of keeping advised of all proposed Federal legislation and departmental rulings and regulations involving, directly or indirectly, questions of engineering; and that such agency keep the society or its locals advised from time to time of such matters. It shall also be the duty of the various locals to keep advised on all proposed state legislation affecting engineering matters, and the said locals shall actively interest themselves to the end that proper legislation may be enacted. It is also recommended that such agency, and the state and national councils, shall keep advised as to the proposed creation of Federal and state commissions, whose activities may affect engineering enterprise; and that the influence of the locals and the society at large shall be directed toward securing the appointment of engineers upon such commissions.

The Service of the Engineer to the Community, State and Nation—The engineering profession owes a duty to the public which it is believed can best be discharged by the active participation of every engineer in the civic work of his locality. To this end it is urged that the engineer join the civic body of his community, and, if there be no such organization, that he should then endeavor to organize the community for civic work, in sympathetic coöperation with the governing body. The engineer's duty to the public also requires that he give his best efforts to matters of state, interstate and national character, calling upon the various engineering bodies for assistance and coöperation when necessary.

Patent Law—Inasmuch as a nation-wide society of inventors has been formed, composed largely of engineers, one of whose objects is to handle the subject of patent law, it is recommended that no action be taken on this subject at the present time.

Coördination of Government Activities—It is recommended that the influence of the entire membership of the society be directed toward the creation of a Federal Department of Public Works, the secretary of which shall be technically qualified and a member of the President's cabinet, and that the law creating such department shall provide for the coördination of all Government engineering activities.

Industrial Affairs—That fundamentals of industry and their inter-relations are based on engineering principles which form a part of the education of the engineer.

NEWS OF THE WEEK

New York, June 19, 1919

$200,000,000 French Contract to American Firm

Vulcan Steel Products Company Engaged to Rebuild Nancy District—Large Organization Required

That the Vulcan Steel Products Co., 136 Liberty St., New York City, has just received a cost-plus contract, valued at $200,000,000, for rebuilding the Nancy district of France, was made known to a representative of *Engineering News-Record* yesterday morning in an interview with the officer of the Vulcan Co. who arrived here this week, after closing the contract in France. Plans for a part of the project are on the way to the United States. The preliminary work of accumulating an organization and obtaining bids on machinery and equipment of all kinds will be started at once, so that the actual construction work may go forward the moment the peace treaty has been signed. Another retarding factor is the present high rate of exchange.

Associated with the Vulcan Steel Products Co. are MacArthur Brothers and the McClintic-Marshall Co., which will handle the construction work. French labor will be used, and it is understood that preference will be given to French manufacturers of machinery. However, a vast amount of American machinery will be bought.

Industrial Needs Paramount

Although the contract covers all classes of construction, particular attention will be devoted to industrial works, because of the revenue they will produce. For example, it is estimated that 5000 breweries have been destroyed. If only 20% are rebuilt, it will mean a thousand such plants. In that event it is quite likely that some American manufacturer of brewing machinery will become associated with the Vulcan Co. The same may happen in connection with the cement, textile and other industries. It is possible that a French company will be formed to handle the work over there for the Vulcan company.

Some time ago newspaper despatches stated that Europe intended to do its own rebuilding, without foreign assistance. It is now recognized that the task is far beyond the capabilities of post-war Europe. The plans for reconstruction are prepared by local committees. The French Government recognizes these committees as being responsible bodies. The Nancy contract was let by the committee in that district.

Report of Development Committee Discussed at Civil Engineers' Convention

Committee To Draft Another Report Before November 1, Based on Views of Members—Lively Two-Hour Discussion

(By Wire from Minneapolis)

Delayed two years by the war, the forty-ninth annual convention of the American Society of Civil Engineers convened in Minneapolis June 17. The main topic of the business session was the development committee's report.

At the opening session the visitors were welcomed by Governor Burnquist, and the president delivered the annual address (given in full on page 1208 of this issue). He was followed by Francis C. Shenehon, who in an address of singular charm spoke of the engineering features of the Twin Cities and their tributary territory.

Prompt Action on Report

The afternoon session, except for some routine announcements, was given over to a discussion of the development committee's report, which, though presented only the day before to the board of direction, had been put into type and distributed to the members. In presenting the report the secretary announced that the board desired that it be given careful study by the members and that they communicate their views to the chairman or the secretary of the development committee as early as possible. It is the hope of the board that the response will be such that the committee will be able to draft a subsequent report, final or progress, and submit it to the board by Nov. 1. That will allow of its distribution in ample time to have full discussion thereon at the annual meeting in January. (The report in full will be found elsewhere in this issue.)

Despite the fact that the weather was sweltering, and that the members one by one discarded their coats until all were coatless, including the president, discussion of the report continued for full two hours. In general, there was indorsement of the fundamentals laid down by the committee, and in every case full appreciation of the great amount of work done by the committee in drafting the document. The members of the development committee, on request of the chair and voluntarily, gave emphasis to certain sections of the report and enlarged on the committee's reasons for the recommendations.

Gardner S. Williams, of Detroit, expressed the view that two chief features of the report were the recommendations: First, that of election of directors by districts and the district organization scheme, and, second, that the society retain technical matters as its chief function, leaving to a separate system of organization the civic and welfare activities.

Robert A. Cummings, of Pittsburgh, pointed out the very distinct departure in the philosophy of the organization involved in the building from the bottom up in the plan for civic activities. The organization for technical work, on the other hand, he felt, is properly built from the top down, since technical work necessarily involves standards which are set at the top. Prof. George F. Swain, of Boston, felt that the section on licensing gave implied approval of the licensing idea with which, he said, he was not in agreement. He thought that a code of ethics should be negative in statement, and brief.

Lewis D. Rights, of New York, raised the question of the method of obtaining funds for the proposed enlarged activities. He asked whether an increase in dues to $25 for all members should be considered, and stated that the publication committee had thought of proposing to raise revenue by inserting advertising in the *Proceedings*. To this question of raising funds George G. Andrews, of Los Angeles, made answer that he felt certain the needed funds would be forthcoming when the members received the large measure of service provided for in the recommendations.

Needs of Young Men Discussed

William Anderson, as did other members, stressed the need for making adequate provision for the young men—in fact, no section of the report received such repeated emphasis. On the question of licensing, Mr. Anderson believed the society must meet it eventually and should address itself immediately to the problem in order to meet it with the greatest intelligence.

Charles Hansel, of New York, speaking of the section on the civic duties of the engineer, urged that, however it might be rewarded, it should carry the thought that each engineer had a duty as a citizen to become a member of the civic association of his community.

Following the program of the meeting, as outlined, the president's reception was held Tuesday evening. The other events of the meeting promised to be well attended, a large number having signified their intention of making the trip to Duluth and the iron range at the week end. E. J. M.

Southwestern Water Works Annual Meeting in Kansas City

The eighth annual convention of the Southwestern Water Works Association, to be held in Kansas City, Mo., June 23-26, as previously announced in these columns, will be devoted largely to round-table talks bearing on various current water-works problems. They will include practical five-minute talks by superintendents and members of the association on difficulties that have arisen in their experience, and methods for overcoming them.

Among the formal papers that will be presented at the meeting are: "Some Economies That May Be Effected in the Operation and Maintenance of the Water-Works System," by Homer V. Knouse, of Omaha; "Water Purification and Treatment," by D. H. Hunter, of St. Louis; "Sterilization of Water and Sewage," by Dave Morey, Jr., of Dallas, Texas; "Municipal and Private Utilities Versus the Consuming Public," by Charles Ade, of San Antonio, Texas; "What Constitutes a Water-Works System," by Clarence E. Ridley, of Port Arthur, Texas; "Waste Control by House Inspection with District Metering," by E. W. Case, of New York.

The round-table talks will include discussion of such subjects as benefits to be derived from monthly and quarterly reports by superintendents to their boards, monthly meetings of all employees to further coöperation, and cost of meter upkeep.

The Railroad Administration has granted a special round-trip rate, for delegates, amounting to 1⅓ one-way fare.

Changes in Texas Health Board Recommended

Recommendations for a department of sanitary engineering in the Texas State Board of Health, appointment of an experienced sanitary engineer as one member of the board, and a six-year term for board members, are included in the report of the Texas Public Health Commission appointed by Governor Hobby in November, 1918.

More Aqueduct Power Bonds

Aqueduct power development will proceed at Los Angeles, following a vote on June 3 of some 16,500 to 21,200 in favor of the issue of \$11,000,000 bonds for municipal purchase of the distributing system of the Southern California Edison Co. and \$2,500,000 for power-plant extensions along the aqueduct. The voters also authorized the sale of surplus power by the city to outside communities.

Contributions by Engineers, Architects and Constructors' Conference on National Public Works

M. O. Leighton, Chairman.

PUBLISHER'S NOTE: The space occupied under this caption is donated to serve as a means of frequent and intimate communication between the Engineers, Architects and Constructors' Conference on National Public Works, and the members of the profession. The contributor takes full authority for the statements made.

The Reply of the Corps of Engineers, United States Army:

The long-expected response of the Corps of Engineers, United States Army, to the activities of the engineers, architects and constructors of the country looking toward the establishment of a National Department of Public Works, has been made. It is in the form of a bill designated S. 1376, 66th Congress, First Session, introduced into the Senate June 5, 1919, by Senator Ransdell of Louisiana. It may be inferred that this senator is not prepared to father the measure, for the customary legend at the head of the bill contains the additional words "by request," after Senator Ransdell's name.

The bill is 35 pages long and contains 29 sections. It proposes to create an "Auxiliary Engineer Corps" in the United States Army for duty on works of public improvement—a noncombative corps of engineers which shall be "under the command and direction of the Chief of Engineers, U. S. A. . . . Its personnel shall be assigned by the Chief of Engineers to duties under his charge; specifically, on river and harbor improvements, inland waterways, locks and canals, fortifications, embankments, levees, dikes, breakwaters, piers and in the supervision and *in the construction of* national highways and bridges, and to any other public work that shall be now or hereafter assigned to the Chief of Engineers under the War Department. This organization shall also perform the duty of guarding and protecting all national public works."

Whether or not the foregoing language places the construction of national highways and bridges under the Chief of Engineers and thereby increases the authority of the Engineer Corps beyond that now conferred upon it is a question for the lawyers to determine. It may be observed, however, that, even if such authority is not specifically conferred, the language creates an "open sesame" and one is reminded of the ancient legend concerning the camel who received permission to place his nose in the tent. The bill is too long and comprehensive to be reviewed adequately here, but those who read it will have no question that it is the first step in the attempt, of which many of us have been aware, to militarize the public-works functions of the Federal Government.

The Engineers, Architects and Constructors' Conference on National Public Works took action at the recent Chicago meeting directly opposite in spirit and purport to that proposed under S. 1376. Therefore, the officers of this federation are in duty bound to oppose this bill. In order that the engineers, architects and constructors of the country may be informed concerning the first steps taken in opposition, the letter from the chairman of the conference to the chairman of the Senate Committee on Commerce (the Hon. Wesley L. Jones is chairman of the committee), to which the bill has been referred, is reproduced below:

MY DEAR SENATOR JONES:

On June 5 Senator Ransdell introduced into the Senate, "by request," a bill to create an Auxiliary Engineer Corps in the United States Army for duty on works of public improvement. It is numbered S. 1376 and has been referred to the Committee on Commerce.

I have the honor to be chairman of a federation of societies with an aggregate membership of 105,000 engineers, architects and constructors. This federation, which is known as the "Engineers, Architects and Constructors' Conference on National Public Works," is opposed to the provisions of the bill above-named, and at its convention in Chicago, Apr. 23-25, adopted a program contrary thereto in all respects.

On behalf of the federation aforesaid, I respectfully request that when the Committee on Commerce designates S. 1376 for hearing, said federation be given an opportunity to prepare and present its views.

For more than forty years the engineers, architects and constructors of the United States have almost unanimously been advocating the consolidation of the engineering and construction work of the Government into a Department of Public Works. The United States stands practically alone among the great and small nations of the world in that it has no such department. The matter has been considered and acted upon from time to time by various engineering societies throughout the country, but all efforts have heretofore been futile, for two reason: (a) The engineers, architects and constructors of the country have given local and sporadic rather than united and continuous support; (b) the Corps of Engineers of the United States Army has always been able to defeat any proposal that has thus far been advanced to Congress. The engineers, architects and constructors of the country are now united, and they propose to present to Congress in the near future a well considered plan for a Department of Public Works that will correct the present chaos in our national construction matters and achieve economy and efficiency.

I will not burden you now with a detailed statement of the reasons which, after more than forty years of mature consideration by well balanced men, prompt the forthcoming recommendations. With respect to S. 1376, we shall in due time endeavor to substantiate our belief that there is no more sure, certain and insidious way of accomplishing militarism in the United States than through the militarization of our public works. Heretofore, this militarization has extended principally to the rivers and harbors operations, with results that have repeatedly been characterized in a way not at all favorable to the Corps of Engineers. The bill S. 1376 extends Army control to public roads, bridges "and any other public work that shall be now or hereafter assigned." This bill is merely a part of a very ambitious plan to place the Army in the saddle over all engineering operations of the Government.

The genesis of S. 1376 is well known. You will find attached hereto a sample of propaganda circulated among the civilian force of the Corps of Engineers through the district office in New Orleans. It is hardly necessary to remind one as familiar with official Army procedure as yourself that no civilian attached to the Corps of Engineers would be so venturesome as to distribute this amazing circular without "knowledge and consent" of headquarters at Washington.

It is a very long way from the War Department to the capitol if one goes via

(*Continued on page* 1234)

To Arbitrate Jurisdictional Building Strikes

Engineers, Architects, Contractors and Labor Unions in an Agreement to Prevent Source of Trouble

Organized labor, through the American Federation of Labor, has joined with the large building employers' association, the American Institute of Architects, and Engineering Council, to form a board to arbitrate the so-called jurisdictional strikes which make up so large a part of the labor trouble in building operations. This board is to be known as the National Board for Jurisdictional Awards in the Building Industries, and consists of eight members, three to be selected by the building-trades department of the American Federation of Labor, and one each by the American Institute of Architects, Engineering Council, the Associated General Contractors of America, the National Association of Builders' Exchanges, and the National Building Trade Employers' Association.

Against Sympathetic Strikes

According to the constitution which was drawn up and adopted at the recent meeting of the American Federation of Labor, the duties of the board shall be to hear claims for jurisdiction over work performed by building trades and to determine by which trade the work in contention shall be performed, and to make an award in conformity with the facts submitted by the contender. At least a two-thirds majority of the voting members of the full board shall be required to render an award, in all cases.

The constitution as adopted further provides that when a dispute arises, the employer to whom the work has been given shall proceed with such workmen as in his judgment he may see fit to employ, pending a decision of the board, but the right of any contestant to the dispute shall not be prejudiced in its claim for a final award. Each signatory to the agreement agrees that the membership of its organization shall not take part in sympathetic strikes in any case of jurisdictional dispute. The constitution further provides that local organizations signatory to the agreement shall secure the enforcement and compliance of their organizations with the provisions of the agreement and the awards of the board. Local organizations refusing compliance with the provisions of the agreement and the awards of the board are to be suspended from their international organization, and the international organization shall proceed at once to man the job and the employer shall coöperate with the international organization in so doing. Any architect, engineer or employer represented on the board through an organization signatory to the agreement shall be suspended from his organization upon failure to comply with the provisions of the agreement and the awards of the board.

Water Purveyors Hold Thirty-Ninth Convention

American Water Works Association Reviews War Conditions and Looks Into Future—Rates, Prices, Hydrant Damages

Goodly numbers in attendance, a wieldy program well handled, an unusually large and varied exhibit of water-works appliances, a notable committee report on private fire protection services, much attention to war and after-war phases of water-supply, and a paper giving promise of a new and unique reciprocating pumping engine, were features of the convention of the American Water Works Association held in Buffalo last week. A number of the papers read are abstracted on pp. 1193-1198.

Effects of the War

Impressions left by a review of some five hundred court and commission decisions affecting water-works were presented by Leonard Metcalf, consulting engineer, Boston, Mass. Summarized, these impressions were:

"Public ownership is less attractive to the people in light of recent experiences." Commission jurisdiction is becoming more complete. The tendency is for the commissions to consider original cost "the fairest measure of value," but "many competent observers believe that past valuations or rating bases have frequently been too low." The older commissions generally recognize going value. Franchise values have shrunk materially in this as compared with the previous decade. The treatment of depreciation "has improved immensely." There is a marked improvement in the distribution of the water-works burdens between private consumers of water and the general public.

A review of water-rate decisions given in "Public Utility Reports Annotated," for 1915 to 1918, shows increases granted to four plants in 1915, 12 in 1916, 15 in 1917 and 67 in 1918. The lag between mounting expenses and grants of rate increase was 12 to 18 months. Although there were many substantial increases, commissions did not grant relief from increased war burdens to utilities generally.

The larger part of Mr. Metcalf's paper was devoted to a somewhat detailed study of the effect of the war upon water-works revenues and expenses. That portion of the paper appears in abstract on p. 1193.

In the course of the discussions on Mr. Metcalf's paper, R. B. Howell, of the Omaha Water District, said that 1917 was a very prosperous year for his works. Although rates were again reduced, a profit was shown. After questions by various members had been answered by Mr. Howell, it was remarked by J. N. Chester, of Pittsburgh, that the secret of Omaha's success is that it has municipal ownership under the sort of management more common to private ownership. Mr. Chester also stated that rate increases depend more upon political conditions than upon the necessities of the case. J. W. Ledoux, of Philadelphia, and others, complained of the slowness of the utility commissions in rate cases.

Besides the data and opinions given in Mr. Metcalf's paper, Charles Wood, of Philadelphia, submitted a number of opinions gathered by him: A representative of the manufacturers of cast-iron pipe reported that there had never been a time when the stock of water and gas pipe was so low as now. The president of one of the largest cement companies said cement has fallen at some points and there may be a further decline, but it is safe to say that the price of cement will never go down to its old level.

High prices, he added, are world-wide and apply to all commodities. The editor of *Iron Age* called attention to the large percentage of labor entering into the cost of pig iron, which makes against the lowering of the prices of this commodity.

New Price Level Now

Still another summary was presented by Edgar A. Buttenheim, editor of the *American City*, who said that the gist of the results of his investigations is that although there are all kinds of water-works construction in sight, there is too much disposition to wait a little longer in hopes of lower prices. It must be realized that we are on a new and higher scale of price levels. Dennis O'Brien, of the A. P. Smith Manufacturing Co., said that a questionnaire sent to members of the Water-Works Manufacturers' Association disclosed much independence of thought on prices. There is an undoubted feeling abroad that if one waits long enough a considerable reduction in prices will be seen. In opposition to this the economists, reasoning from the volume and movement of the circulating medium, predict continued high prices. The plain business man sees loss of laborers through war and immigration, high cost of transportation, and a demand for goods to make up for slackened production and normal increase. The shelves of the country are bare. Labor prices will go up rather than down. So, finally, the business man reaches the same conclusion as the economist.

Maj. E. C. Church, U. S. A., of New York City, urged that attention be given to deferred maintenance, which should now be taken up even if prices are high.

Instead of the association having a "Superintendents' Day," parts of several sessions were set aside for the discussion of subjects of appeal to the superintendents, and ample opportunity was afforded for question-box discussions.

The net result was small except under the set topic, that of damages to fire hydrants by motor vehicles. This was

opened by W. W. Brush, of New York City, who said that nearly 400 hydrants out of a total of 40,000 are damaged yearly by motor vehicles in his city. Repairs are generally made by removing and welding the standpipe. Welding alone costs $6 when done by the city and $8 or more when done in a private shop; digging up and resetting the hydrant, yard assemblage and cartage bring the total cost of repairs up to $25 to $30. There have been breaks where the hydrants were provided with fenders. In fact, protection against the heavy motor trucks now in use seems impossible. F. W. Cappelen, of Minneapolis, said fenders had not been successful there. His hydrant breaks due to motor vehicles had been 1 to 150 hydrants. Most of the breaks had been at street intersections. No one present seemed to favor the use of either flush hydrants or hydrants at the building line.

Brief Mention of Papers

Filtration of the Buffalo water-supply, said Henry F. Wagner, must wait for a reduction of the present excessive consumption, after which mechanical filters may be built on land near the pumping station, now partly under water. Some air-lift pump installations and the use of the air lift in connection with water treatment, where aëration is needed, were described by John Oliphant, of the Sullivan Machinery Co., Chicago.

Army and related water-supplies received an entire session. W. H. C. Ramsey, designing engineer, outlined the principles used in design, and described in detail the water-supplies of the many housing projects of the United States Shipping Board. Lieut. Col. Dabney H. Maury stated that the water-supplies of our cantonments and other camps served 4,000,000 troops and 2,000,000 civilians, without a single known case of water-borne typhoid, and with a very low fire loss. Lieut. Col. F. W. Scheidenhelm told how water was provided for the First Army while at the front in France. These three lantern-slide talks having held the attention of the convention through a whole session, the fourth paper scheduled for that sitting was thrown back to the next day, when William J. Orchard, manager Wallace & Tiernan Co., Inc., New York City, described the motor-mounted water-purification plants and laboratories used at the front—to which, it may be noted, Colonel Scheidenhelm gave praise.

Although the aim was to provide only 2 gal. of water to each man at the front, and sometimes only a fourth of that could be delivered, the task was not a small one, according to Colonel Scheidenhelm.

In the St. Mihiel drive the number of men supplied with water was 30 times as large as the civilian population of the district. The general plan followed was to have reconnoissance parties locate and test available supplies in advance of the occupation of a district. Collecting and distributing centers were called "water points." Here water, provided by gravity or pumping, and treated as might be necessary, was delivered to water tanks or cans on motor trucks, or other vehicles, or in some cases to tank cars running on light railways. The water so hauled was delivered directly to the soldiers or else to improvised storage, sometimes holes in the ground lined with tarpaulin; or canteens might be filled from storage tanks supplied by gravity or pumping. Under still other conditions, Lister bags, mounted on tripods, were used for the disinfection of water and its delivery to canteens. Soldiers in trenches were supplied from large water bags which were carried on the backs of men.

Reports of Special Committees

Had it not been for the valuable monograph designed to be the final report of the committee on private fire protection service, submitted for the committee by Nicholas S. Hill, Jr., chairman, the past year would have been almost barren of results so far as the technical committees of the association are concerned. This report makes an illustrated pamphlet of 58 pages. The various physical and financial questions involved are reviewed, and specific recommendations as to each are made. Much hearty commendation of the report in general followed its reading. Objections were made to some of the conclusions. In order that these objections, as well as written discussions yet to be received, might receive full consideration, and the whole be crystallized and the association take a final and positive stand on this vexed subject, which for years has occupied much of the time of conventions, it was voted to continue the committee, instead of adopting the report and discharging the committee, as the latter had proposed.

In behalf of the American Committee on Electrolysis, Alfred D. Flinn and Edward E. Minor submitted a progress report. The joint committee representing various utilities has conferred with the Bureau of Standards. A technical subcommittee has been created, and a plan has been formulated under which experts would be engaged to study electrolysis. The committee proposed that the American Water Works Association authorize the employment of an expert, but the matter was referred to the executive committee for consideration, in view of possible risks of commitments that might affect litigation.

The committee on revision of standard specifications for cast-iron pipe reported that no meeting has been held during the year but that it hoped to submit something for consideration next year.

The committee was continued, as was also the committee on form of contract and bond.

A canvass of ballots showed that a total of 382 votes had been cast for new officers, with almost unanimous choices, as follows: President, Carlton E. Davis, chief of the Bureau of Water, Philadelphia; vice president, Capt. M. E. Worrell, Q. M. C., formerly of the Meridian, Miss., water-works; treasurer (reëlected), J. M. Caird, chemist and bacteriologist, Troy, N. Y.; trustees, W. H. Randall, superintendent of water-works maintenance, Toronto, Ont., and F. C. Jordon, secretary of the Indianapolis Water Company.

Montreal was selected as the next meeting place, its chief rival being Detroit.

The financial condition of the association was reported as being favorable. The investment fund has reached $13,000. During the year which ended Mar. 31, 1919, there was a net loss of 39 in membership, attributable to the war. The membership on that date totaled 1241, of whom 1024 were active, 91 corporate, 121 associate and five honorary. Taking figures compiled as of September, the membership for the past five years has been 1136, 1229, 1361, 1360, 1308. Geographical sections on Apr. 1, 1919, were: Canada (not officially organized), California, Central States, Four-State (parts of New Jersey, Pennsylvania, and all of Maryland, Delaware and the District of Columbia), Illinois, Iowa, Minnesota, New York State (with part of New Jersey). The committee recommended that state sections be organized whereever the state membership was as many as twenty.

Report on the "Journal"

The publication committee reported that after several months' effort it succeeded in getting original contributions for the *Journal*. The social value of association membership is not sufficient to hold members. It was recommended that a larger amount of original matter be secured for the *Journal* and that it be published six instead of four times a year, at an estimated cost of $7500 a year. This was approved.

A ride on the lake with a visit to one of the Buffalo pumping stations was provided by the City of Buffalo. At the station a 3,000,000-gal "Unaflow" pumping engine (see p. 1193) was seen in operation. A trip to Niagara Falls, a smoker, and special entertainment for the ladies were provided by the Water-Works Manufacturers' Association, Charles R. Wood being chairman of the entertainment committee. Another committee of the same association, with Burt B. Hodgman as chairman, deserves special mention for the unusually large and varied exhibit of water-works appliances.

Conference on Public Works

(*Continued from page* 1232)

New Orleans. The engineers, architects, and constructors of the country are coming to the doors of Congress very soon, with a respectful petition which will be the result of forty years of the best engineering thought. But, in so doing, we shall remember the fundamental engineering axiom that a straight line is the shortest distance between two points.

Reference in the foregoing letter to organized propaganda will be made

clear by the following reproduction of the circular sent out from the district office of the Engineer Corps at New Orleans:

Strictly Personal

1. The purpose of this letter is to enlist all chief clerks in the United States Engineer Service in a "push" to shove a bill through Congress for mobilizing an Auxiliary Engineer Corps. A bill for this purpose was recently placed in the hands of Senator Joseph E. Ransdell, with a view to having it introduced by request at the coming session of Congress. This bill provides for a complete organization from top to bottom—non-combative with a military status and under the direction of the Chief of Engineers, U. S. A., with the rank he now has, major general, and the division engineers with the rank of brigadier general, and the district engineers with rank of colonel; with provision for ranks for assistants below the district engineer. The corps is to be mobilized from the *experienced* men of *all* classes in the office and field now in the service. Its duties are as now—construction, care of maintenance of public works; and national highways and bridges to be added. Let us talk about national good roads; absolutely necessary for the welfare and prosperity of the nation.

2. The foundation of this organization rests solely upon merit, in which the lowest paid man, if he is made of the right stuff, has a chance to make something of himself. It is not a salary grab, nor does it provide any fat jobs.

3. It provides for a three-year practical training period for all who enter the service and who have had no previous engineer experience, before a man can get into the permanent corps, unless he qualifies for a commission before that time.

4. It provides graded pay in the various classes of the personnel, and also longevity pay of 5% increase for every three years' service, for eight 3-year periods; besides the opportunity, if qualifications justify it, for promotion from class to class with higher pay in such class. It provides also for an efficiency board that shall pass upon the qualifications of the personnel, so that justice is done to all men; with reference to duties performed and rank and compensation, which any member of the corps is justly entitled to. I may perform the same duties as junior engineer which you perform as inspector. The inequality of grade and pay is apparent.

5. As the honor men of West Point furnish the personnel for the Army engineers, so shall the honor men of our schools and colleges furnish the personnel of all departments of office and field service, for the Auxiliary Engineer Corps, through the three-year training period.

6. The district engineer is the commanding officer of the district, and the contracting officer, with division of duties under several departments each in charge of experienced assistants under him.

7. The duties of custodian of property and disbursing officer will be divorced from the duties of district engineer, leaving the hands of the latter untied for strictly engineering duties. No corporation would think of merging the duties of chief engineer with that of treasurer or paymaster.

8. Now then—it is essential to watch progress at Washington. Essential to have the bill introduced in the coming session, and essential to keep it going till passed.

9. *When you hear* that the bill is introduced, call on your Congressman or Senator for printed copy.

10. Talk for such legislation—be enthusiastic over it—get your business friends to write letters requesting the passage of the bill. Keep at it and don't let it rest. It will take time to get the bill through.

11. It may be necessary to keep a man in Washington under pay to "*mark time*" and keep a sharp lookout. All the engineering district, I feel sure, will rally to the necessary financial assistance.

12. If you are really interested, send a self-addressed envelope, $3\frac{1}{2}$ in. x 9 in. with 3c. postage stamp affixed, for copy of "Reasons Why an Auxiliary Engineer Corps Should be Mobilized at This Time." Any further "dope" desired will be furnished, but always send self-addressed stamped envelope.

13. Later on, if you desire it, we will have the bill cyclostyled. This work, with a copy of the brief mailed flat, will cost about 15c. for postage and paper.

14. It is desired to work and talk quietly among the employees and our friends in each district—though the New Orleans *Times-Picayune* recently published something about the proposed legislation. I feel sure the district engineers do not care to have anything to do with this legislation one way or another. They are trained to do their duty and not be relieved from it. If things have gotten into a deep rut, any relief needed must come through the people and Congress; so it is up to us to take the initiative. Strong influence is working to turn public works over to the Quartermaster Corps because they have already so many of our men in the service, and there is talk of a waterways commission and a construction engineer branch in the Quartermaster's service; but it is not believed that either the people or Congress are ready for a change of engineers. The Auxiliary Engineer Corps will meet any public necessity if there is one, for a waterways commission. There is a chance for any engineer that knows anything about river and harbor work to get in, as it calls for men having this special qualification, and where he will have every opportunity to make use of it. Let us work for it. Personal work among ourselves and friends, and before Congress, will be of much value.

Address, John D. Schmidt, 519 Canal St., New Orleans, La.

National Service Committee Makes Report of Activities

At the recent regular meeting of Engineering Council, the National Service Committee reported that since the Chicago conference on a national Department of Public Works held last April (see *Engineering News-Record* of May 1, 1919, p. 857) the work has been divided into four parts: (1) Organization of executive and finance committees; (2) drafting of a bill; (3) organization of a campaign committee, and (4) a review of public-works laws of other countries.

The Chicago conference appointed an executive committee, including Cass Gilbert, Morton C. Tuttle and W. O. Winston, who declined appointment; their places were filled by J. Parke Channing and W. H. Hoyt, of Duluth, and the National Lumber Manufacturers' Association is to name a member. The committee on text of bill has completed its labors, and it is the intention to consult leaders in Congress and obtain advice as to its introduction.

The campaign committee is still in process of organization, the desire being to obtain one or more members from each state in the Union. It was determined to create separate state committees, all synchronizing with the Washington office.

The review and compilation of the public-works laws of other countries are practically completed.

To coöperate with the state campaign committees and supply them with information and talking points, it is proposed to obtain a man with expert knowledge of Government procedure. The engagement of a publicity man is also proposed. The committee desires to conduct the campaign by avoiding objectionable methods of the past, and substitute therefor a campaign, conducted on a high and dignified plane, consisting largely of counsel given to members of Congress by their constituents—thoughtful, serious advice given in an individual capacity in much the same way in which an engineer or architect would advise a client.

In order to introduce Engineering Council to members of Congress and make known its purposes, a letter was addressed to the chairmen of various committees of the House and Senate. Appreciative acknowledgments have been received from a large number.

A regular monthly bulletin is now issued. It aims to cover the most important Governmental engineering work, the last one being a list of all engineering legislation which has been introduced into the 66th Congress and a brief discussion of the most important measures included therein.

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Assistant designing engineer, Naval Ordnance Plant, South Charleston, W. Va., \$9.20 per diem. July 8. File applications before July 8.

Valuation engineer, \$3600-\$4800 per year, and assistant valuation engineer, \$2500-\$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, \$2400 to \$1800 per year, computer (Grade I) \$1800 to \$1400 and computer (Grade II) \$1400 to \$900, Ordnance Department. Applications will be received until further notice.

Assistant inspector of engineering material (aircraft), \$5.92 per diem, July 15. File applications before July 15.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 6 Beacon St., Boston; June 27-28, Atlantic City, N. J.

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 30, Oct. 1-3, Albany, N. Y.

The Engineers' Society of Milwaukee held its regular monthly meeting, June 11. It was addressed by G. G. Curtis, of the Bray Studios, Inc., New York City, who showed and described the films, "The Motion Picture's Secret Part in Winning the War" and "The Motion Picture of the Invisible," illustrating gasoline vapor, sound waves, electric current and other unseen forces.

The Western Society of Engineers was addressed June 9 by J. H. Waterman, superintendent of timber preservation, Chicago, Burlington & Quincy R.R., who spoke on "Results Obtained from Treatment of Track, Ties and

Bridge Timbers." The celebration of the society's 50th anniversary has been postponed until June 27-28. The first day's program will include the topics, "Fifty Years of Engineering Progress" and "The Engineer in War." On the second day there will be a basket picnic at the sand dunes on the south shore of Lake Michigan.

The West Virginia Engineers' Association was tentatively formed at a meeting held in Charleston June 8, at which a constitution and by-laws were adopted. No officers were elected at the organizing meeting.

The New England Water Works Association and the **Boston Society of Civil Engineers** will hold a joint field day at Pemberton, Mass., June 25, with dinner at the Pemberton Inn. The boat will leave Rowe's Wharf, Boston, for Pemberton at 10:15 a. m.

The New York Chapter of the American Association of Engineers was addressed June 11 by Maj. David A. L'Esperance, who spoke on "The History of the 15th New York Regiment." the meeting was also addressed by A. H. Krom.

The Engineering Society of Akron, Ohio, held its first annual banquet June 10, at which E. E. Workman, president of the Akron Chamber of Commerce, spoke on the proposed city plan for Akron.

The Louisiana Engineering Society was addressed June 9 by Thomas L. Willis, city engineer of New Orleans, who spoke on garbage disposal, with particular reference to conditions in New Orleans.

The Montreal Branch of the Engineering Institute of Canada gave a dinner to Brig. Gen. Charles H. Mitchell, C.M.G., D.S.O., June 12, on the occasion of his return from overseas. General Mitchell gave an account of his experience and the part played by the engineering branch of the service on the other side of the ocean in winning the war.

Personal Notes

FRANCIS C. SHENEHON and ADOLPH F. MEYER have become associated under the firm name of SHENEHON & MEYER, consulting and designing engineers, with offices in the Metropolitan Bank Building, Minneapolis. Mr. Meyer enters the new firm from his work as special lecturer on hydraulic engineering at the University of Minnesota, having very recently served also as chief engineer and general superintendent of pulp and paper mills, Minnesota & Ontario Paper Co. He is a graduate in civil engineering, Wisconsin University, class of 1904, and has been engaged in engineering work, more particularly in the field of hydraulic engineering, since that date. From 1914 to 1917 he served as associate professor of hydraulic engineering, University of Minnesota, at the time when Mr. Shenehon was dean of the college. Since that time Mr. Shenehon has been engaged in a variety of work, in private practice, specializing largely in hydraulic engineering.

LIEUT. COL. DABNEY H. MAURY, Construction Division, U. S. A., who was advisory engineer for the original construction of water-supplies in the Army, and who recently received his discharge from the service, is in Chicago arranging for temporary consulting-office quarters. Several Eastern engagements prevent his resuming his former practice in Chicago for the time being, and he is at present making his headquarters at the University Club. Colonel Maury states that the advisory engineer's office handled 275 different projects, supplying 4,000,000 troops and 2,000,000 civilians. No typhoid fever has been attributed to the water furnished.

W. E. HART has been appointed district engineer in charge of the Minneapolis office of the Portland Cement Association, handling work in Minnesota and North and South Dakota. He has been connected with the association for the past two years, his work being principally in South Dakota. He was previously county engineer of Eddy County, North Dakota, and city engineer of New Rockford, North Dakota.

CAPT. LEVANT BROWN, Engineers, U. S. A., has received his discharge from the service and has become associated with the San Francisco office of the United States Bureau of Public Roads, as senior highway engineer. Captain Brown was with the Bureau of Public Works in the Philippines as a constructing engineer for ten years, before entering Army Service.

MAJ. SAMUEL W. FLEMING, JR., a member of the firm of GANNETT, SEELYE & FLEMING, of Harrisburg and Erie, Penn., who recently returned to this country from overseas, expects to receive his discharge at an early date. Major Fleming served with the 315th Infantry, and has been decorated with the Croix de Guerre and the Distinguished Service Cross.

PROF. CHARLES J. TILDEN, head of the department of civil engineering, Johns Hopkins University, has been called to the Sheffield Scientific School of Yale University as head of the department of engineering mechanics, and will begin his duties in that position next September. Professor Tilden has served for nearly six years as head of the department of civil engineering at Johns Hopkins. In February, 1917, he received his commission as a captain in the Engineer Officers' Reserve Corps and was ordered to active duty, but later returned to the inactive list to become secretary of the general engineering section, advisory committee, Council of National Defense. In May, 1918, he was appointed to the department of education and training, United States Shipping Board, Emergency Fleet Corporation, and was in charge of education and training work in Districts Nos. 8 and 11 on the Pacific coast. He returned to Johns Hopkins University in October last year.

LIEUT. COL. W. G. ARN, Engineers, U. S. A., recently received his discharge from the service, and has resumed his former work as assistant engineer, maintenance of way, Illinois Central-Yazoo and Mississippi Railroad System, with headquarters in Chicago. Colonel Arns entered the service on February, 1917, as captain in the Engineer Officers' Reserve Corps, and was called to active service in May and assigned to the 13th (Railway) Engineers. In March he was promoted to major, and in April, 1919, to lieutenant colonel of the same regiment. While in France he was located in the Verdun sector from September, 1917, to March, 1919, in charge of maintenance and construction work.

C. R. CUMMINS and N. F. BLAIR have become associated under the name of the CUMMINS-BLAIR CO., which will be affiliated with the present C. R. Cummins Co., with offices in the Leader-News Building, Cleveland. The new company will engage in reinforced-concrete and brick building construction.

LIEUT. COL. HAROLD TROTTER, D. S. O., has returned to Canada after several years' service at the front. Before the war he was a member of the firm of HENRY HOLGATE, consulting engineers, Montreal. He entered the war as a captain in the Canadian Engineers.

C. E. SHEARER, who for the past year has been engaged in bridge engineering for the Government of the Philippine Islands, has returned to his office in Memphis to resume private practice.

LIEUT. COL. GEORGE A. JOHNSON and MAJ. WEBSTER L. BENHAM, whose association in partnership under the firm name of JOHNSON & BENHAM was recently announced in these columns, have offices in the Firestone Building in Kansas City, Mo., and not in the Pathfinder Building, as previously stated. Colonel Johnson entered the service originally as officer in charge of the water and sewer section of the maintenance and repair branch of the Construction Division. Original construction of water supplies from the first was handled by LIEUT. COL. DABNEY H. MAURY, advisory engineer for water-supply of the Construction Division of the Army.

LIEUT. W. L. RHULE, Quartermaster Corps, U. S. A., who recently received his discharge from the service, has become associated with his father, George M. Rhule, in building construction, with headquarters in Altoona, Penn.

M. C. HUTCHINS, engineering department, Southern Railway, has been elected city engineer of Charlotte, N. C., succeeding J. C. CALDWELL, who has resigned to enter the contracting business of Caldwell, Thompson & Company.

JAMES A. SALTER has been appointed state architect of North Carolina, the appointment being authorized by the State Building Commission through act of the legislature creating the office.

L. J. DRIGGS, construction engineer, Pennsylvania Public Service Co., at Phillipsburg, has been appointed construction engineer, Citizens' Light, Heat & Power Co., of Johnstown.

FRANK T. SHEETS has been appointed designing engineer, Illinois Division of Highways, with complete charge of the design, preparation of plans and surveys of all roads and bridges constructed by the state.

CAPT. OMAR GASTON, Construction Division, U. S. A., who recently received his discharge from the service, has become general superintendent of building construction, Dahlman Construction Co., Milwaukee.

MANLEY OSGOOD, assistant plant engineer, Merchant Shipbuilding Corporation, Harriman, Penn., has been appointed chief engineer, Detroit Bureau of Governmental Research, with office at 100 Griswold Street.

MAJ. HERMAN F. DOELEMAN, Construction Division, U. S. A., has received his discharge from the service and has resumed his practice as a consulting engineer, with offices at 507 N. Charles St., Baltimore.

CAPT. JOHN K. WILLIAMS, Engineer Corps, American Expeditionary Forces, has received his discharge from the service and has accepted a position in the city engineer's department in San Diego, Calif.

J. H. BARNES and JOHN R. LESLIE have become associated under the firm name of the LESLIE-BARNES ENGINEERING Co., St. Joseph, Mo. Mr. Barnes has resigned as engineer of the city park board to devote his entire time to the new company.

LIEUT. JAMES FERGUSON has returned to Canada after four years' service overseas and has resumed his work in the engineering department of the Canadian National R.R., with headquarters in Montreal.

B. HAROLD WILLS has received his discharge from the Army and has returned to his former work in the engineer's office of Burlington County, at Mount Holly, N. J.

MAJ. D. D. GUILFOIL, 108th Engineers, U. S. A., who recently returned from France, has received his discharge from the service and has returned to his former work as sales engineer, SAUERMAN BROS., engineers and manufacturers, Monadnock Block, Chicago. The 108th Engineers, composed mainly of Chicago men, participated in the Somme and Meuse-Argonne offensives and, following the armistice, was a part of the army of occupation in Luxembourg.

L. R. WOODHULL has been appointed engineer, State Building Commission of North Carolina.

MAJ. E. J. COE has been appointed city engineer of Duluth, Minn., succeeding COL. LIONEL AYERS, resigned.

NILES C. SORENSEN, structural engineer and architect, has opened offices at 500 Congress Building, Detroit, for the practice of architecture and architectural engineering.

ARTHUR G. SKOUGLAND has been appointed engineer of the park board of St. Joseph, Mo., succeeding J. H. BARNES, resigned to enter private practice, as noted elsewhere.

G. W. COMSTOCK has been appointed county road engineer of Wetzel County, West Virginia, with headquarters at New Martinsville.

WILLIAM E. MITCHELL, 305th Engineers, has returned to Altoona, Penn., and will soon leave for Duluth to supervise construction work for R. C. Woods & Co., Camden, N. J.

T. H. JOY and H. E. GALLUP have announced the dissolution of the firm, the JOY-GALLUP Co., engineers and architects, Birmingham, Ala.

Asphalt Association Formed

Representatives of several asphalt-producing companies of the United States and Canada have completed the organization of an association, the title of which is to be "The Asphalt Association." Its purpose will be to disseminate information on the uses of asphalt, with particular reference to highway and street paving, coöperation with city, county and municipal officials and with scientific bodies and colleges seeking to bring about the most effective methods for the use of the material. The New York office will be located at 15 Maiden Lane. Other offices will be established soon in Chicago and Atlanta, and ultimately in other cities in the United States and Canada.

The following officers were elected for the ensuing year: President, J. R. Draney, general sales manager of the United States Asphalt Refining Co.; vice-president, W. W. MacFarland, assistant secretary of the Warner Quinlan Company; treasurer, N. G. Luykx, of the Freeport & Mexican Fuel Oil Corporation; secretary, J. E. Pennybacker, formerly chief of management of the United States Bureau of Public Roads, during the war period secretary of the United States Highways Council, and, more recently, director of roads of the American Automobile Association. Mr. Pennybacker will be the active officer in charge of the affairs of the association.

Exhibits Numerous and Varied at Water-Works Convention

Activity in the water-works field of engineering is indicated by the unusually large number of exhibits at the recent annual convention of the American Water Works Association in Buffalo, N. Y. The exhibits themselves were quite varied in character, covering practically every detail of apparatus, process and literature pertaining to the field. On account of the unexpected number of exhibitors, it was necessary to provide overflow exhibition rooms to accommodate them. The names of the companies which were represented are as follows:

National Water Main Cleaning Co.
Rensselaer Valve Co.
Pittsburgh Meter Co.
Engineering News-Record
The A. P. Smith Manufacturing Co.
Wallace & Tiernan Co., Inc.
The American City
Builders' Iron Foundry
Thomson Meter Co.
Gamon Meter Co.
Fire and Water Engineering
Lock Joint Pipe Co.
Municipal Journal and Public Works
Engineering and Contracting
Eddy Valve Co.
Buffalo Meter Co.
The Pitometer Co.
United Brass Manufacturing Co.
The Central Foundry Co.
Glauber Brass Manufacturing Co.
United Lead Co.
E. I. du Pont de Nemours & Co.
Union Water Meter Co.
Hays Manufacturing Co.
Pittsburgh-Des Moines Steel Co.
Birch-Hintz Manufacturing Co.
Lead Lined Iron Pipe Co.
Electro Bleaching Gas Co.
Modern Iron Works
Joseph Dixon Crucible Co.
W. & L. E. Gurley
Worthington Pump & Machinery Corporation
N. Mueller Manufacturing Co.
The Kennedy Valve Manufacturing Co.
Pittsburg Filter & Engineering Co.
Neptune Meter Co.
Water Works Equipment Co.
Ford Meter Box Co.
Multiplex Manufacturing Co.
Chicago Bridge & Iron Works
New York Continental Jewell Filtration Co.
Canadian Engineer
The Leadite Co.
H. W. Clark Co.
Hersey Manufacturing Co.
Sullivan Machinery Co.
Ross Valve Manufacturing Co.
Hauck Manufacturing Co.
The Garlock Packing Co.
McNutt Meter Box Co.
Bingham & Taylor
Simplex Valve & Meter Co.
Pennsylvania Salt Manufacturing Co.
National Meter Co.
Flower Valve Manufacturing Co.
Allis-Chalmers Manufacturing Co.
United States Cast Iron Pipe & Foundry Co.
Arnold-Hoffman Co., Inc.
El Ingeniero y Contratista
United States Rubber Co., Mechanical Goods Division
American Manganese Bronze Co.
Irving Iron Works Co.
Badger Meter Manufacturing Co.
Carbic Manufacturing Co.
Flexible Armored Hose Corporation
Darling Valve & Manufacturing Co.
Richardson Phoenix Co.
International Filter Co.
John Fox
Roberts Filter Manufacturing Co.
American Steel & Wire Co.
De Laval Steam Turbine Co.

Impostor Soliciting Loans

The Thomson Meter Co. issues a warning that an impostor is traveling through the New England States representing himself as a relative of a former officer of that company, and soliciting loans to pay hotel bills, railroad fare, etc. If he should call upon the reader, the company requests that

he be held on suspicion, wiring immediately to E. M. Shedd, 266 Brookline Ave., Boston, Mass., or the Thomson Meter Co., 100 Bridge St., Brooklyn, N. Y.

Government Surplus Materials To Be Sold in Seven Classes

Under arrangements made after the signing of the armistice to dispose of Government surplus materials with the least disturbance of normal business conditions, the director of sales, C. W. Hare, assisted by a score of assistants, has classified under seven sections the materials to be disposed of. Each section is supervised by assistants chosen because of their previous familiarity with the commodities over which they have charge. These materials include those which had been contracted for previous to the armistice and which the Government was forced to take over when the signing of the armistice practically suspended operations in over 500 manufacturing plants throughout the country. Practically all these plants were turning out, as component parts or finished products, materials foreign to their peace-time production.

The various sections which will handle the materials as classified are as follows: (1) Contractors' and railway equipment and building material; (2) plant facilities, including completed and uncompleted manufacturing plants, warehouses, etc.; (3) machine tools; (4) motor vehicles, vehicles, and aircraft; (5) quartermaster stores; (6) ordnance and ordnance stores; (7) raw materials and scrap.

The actual selling of the surplus materials is to be done by the several bureaus of the War Department which holds title to the property to be disposed of. Sales will be made under the following rules: (1) For cash at auction; (2) to the highest bidder on sealed proposals; (3) at the current market price if there is an established market for such property and current market quotations accompany the report of sales; (4) by negotiations under competitive conditions and provided the price obtained is not less than the price fixed by appraisal, or is the highest of not less than three independent competitive bids.

Material-Handling Machinery Manufacturers Meet

Four sessions of a semi-annual meeting of the Material-Handling Machinery Manufacturers' Association were held June 10-11 at the Hotel Astor in New York City, with a large membership in attendance. Most of the time was given over to discussions of proposed publicity methods by which the attention of engineers and manufacturers could be brought to the advantages and economies of machinery instead of hand labor for handling all kinds of material, but an evening session was devoted to more general subjects, with special attention to machinery used in ports and terminals.

BUSINESS NOTES

THE BARBER ASPHALT PAVING CO., of Philadelphia, announces that, following the promotion of Charles W. Bayliss from manager of the street and road department to vice-president in charge of sales, the following changes in organization have become effective: J. E. Morris is appointed manager of the street and road department, Philadelphia, Penn.; H. M. Stafford succeeds Mr. Morris as assistant manager in charge of the Eastern district, with headquarters in Philadelphia; F. F. Massey succeeds Mr. Stafford as assistant manager in charge of the Southwestern district, with headquarters in Memphis, Tenn., and G. R. March succeeds T. H. Morris as sales manager of the Iroquois department.

THE WILLIAM B. SCAIFE & SONS CO., of Pittsburgh, Penn., manufacturer of steel buildings and bridges, transmission towers, and storage tanks for oil and water, announces the opening, July 1, of a Chicago sales and engineering office at 38 S. Dearborn St. Charles F. O'Hagan, formerly chief engineer of the company at Pittsburgh, will be resident engineer and manager.

THE BAILEY METER CO., of Cleveland, Ohio, announces that E. A. Hitchcock has become associated with the company as vice-president. He will supervise the training of technical graduates for the company's service and sales department. For the past six years he has been connected with the E. W. Clark & Co. Management Corporation in an advisory capacity. Previous to that time he was professor of experimental engineering at the Ohio State University.

THE BORDEN CO., of Warren, Ohio, manufacturers of Beaver easy-working die-stocks and square-end pipe cutters, announces that C. A. Greene, its Chicago representative, has opened a downtown office at 549 W. Washington Boulevard.

THE CHICAGO PNEUMATIC TOOL CO, Fisher Building, Chicago, Ill., announces that J. W. McCabe, who was district sales manager of the company at Buffalo, N. Y., has been appointed special representative for the foreign-trade department. The company announces also that W. H. White has been appointed acting district manager of sales at Buffalo during Mr. McCabe's absence on a trip to the Orient.

THE CHALMERS PUMP MANUFACTURING CO., of Lima, Ohio, announces that it has purchased the entire pumping machinery business of the Canton-Hughes Pump Co., of Wooster, Ohio. Beside C. F. Brown, president, and Fred Biszantz, secretary and treasurer, of the old Chalmers Pump & Manufacturing Co., Frank D. Shumate, of Chicago, has become associated with the company as vice-president and sales manager. Mr. Shumate has been connected with the Worthington Pump & Machinery Corporation for the past 13 years.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO. announces the appointment of H. L. Garbutt, for the past six years manager of the line-material section of the company at East Pittsburgh, Penn., as manager of the supply division of the San Francisco office. Mr. Garbutt was formerly in the sales organization of the Drew Electric & Manufacturing Co., of Indianapolis.

THE MACOMBER & WHYTE ROPE CO., Kenosha, Wis., has opened a branch at 30 Church St., New York City, under the management of E. E. Robirds; also a branch at Birmingham, Ala., in charge of James A. Boope, 805 American Trust Bank Building.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE AMERICAN DISTRICT STEAM CO., of North Tonawanda, N. Y.; catalog, 80 pages, illustrated; descriptive of central-station and interior heating equipment. Also a folder entitled "The Radiator Has the Floor," describing the "Adsco" vapor heating system.

THE HODGES STUCCO MACHINE WORKS, of Union Central Tower, Cincinnati, Ohio; pamphlet, 9 x 12 in., eight pages, illustrated; describes the Hodges electric stucco machine for applying stucco by centrifugal action.

THE WALLACE & TIERNAN CO., INC., of 349 Broadway, New York City; folder, 8½ x 11 in., 4 pages; states the necessity for sterilization of water supplies affected by spring rains and floods and advocates the use of liquid chlorine as the agent.

THE M. & M. WIRE CLAMP CO., 2 Fifth St., S. E., Minneapolis, Minn.; pamphlet, 3½ x 6 in., 15 pages, illustrated; describes the use of adjustable concrete form clamps.

THE CENTRAL FOUNDRY CO., of 90 West St., New York City; leaflet, 8 x 6 in., one page, illustrated; describes the use of "Led-Lok" for the connection of cast-iron soil pipe, consisting of a lead joint which is locked into the pipe.

THE HOOD MANUFACTURING CO., of 3227 First Ave., South, Seattle, Wash.; catalog, 7 x 10 in., 16 pages, illustrated; gives specifications for and illustrates the use of Hood tractors.

THE MCMYLER INTERSTATE CO., of Cleveland, Ohio; bulletin No. 40, 8½ x 11 in., 49 pages, illustrated; describes and gives layouts for the use of shipbuilding cranes.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

Volume 82 | NEW YORK, THURSDAY, JUNE 26, 1919 | Number 26

Philosophy and Romance

SELDOM does one hear an address of such singular charm as that of Francis C. Shenehon, delivered before the annual convention of the American Society of Civil Engineers. His subject, "The Engineering Activities of the Twin Cities," invited a dry-as-dust treatment —a stringing together of facts and figures that would swamp the visitor but leave him impressed with the idea, however vague it might be, that he had come to a country of engineering wonders. Instead, the address has an irresistible pull, is inviting, not repelling, gives the basic reasons, geologic and economic, for the location of St. Paul and Minneapolis, and then paints the picture not only of what is but what may be in the future. The philosophy illuminates the romance and justifies the vision. We urge every engineer, no matter what his specialty or place, to read with care, and then reread, the address of Mr. Shenehon. It is not merely interesting and informative, but is an unusual model of something we sadly lack in our engineering writing—a technical theme handled with grace and charm, losing nothing of its technical value, but rather being enhanced by the treatment.

Precautionary Maintenance of Motor Trucks

MAINTENANCE is as essential to a motor truck as to the road upon which it travels. While this statement seems obvious, there is an abundance of ocular evidence that many contractors and other truck owners disregard it—in its preventive aspects, at least. This tendency is seen in the condition of tires which have been practically ruined by overloading, skidding, overspeeding, and misalignment of wheels. The reasons for this neglect are no doubt lack of understanding on the part of the owner of the cost of tires relative to other truck maintenance and lack of knowledge as to the principal causes of excessive tire wear. What may be the result of such abuse is set forth in an article by A. F. Masury on p. 1262. The facts presented are well known to tire and truck manufacturers and dealers, but it is doubtful whether the majority of truck operators realize that, normally, gasoline and tire costs are equal. Failure to grasp this fact is probably due to the insidiousness of tire wear. Gasoline waste is immediately apparent both in bills and decreased truck efficiency, but in tire abuse the damage occurs in a manner which is not noticed until the tire goes to pieces. Neglect of precautions against abuse leads to a tire cost which often outweighs the utmost possible extravagance in gasoline waste, an excess which is not realized unless accurate itemized cost data have been kept. In the absence of such data, particular attention should be given to preventing those conditions of truck adjustment and operation which are known to be destructive.

Another Joint Concrete Committee

THREE years ago the Joint Committee on Concrete and Reinforced Concrete completed its third and "final" report, and shortly thereafter its constituent committees were discharged by their respective societies. Since then the world has been too full of other activities to bother much about standard specifications. The final report was an admirable document, which, in spite of the rigidity and conservatism peculiar to the efforts of joint action, is recognized as having the authority it deserves. Nevertheless, the subject of concrete, like all other technical subjects, is moving, and fresh consideration of concrete specifications is now necessary. It is, therefore, pleasing to note that the American Society for Testing Materials, through its executive committee, has initiated action toward the formation of a new joint committee to prepare standard specifications for reinforced concrete, with the same constituent societies as were brought together in the older joint committee. This committee should be formed at once and should proceed immediately to work, for some time must elapse before a report can be expected from it. As was pointed out in these columns three years ago, the opportunity for some authoritative utterance on the manufacture of concrete is more important than one on the design. Much remains to be crystallized regarding concrete as a material. To this, it is hoped, the new committee will devote most of its attention.

"Movies" in Science

MOTION-PICTURE houses for some time have been showing pictures of what they call the "analysis of motion," in which well known actions, such as figure skating, sprinting and baseball pitching, are reproduced on the screen at one-eighth the actual speed of the performer. Every element of motion in these pictures stands out with snapshot clearness. Grace hitherto unsuspected is revealed, and the methods by which results are achieved are understood as never before. This latter phase has decidedly an engineering application in the development of motion study and its consequent readjustment of production methods. No false or unnecessary movement can escape detection, but at the same time the sense of motion, lacking in a series of snapshots, is always present. An analogy may be found in the system used by Nathan C. Johnson in studying the setting of concrete, as referred to on another page. While the popular "movie" film slows down normally fast processes, Mr. Johnson's automatic camera speeds up the normally slow, so that one can, for instance, observe in a few minutes the physical and chemical phenomena of many days. Motion pictures have already had a marked influence on social conditions; may they not nave a bright future in science?

The Development Committee's Report

WITH the presentation to the board of direction of the progress report of the committee on development, there devolves on each member of the American Society of Civil Engineers a duty to study the report in detail and to communicate his views to the committee. Such is the wish and request of the board. The report has been prepared by a body representative of the society geographically and in varying points of view. It is a crystallization of ideas that have long been developing and that have assumed their present form after some months of study and four days of the hardest kind of work in Minneapolis.

Though the resolution accompanying the document states that the report contains "certain fundamentals which it is anticipated will form the basis of its ultimate report," it is clear from the discussion in Minneapolis that the committee is open-minded. It is seeking the views of the members of the society. It wants to know what of the content of the report they consider good, what they wish modified or rejected.

Space does not permit either detailed analysis or discussion. In general, it will be conceded, we believe, that the report stands on solid ground. Such radical innovations as the proposal to consolidate the four leading societies into one or to make the welfare work supreme are rejected. On the other hand, there is recognition that all engineering societies need to be drawn closer together, and that present conditions require more attention to welfare work than was necessary in the past. The provision for these steps is made without interjecting elements that would lessen the society's prestige.

In the four major divisions of the report the controlling ideas are plainly evident. In the category of technical activities, the spirit is that of development of a fuller service to the membership, a service that shall include in well rounded fullness the wide scope of what is now termed civil engineering. Question must be raised as to the source of the funds for the proposed enlarged work, but that will necessarily have the detailed consideration of the committee if the plans outlined are approved.

As to internal affairs, the ruling idea is that of organization along the lines of our Governmental system, so that the members in each community and each district may come to know one another better and by better acquaintance work more effectively for the advancement of the engineering profession. An important feature in this section of the report is the emphasis on the need for taking care of the younger members—not merely of the society but of the whole profession.

As to external relationships, the recommendations look to a federation for civic work of all elements of the profession, the method of organization being from the bottom up—through the locals and the state organizations to a national council.

In regard to public relations there are three dominant points: Publicity, that the function of the engineer may become better known; vigilance and action in matters of legislation affecting engineers; and the duty of the engineer as a citizen. As to each of these major lines of activity much will, we hope, be said in the near future.

It is evident that the committee has pitched high its ideal for the society. Appreciating the quality and the size of the membership, it proposes a program that a weaker body could not or would not dare attempt. As to the vision, generally, there will probably be little disagreement. As to detail and method there will be differences of opinion, and on these differences the committee desires light from the members.

In considering the report, there are two important facts to be remembered: (1) Whatever plans are evolved from the work of the committee will have the backing of nine thousand engineers of a class whose individual achievements are a warrant of effective action once they place themselves back of a definite program; (2) the ultimate report, strong as it will be with the backing of nine thousand civil engineers, will not stand alone. The other three national societies have similar committees. The inevitable conference report which, obviously, will not touch the internal affairs of the individual societies, will have mobilized for it the strength of forty thousand leaders of the profession.

The report, then, is destined, when developed into its final form, to have tremendous influence. Progress in the Mechanical Engineers' committee has been sufficient to show that the thinking in that society on external and civic relations is along parallel lines. The same vision is controlling that has actuated the Civil Engineers' committee—a vision of enlarged service to the profession and to the community. The other societies, if their participation in Engineering Council is a criterion, will have similar views. Forty thousand engineers united in effective organization, with a vigorous program such as they have the ability and vision to draft, can do more for the members of the profession than any other agency. Therefore, it behooves the members of the American Society of Civil Engineers to express their matured views on the report. The committee on development has reached the point where it must have their help and counsel. After the members have responded, the program for action can be formulated.

Good Roads on Long-Term Bonds

NEW York State has recently had a change in its highway administration, and with it has come a change in highway policy. The former administration, against the advice of its engineers, leaned, latterly at least, to the construction of a large mileage of cheaper type of highway. The object, if one may put it so, was political rather than statesmanlike—the desire to satisfy the clamors of the populace rather than to give them that which the state's own experience had demonstrated to be the most economical in the long run.

Furthermore, under the New York law the state assumes responsibility for maintenance and rebuilding, once it has taken over a road. It is to the interest of the local community, therefore, to get as much mileage as possible. If that mileage be constructed with a surfacing that wears out in four or five years, or less, it is no concern of the local community, except in so far as it contributes to the general state tax levy. It is a bad business procedure for the state, however, not merely because the maintenance cost of heavily traveled roads is high, but because the state highways are financed by fifty-year bonds, and with a continuance of this procedure issue upon issue would be piled up to pay for surfacings that had disappeared.

The figures in the New York case are very convincing. In the period from January, 1915, to December,

1918, the maintenance on 284 miles of brick road cost $210 per mile per year; on 208 miles of concrete roads, $138; on 2793 miles of bituminous macadam, penetration method, $490; on 2451 miles of water-bound macadam, $911, and on 173 miles of gravel macadam, $843. All of these figures are for the maintenance of surfacing without the reconstruction of more permanent or expensive types.

With such experience data available, we are not surprised at the reversal of policy in the highway department. Henceforth, ultimate economy is to be looked to and the mileage that the local communities do get will, in wearing ability, bear some decent proportion to the life of the bonds under which they are financed.

No one in these days will defend fifty-year highway bonds, but, that being the law, it is plain that the highest type construction only should be allowed on the heavily traveled roads.

City Transit Concentration

CITY growth has changed the aspect of many transit problems since the inauguration of the earliest rapid-transit systems. Improved transit facilities, constructed because of growing congestion, have in turn attracted more business to their neighborhoods, and have further increased the crowding of business and of traffic. Today transportation is the throttling point of city activities; housing, heating and lighting, telephone and other services have possibilities which our present demands do not approach, while the transportation systems are seriously overburdened.

New problems have come into being with the change of conditions. On the one hand, the congestion of traffic that has been created must be dealt with; better means must be devised for handling the very dense traffic with which existing transit routes have burdened themselves. On the other hand, concentration of traffic by a few transit routes must be counteracted and distribution of business and of traffic brought about. In connection with both directions of development, the coordination between street and transit routes needs to be improved, and the condition of mob-like crowding which exists at the entrances to important rapid-transit stations must be relieved. Some, perhaps all, of the new problems of transit congestion are worth consideration in connection with the discussion of continuous-train service which appears on another page.

If the continuous-train system will solve a sore and extreme problem, like that of 42nd St., it has much larger possibilities. Its distinguishing characteristics are its great traffic capacity, and its distributed station service. When we are confronted by serious overloading both of rapid-transit lines and of their street approaches, these qualities give the "moving sidewalk" a commanding claim for attention in transit planning.

Relatively few engineers have concerned themselves broadly with transit problems in the past; in the future these problems will concern many. City passenger movement—both surface and rapid-transit—is in the field of the municipal engineer, for it deals with one of the most essential services in the city's existence. Hitherto not all municipal engineers have been sufficiently free of the pressure of the moment's duties to face resolutely the problems which the future will bring. Mr. Seaman's article may prove helpful, therefore, by picturing conditions of serious character which, though now restricted to only two or three cities, are likely to become much more general.

Of greatest value, perhaps, is the emphasis which consideration of continuous trains lays upon what may be called the crosstown traffic problem. Reference to the conditions existing in the southerly one-third of Manhattan Island will bring this problem most clearly before the mind, although it exists in every large city. It is the problem of delivering traffic to an area rather than to points along a line—in other words, of distributing from the trunk lines of transit; and in Manhattan this distribution is crosstown. The one- to two-mile width of the island is adapted for highest-grade business use over its entire width, yet in the past only the central axis has been so developed, while the outskirts, because distant from the central axis, were left to second- and third-class service. In earlier years, moreover, concentration of all major business along a single line was most in harmony with the needs of the business. But, many decades ago, the facilities of a single street were out-grown, and today the great need is for means of spreading the traffic from river to river.

Counteracting the natural tendency toward lateral spread, however, there has been in New York the obstacle of the growing difficulty of crosstown transit. In recent years this difficulty has become serious indeed. The problem has had some study by the rapid-transit construction authorities of the city, but action has ever been blocked by the greater pressure for improved longitudinal transit. It may be hoped that now, with the principal rapid-transit lines nearing completion, the formidable crosstown problem may be taken in hand again. And it may also be hoped that the lessons sure to flow from such study will be noted by the engineers of other communities with respect to their bearing upon local transit needs and plans.

In view of the large possibilities of the continuous-train system, it is remarkable that no trial installation has been made so far. Important objections to the system lie on the surface. There are undoubtedly great mechanical difficulties in the problem. Equally serious doubts may be entertained concerning the ability of a miscellaneous public to use a moving device. But both classes of doubt may be regarded optimistically. As concerns the adaptability of the public, the doubts indeed have largely been deprived of their force by the success attained with moving stairways; their heavy patronage, even in the stores where they are used by women and children almost exclusively, and are often without attendance, overthrows the fear that moving transit devices are dangerous. With respect to mechanical difficulties, the case may be considered in the light of other unpromising railway problems that have been worked out to complete, practical success. In short, the striking correlation between certain vital transit needs, on the one hand, and the improved facilities afforded by the continuous train, on the other, is bound to force the system into notice, and, while difficulties of serious character may be expected in applying it, they do not appear insuperable.

The 42nd St. problem is only one of a class of crosstown problems in New York. The city is a ribbon of parallel threads which lack the bonding strength of cross-connection. Complete control of the crosstown problem, if it can be attained, will create a new basis for the city's development.

Storing and Handling High Explosives During the War

Methods Developed by Ordnance Department in Taking Care of Vast Quantities of Ammunition Were Based on Safety Regulations and Modern Material-Handling Devices

By G. C. Munoz

Major, United States Army, Chief of Construction Section, Supply Division, Ordnance Department, Washington, D. C.

High explosives of the kind used in ammunition are rare commodities in peace times, but even their occasional use would seem to make it worth while to record for future reference the methods of handling and storage developed by the United States Army during the war. To assure the necessary steady flow of this ammunition to the American Expeditionary Forces, embarkation depots capable of handling a 30-day supply had to be built at seaboard points, remote from large communities and yet within the lighterage limits of the major ports from which the material was shipped. The principal problem to be solved in planning these depots was the adoption of standard types of magazines for the safe storage of ammunition, smokeless powder and explosives; the planning of terminal track and wharf facilities for the rapid handling of large amounts of ammunition; and the protection of the military stores from fires or from enemy attack.

Seven of these depots were established along the Atlantic seaboard; they were located as noted in the accompanying table. In addition, storage facilities were provided at the principal shell-loading and bag-loading plants, and since the signing of the armistice special depots for the storage of high explosives have been established in sparsely settled regions in the interior of the country. The tidewater depots were all designed in accordance with certain fixed standards which are given below, although, of course, in each case there were many variations in local conditions which required special detailing. The general layout of an ideal depot is shown in the accompanying drawing.

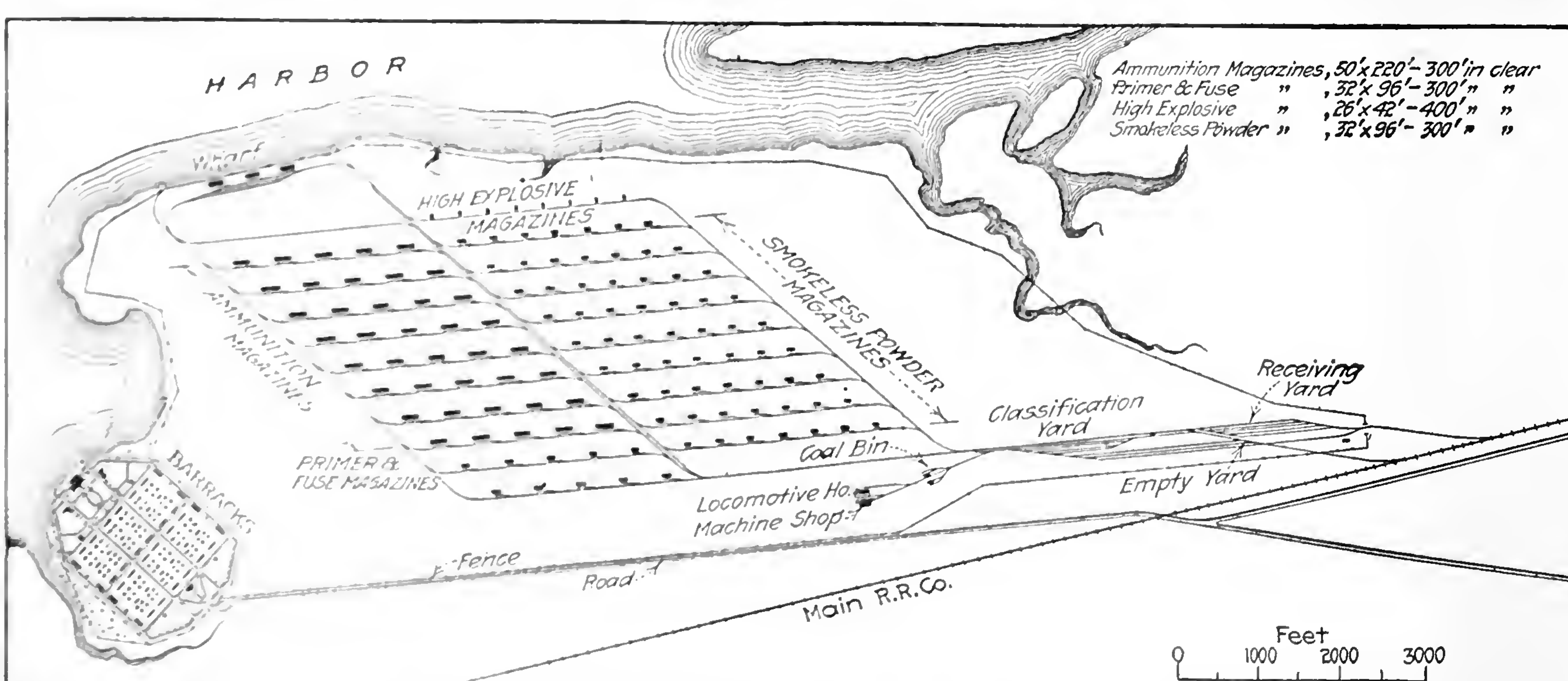
TABLE SHOWING LOCATION AND COST OF ARMY AMMUNITION SEABOARD DEPOTS.

Depot	Harbor	Cost
Raritan Arsenal, New Jersey	New York	$14,883,000
Sandy Hook Ordnance Depot, New Jersey	New York	972,000
Delaware Ordnance Depot, New Jersey	Philadelphia	6,350,000
Curtis Bay Ordnance Depot, Maryland	Baltimore	8,253,000
Turner Ordnance Depot, Maryland	Baltimore	93,000
Pig Point Ordnance Depot, Virginia	Hampton Roads	3,340,000
Charleston Ordnance Depot, South Carolina	Charleston	5,516,000
Total Cost		$39,407,000

As a result of the study of various explosions of ammunition in storage it was concluded that, as in the event of an explosion in any ammunition magazine the shells might be hurled for a distance of one-half mile, it would therefore be necessary to space the magazines that distance apart, to preclude the danger of a bursting shell being hurled from one magazine into the next one and there causing a second explosion. This was obviously impossible, as it would have entailed the construction of tremendous amounts of railroad track and would have required the acquisition of much larger areas of land than could possibly be obtained in the neighborhood of our principal seaports. Experience indicated that a spacing of 50 ft. between magazines would be sufficient to preclude the danger of sympathetic detonation between magazines. It was necessary, therefore, to choose between the above two limits, and a spacing of 300 ft. in the clear between magazines was finally decided upon. The standard layout adopted was to stagger alternate rows of magazines, as this resulted in a slight economy in land.

In planning storage for high explosives in bulk, it was decided that a maximum amount of 250,000 lb. of high explosives per building would not be exceeded. The size adopted as a standard was 24 x 40 ft. by 9 ft. high.

The proper spacing of high-explosives magazines one from the other, and the distances that should be maintained between magazines and inhabited dwellings, railroads, highways, etc., were carefully studied. It was decided to comply with the requirements of the American table of distances regarding inhabited dwellings, public highways and railways outside of the ordnance depots. This table was a result of the studies of a

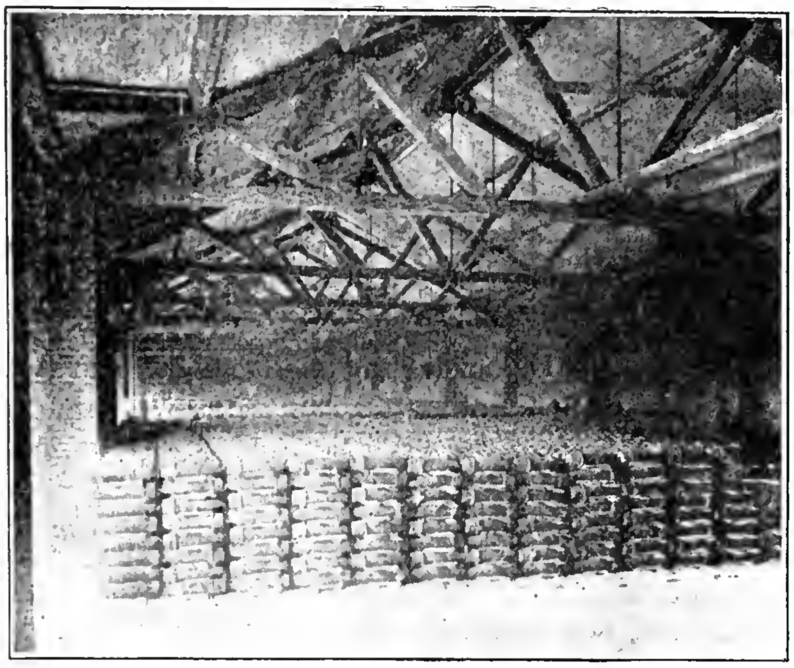


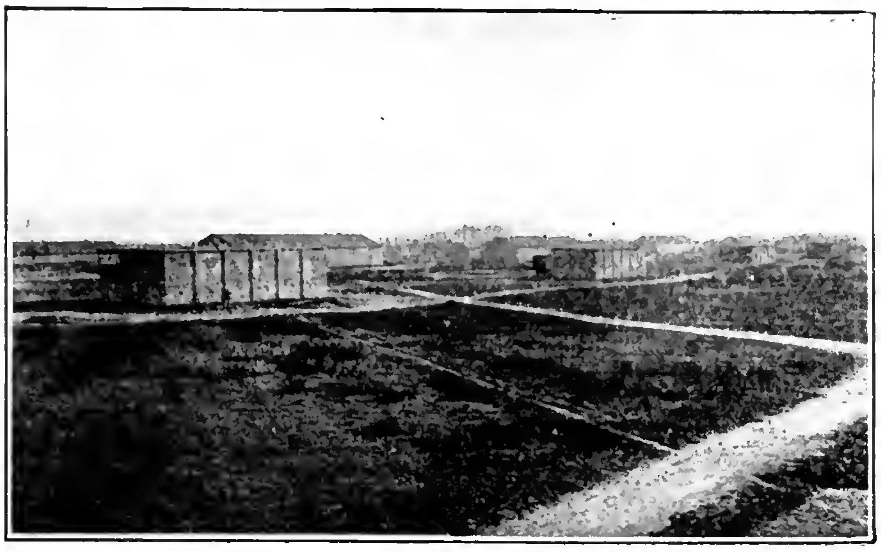
GENERAL LAYOUT OF A TYPICAL ORDNANCE DEPOT, USED AS AN OVERSEAS AMMUNITION-SHIPMENT POINT DURING THE WAR

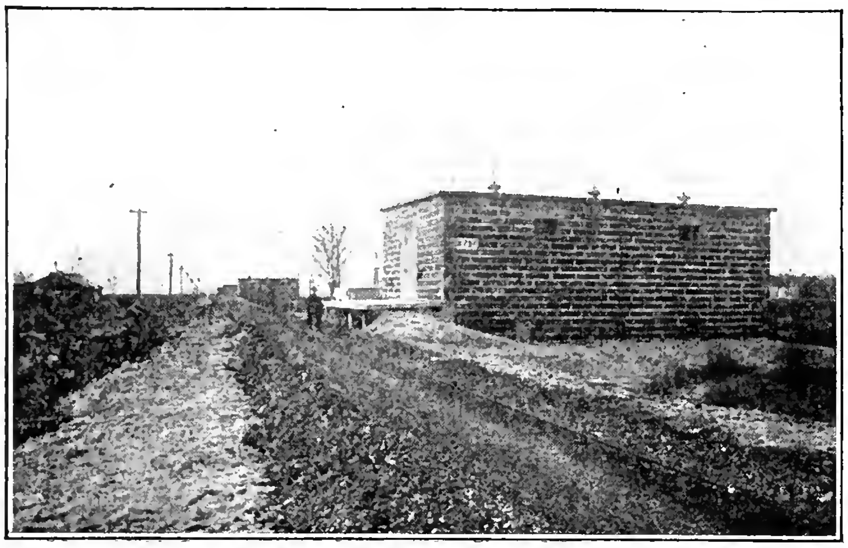
special committee appointed by an association of manufacturers of powder and high explosives established in 1910 and revised in 1914.

A model law for regulating the storage of explosives recommended to various states by the Institution of Makers of Explosives contained a clause regulating the distance between magazines as follows: For 25,000 lb., the spacing between barricaded magazines should be 100 ft. and for each additional 1000 lb. of explosives there should be added a distance of 1⅓ ft., and for magazines without barricades the above spacings should be doubled. According to this rule the barricaded distance between magazines containing 250,000 lb. would be 400 ft. and after consultations with various experts on explosives, it was decided that on account of the relative insensibility of the principal military explosives, T.N.T. and picric acid, as compared with the demolition explosives for which the above rules were made, it was proper under war conditions to store the military explosives in unbarricaded magazines at the barricaded distances described above. This was finally adopted as a standard for the supply division, and all high-explosives magazines of 250,000-lb. capacity were spaced 400 ft. apart in the clear, unbarricaded.

It was decided that smokeless powder should be handled through the ordnance depots in bulk for the reloading of 75s and 4.7s overseas, and loaded in bags for propelling charges for the shells of larger calibers, the bags being packed in fiber or metal containers, those of the latter type being more bulky and more dangerous because each bag contained a core of black powder to assist in the rapid combustion of the charge. A practical test made with several boxes of smokeless powder demonstrated that this material in bulk burns very rapidly but does not explode. It was, therefore, decided that the maximum amount of smokeless powder in bulk to be stored in one building should be 500,000 lb. Allowing for proper ventilation around the walls and for the necessary aisle space, this amount of smokeless powder required a building 32 x 96 ft. by 10 ft. high, which was adopted as the standard-size smokeless-powder magazine.







TYPICAL POWDER AND AMMUNITION MAGAZINES USED BY ARMY DURING WAR IN PORT DEPOTS

Upper left, smokeless powder magazines in group. Upper right, interior of ammunition magazine. Lower left, primer and fuse magazines. Lower right, high explosives magazine

Studies of fires in smokeless-powder factories showed that the flame from a conflagration of a large amount of smokeless powder would reach great distances. It was decided to space the smokeless-powder magazines 300 ft. apart in the clear, as experience available indicated that this would be sufficient to prevent a conflagration in one building from spreading to the adjoining buildings. The spacing adopted is clearly shown in the view of this type.

After the signing of the armistice a revision was made of all high-explosives magazines at the depots established on the Atlantic seaboard, and it was decided that, as a peace-time basis for storage of explosives, the amount of high explosives per magazine should be reduced so that the distance between them would be in strict compliance with the rule described above for the spacing of high-explosives magazines. For the storage of large amounts of surplus high explosives that were on

hand at manufacturing plants, loading plants, etc., new depots were established in sparsely settled areas in the interior of this country. The amount of explosives in them was limited to 250,000 lb. per magazine, and magazines were spaced 800 ft. apart, which is the unbarricaded distance in accordance with the rule referred to above.

In planning the fire protection for the ammunition depots, consultations were held with the manufacturers of explosives, with other experts on the subject, and with the National Board of Fire Underwriters. As a result of this a standard policy of fire protection was adopted and followed at all of these depots. The problem of fire protection was devided into two classes, the first being the protection of the ammunition-storage areas, and the second being the protection of barracks, general storage warehouses, wharves and railroad yards.

Sprinklers Not Warranted

The question of providing the magazine area with hydrants and equipping the magazines with sprinkler systems was discussed informally with the representative of the National Board of Fire Underwriters and with manufacturers of explosives. After thorough study of the matter, it was decided that the great expense of installing a water system through the magazine areas was not justified. If the small fire equipment which it was planned to place at all magazines was not effective in putting out a fire in its incipiency, it was felt that it would then be too late for the sprinkler system to act or for the fire company of the depot to obtain water from a hydrant system scattered through the magazine area. In order to determine whether this decision to omit sprinkler systems from all magazines was justified, arrangements were made at the suggestion of the National Board of Fire Underwriters and through the courtesy of E. I. du Pont de Nemours & Co. to make tests at Carney's Point to determine the value of a sprinkler equipment in fires in the storage of smokeless powder, T.N.T. and picric acid under different conditions. It was the consensus of opinion after these tests were made and studied that the cost of a sprinkler system was not warranted.

It was endeavored to prevent the occurrence of fires in the magazine area by precautions in the construction of the magazines, in guarding, in clearing the magazine area of all fire hazards, and in equipping the locomotives with fire equipment, spark arresters, and specially inclosed ashpans, in order to reduce as far as possible the danger of fire from these sources.

The magazines were protected from fire by a liberal supply of small fire equipment, both inside and outside. The type of small equipment generally used was 40-gal. bucket tanks and 5-gal. hand-pump extinguishers, both being filled with nonfreezing solutions. The fire protection for the barracks was the standard type developed by the Army and used at all cantonments Other important features of the fire protection of the depots were the organization of fire brigades, the establishment of a fire-engine house with facilities for housing the fire marshal and his crew, the installation of electric fire-alarm systems, a liberal installation of telephones, and the construction of numerous small guard houses for housing the detachments assigned to guard duty.

In the design of the ammunition magazines it was attempted to reduce to a minimum the danger from missiles in the event of an explosion; to make the magazines as nearly fireproof as possible; and to make the buildings dry and well adapted to the mechanical handling methods that had been decided on. The standard adopted was a building 50 x 218 ft., with brick pilasters, tile walls, concrete floors and roof of gypsum slabs resting on wood roof trusses and wood purlins. The walls should eventually be plastered on the outside, but this was omitted for the sake of speed and economy. This construction is shown in the views.

Three types of high-explosives magazines were adopted. The type adopted when it was anticipated that they could be used permanently by the Army was very similar to that described above for ammunition magazines and shown in one of the views. The floors, however, were of wood, to avoid danger from striking sparks.

For temporary use, a wood-frame magazine with corrugated asbestos sheathing and gypsum slab roof was used; and for storing dynamite, which material could be detonated by a rifle bullet, bullet-proof magazines were constructed. These latter were similar to those of the permanent type except that the tile was filled with sand and the fire doors were bullet-proofed with steel. A test made with an Army rifle, by firing three bullets at the same spot of a sand-filled tile, resulted in penetrating only the outside shell of the tile.

Smokeless-powder magazines were built of wood frame, corrugated asbestos sides, gypsum roof and wood floors, care being taken not to have any exposed nail heads. One of these is also shown.

Special magazines were built for the storage of primers and fuses. On account of the great cost and importance of these materials, the magazines were made of fire-resisting exterior, the size and spacing being the same as for the smokeless-powder magazines (32 x 96 ft., and spaced 300 ft. apart). The walls of these magazines were of tile, the roof was of gypsum, and the floor of blind-nailed wood plank.

Transportation Methods Important

It was planned to transport ammunition from the magazines to the wharves on flat-cars covered with tarpaulins and to transport explosives in box cars. For the rapid transfer of this material to lighters a front track was built as close to the pierhead line as possible, and light shells and explosives were skidded on hardwood skids direct from the cars to the lighters. For the transfer of heavy shells 15-ton locomotive cranes with 50-ft. booms were provided. These cranes operated on the front track, the flat-cars with shells being spotted on a second track spaced 18 ft. c. to c. from the front track. This spacing gave ample width for the operation of the crane. The standard width of wharf adopted was 46 ft., which left sufficient width in the rear of the second track to permit a fire engine or automobile to pass when the tracks were blocked with railroad equipment. The top of the rail of the front tracks was flush with the floor level, in order to permit of trucking across the tracks when necessary.

The wharves were designed for a live load of 500 lb. per square foot, and the tracks for either a Cooper E-40 locomotive or a 15-ton crane with loaded boom at point of overturning, the boom being so placed as to produce the maximum loads. All bracing was kept at least 3 ft. above mean low water, in order to avoid the delay usually encountered when placing bracing near low-tide level.

Dock sheds of fire-resisting construction, 60 x 216 ft., and spaced approximately 300 ft. apart in the clear, were built directly in the rear of the wharf, and were used as transfer sheds are used on commercial wharves. The floors of these buildings were of reinforced concrete supported on wooden piles and were designed to carry a live load of 600 lb. per square foot. Depressed tracks were built in the rear of the dock sheds to facilitate the rapid unloading of cars into these buildings, and behind these loading tracks small yards were provided to assist in the quick shifting of cars at the wharves.

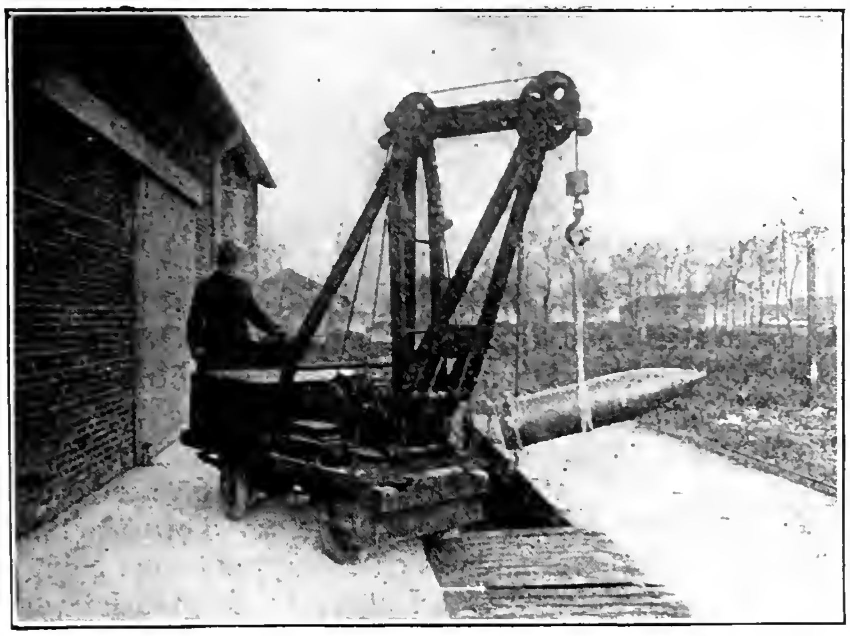
Fire walls were built under all of the ordnance wharves, concrete walls being spaced approximately 510 ft. apart. with intervening timber fire walls constructed of two layers of 2-in. plank, one layer being placed vertically and the other horizontally, and spaced approximately 170 ft. apart.

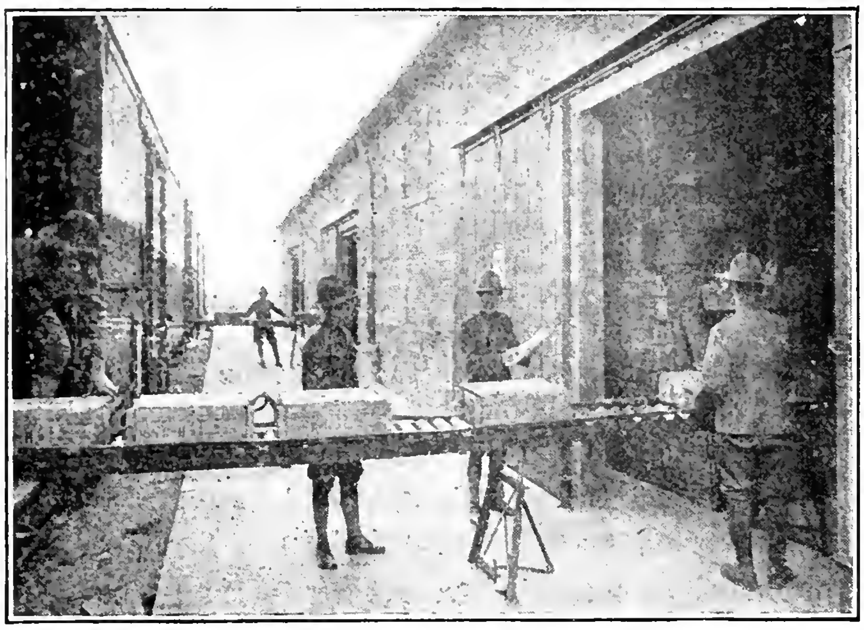
The plan for the pier at Pig Point, Norfolk, Va., differed slightly from the above plan; it was built 4000 ft. from the shore, and it was not anticipated that very heavy shipments would be made from this point. The pier was therefore built 105 ft. wide with a dock shed 260 x 40 ft. with surface tracks on one side and depressed tracks on the other, both sides of the pier being provided with fender piles so that lighters could be loaded on both sides when desired. As a certain amount of vibration was inevitable on this pier, the dock shed was built of wood-frame construction covered with corrugated asbestos.

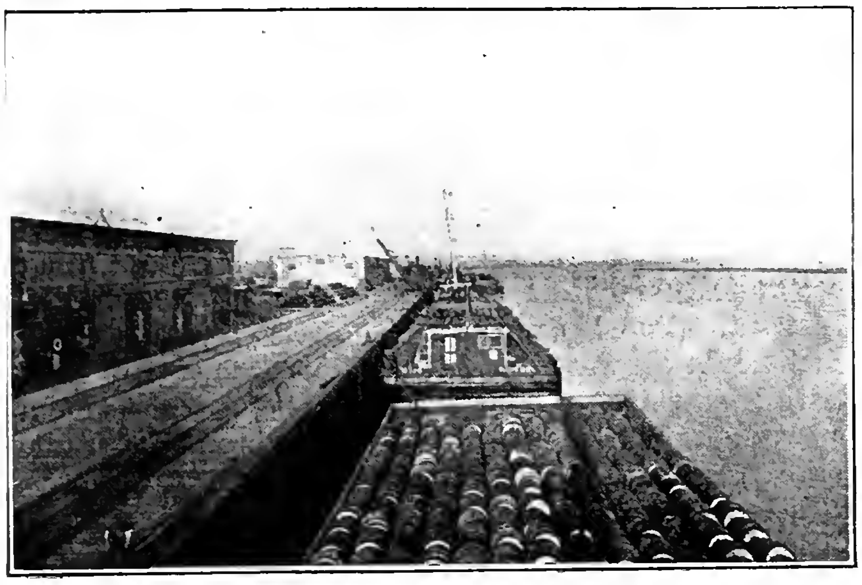
A railroad system was constructed at each depot to make access easy to any point and to provide receiving and classification yards for incoming and outgoing cars. The main running tracks and yards were placed at a safe distance from the magazines. Curvature of track was limited wherever possible to 13°, to preclude any trouble from derailments. The 80-lb. A.S.C.E. rail was selected as a standard for ordnance depots, but, on account of the difficulty of obtaining these rails quickly, a good deal of 67½-lb. rail, which had been manufactured for the Imperial Russian Government but had not been shipped, was used, and proved very satisfactory.

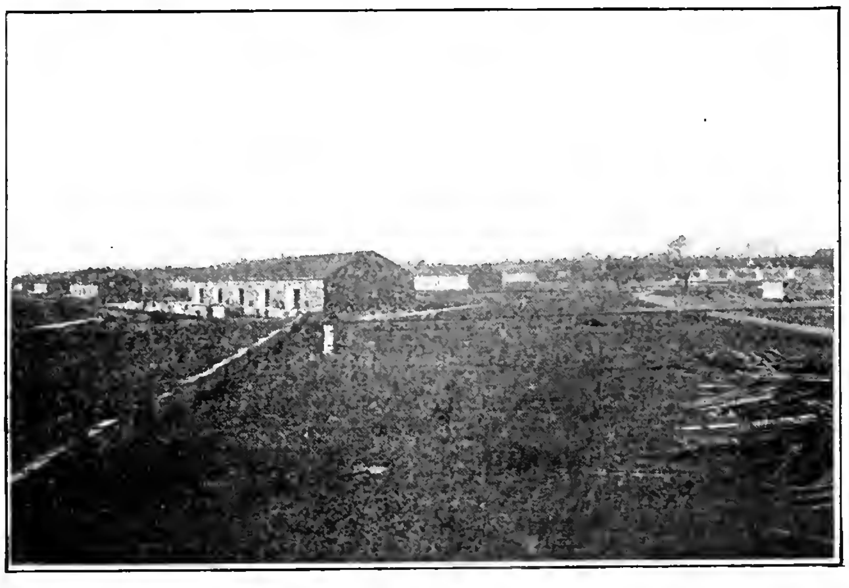
All ammunition depots were surrounded by high fences built of 2-in. chain-mesh woven wire fence of No. 9 galvanized wire surmounted by three strands of barbed wire on an inclined arm, the total height of the fence being 8 ft. To assist in the guarding of the depots a series of flood lights, spaced approximately 500 ft. apart, were installed, mounted above the fence and throwing powerful beams of light parallel to the fence, thus thoroughly lighting a zone approximately 100 ft. wide outside the depots. That the guards inside of the fence might remain in darkness so that they could not be seen from the outside, vertical veins were fastened to the projectors; these reflected all rays directed toward the inside of the inclosure. The projectors were generally spaced 500 ft. apart.

Very careful consideration was given to the use of electrically driven machinery for handling ammunition and explosives in the magazines, but it was decided that any economies that might be gained by the use of this









MECHANICAL METHODS USED IN HANDLING AMMUNITION IN ARMY'S STORAGE DEPOTS
Upper left, electric crane handling heavy shell. Upper right, shrapnel on roller conveyor. Lower left, handling ammunition to barges. Lower right, roller conveyors between magazines

machinery were more than offset by the added risk entailed in running power lines into the magazines. It was, therefore, decided that for powder and high explosives no electrical machinery would be used, and for shells the use of power-driven machinery would be confined strictly to storage-battery equipment, and that the charging of all storage batteries would be carried on in a building outside of the magazine area. Battery-charging stations at safe distances from the magazines were therefore established at all of the principal depots.

On account of the short winter days, and as it was desired to be prepared to handle shipments day and night when necessary, it was essential to provide a means of lighting the magazines. This was accomplished by the use of storage-battery portable lamps, developed for this purpose. These lights were charged at the battery-charging station and could be carried to any magazine where night operations were under way.

Preliminary estimates showed that the trackage at the various depots would average from 10 miles at the small depots to 45 miles at the larger ones, and that the number of carloads passing through each depot would average from 15 to 243 per day. With these facts in mind, studies were made of various types of motive power, including electric locomotives, compressed air, fireless locomotives and oil burners; but there were certain objections to the use of all of these types under war conditions, and it was therefore decided to use for all heavy switching 62½-ton coal-burning steam locomotives, and for light work 40-ton locomotives. The principal reasons for this decision were that electrical equipment was scarce and the large trackage at the depots would have made electric installations very expensive; compressed-air and fireless locomotives were not powerful enough for the heavy work anticipated, and a steady supply of fuel oil could not be counted on at all of the depots. All locomotives were fitted with special inclosed ashpans and spark arresters. The standard locomotive crane adopted for handling heavy shells at the wharves was a 15-ton, eight-wheel, coal-burning crane with a 50-ft. boom.

All of the rolling stock for the operation of the depots was ordered at the commencement of the projects and was used to great advantage by the construction forces.

Roller Conveyors Used

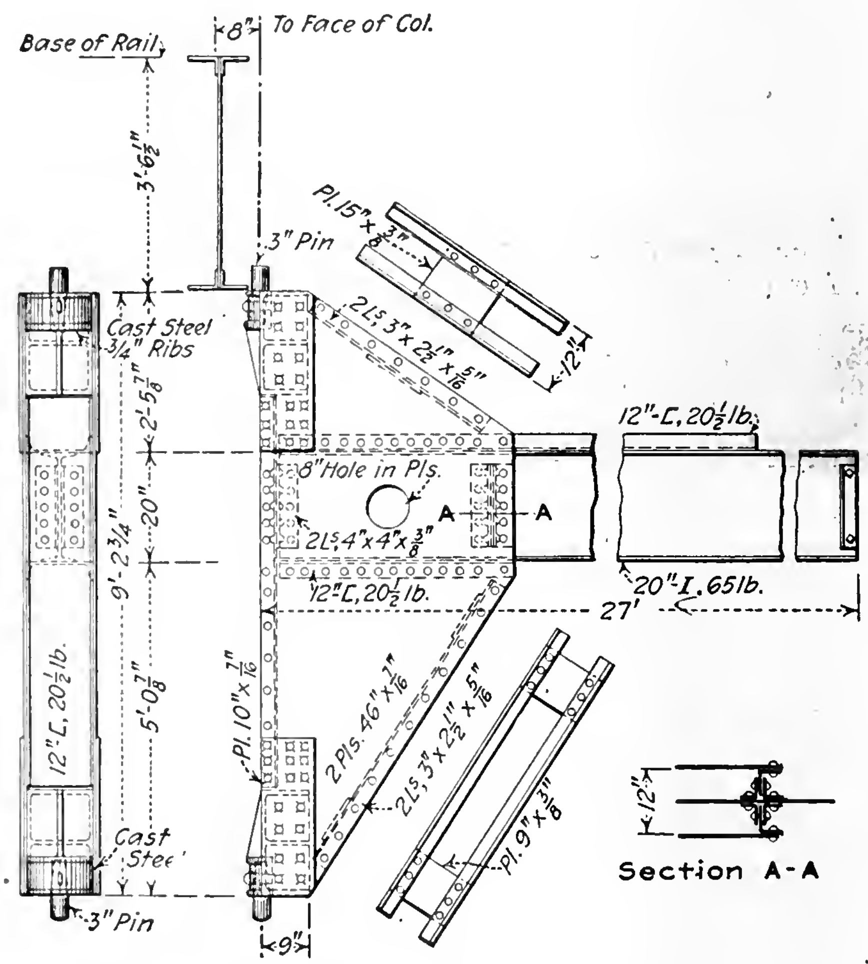
For handling material from cars into magazines, roller conveyors were utilized as far as possible. For inert material and shell, the ordinary steel roller conveyor, made up in 8-ft. sections, was used. Various forms of wooden pallets were provided for moving articles such as shells, bags of sodium nitrate, etc., over the conveyor. For handling explosives such as T.N.T., dynamite and black powder, wood roller conveyors fitted with wood guard rails were used to avoid the risk of sparks.

For handling shell above 12 in. in diameter a special type of storage-battery transfer crane truck, fitted with a short hinged boom and a hoist motor, was provided. As the platforms of the magazines used for the storage of heavy shells were built at car-floor level, this truck could be driven into the car, take a shell either by the nose ring or by means of a rope sling, back out of the car and proceed head on into the magazine to the point of storage. A view is given of one of these cranes in operation.

Jib Crane Designed for Maximum Clearance

TO REDUCE the overhead height of jib cranes recently installed in the Carnegie warehouse of the McClintic-Marshall Steel Supply Co. and thereby give maximum underclearance and lifting height, a special design was developed, using, instead of tension stays to take the cantilever moment, what was virtually a vertical girder. The details of this design are reproduced herewith.

The vertical girder was built up of two main plates with a 12-in. channel on the side near the column, and



SPECIAL DETAILS OF CANTILEVER JIB CRANE

with angle stiffeners and tie plates supporting the edges. The main cantilever beam was framed into the vertical channel just mentioned, and was also connected by four vertical angles through the main plate, as indicated by section AA. Horizontal 12-in. channels were selected to connect the flanges to the main plate, as shown in the drawing, one of these channels on the upper flange being extended for a distance of about 18 ft. to give lateral stiffness to the cantilever beam. An 8-in. hole in the main plate was necessary in order to allow access to the rivets on the inside of the box section.

The bearings are of cast steel, using in general a thickness of ¾ in. for the ribs and main metal. The design was made by P. L. Wolfel, chief engineer, McClintic-Marshall Co., Pittsburgh, Penn.

Publicity To Help Minnesota Water Projects

An educational campaign to assist municipalities which need new water-supplies or improvements in their existing supplies is a new activity being carried out under H. A. Whitaker, director of the Minnesota State Board of Health. The program includes a thorough investigation and report, also conferences with local officials and organizations, and lectures at public gatherings, in order that the people may have an opportunity to realize the importance of the problem before the time arrives for voting the necessary funds.

Long Concrete Bridge Contract To Be Let in Four Parts

Structure Nearly Mile Long Across Mohawk River and Barge Canal at Schenectady About To Be Built

JUST before the United States entered the war the State Engineer of New York had prepared plans for a long, reinforced-concrete bridge across the New York State Barge Canal and the Mohawk River between Schenectady and Scotia, N. Y. The work was held up during the war, but appropriation has now been approved by the legislature and preliminary work incident to the award of contracts will be begun immediately.

GREAT WESTERN GATEWAY, A CONCRETE BRIDGE NEARLY A MILE LONG, TO BE BUILT AT SCHENECTADY, N. Y.

In addition to the size of the structure, it is interesting on account of the novel division of labor proposed for the construction. Under a plan now in preparation, the first contract to be awarded will involve the construction of the approaches and abutments at either end of the bridge. The second contract will involve the excavation, the driving of foundation piles, the placing of concrete in the foundation of all the piers and abutments exclusive of the end abutments. This contract can be awarded at practically the same time as the first one, inasmuch as the two contractors can operate without any material interference. As this second contract will be composed almost exclusively of work in which contractors experienced in the building of foundations and the driving of piles would be interested, it is thought that keen competition will result. The third contract consists of placing concrete above the foundation lines, including arches and balustrades in the main portion of the structure, and the fourth in the pavement of the bridge and approaches. This fourth will be the last part of the work to be placed under contract. Under this scheme the first and second contracts would be practically completed through the 1919 season, and in 1920 the third contract would be awarded; the work would be completed toward the end of 1921.

The bridge is to be called the Great Western Gateway or Gateway Bridge. It has a total length of 4436 ft. comprising 23 spans varying from 106 ft. to 120 ft., and one 212-ft. span over the Barge Canal channel. The river at the site is divided into three channels by Van Slyck Island and Hog Island. Between Van Slyck Island and the Schenectady shore is the channel which leads up to the Schenectady Barge Canal terminal. Between the islands is the Barge Canal channel, and between Hog Island and Scotia is the river.

Starting at Washington Ave., Schenectady, as the continuation of State St., the main artery of east and west traffic through the city, the first 300 ft. of the structure to the Schenectady abutment will be in the form of a parkway 100 ft. wide between retaining walls. In the center of this will be a grassed reservation 20 ft. wide for street-railway tracks, and flanking this will be reservation roadways, 20 ft. wide, for vehicular traffic. Flanking the roadways will be grassed areas 10 ft. wide and then outside concrete sidewalks 10 ft. wide. From the Schenectady abutment to the Scotia abutment the roadway will be 40 ft. between curves, with double tracks for electric cars in the center, and two 6-ft. sidewalks. Four arch spans 106 ft. each, cross the terminal channel to the triangular pier on Van Slyck Island, where the bridge turns at an angle of 54°. The crossing of Van Slyck Island is in three arch spans 110 ft. each, one arch span 117 ft., all square-ended, and four arch spans 120 ft. each on a skew of 18°. Then comes the 212-ft. span across the Barge Canal, which is on a skew, then six 120-ft. skew spans, an anchor pier on the far side of Hog Island, and five more skew spans of 120 ft. each. The structure between abutments is divided into five sections by two anchor piers and the massive piers of the channel span.

All arches will be open spandrel, rib type. The 212-ft. span will be carried on two ribs 12 ft. wide, 24 ft. apart. All other spans will be carried on three ribs, the outer ribs 6 ft. wide and the center rib 12 ft. wide, with a clear distance between ribs of 12 ft. On the Scotia end, for a distance of 940 ft., the approach will consist of an earth embankment.

The new structure will replace the old steel toll bridge which crosses the river about 1200 ft. to the east. It will be paid for jointly by the State of New York, the City of Schenectady, the County of Schenectady and the Village of Scotia. The contract plans were prepared by Frank M. Williams, state engineer, from the original design by B. H. Davis, consulting engineer.

Good Results From Filter Galleries

Bacterial count of the water obtained in 1918 from the underground galleries of the Des Moines, Iowa, Water Works Co., which are flooded at times of low river stages and high consumption, indicated a 94.5% reduction from the average of 19,047 bacteria per cubic centimeter in the adjacent Raccoon River. Treatment with chlorine gas reduces this count to 48, according to a paper read at the recent meeting of the Iowa Section of the American Water Works Association by A. T. Luce, engineer and superintendent. The rate of infiltration from a series of ditches and pools extending along the land side of the galleries is estimated at 1,000,000 gal. daily per acre flooded.

Continuous Trains for Forty-Second Street Transit

Problems of Dense Traffic—Moving Platforms or Continuous Train Recommended for New York Ten Years Ago—Shown to Have Advantages in Speed up to Four Miles, and Remarkable Capacity

By Henry B. Seaman

Consulting Engineer, New York City; Former Chief Engineer of the Public Service Commission for the First District, New York

A RAPID-TRANSIT problem of peculiar importance is contained in the case of the 42nd St. shuttle-train service in the new subway system of New York City. The problem is that of short-distance transfer of a very dense traffic, and is by no means confined to New York City or to the 42nd St. connection. But the latter is of such immediate urgency as to require serious study at the present moment. It is the writer's conviction that the moving platform, or the continuous-train system, offers the only solution of this problem. Moreover, the same system is able to meet requirements of exceedingly dense rapid-transit traffic in other cases, for long as well as short distances. In the present period of active rapid-transit development, the subject merits general attention.

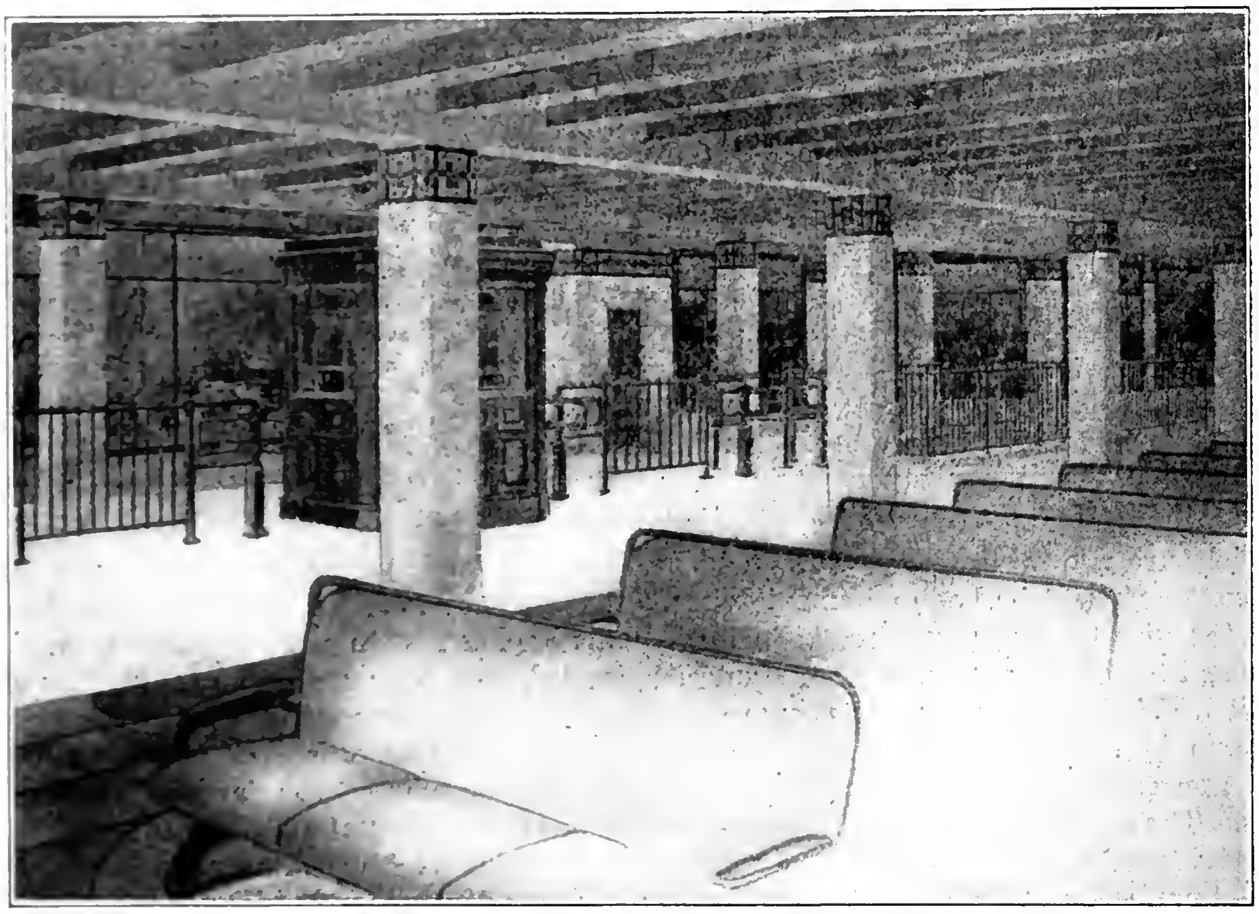


FIG. 1. HOW A MOVING PLATFORM SUBWAY INSTALLATION WOULD APPEAR, WHEN VIEWED FROM THE CENTER LINE OF COLUMNS (SLOW SPEED APPROACH PLATFORMS BEYOND THE SEAT PLATFORMS)

Ten years ago, when chief engineer to the Public Service Commission of New York City, the writer reported to the commission that moving platforms offered distinct advantages over separate trains with respect to speed as well as to capacity, recommended that an installation be made forwith. The general facts set forth in that report are as fully applicable today as then, and reference to them will support the statement that other rapid-transit routes than the 42nd St. shuttle connection may advantageously be equipped with continuous trains.

When the original subway, running north and south in Manhattan, was built, it was laid out on an indirect route through 42nd St., in order to reach the most populous localities and thus insure the immediate financial success of the project. But it was evidently intend eventually to complete the east- and west-side routes as now constructed. It would, therefore, seem that the connecting link across 42nd St. should have been considered and designed at the same time, in order to function with this general subway development. That this was not done can only be explained by the extraordinary pressure to rush the general improvement.

When, upon the opening of the new subways, it was found that no consideration had been given to this important matter, and it became necessary to close down the crosstown service in 42nd St. temporarily in order to avoid the resulting confusion, the citizens were naturally surprised and expressed disappointment. At the suggestion of the chairman of the commission, colored guide lines were then introduced. This was expected to reduce confusion, and the shuttle service was reëstablished. Other than this, however, there have apparently been no serious attempts to provide permanent relief of the congestion and inconvenience at this point.

A suggestion has recently been made by a former member of the commission that the shuttle service be operated from 14th St., running trains on the local tracks of the main line to 42nd St. and thence across to Seventh Ave. As a considerable portion of the crosstown traffic comes from the Steinway tunnel on the east and an ever-increasing number from the Lexington Ave. extension on the north, such operation would offer, at best, only partial relief.

Furthermore, in order to introduce a shuttle service which would be even approximately satisfactory, it would be necessary to switch at least half the local trains from 14th St. on the main line to the shuttle service across 42nd St. Since the interval between trains on the main line is about 2½ min. during rush hours, it would reduce the service on both the shuttle and the Lexington Ave. main line (above 42nd St.) to 5-min. headway, which would be entirely unsatisfactory in either case. Rush-hour service on all lines should approach 2-min. intervals as closely as practicable.

An alternative would be to deflect half the local trains on the lower east-side line across 42nd St. and then northward on the west-side line, and in turn deflect a corresponding number of trains from the lower west-side line across 42nd St., and thence northward

on the east-side line. This would form a balanced system of operation, and would come nearer to fulfilling the requirements than any other train service which could be proposed, though the shuttle service would still be restricted to 5-min. intervals. In order, however, to make the necessary connections from the lower west-side to the upper east-side line, these plans should have been included in those of the general improvement—if, indeed, they could have been made at all. Now, with the general development which has since taken place, notably the completion of the Hotel Commodore, such connections cannot be made except at prohibitive cost.

The next possibility is utilizing the Steinway tunnel for relief by extending it westward to Seventh Ave. Plans for such extension were considered years ago, and undoubtedly such construction is still possible. But these plans were merely for the convenience of the traffic from Long Island City, and were not intended to fill the purposes of the present shuttle service. The tunnel is too deep for the purpose, and is difficult of access from the street surface.

At Lexington Ave., and again at Seventh Ave., the Steinway tunnel extension must pass below all other subways. It could approach the surface only somewhere midway between these two points; that is, in the vicinity of Fifth Ave. and 42nd St. But here street traffic is already so congested that a further increase is undesirable. Plans for a revision of street grades at Fifth Ave. have been under consideration.

An expenditure of possibly $3,500,000 would be required to construct the Steinway tunnel extension. The present subway section in 42nd St. would be of little value unless use could be made of it as an auxiliary. Some three years were required to construct the 42nd St. subway, and it could hardly be expected that the more difficult Steinway tunnel extension would be built in less time.

Moving Platform Operation

With these three suggestions of train service eliminated, the remaining expedient is the introduction of the moving platform, or a similar device, in the subway as at present existing.

While the introduction of this method of transportation would be novel and would call for the greatest structural and mechanical engineering skill, the system has been investigated by the most eminent engineers of their day and has received their unqualified indorsement. It is the escalator principle of continuous service, applied to horizontal transportation. To object now on the score of its novelty is not "conservative," but rather unprogressive and unscientific. The work should be undertaken, however, only by men of clear vision and of strong mechanical instinct, men who are determined to succeed and who are capable of overcoming obstacles as they appear.

The introduction of the moving platform into the present subway in 42nd St. would save the bulk of the expense of the Steinway tunnel extension. The cost to the city would be nominal. Close connections could be made with the Interborough subways which it is intended to serve, as well as with other subways, if so desired.

In its operation there would be no intervals of waiting between trains, as with car service, since the platform is ever there and ever moving. The traffic level would be nearer the street surface. Entrances and exits could be provided at every street, or, indeed, at every store. Finally, the equipment may be so designed that when it is in full operation and has demonstrated its efficiency it may be extended through the Steinway tunnel, affording continuous passage from Long Island City.

Studies of the moving platform or continuous-train system, made for the purposes of the report to the Public Service Commission in 1909, already referred to, brought to light very significant facts concerning the transportation value of the system. In point of capacity it surpasses the highest demands of present-day

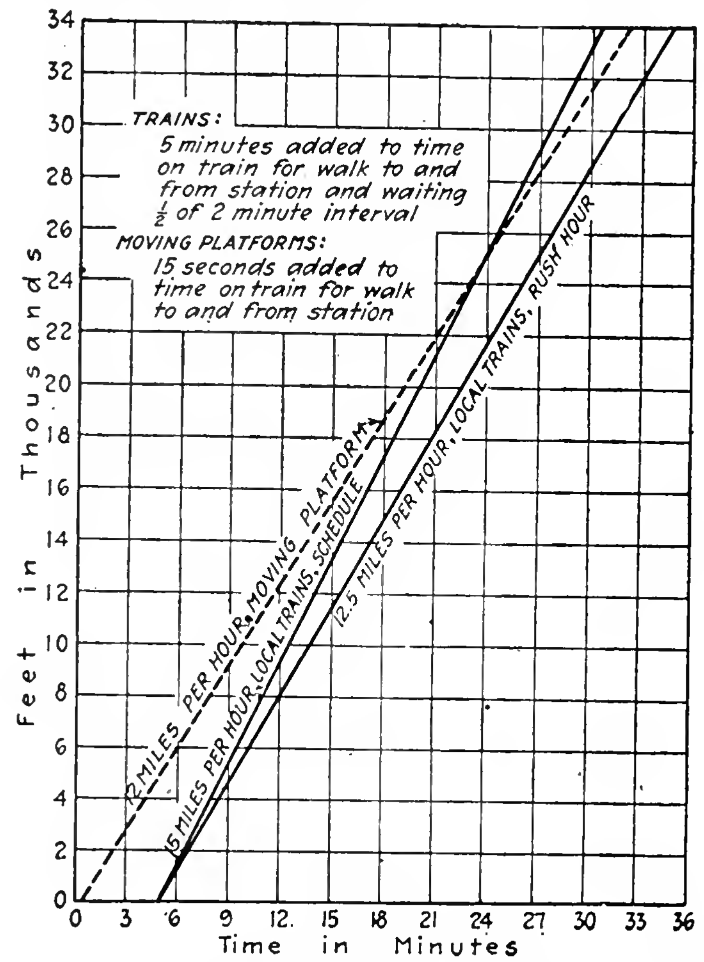


FIG. 2. SPEED COMPARISON OF MOVING PLATFORM AND TRAIN

traffic. In point of speed it has the advantage over the present system for all distances up to four miles.

For the speed calculations, data were taken from rapid-transit service as it existed in New York City, average conditions being selected as follows:

Distance between express stations	2 miles
Distance between local stations	⅓ mile
Distance between cross streets	1/20 mile
Speed of express trains, including stops	25 miles per hour
Speed of local trains, including stops	15 miles per hour
Speed of moving platform	12 miles per hour
Speed of pedestrians	3 miles per hour
Average interval between trains	3 min.

It was assumed that the average passenger starts his journey at a point distant from a local station by one-fourth the spacing of stations, and travels to a point of destination likewise one-fourth the station spacing away from a station. It was assumed that he must wait at the station for a time equal to one-half the interval between trains. These data led to conclusions which are plotted on the diagram, Fig. 2, herewith.

For all distances less than four miles the moving platform is a quicker mode of conveyance than local train service or even local and express service combined. This is true on the assumption of a speed of 15 miles per hour for local trains. But, as a matter of fact, local

service during rush hours averages only about 12 miles per hour, and under these conditions the platform has the advantage over the train for all distances.

Great superiority in passenger capacity is, however, the primary distinction of the moving platform, next to its ability to receive and discharge passengers anywhere along the line. It can carry 73,500 passengers per hour, all seated, against 58,500 passengers for ordinary trains with both express and local service on separate tracks (36,000 for eight-car express trains, 22,500 for five-car locals) of whom only one-third would be seated. Ten years ago the writer reported that "the

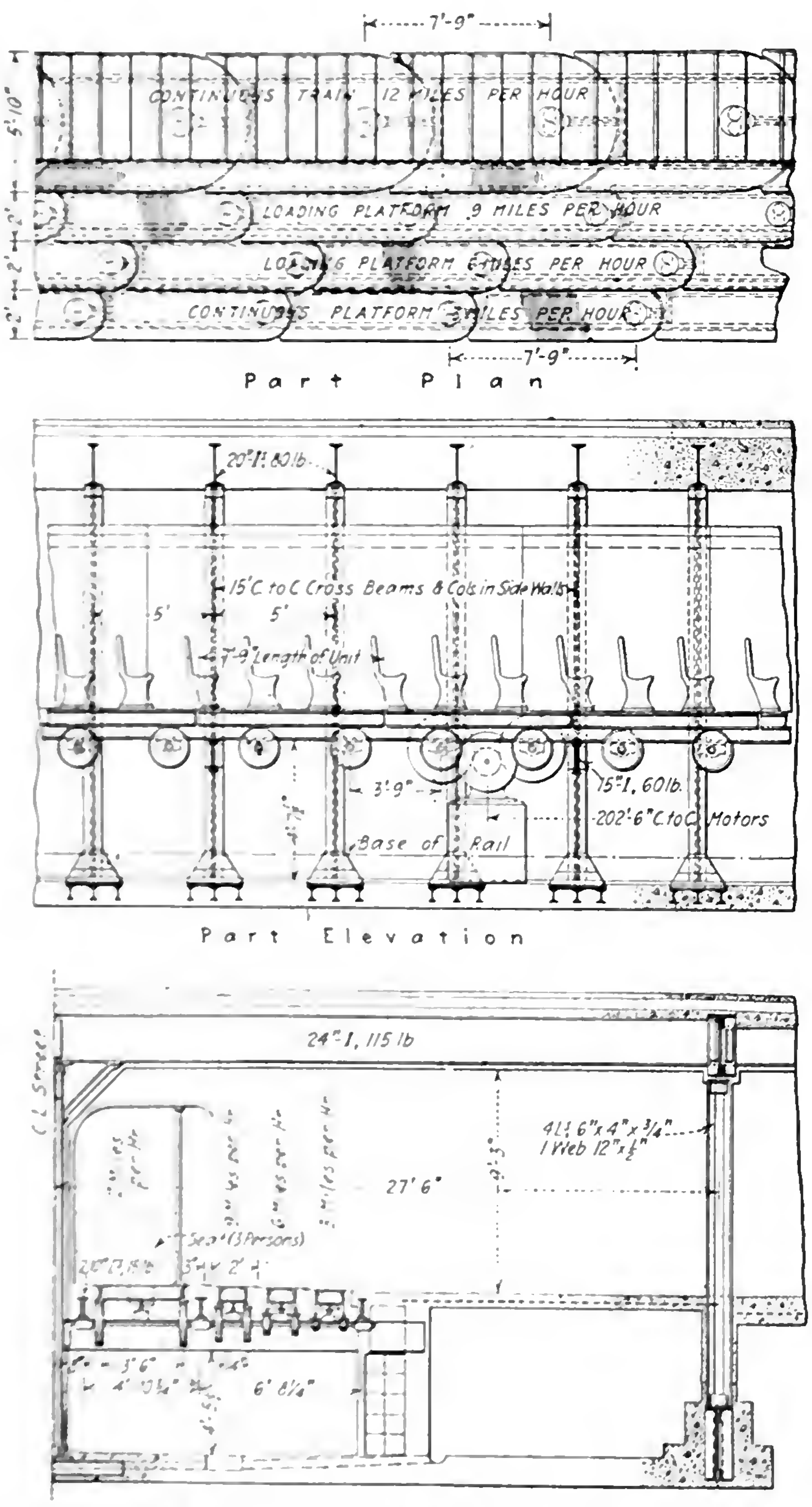


FIG. 3. ADAPTATION OF MOVING PLATFORM TO A SUBWAY DESIGNED FOR TRAIN OPERATION

capacity of the moving platforms is beyond any requirements which can at present be foreseen." Though the density of traffic in the New York subways has more than doubled in the interim, this statement is approximately true even today.

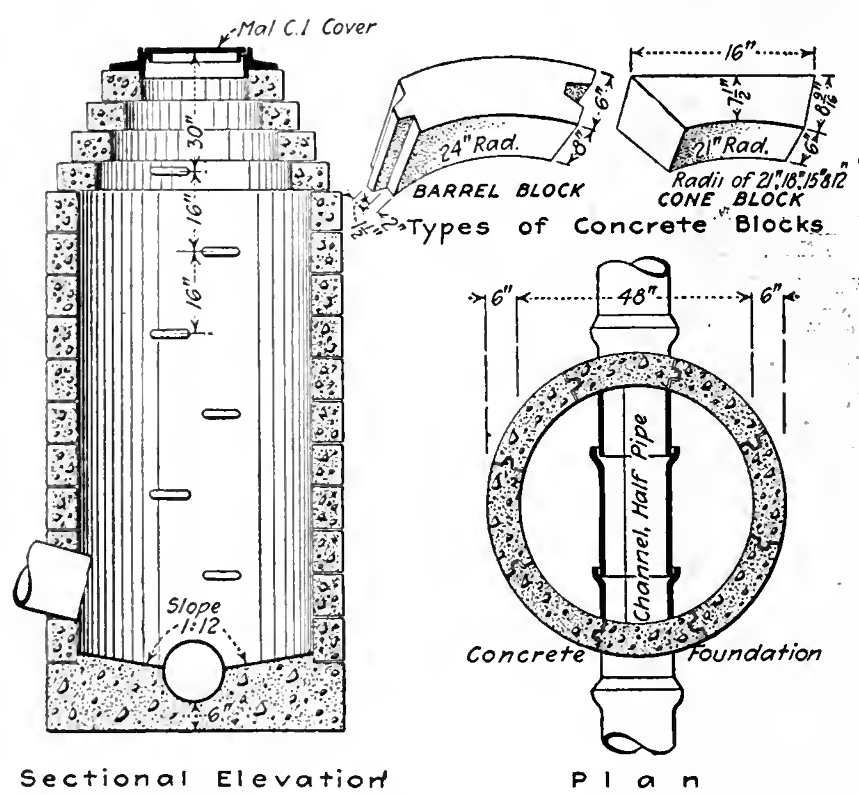
Introduction of the moving platform into the future transit system of New York City is inevitable. The channels of subway construction in lower Manhattan are practically filled, and in the increase of travel which will develop the inadequacy of the present transit facilities to accommodate it will become increasingly evident.

Design and Cost of Concrete-Block Manholes for Pipe Sewers

By R. A. Koerner

City Civil Engineer, Terre Haute, Ind.

CONCRETE-BLOCK manholes for pipe sewers, as built at Terre Haute, Ind., in accordance with the accompanying illustration, cost 40c. each, or about $8 per foot of height. The blocks are made of 1:2:4 concrete, with 10% of hydrated lime added for water-



CONCRETE-BLOCK MANHOLE FOR PIPE SEWERS

proofing. The floor of the manhole is sloped to obviate the remaining of sewage in the manhole when the sewer is running over half full. The same general design is used for catchbasins. So far as known, the design shown is original with the writer, who was led to make it by the exorbitant price demanded for brick.

Salvaging Construction Material in China

A letter from Donald F. McLeod, professor of railway engineering in the Chinese Government Engineering College at Tangshan, North China, describes an interesting adaptation of local materials to construction in hand. The contractor who dug a large, open well on the campus, 30 ft. in diameter and about the same depth, used for cribbing the stalks of a plant similar to sorghum to hold up the sides of the excavation, together with the surcharge due to the material excavated, until he could get a stone lining in place. He successfully salvaged all his sorghum stalks as the stone wall was completed. The letter continues: "Sorghum stalks are valuable as fuel when they are of no further use for building material. Although there are coal mines here the shafts are deep, about 1300 ft., which makes coal cost $4 per ton; pretty high for a man who gets only 30c. a day in wages. Consequently, nothing in the way of vegetation is despised as fuel, every leaf, every blade of grass being carefully gathered up for that purpose."

The title here used is that employed by Mr. Shenehon. Had we rewritten it we would have called the article, "The Philosophy and Romance of the Engineering Activities of the Minnesota Country."—EDITOR.

The Engineering Activities of the Twin Cities

An Address by Francis C. Shenehon, Consulting Engineer, Minneapolis, Before the Forty-Ninth Annual Convention of the American Society of Civil Engineers, Minneapolis, June 17, 1919

IN interpreting this subject "The Engineering Activities of the Twin Cities," it will be assumed that the Twin Cities are simply the hub of a radiating series of engineering activities, that follow transportation lines southward to the Gulf of Mexico, reach northward to the Lake of the Woods, and, loosely defined, eastward and westward to the Gulf of St. Lawrence and the Red River of the North. You will observe that the engineering activities of the Twin Cities are far-flung!

As I proceed to develop my theme, Sherlock Holmes might discover that my interests and convictions are hydraulic, because *water*, whether I will it or not, recurs and resounds like the burden of an opera.

The early voyageurs, Radisson and Groseilliers, who penetrated the wilderness and reached the prairies of Minnesota, and the Mississippi River in the vicinity of Winona, some miles south of St. Paul, started their pioneering journey at Montreal, proceeded by canoe up the Ottawa River to Georgian Bay, Lake Huron, thence to the inlets along the west short of Lake Michigan; and finally made an overland journey of 150 miles westward to the Mississippi. This was about the middle of the 17th century. These voyageurs prepared no maps of this region. Joliet in 1673 reached the Mississippi by way of Lake Michigan and the Illinois River, and opened a water avenue from the south for French exploration of Minnesota. Almost exactly 240 years ago this time of year, Sieur Duluth landed in the vicinity of the present City of Duluth, and penetrated the inland country of Minnesota to Mille Lacs, about 70 miles from Minneapolis—the first white man to report and record his explorations. Later on the Sieur La Salle, and Father Louis Hennepin (in the summer of 1680) came to St. Paul. Hennepin went on to the cataract to which he gave the name of his patron saint, Anthony of Padua. The Dakota Indian name for St. Anthony Falls was Minni-i-ha-ha—"the rushing water"—a name now transferred to the smaller falls immortalized by Longfellow, Minnehaha—"laughing water."

"Exploration Engineers"

These pioneers were *Exploration Engineers*, and their activities have had to do with present engineering activities in the Twin Cities—and they reached here by water transportation in birch-bark canoes. The motives of these exploration engineers, engaged in a reconnaissance survey for the advance of civilization across a continent, were mixed. The inculcation of religion in pagan souls, the extension of imperial domains, fur trading, adventure—and the search for a westerly passage from France to China—all had a part. The naming of the St. Lawrence Rapids at Montreal, Lachine Rapids—or "the Chinese rapids"—illustrates the geographical misapprehension as to the nearness of the Orient, which was actually more than 8000 miles toward the sunset. It is said of Nicollet, "so confident was he of reaching China that he took with him a gorgeous mandarin's robe of damask to wear at his court reception."

This Minnesota country, penetrated by these exploration engineers, was inhabited by savage peoples—Indians—whose chief engineering activities were military—eternal warfare. They subsisted by hunting and fishing perhaps more substantially than by agriculture. Wild rice grew in marginal shallows of the lakes and rivers, wild fowl fed on the wild rice; moose came to the water, as cattle do, to drink, keep cool and avoid fly pests; fish abounded; the streams were avenues of transportation—hence aboriginal populations kept close to the waterways.

Where French and Indian Met

It is rather astonishing how this dependence on lakes and streams is reflected in Indian names, which now exist as geographical permanencies. Minnesota means blue or misty water. The name was first applied to the Minnesota River, and then taken over by the state. Missouri is Dakota for turbid water. Mississippi is Algonquin for far-reaching waters. Minnetonka means Great Water. Minneapolis is a half-breed name—Indian mother, "Minne," waters, Greek father, "polis," city—hence, the City of Waters. These recurring Indian names, and the French names Radisson, Hennepin, Nicollet, La Salle, Joliet, Frontenac and Duluth, still keep vivid the color of two centuries in which the picturesque glories of the French civilization met, by forest and prairie, the ancient, unprogressive, but picturesque, savagery.

My conception of a civil engineer is that he is a surgeon operating upon the earth as his patient; and in developing my subject it appears desirable to touch very lightly, and very briefly, on an activity, essentially engineering, which preceded the Indian and the French in this region. The Panama Canal in some form might ages ago have been cut by geologic action, without the guiding hand of the engineer as we know him. And this surgical operation successfully completed at Panama has done a thing which we find in other places already done for us by sure, slow, constructive geologic forces directed by the Engineer of the Universe. The problems engineers deal with today are inextricably and fundamentally dependent on natural evolutions and physical changes of the past. We take up the task at the point to which Nature has already brought it, and accelerate, retard or modify the project. We are in partnership with every elemental physical force of the universe, and each one of us likes to think of himself as the dominant senior partner.

Geological agencies conferred on Minnesota vast stores of hematite, the blood-red iron ore. Perhaps an account of the genesis of this deposit, the succession of events resulting in making it accessible and commercially worth while, will be of interest, particularly to those who are to visit the Iron Range. About $4\frac{1}{2}\%$

of the crust of the earth is iron; and every stream entering the ocean carries to this omnibus catchment basin a small contribution of this metal. It gradually precipitates in the deep sea bottom, securing oxygen and carbon in part from animal and vegetable organisms, until after countless æons great beds of ore are laid down. Then as the earth cools state-wide slabs of crust are reared above the sea level. A glacier scrapes off and truncates this pyramidal mass. Now, this hematite, as it came out of the sea, was not commercial ore, it was only about 30% iron. But, exposed to the elements, it weathers. The oxygen and carbon in part disappear, while all iron remains, until enrichment is complete, and the ore is commercially good, with 50% or more of iron.

The geological formations exposed in the Mississippi River gorge are interesting in their genesis, and tremendously important to the Twin Cities as bearing on present engineering activities.

Down underneath is the St. Peter sandstone several hundred feet in thickness. This is made up of fine, rounded grains of white sand imperfectly cemented with porcelain clay. This sandstone is so soft that you can carve your initials in it with your finger nail. It is porous and contains in part the artesian reservoir of water. On top of the sandstone are 4 ft. of blue shale, and above this about 30 ft. of limestone; then on top glacial drift, about 30 to 40 ft. of a mixture of sand, gravel, boulders and clay.

The sand was deposited ages ago in the sea, near shore in shallow water; then the bottom of the sea subsided, and in the deeper water the finer sediment, mud with some lime and some organic life, formed shale; the bottom of the sea was then further depressed, and in the deep sea, far from offshore sedimentary deposits, the pure hard limestone formed, imprisoning in its solidifying grip the organic dead. Then the ice sheet, a mile thick over this region, melted and left the rock débris, which we call glacial drift.

Might Have Been No Minneapolis

The significance of these geological formations is shown by the recession of the Falls of St. Anthony from somewhere down in Iowa to its present location in Minneapolis. The destructive force of the falling water successively cut out the soft sandstone, undermining the limestone ledge, toppling it down, and permitting the persistent northward travel of the falls, with the ever-lengthening gorge. If civilization and engineers had been in Minnesota some thousands of years ago, the water-power might have been caught and held at St. Paul, and there would have then been no Minneapolis! Minneapolis itself nearly lost the water-power by northward recession of the falls some forty-odd years ago. But engineers terminated the freedom of geologic action, built a great cut-off wall of concrete to protect the sandstone, and directed the flood waters over a timber apron. The engineeering activities of that day, in this arresting the recession of St. Anthony Falls, makes an interesting chapter in local history. The Mississippi River for sixty miles above Minneapolis has its channel in glacial drift. The high dam in the gorge below is founded on glacial drift mixed with fragments of limestone, while the power house and the vessel lock, at the two ends of the dam, are founded on the sandstone.

The Third Avenue bridge, a monumental recent engineering construction, is founded on the limestone ledge.

The sandstone formation is readily tunnelled, and Minneapolis and St. Paul, in particular, utilize this very fully for sewers.

With this historic and prehistoric background, the story of more recent developments and present engineering activities should be more understandable.

Navigation and City Location

In the days when Minnesota was on the lonely frontier, St. Paul grew to be its most populous city and later its capital, because it was at the head of practicable steamboat navigation—a water reason. Contrary to the rule of growth of cities, which fixes them a day's journey apart, Minneapolis grew into our largest city, centering about the great water-power here—a descent of about 48 ft. in a cataract in the Mississippi River, with over 20,000 available horsepower—another water reason. Another city, Stillwater, grew up at the virtual head of steamboat navigation on the St. Croix River, a tributary stream of the Mississippi, which is the trunk line of navigation leading to the Gulf of Mexico.

In passing, it may be of interest to note that in the division of spoils in state institutions St. Paul received the desirable capitol, Stillwater the desirable penitentiary, and Minneapolis the then doubtful university, all now centers of engineering activities.

Minneapolis and Stillwater had a kinship in the fact that a form of navigation, much exceeding the steamboat in importance, existed in the floating of logs on the upper Mississippi and the upper St. Croix, which, with their many tributaries, found their headwaters in the heart of limitless forests of pine, hemlock and cedar. At Minneapolis the forest products met water power which, with steam power, converted logs into lumber. At Stillwater steam sawmills operated and the logs were also rafted, to continue their journey southward. The floating of logs was the most considerable navigation which the Mississippi River through the State of Minnesota has ever known. It is a familiar fact that a stream which does float logs, and crosses a state boundary, ceases to exist only as a child of the state in which it has its source, but becomes a ward of the Federal Government, subject to all the limitations and advantages which this implies. The transportation of logs and the cutting up of logs in the past have been essential and important engineering activities, which now have practically vanished with the near destruction of the forests.

The water powers at Minneapolis and in the vicinity are the present dominant natural elements, which create engineering activities, which in turn supply other engineering activities. For the future, when population is dense enough, river navigation promises to mean much for Minneapolis, St. Paul, Stillwater and other river cities.

At the present time, by the building of the high dam and lock between Minneapolis and St. Paul, the actual head of navigation for steamboat service on the Mississippi River is brought to Minneapolis. The construction of this vessel lock and dam is one of the fairly recent engineering activities of the Twin Cities. The evolution of the project from a two-lock scheme, which neglected the water power (10,000 horsepower) inevitably present, marks the transition of the Federal Government from the rôle of navigational proprietor

alone, blind to other uses, to the larger rôle of master of navigation and water power both. It is a little discouraging, however, to note that three years, during the war period, when our railways were congested getting coal to this water-power city, much steam-generated power was in use and coal consumed, while potential power equivalent to perhaps 50,000 to 100,000 tons of coal a year was wasted through the sluiceways or over the crest of the dam. The dam itself is of the Ambursen type, with normal 30-ft. head, with power-house foundations built contemplating a use of 6000 cu. ft. per second in generous river stages. The use of this power awaits action by Congress on a general water power bill.

The main 48-ft. drop at St. Anthony Falls is largely used for grinding flour, the most important engineering activity of Minneapolis. The flour mills have a story of their own, and this will be told at the mills to visitors. The annual production of high-grade flour ranges from 16,000,000 to 20,000,000 barrels.

Half a mile downstream from St. Anthony Falls, a second development exists with a fall of 18 ft., used by the local traction company.

Power Auxiliaries Needed

As the flow of the Mississippi River sometimes dwindles to 1000 cu.ft. per second in mid-winter attenuation, great steam auxiliaries are everywhere supplied. The Riverside station of the Minneapolis General Electric Co. with its recently installed 25,000-kw. turbo-generator, is the most colossal auxiliary of the Twin Cities, supplying current to the mills and other manufactories, and to public utilities as well, in times of low river flow.

The water power plants and water power sites of the Northern States Power Co. on the Mississippi and St. Croix Rivers represent engineering activities, existing and of the near future, of great interest. The Main St. station develops a portion of the St. Anthony Falls power. The Coon Rapids dam, with 18-ft. head, completed in 1914, is on the Mississippi River about 11 miles above Minneapolis. The Taylor's Falls plant of this company, on the St. Croix River, about 41 miles by transmission line from Minneapolis, has a fall of 60 ft., and 20,000 installed horsepower, mostly used in the Twin Cities for manufacturing and public utilities. The undeveloped dam sites of this company on the St. Croix and Mississippi Rivers represent in their future development problems of exceeding interest. Some of these dams will be on rock foundations and some of them will mean 30 or 40-ft. heads on glacial-drift foundations; which will call for most skillful planning and execution, and will doubtless, when constructed, mean long strides of advance in the art of dam building on porous foundations.

No summary of the engineering activities pivotal on the Twin Cities can omit mention of the great head-water reservoirs of the Mississippi River. These reservoirs have utilized two large and several smaller natural lakes. Their combined capacity is over 100,000,000,000 cu.ft., with a watershed area of about 4000 square miles, and an additional water area of over 400 square miles.

Controlled by the Federal proprietor, who by law must regard navigation, however little it is, as the predominant interest to be served, the release of water is not always beneficial to the water powers, and sometimes is detrimental, as in midwinter when power needs are great and river flow meager. The water powers are really at the present time a greater public resource here than navigation itself. The benefit in vessel draft is about 1 ft. at St. Paul, tapering off to zero perhaps a hundred miles downstream. I imagine it will require an act of Congress to modify the release of reservoir storage so as to give the maximum benefit to the important water powers of the Mississippi. The attitude of the Federal proprietor is likely to change when the Federal water power at the high dam becomes a beneficiary.

The things discussed thus far represent engineering activities which are inherent in the physical and geographical characteristics of the Minnesota region. The existence of these things has caused great aggregations of people to cluster here. This population must be served by many engineering activities. Railways must bring to them many things to supplement the regional products, and must take away the things produced here. Minneapolis and St. Paul are two beads threaded on five transcontinental lines; and four axial north-and-south lines reach toward the Canadian store house and the cotton belt. Locally we are excellently served by a traction system which is suffering from 5-c. fares and franchise uncertainties.

Water-Supply

The water-supply here cannot fail to represent an engineering activity of transcendent interest — more particularly after July 1. The Mississippi River which has served so efficiently in the past in bringing forest production to Minneapolis brings also the sewage of the City of Anoka, 20 miles upstream. Minneapolis uses the Mississippi River, as it departs southward, to convey its sewage to St. Paul. These two facts made Mississippi River water a bad beverage for Minneapolis, and an impossible source of water-supply for St. Paul. Up to 1912 Minneapolis did pump its domestic supply unpurified from the river, notwithstanding the malign contributions from Anoka. Well-to-do people bought spring water crystalline clear in bottles. Venders sold water as they now sell milk—only seven years ago. The poor and the careless had winter cholera and typhoid fever. The first civic awakening dosed the water with chlorine, which helped while the present mechanical filtration plant was planned and constructed. Investigations for a better water-supply gave consideration to four possible sources. Lake Superior, 140 miles away, was alluring. Mille Lacs, a lake 207 square miles in area, 70 miles away, was enticing. The subterranean artesian supply, rising by gravity to perhaps 100 ft. below the street level here, had many advocates. The Mississippi—"a poor thing, but our own"—could not be overlooked.

The investigations resulted in the rejection of the Lake Superior source as too distant, the Mille Lacs supply as inadequate, the artesian as too hard and too uncertain, and the acceptance of the sometimes turbid, sometimes defiled, but always adequate, Mississippi River water, which by skillful engineering processes has been relieved of its baser ingredients and converted into a crystalline, wholesome supply. The typhoid rate in Minneapolis is singularly low. Schools and hospitals freely use the domestic supply for drinking purposes.

and all persons may meet confidently the era of alchoholically dry days.

St. Paul secures its water-supply from a group of lakes, reinforced by the artesian flow.

In concluding this meandering talk on the things conceived as of vital engineering interest to the Twin Cities and their zones of influence, I wish to speak for a few minutes of the most important inland navigational resource of the world, which now brings steel vessels built on the Clyde in Scotland to our Minnesota harbor at Duluth. As the Mississippi River gives Minnesota a water route to the Gulf of Mexico, the Panama Canal, the Pacific Ocean and the Orient, so the Great Lakes lead to the Gulf of St. Lawrence, the blue Atlantic, England, France, the Mediterranean, the Suez Canal and the Indies. Minneapolis is at the utmost inland reach of the Mississippi, and Duluth at the utmost inland reach of the Great Lakes.

Nowhere exist such alluring, splendidly big engineering things, solved and unsolved, as in this chain of magnificent lakes and stately rivers. It has been my privilege to have had a part in the things solved, and it is still my privilege to work on the things unsolved, and I regard myself as peculiarly blessed in working within such far-reaching horizons.

The hematite ore of Minnesota is vitalized and made marketable—80 per cent of the whole country's supply —by this waterway, which carries the ore to the coal, and brings coal to some of the ore smelted at Duluth. It is probable that the bulk of this ore would lie unmined and unused were it dependent on rail transportation. It costs roundly $1 a ton to get the ore by rail 100 miles from the Missabe Range to the lake shore at Duluth, and it costs $1 to cary this ton of ore 1000 miles to Buffalo.

The tonnage passing the big ship locks in St. Mary's River, at the foot of Lake Superior, exceeds the combined tonnage of the Panama and Suez Canals.

Exit to the sea is still limited by the shallow drafts of the Erie, Welland and St. Lawrence Canals. But the Welland Canal is building now for 25-ft. draft in the canal prism and 30-ft. draft in the locks; and the St. Lawrence waterway will follow this lead. That is one of the big engineering things. The New York State Barge Canal shrinks to a trifling thing, with these great projects evolving.

The Chicago Drainage Canal, diverting a considerable stream of Lake Michigan water, has created the need of the regulation of Lakes Michigan, Huron, Erie and Ontario, by controlling work in the outflow rivers—Niagara and St. Lawrence in particular. St. Mary's River, the outlet of Lake Superior, is already under artificial control, in the interests of navigation and water power; and projects are maturing for the manipulation of the outflow in the Niagara and St. Lawrence Rivers. Each year, to a greater extent, it is realized that after all the lakes are storage reservoirs of almost limitless capacity and incalculable value. Nature has one sole motive in her operation of the outflow rivers, which is to rush the waters to the sea. The water returns through the heavens, and the endless cycle of rainfall and outflow goes on. But this water, when engineers intervene, must be made to serve better the artificial uses of navigation and power.

So it will come to the point where we must *budget* the water eventually—why not now?

Budgeting the water means spending it systematically and scientifically, in well thought out apportionments, which will make the Niagara and the St. Lawrence better navigable ways and better water power streams.

Water power is really the thing which inflames the imagination. Aladdin with his lamp never conjured genii to serve him so omnipotent as engineers have made emerge from seaward-bound waters. And the Niagara and the St. Lawrence descending to the ocean held in their depths potentialities to assume tremendous burdens of labor which still pitilessly strain human muscles.

In these things of which I have spoken I conceive to be in the largest sense the significant engineering activities of the Twin Cities.

Results of Long-Time Tests of Creosote-Treated Fence Posts

By C. H. Teesdale
Engineer in Forest Products, Forest Products Laboratory, Madison, Wis.

Over 2000 fence-posts were treated and set during 1908 and 1909 by the United States Forest Service, in coöperation with the University of Minnesota. Quite a number of these posts were treated with water-gas-tar creosote and others with coal-tar creosote, the hot and cold bath open-tank method being used and the entire post treated. An inspection in the summer of 1918, 9½ years after the posts were set, gives some interesting information, as it affords a direct comparison between coal-tar creosote and water-gas-tar creosote as wood preservatives. The table gives results from three inspections of these posts in 1913, 1916 and 1918.

BASSWOOD AND RED OAK POSTS TREATED BY COAL-TAR AND WATER-GAS-TAR CREOSOTE

Treatment	Species	Years of Service	Inspected	Number Tested	Good, %	Partly Decayed, %	Badly Decayed, %	Removed Account Decay, %
Coal-tar	Basswood	4½	1913	458	93.0	6.3	0.5	0.2
Creosote	Basswood	7½	1916	484	87.0	9.5	3.1	0.4
Creosote	Basswood	9½	1918	337	73.5	17.4	4.4	4.7
Water	Basswood	4½	1913	35	100.0	....	...	...
Gas-tar	Basswood	7½	1916	36	86.0	8.3	5.6	...
Creosote	Basswood	9½	1918	27	78.0	14.7	7.3	...
Coal-tar	Red Oak	4½	1913	226	100.0	....	...	...
Coal-tar	Red Oak	7½	1916	325	99.2	0.8	...	...
Creosote	Red Oak	9½	1918	330	94.5	1.8	1.2	2.5
Water	Red Oak	4½	1913	42	100.0	....	...	...
Gas-tar	Red Oak	7½	1916	98	97.0	1.0	2.0	...
Creosote	Red Oak	9½	1918	93	92.5	5.4	...	2.1

It is seen that at the last inspection 73.5% of the basswood treated with coal-tar creosote and 78% of that treated with water-gas-tar creosote were still sound. In the case of red oak 94½% treated with coal-tar creosote and 92½% treated with water-gas-tar creosote were still sound. It was found that the basswood posts did not take the treatment well, and for this reason this species is not recommended for open-tank treatment.

River Water Treated for Compensation Supply

To fulfil its obligations to supply compensation water to satisfy riparian or power rights, the City of Sheffield, England, will treat 9,000,000 Imp. gal. of Don River water per day to fit it for industrial use and pump it 11 miles back into the Loxley and Rivelen Rivers, tributaries of the Don. The water will be taken from the Don below Sheffield. Parliamentary authorization was required, and the committee hearing occupied 13 days. The London *Surveyor* states that this is new principle as to compensation water.

Enlargement of the Yakima-Tieton Main Canal

Half Circular Section of Reinforced Concrete Increased in Height—Bonus System Successful in Overcoming Great Scarcity of Labor at Favorable Cost

By G. C. Finley
Engineer United States Reclamation Service, Yakima, Wash.

UPON the extension of the boundaries of the Tieton Project of the Reclamation Service in the State of Washington from 24,000 acres to 32,000 acres, it became necessary to increase the capacity of the Tieton Canal. The reinforced-concrete section of this canal was circular, open at the top, slightly exceeding a semi-circle in cross-section. To enlarge the canal, a new top segment on each side was cast in place after the old concrete bracing ties were removed and a notch was cut for bonding the old to the new concrete. An acute labor situation was successfully met by introducing a bonus system, which also resulted in more than doubling the amount done per day, making possible the completion of the work, as desired, last fall.

The Tieton Canal was constructed by the United States Reclamation Service during the period from 1907 to 1909, and has been used to carry water for irrigation for the past eight years. The Tieton project, to which this canal supplies water, covers 32,000 acres, of which 26,000 acres are in a high state of cultivation. This past season there was produced $2,500,000 worth of foodstuffs, and the water duty was 2.36 acre-feet delivered on the farms.

The canal was originally constructed of reinforced concrete in sections on the flats along the river, the sections being transported to the canal site, then placed and grouted together. The sections were circular in form, 8 ft. 3⅝ in. in diameter, the top edge being 22 in. above the horizontal diameter and tied together by a 4 x 6-in. reinforced-concrete bar. They were built 2 ft. long and 4 in. thick, reinforced with ¼-in. steel longitudinally and ⅜-in. circumferentially.

The canal varies in elevation above the river from 0 at the point of diversion to 500 ft. at the lower end, and is constructed along a very rough and precipitous cañon wall. Fig. 1 shows a section of the original canal as completed in 1909.

Enlargement Necessary—The canal was designed and constructed for a project of 24,000 acres, but the boundaries of the project were subsequently extended to embrace 32,000 acres. This increase in area and a growth of algæ which reduced its capacity somewhat made it necessary to enlarge the canal section to carry the required quantity of water. The enlargement of the entire canal was begun in the fall of 1916, was continued in the fall of 1917 and then finally completed in the fall of 1918. Due to weather conditions in the Tieton Cañon and the necessity for continuing the operation of the canal, the working season was only from the first of October to about the middle of November, or about seven weeks each year.

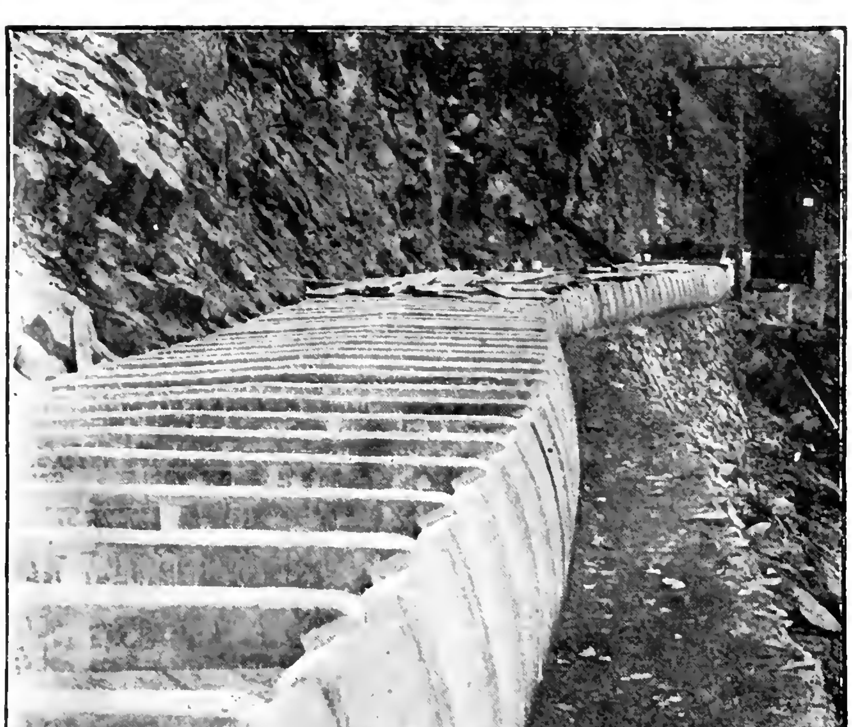


FIG. 1. ORIGINAL CANAL SECTION AS COMPLETED IN 1909

FIG. 2. TRANSPORTING CEMENT BY TRAMWAY

The necessary materials consisted of cement, sand and gravel, structural and reinforcing steel, and lumber for forms. The cement, steel and lumber were hauled by motor truck from Naches, an average distance of 15 miles. The aggregate was all hauled by teams from various points along the river, either direct to the canal or to the foot of tramways. The sand was screened through a ¼-in. mesh, and the gravel passed through a 1¼-in. mesh. Fig. 2 shows how the cement was transported at one point of the canal by inclined track and tramway.

One of the big problems was the distribution of materials along the canal. There were various parts of the canal up to 1½ miles in length where materials were delivered at only one point. This distribution was made by using mules hitched to small cars, as in Fig. 3. This work was first attempted by using men and cars, but the mules after the first few days were found to haul more load and make better time. The small stream of water shown running in the canal was used for the hoist boiler and for mixing concrete.

The preparation for joining the new work to the top of the original canal meant the removing of the concrete crossbars and the chiseling of a groove along the top of each side of the canal. This chiseling was first done by hand, but later by using two small pistol-grip

FIG. 3. MULES AND SMALL CARS USED FOR DISTRIBUTION OF MATERIAL ALONG CANAL

drilling machines run by an air compressor, operated by hand. Fig. 4 shows the canal as prepared for the enlargement. The hammers used for chiseling along the canal were found to work very successfully, in time and cost.

The old concrete crossbars were broken up and used for aggregate, and the reinforcing steel was salvaged. The new crossbars were made from 3-in. standard channels spaced 5 ft. apart and extended 6 in. into the old concrete. No provision for a contraction point was made in the new work, as 1% of temperature steel was provided and the work was all done during cool weather. To date there have not been any serious temperature cracks in the entire canal. The addition as constructed gave the canal a certain longitudinal strength as a beam, which may be of value in case of undermining. The maintenance work on the repair of the joints each season, due to temperature, has been materially reduced. Fig. 4 gives the general dimensions and details of the enlarged section.

Form Construction—Forms made of 1-in. surfaced cedar were used for the work and placed to grade by using a Y-level. The inside surfaces were all pointed with linseed oil twice during each season. Fig. 5 shows how the forms were placed, also the structural and reinforced steel and materials as they were placed.

Fig. 6 shows the manner in which the concrete was mixed and placed. The work was carried on by a number of crews of about 18 men, each in charge of a foreman. Each crew used about 600 ft. of forms, of which about 250 ft. were removed each day and moved ahead and refilled. The mixing and placing were all done by hand, the mix being 1 : 2 : 4 with sand and gravel aggregate. The mixing was done on a board supported above the canal by wooden horses which were moved forward along the canal. The concrete when mixed was shoveled direct into the forms. The forms were removed in 48 hours, and, because of careful mixing and tamping very little finishing was found necessary. The original canal was raised by placing the forms tangent to the curve a sufficient distance to make 1 ft. in elevation. The progress of the work from the beginning in 1916 until the close in 1918 varied per crew from 140 to 400 lin.ft. of canal per day.

Fig. 7 gives a view of the present completed canal, showing the steel crossbars, new work and the point of contact between the original canal and the enlargement. The capacity has been increased from 300 cu.ft. per second to about 350, which will be sufficient for the full development of the project.

Weather conditions during the working season on the canal were generally favorable, and especially during 1918 the weather was perfect, with no time lost on account of rain and no concrete damaged on account of cold weather. There was an average of 12 hours daylight during the working season.

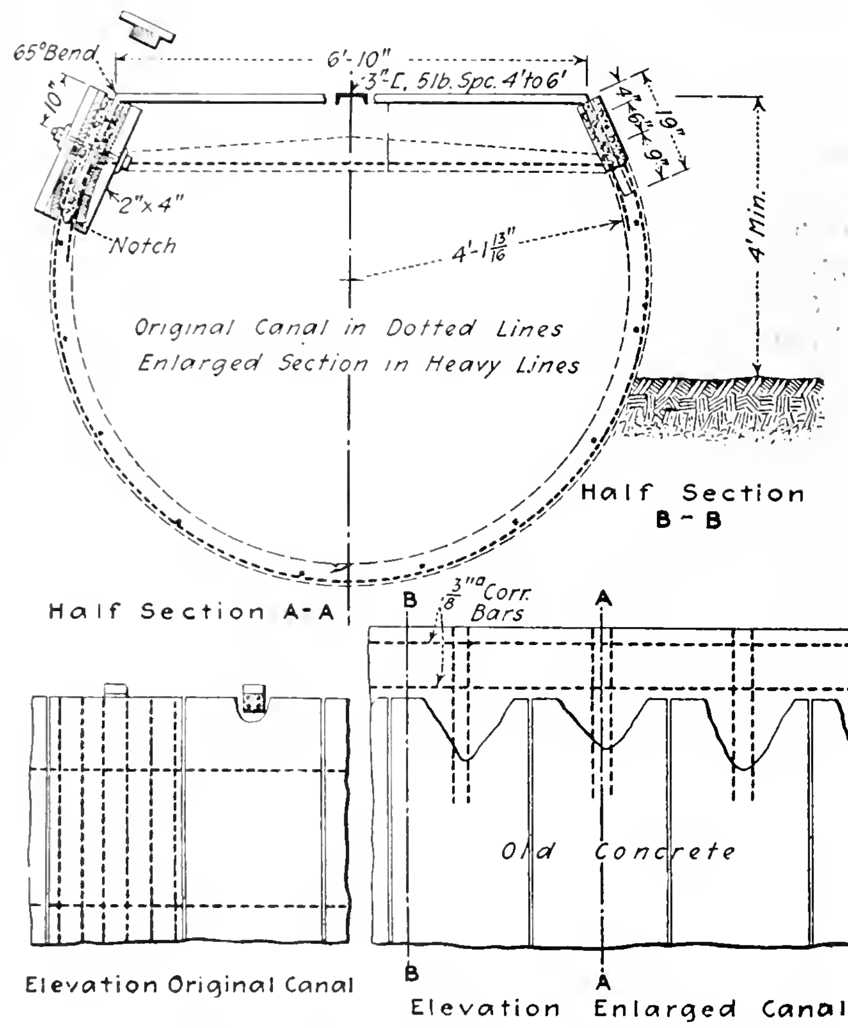


FIG. 4. DETAILS OF ORIGINAL AND ENLARGED SYSTEMS

Labor Situation—The local supply of labor during 1918 decreased rapidly from early spring on account of shipbuilding, logging and other war industries offering high wages on the coast, and, beginning with the need for farm labor in the valley about June 1, the labor situation in general began to look very serious for construc-

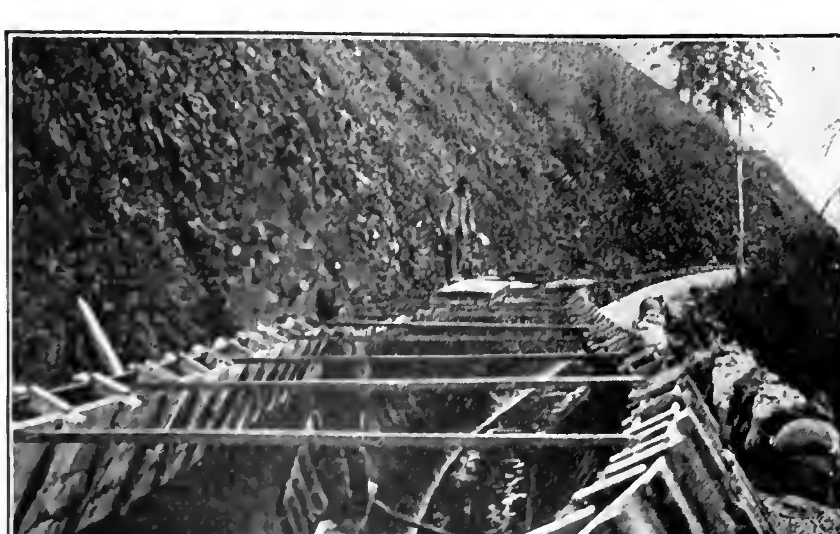


FIG. 5. BRACING AND FORMS IN PLACE

tion work of any kind. Wages were increased about 50%, which made the cost almost prohibitive.

The only time during which the enlargement work on the Tieton Canal could be done was the month of October and the first half of November. This was during the time when the farmers were harvesting their third cutting of alfalfa and practically the entire apple and potato crops, all three of which are produced in large quantities in the Yakima Valley. Prices for farm crops in general were most favorable, so that farmers were paying almost any price in order to obtain sufficient

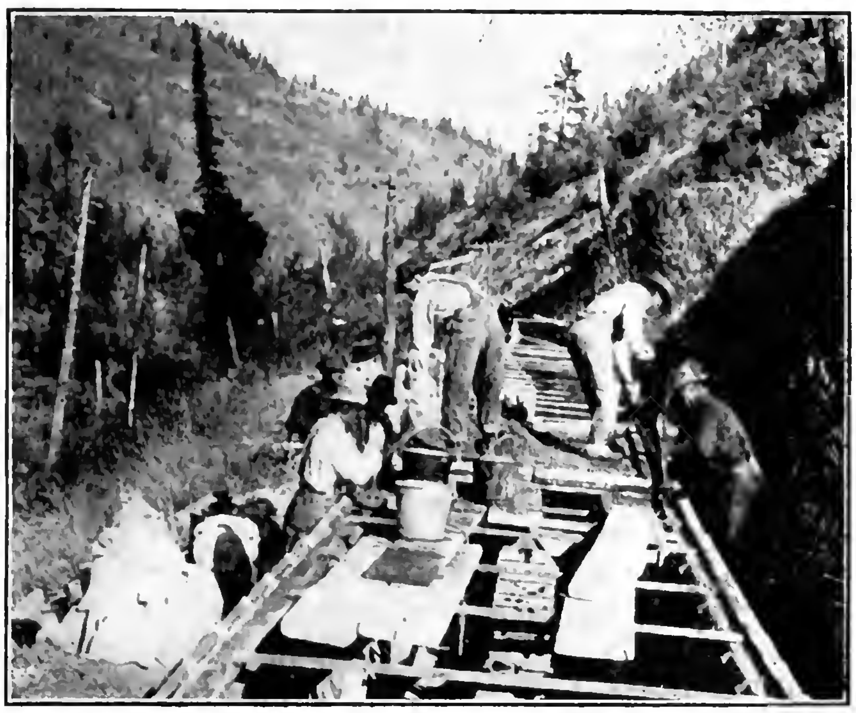


FIG. 6. HOW CONCRETE WAS MIXED AND PLACED

labor for harvesting these crops. Concrete work, especially where the mixing is done by hand, is not attractive to the average laborer because everyone knows it is hard work. Furthermore, a similar job was in progress where wages and living conditions were favorable, only about one-third the distance from Yakima, and this camp was not able to obtain sufficient men.

The estimate of the number of men necessary to complete the remaining work on the canal in the time required was about 160. This meant five crews of about 18 men each, mixing and placing, and the necessary labor to supply material. There were about 40 men in camp who were doing such preliminary work as building roads, erecting a tramway, building forms and screening sand and gravel. On Oct. 1 we were in need of about 120 more men. Labor for construction work in the Yakima Valley is obtained through Spokane and Seattle; many make Yakima their local headquarters.

Bonus System—In order to assist in the solving of the problem of getting sufficient labor while weather conditions were favorable, a bonus system of wages was adopted. The work had been started in 1916 and continued in 1917, and the plans were to complete the job in 1918. There were 126 stations completed in 1916; 97 stations in 1917, and 254 stations remaining. There had always been a labor shortage on this work, but especially during 1917. In 1916 the average progress was 150 ft. per day; in 1917 this average was brought up to 160 ft. per day.

As is the practice in establishing a bonus rate, the cost is divided equally between the employer and employee for any amount of work done over and above what is considered an average day's work, amounting to about 3c. per man per foot. Laborers must have a certain amount of bonus in order to become interested, and it was decided that 140 ft. per day should be counted as a good day's work. Therefore, each man in the crew received 1½c. per foot each day for any amount completed over 140 ft. The granting of this bonus was contingent on a man working 10 days, and the amount of bonus was determined on each 10-day period.

COST OF ENLARGEMENT WORK—TIETON MAIN CANAL

	1916	1917	1918	Total
General Costs				
Stations enlarged during year..	126	97	254	477
Number of yards of concrete placed	433	333	874	1,640
Cement delivered	$2,926.36	$2,373.34	$4,767.87	$8,567.57
Sand and gravel delivered	4,292.25	3,491.71	7,679.55	15,463.51
Forms, labor and materials	2,583.61	1,655.82	6,632.71	10,872.14
Mixing and placing concrete	1,921.22	1,881.47	11,535.61	15,338.30
Finishing and protection	666.47	759.39	2,715.97	4,141.83
Equipment charge	831.46	375.77	1,854.73	3,061.96
Unit Costs				
Cost of cement delivered in barrels	$3.85	$4.10	$4.15	....
Lumber delivered—per thousand	11.00	......	17.00	....
Wages paid for labor—base rate	2.40	3.00	4.50	....
Cost of reinforcing steel—per lb. in place	0.045	0.054	0.062	....
Cost per cubic yard of concrete	30.54	31.64	40.26	35.00
Final Costs				
Preparation, chiseling, etc.	$1,793.87	$1,995.37	$7,458.03	$12,747.27
Reinforcing steel in place	1,175.52	1,101.29	3,738.40	6,015.21
Steel crossbars	5,656.11	6,137.41	12,276.76	24,070.28
General expense	1,595.40	2,146.36	5,268.44	9,010.20
Total cost of work	23,442.27	21,917.93	63,928.07	109,288.27
Cost per lineal foot of canal	1.86	2.26	2.52	2.30

The cement haul was by teams in 1916 and 1917, an average distance of 18 and 16 miles. In 1918 motor trucks were used and the average distance was only 10 miles.

No lumber was bought in 1917, old forms being used.

Structural steel purchased in 1918 was 1¼-in. reinforcing steel and not 3-in. channels, as previously used, because it was impossible to purchase the standard channels.

During the first two bonus periods the average amount of work was about 200 ft. per day. During the third bonus period this average was brought up to 220 ft. per day. The interest in this system of paying for work seemed to grow from the beginning of the work, and during the last period, which was from Nov. 10 to the date of completion, Nov. 18, 1918, the average

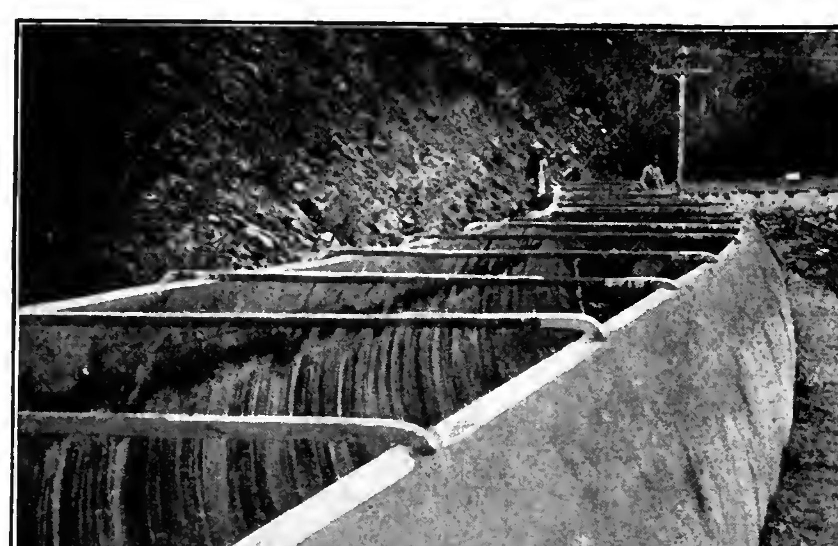


FIG. 7. COMPLETED CANAL SECTION AFTER ENLARGEMENT

was 300 ft. per day, with a maximum of 404 feet.

Without a doubt, the result of this system of wages was very material in obtaining sufficient men to complete the work. This scarcity of labor was such that only three crews were working until Oct. 25, and four crews from this date until the completion of the work. There was an increase daily of the number of men in camp from 40 at the beginning of October to a maximum of 160, the increase being gradual. There was very little trouble in holding the men on the work, as wages in general were good and so was the mess.

Figuring the cost of the work done in 1918 carried out under the prevailing wages without bonus, using the work done in 1916 as a basis, it amounts to $3 per lineal foot, which was the estimate prepared for the work. The main result of the bonus system was that it proved to be a sound basis for productive efficiency. The entire canal was completed, and the figures show that the advance in costs in 1918 is considerably below the general advance in labor and materials.

The work was done under the supervision of R. K. Tiffany, project manager of the Yakima Project, with the writer as engineer in direct charge of the work.

Save $10,000 by Breaking Old Stone Across the Bed

Salvaged stone from an old boiler house at the river pumping station of the Louisville Water Co. was broken across the bed and its use on the new boiler house under erection has saved $10,000.

The old structure was 75 ft. square and 25 ft. high, and built of solid stone from Bedford, Ind. The new one is 75 x 150 ft. in plan and varies in height from 25 to 85 ft. It is similar in construction to the pumping station described in *Engineering News-Record* of May 9, 1918, p. 905, being faced with 6 in. of stone and backed up with reinforced concrete. The stone in the old building varied in thickness from 6 to 8 in. and in length from 3 to 4 ft., all being headers 2 ft. wide, faced on both inside and outside. Thus, hauling the stone six miles each way to the mill for sawing and refacing would have entailed considerable expense, making the cost practically the same as that of new stone. All of the stones were laid on their beds, and every stoneman who passed on the work said it could not be split across the bed except by sawing and drilling. The best price obtainable for sawing and refacing with a rock face and loading on cars at the factory was 57c. per cubic foot. The 25,000 cu.ft. has been done, according to J. A. Wilson, chief engineer and superintendent for 14c. per cubic foot with little breakage.

The splitting of each stone into three pieces was done by laying the piece to be broken on a bench made of 12 x 12-in. timbers, placing under the stone a $\frac{3}{4}$-in. iron rod and striking 6 to 10 blows with a 12-lb. hammer.

Calcium-Chloride Solution and Setting of Concrete

Results of Numerous Tests Show That Strength of Concrete Is Not Lowered—Hastens Setting Materially

CALCIUM-CHLORIDE solution materially hastens the setting of portland-cement concrete, and new tests have shown that up to the end of one year the strength of the product is not injured, according to the annual report of H. Eltinge Breed, until recently first deputy commissioner of highways, New York State Highway Department, and now consulting highway engineer, New York City.

In leading up to the portion of his report reproduced below, Mr. Breed stated that, although the department had had unusual success in doing its own construction work upon its unfinished contracts—in fact, so successful that the question is raised as to whether it might not be advantageous for highway departments to be authorized and prepared in emergencies to do their own construction as well as engineering work—still, he felt that perhaps the best contribution made this year by his department to the good-roads movement in the state and elsewhere was through the medium of its research work.

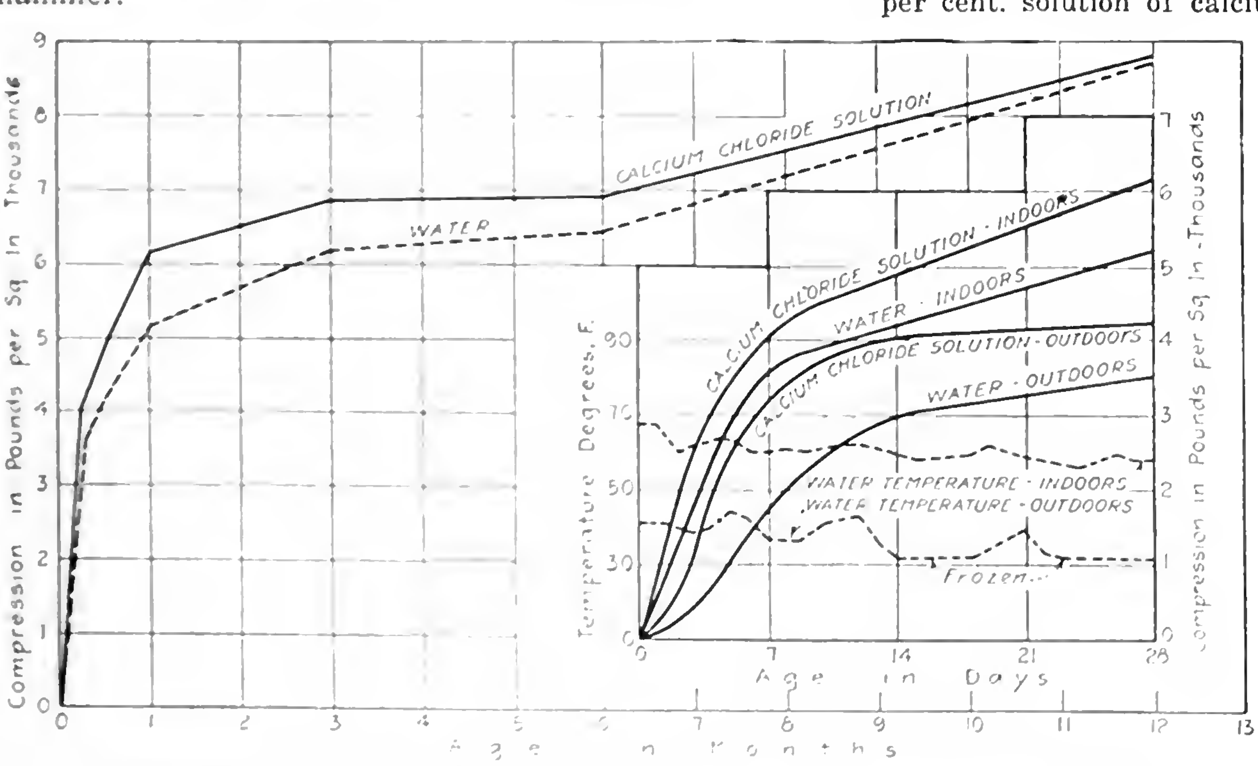
Important phases of this research work are the impact studies, described in *Engineering News-Record*, June 5, 1919, p. 1103, and the experiments with calcium-chloride solution. The following is an extract from Mr. Breed's report referring to the latter:

A series of tests were completed to determine the advantages in use of calcium-chloride solution to hasten the setting of cement concrete. It has been stated that by use of this solution concrete gun foundations could be put in use three days after construction. The tests made by this department were for the purpose of determining whether the rapid setting would decrease the ultimate strength which the concrete would attain. It is well known that abnormally quick setting cements do not usually make concrete which is as strong ultimately as the slower setting cements.

Laboratory test samples were prepared and tested at ages varying from one day to one year. The results are shown graphically herewith. They indicate the use of a 4 per cent. solution of calcium chloride as mixing water for cement concrete increases the strength attained at all ages up to one year.

Beyond that it is still problematical, but what evidence we have indicates certainly no deterioration, and a probable continued, but slower, gain. The maximum increase appears to be about 20 per cent. at the age of one month.

The importance of this determination will be appreciated when it is considered that by the use of this solution it will be possible not only for the contractor but also for the public to make use of cement-concrete pavements a few days after they have been laid, without risk of damage. It will mean the completion of much work in the autumn which has hitherto had to wait over unfinished until spring.



STRENGTH OF CONCRETE WITH AND WITHOUT CALCIUM CHLORIDE.

Sinking and Concreting Mine Shaft 936 Feet Deep

Lining and Walls of Four-Compartment Shaft No. 5 of Miami Copper Company Concreted Simultaneously With Excavation Operations—Blasting Impossible Below 200-Foot Depth

By Richard L. Russell
Superintendent, The Foundation Company, Miami, Ariz.

Several novel details in underground construction were developed and applied in the sinking and concreting of shaft No. 5 of the Miami Copper Co. at Miami, Ariz. This shaft has four compartments and is 936 ft. deep, and the concrete lining was carried on at the same time as, and without interference with, the sinking, 700 ft. of the shaft lining having been placed and two large stations having been excavated and concreted by the time the shaft had reached its final depth. The section, shown in Fig. 1, is 13 ft. x 16 ft. 4 in. clear and required an excavated section 15 x 19 feet.

The entire shaft lies in what is locally known as Gila

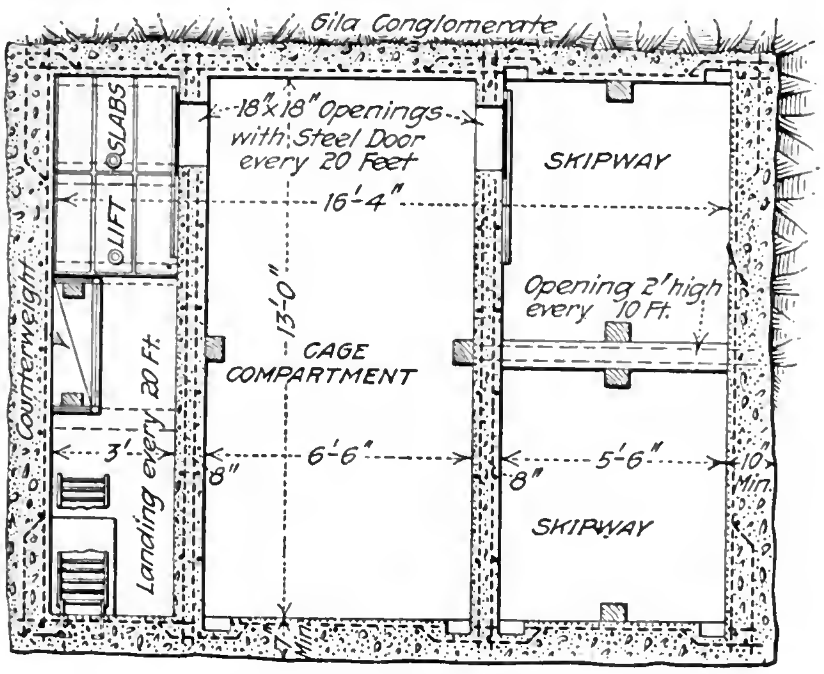


FIG. 1. CROSS-SECTION OF SHAFT, SHOWING CONCRETE LINING

conglomerate, a formation which is typical hardpan rather than a true conglomerate. Although the material is very hard, no blasting was done after water was encountered at a depth of about 200 ft., it being found practically impossible to remove the powder fumes from the fissures in the water-laden hardpan. Light jackhamers with "bull points" from 2 to 3 ft. long were used to break the ground. This method, besides permitting the walls to be trimmed neatly, with far less overbreak than would result from blasting, permitted a progress of 100 ft. per month.

The shaft was located on the side and near the top of a small, steep hill, the top of which was graded down by the contractor to the elevation of the collar of the shaft. The plant layout is shown in Fig. 2. The shaft being near the present operating plant of the Miami Copper Co., the air, water and electricity were delivered by that company at the collar of the shaft.

The contractor began erecting the headframe and other working structures Dec. 11, 1917, and hand excavated for the top 25 ft. of shaft without blasting, in order to avoid disturbing the ground adjacent to the collar. As the hoist could not be delivered until the end of January, 1918, the contractor obtained, late in December, permission to drift in from a tunnel of the Miami Copper Co. which passed within 20 ft. of the southerly corner of the shaft at a depth of 118 ft. This permitted the tramming of muck by hand a distance of about 300 ft. through the tunnel to a dump in the gulch at the tunnel entrance.

After the line of the shaft was reached, a raise was driven for the purpose of meeting the excavation from the surface. This raise was 2½ x 6 ft., of which 2½ x 2 ft. was a manway with ladders and the remaining space was occupied by a cribbed chute. At the tunnel level the drift was widened and the full shaft section excavated to make a working chamber large enough to accommodate a switch, which permitted the sidetracking of an empty car while another car was being loaded.

The full section of the shaft was then broken down through this chute by the use of 40% dynamite.

The drift was started Dec. 26, 1917, and completed Jan. 1, 1918; the raise was started Jan. 2, 1918, and completed at 6 a.m. Jan. 8, 1919—a rate of 5 ft. per eight-hour shift. The full section of shaft was excavated to the level of the tunnel Feb. 20, 1919, and 60 ft. of shaft had been concreted in the same period, as follows:

As soon as the excavation had reached a depth of 35 ft. the forms for the 25-ft. collar were started on 12 x

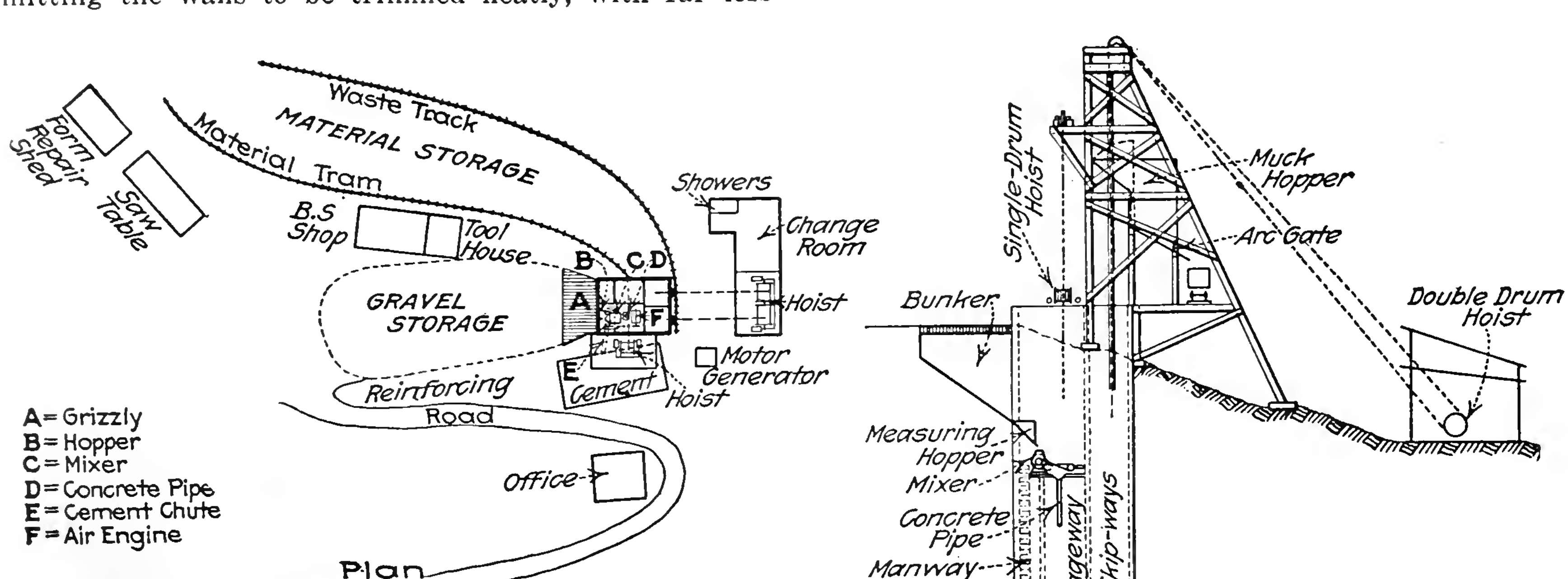


FIG. 20. PLAN OF CONSTRUCTION-PLANT LAYOUT FOR SINKING AND CONCRETING MINE SHAFT

12-in. bearing timbers placed in 18-in. hitches cut in the hardpan walls. No back forms were used, and the whole 25 ft. was poured continuously. As no water was encountered, no timbering was necessary.

While the collar was being concreted, the excavation had progressed to a depth of 55 ft. Hitches were again cut in the walls, and the three 12 x 12-in. bearing timbers were lowered into them. On these bearing timbers was placed a timber frame, the exact size of the concreted section, which served both as a bottom form and a sill on which the form panels could be set. The vertical reinforcing rods were then hooked to the verticals which had been left projecting from the bottom of the previous concrete, and the horizontal reinforcing was wired to the verticals. A 5-ft. section of forms was then placed and concrete was poured, this process continuing until the concrete was carried up to the bottom of the collar section. It was found that the ground would safely permit the opening up of a depth of fully 25 ft. of shaft without lateral support, and the concrete was carried down in 20-ft. sections by the above process for the first 200 ft. of the shaft.

As soon as the raise from the tunnel level was finished and the breaking-down process was well under way, a small air hoist was installed at the tunnel level, and the two skip compartments were sunk and timbered as a pilot shaft, this muck being hoisted to the tunnel level and also trammed through the tunnel. Thus excavation was being carried on simultaneously at two levels

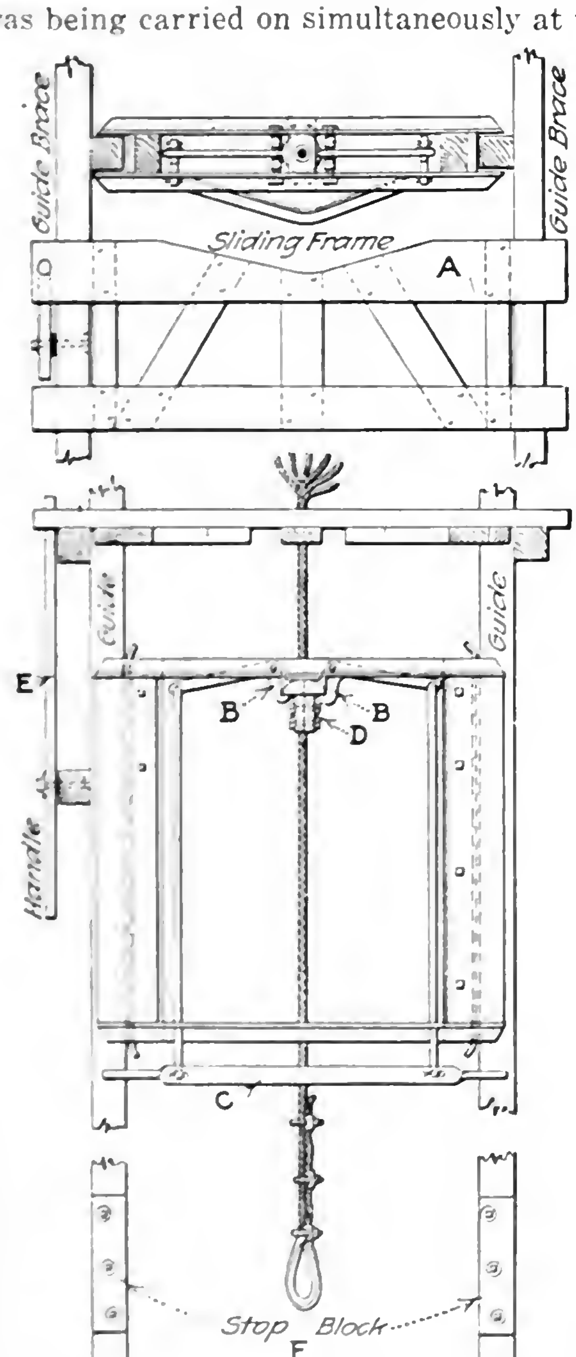


FIG. 3—CROSS-HEAD AND SAFETY DEVICES

without interference, while waiting for the double hoist to be delivered.

By the time the whole shaft had been excavated down to the tunnel level a two-compartment pilot shaft 100 ft. deep was ready, one compartment serving as a chute through which to draw off the muck from breaking down the full section of the shaft and the other a hoisting compartment to the tunnel level through which the muck was still trammed.

Water was encountered at this depth (218 ft. below the surface) and while the full shaft section was being excavated to this depth the double-drum hoist was delivered and installed and a special crosshead was devised to comply with the requirements of the Arizona mining laws and at the same time permit the bucket to be dumped into the receiving bin in the headframe without excessively increasing the height of the latter.

As it was neither possible nor desirable to keep the bucket guides extended nearer the bottom than 15 to 30 ft. while sinking was in progress, this crosshead had to be such that it could be stopped at any desired point in the shaft as well as at the headframe and allow the bucket or skip to continue on, for filling or changing at the bottom or dumping when reaching the headframe. This was accomplished by the arrangement shown in Fig. 3.

A lug D was securely clamped to the cable about 6 ft. above the shackle loop. This lug engaged the dogs B and thus attached the crosshead securely to the cable. When the crosshead reached the top of the headframe, the top lander pulled the lever E and slid the frame A over against the guides and gave the lowering signal. The bumper C then hit the frame A, the dogs B released the lug D and the crosshead was left resting on the frame A while the bucket was dumped, after which the latter was raised high enough to take the crosshead off the frame A. The frame was then slid back and the bucket with the crosshead attached was ready for lowering. At the bottom of the shaft, or at any other point where free use of the bucket was desired, stop blocks E were bolted to the guides and performed the same function as the frame A at the headframe. This crosshead gave perfect satisfaction.

From the 218-ft. depth to the bottom the full section of shaft was excavated by the use of bull points; three men using jackhamers working them into the material loosened all that four muckers could load into the buckets.

It was found that the water caused the hardpan to slough very treacherously soon after a wall was exposed. Full timbering was therefore carried on with the excavation from the 250-ft. depth; 8 x 8-in. plates, posts and dividers and 2-in. lagging were used. Corner joints were framed as shown in Fig. 4 in order to secure an increased bearing surface. As the shaft was concreted, all timber and lagging were removed and re-used, some timbers being used as many as four times. This not only resulted in a large material saving but also saved a high framing expense, as carpenters were paid $7.25 per shift at that time.

The section concreted in one operation was increased to 100 ft.; that is, the 12 x 12-in. bearing timbers were lowered 100 ft. and set in hitches and the 100-ft. section was concreted upward in 5-ft. courses.

The water was bailed into buckets and hoisted, five buckets per hour, or 600 gal. which, together with the

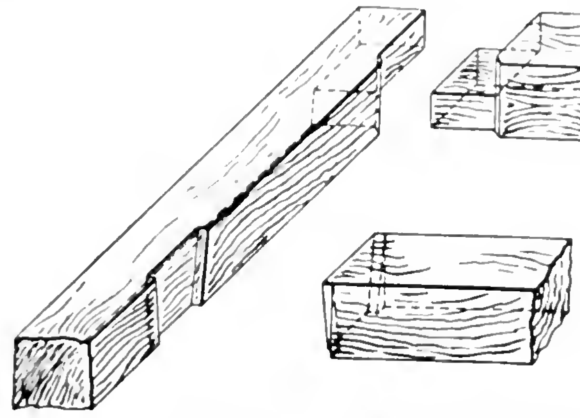


FIG. 4. DETAIL OF TIMBER FRAMING

water shoveled and hoisted with the muck, was sufficient to keep the bottom free. A timber bulkhead 6 in. thick was kept not over 50 ft. above the men working in the bottom over all of the shaft except the two skip compartments. While the reinforcing and forms were being set in one of the skip compartments all the hoisting from the bottom was done in the other compartments, and after the forms were set one of the skip compartments was bulkheaded at the level of the top of the forms, as were the cage and manway compartments, one skipway only being left open for hoisting.

Upon the completion by the contractor of the contract for lining with concrete the old shaft No. 3 of the Miami Copper Co., a mile distant from the new shaft No. 5, about Apr. 1, 1918, the single-drum hoist from shaft No. 3 was installed at shaft No. 5, as shown in Fig. 2, working from extension timbers from the same headframe and operating in the cage compartment.

This hoist handled all reinforcing, forms, concrete pipes and timbers to the form and concrete gangs, and as there was always a bulkhead in this compartment over the men in the bottom, the danger of working at two different levels was greatly lessened. This hoist was also used in pulling and resetting the rather heavy wooden forms in all compartments. It proved nearly as fast as a derrick and obviated the use of the slow and expensive block-and-tackle method.

Separate bunkers for sand and gravel were excavated immediately adjacent to the collar of the shaft at the manway end, and the sand and rock from the crushing plant, which was installed in the creek bed, was dumped through grizzlies into these hoppers. Through openings left in the shaft collar, with arc gates, the sand and stone passed into measuring hoppers inside the manway and cage compartments. These hoppers were of the proper dimension for a one-bag batch, and from these hoppers the material was chuted to a batch mixer located in the shaft cageway compartment 20 ft. below the surface. The cement was slid in bags down a chute from the door of the cement shed through an opening in the south side of the cageway compartment directly to the mixing plant.

The mixer, of 8-cu.ft. capacity, was belt-driven from a small air hoist set at the same level. This plant occupied the southerly half of the cage compartment and manway compartment, the wall between the two being omitted temporarily for its accommodation, the whole plant occupying an area only 7 ft. x 9½ ft., as clearance for buckets and material handled by the small hoist in the cage compartment had to be maintained at all times.

The 1 : 2 : 4 mixture of concrete was dumped from the mixer through a 6-in. iron pipe with screwed couplings and with the fall broken at junction boxes every 300 ft. and at the swiveled chute which carried the concrete to the forms around the shaft. This pipe was supported by timber clamps resting on 6 x 8-in. timbers carried in recesses left in the concrete when poured, and on the shaft timbers where the concrete had not yet been placed.

In the manway compartment the permanent iron ladders were placed in position as the concrete lining was placed. In advance of that, the permanent ladders were placed on temporary wooden landings. Concrete-lined stations were located at 235, 490, 576, 643, 729, 770, 835 and 920 ft. below the surface. The 490- and 576-, also the 770- and 835-ft. stations were the top and bottom of future ore pockets. The ore pocket between the 643- and 729-ft. stations is now being constructed.

To facilitate the construction of these pockets, 4 x 4-ft. cribbed chutes were excavated before the shaft was concreted just outside of the concrete walls of the northwestern skipway, with a gate and a chute leading into the skipway at the bottom of each pocketway. When the ore pockets are constructed the muck will be shoveled into these chutes and drawn off at the bottom and the cribbing removed as the excavation proceeds, thus effecting a considerable economy in the cost of excavation.

For the hoisting in the cageway compartment, cable guides were installed, carried on reels on the headframe and unreeled as the shaft was deepened, and even at the full depth of 936 ft. these did not oscillate enough to cause any difficulty.

To avoid trouble with the permanent guides from the use of expansion bolt fastenings, and to avoid the irregular spacing of bolt holes in the guides if anchor bolts were set in the concrete as it was poured, a novel guide fastener was designed. It was built in the concrete as poured, but still allowed drilling of the bolt holes by templet after the shaft was completed and allowed a leeway for any reasonable irregularity in location while pouring. These fasteners are shown in Fig. 5.

A chart was kept showing the progress made each day by each shift on each part of the work. A large-scale elevation of the whole shaft, stations, tunnels and ore pockets was made, and a certain portion was allotted to excavation, timbering, form work, reinforcing, concreting, etc. To each shift boss was asigned a certain color, and the portion of the chart representing the location and the amount of work done was colored for the shift doing the work. The date was then written through the color. Quantities for this purpose were determined both by actual measurement and by the foremen's reports. For instance, the number of buckets of

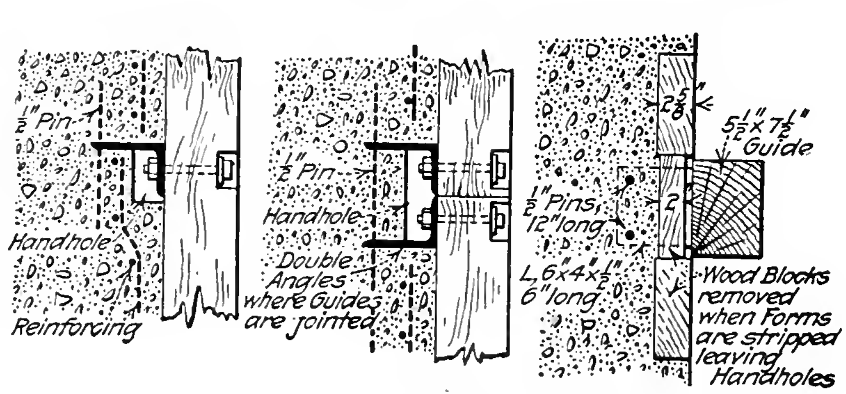


FIG. 5. DETAIL OF NOVEL GUIDE FASTENING

muck hoisted was a close check on the advance in sinking for that shift. The foremen were never formally notified that this chart was being kept, but within two days from the time it was instituted they all seemed familiar with it and watched it closely.

This chart not only furnished information as to progress at all times and gave a comparison of the work accomplished by each shift, but it also served as a record which showed at a glance which shift boss had excavated any part of the work. If faulty workmanship had been discovered it would have been simple to trace it.

Probably the greatest value of the chart, however, lay in the competition it aroused among the shift bosses, who realized that their work was being closely followed and that they were getting due credit.

In spite of the fact that the hardpan through which the shaft was driven is so firm that all former shaft sinking in the district had been done by blasting, it sloughed badly upon exposure to the air, and this without warning. Ground which had been sounded and found solid but a few minutes before would suddenly fall with no warning, so that the sinking combined the difficulties of both hard-rock work and soft, treacherous ground. In spite of this fact, there have been no serious accidents to either construction or the employees during the entire work, which means that while every precaution has been taken to safeguard the men and the work, good luck has also favored the job.

The Foundation Co., of New York City, did this work by contract, under the supervision of its Pacific Coast department, with Bayly Hipkins, vice-president and Pacific Coast manager and A. S. Lilley assistant manager; and under the direct charge of the writer as superintendent, James H. LeFeaver as assistant superintendent and John Sheehy as night superintendent.

Suggests Light Railway Feeder Lines

Light railways of the type used between the main-line railways and trenches during the world war were suggested as having a definite transportation value in sparsely settled countries, in a paper by Charles F. Lang, president of the Lakewood Engineering Co., read before the Pan-American Commercial Congress in Washington. Mr. Lang called attention to the developments in detail design and construction which were brought about by the war use of the narrow-gage railway, with its readily portable track and tie system. He suggested the use of such a railway to supplement the highway and the standard-gage railroad. He said there were a number of places where both the highway and the main-line railway were too expensive to build, particularly in undeveloped stretches of territory. The light railway could be laid out on fairly steep grades with high curvature through undeveloped country with a minimum of earthwork, and there could be in every farm or mine area a personally owned track, each tying up with the through line. He also suggested that in sparsely settled territories which might not warrant the expense for a first-class highway the narrow-gage railway could be used (1) for the construction of a cheaper improved highway which would be sufficient to carry light passenger traffic, and (2) the railway having been used for such construction, it could be used as a railway for the heavier traffic, both the railway and highway together costing less per mile than a hard-surface road would cost now in the United States or Canada.

Important and Neglected Features of Tire Maintenance

Tire Cost and Fuel Cost Are Normally About Equal For Large Trucks—Abuse May Cause Tire Cost to Be Excessive

By A. F. Masury
Chief Engineer, International Motor Company, New York City

Large numbers of persons who use motor trucks—such as contractors—consider that economy, as far as the trucks are concerned, means gasoline saving. However, saving of tire cost is equally important. On a heavy truck the tire cost and fuel cost are about equal. On lighter vehicles tire cost is slightly less than fuel cost, unless pneumatic tires are used, when the tire cost will slightly exceed fuel cost. Why, then, should we hear so much about means of saving gasoline and so little about economizing on tires? While the two items of cost are normally of equal magnitude, abuse of tires can raise their cost out of all proportion to their normal cost, and can swell this item far beyond the utmost extravagance in fuel.

It is a fortunate circumstance that gasoline waste inevitably limits the ability of the vehicle to perform, and that unless the carburetor adjustment is set for reasonable economy the truck will hardly operate at all and consequently cannot consume an excessive amount of gasoline. On the contrary, tire abuse, unfortunately, limits the performance of the vehicle but little, and in addition gives rise to increased chassis maintenance and even increased fuel cost.

Truck owners are often encountered who are extremely particular about carburetor adjustment, who employ the latest air-warming devices, and insist that the engine be shut off at each stop, but they allow the tires to remain cut and slivered, the wheels out of line, and the truck running daily on the car tracks. The truck will actually consume less gasoline without a governor than with one, but the removal of the governor and the consequent overspeeding imposes a heavy toll on tires.

Commonest among tire abuses are overloading, overspeeding, running in car tracks, neglecting cuts and tears, spinning, skidding and sliding the wheels, and wheel misalignment.

Overloading—This stresses the tires beyond their elastic limit, utterly destroying the life of the rubber, and, therefore, the durability and cushioning ability of the tires. Fig. 1 shows a tire which has been over-

FIG. 1. OVERLOADING DESTROYS THE LIFE OF THE RUBBER AND CRACKS THE TIRE

loaded. Note the peripheral crack near the base and the separation of the tire at the base.

Overspeeding—Even with a light load, overspeeding has the same effect as overloading, since the increased speed causes the impact of the tire on road bumps to be magnified. Running over a bump at twice the normal speed pounds the tire eight times as hard, and consequently may overload it at one spot 400%. A tire treated in this manner may be seen in Fig. 2. If high speed is necessary, pneumatic tires should be used, though they cost more; it will be much cheaper than putting solid tires in the condition shown, after a few hundred miles.

Running in Car Tracks—This simply cuts the tires by centering the pressure at one point instead of evenly over the treads. A tire which has been run in car tracks is shown in Fig. 3. The edges of the rails, particularly the guard flanges of street-car tracks, become sharpened by the friction of the car wheels. Running tires over them is much like running them over the edges of steel knives.

When solid tires are cut or torn by glass or sharp stones the rubber slivers. These slivers should be cut off as soon as they appear. Care should be taken that a clean notch just below the end of the tear is made. If the sliver is left on, it will contribute nothing to the strength of the tire but will continue to extend until half the tread width is torn loose. Fig. 4 shows the condition produced in a tire by allowing slivers to remain uncut.

Spinning, Sliding and Skidding—Spinning and sliding the tires in starting and stopping, and skidding in rounding curves, also leaves serious destructive effects similar to that shown in Fig. 4. Upon loss of traction most drivers will speed up their engines under the wrong impression that this will increase traction. Actually, it does the reverse. The more slowly a wheel turns the better traction it has, the more gently it is started turning, the less liable it is to slip. When a wheel begins to lose traction the driver should throttle the engine rather than speed it up, retarding his spark and being ready to release the clutch to prevent stalling. In engaging the clutch it is also well to let it in gently, and low gear should be used, as this will permit the wheels to turn very slowly without so much danger of stalling.

In the application of the brakes the wheels should not slide. Not only does sliding the wheels injure tires, but it reduces the braking effect. The quickest stop is made when the wheels are just turning and the abrasion of the tires is least. Skidding on rounding curves is as unnecessary as it is dangerous. It is due to turning at excessive speed. All of these abuses do untold harm to the tires. A tire is made to roll over the ground, not to slide.




FIGS. 2 TO 5. CONDITIONS RESULTING FROM VARIOUS ABUSES OF SOLID RUBBER MOTOR-TRUCK TIRES
Fig. 2. Overspeeding. Fig. 3. Running in car tracks. Fig. 4. Neglecting slivers, skidding and sliding. Fig. 5. Misalignment of wheels.

Besides these more obvious causes of excessive tire wear, there is an insidious cause which is too apt to be overlooked. This is faulty alignment. When the tire rolls smoothly there is a minimum of wear, but if out of alignment, it has a combination rolling and sliding movement over the road which not only causes rapid wear but consumes power. There are two forms of faulty alignment; that in which the wheel itself is out of line, so that it wobbles, and that in which the wheel spindle is at an improper angle, so that the wheel is constrained to a position out of parallel with the direction of the vehicle's motion.

Wheel wobbling is caused by warping of the wood and strains. Some of the strains which get wheels out of true can be avoided. When a truck is driven diagonally into the curb, for instance, or when a corner is rounded too sharply or a boulder is struck a glancing blow, the severe lateral strain at one point of the circumference of the wheel is apt to warp it. Sometimes carelessness in applying or removing pressed-on tires warps the wheel, and in some cases a careless operator

will press the tire on crooked, so that the effect on the tire is the same as that of a warped wheel. The remedy is to have the tire pressed off and the wheel trued.

Misalignment of the wheel spindles is due to excessive shocks, such as running into curbs, overspeeding on rough roads, and so on, which bend the axle or the steering arms of the front steering knuckles. The destructive effect of a slight misalignment can readily be appreciated when one realizes that if a wheel is only out of line one degree horizontally it must slip 92½ ft. sidewise in a mile of travel. The destructive effect upon the tire is the same as though the truck were pulled sidewise this distance by a winch. On the periphery of the tire one degree is only equal to about $\frac{9}{32}$ inch.

Alignment of wheels can only be made true by accurately checking the distance between the wheel felloes. There are several good methods of doing this, and a number of methods that are not so good.

Most motor trucks have their rear wheels exactly parallel. To test their alignment, the simplest method requires two men and a tape. The end of the tape is held against the front of the inside space on one rear wheel, and the tape stretched across the corresponding point on the opposite wheel, care being taken to have the tape level and stretched tight. The bottom points of the felloes are then checked, and then the rear points. All three of these measurements should be the same. The most common misalignment of the rear wheels is what is called a spraddle. By this is meant that the bottoms of the wheels are farther apart than the top. If this condition is found, the wheel bearings should be inspected for looseness first. If these are properly adjusted, then the axles should be straightened.

Front wheels should not be parallel. For greater strength and easier steering they are cambered; that is, the wheels are farther apart at their tops than at their bottoms. To correct the resulting tendency for them to roll incorrectly they are correspondingly gathered so that their fronts are drawn or toed-in, usually about ⅜ in. Measuring as before, correctly aligned wheels will have their bottoms and their fronts about the same distance apart; the bottoms may be ⅛ in. closer together than the fronts, but should not be farther apart than the fronts.

If these measurements do not check, the gather at the front may be adjusted by means of the tie-rod, which is threaded for adjustment. Before adjusting the tie-rod, however, it would be well to be sure that the steering arms have not been bent. This can be determined by measuring the distance from the ball or pin, as the case may be, to the wheel felloes. The two arms should be the same distance from their respective wheels. If they are unequal, the one that is bent should be straightened, until the distance is the same, and the final adjustment made on the tie-rod.

So far, these checks apply only to the relation of the wheels to each other. Another important check must be made on the alignment of the axles with the frame. Naturally, the axles should be perpendicular to the chassis center line. This can best be checked by selecting a fixed point at the center of the axle, such as the front universal, and checking the measurements from it to the nearest unobstructed point on each rear wheel. The two should be equal. If unequal, be sure that the truck is on level ground and that the two rear springs are deflected equally. This may be checked by measuring the distance from the bottom of each frame side rail to the axle. If unequal, a jack may be used to raise the low side of the axle to the same level as the other side. The measurement to the universal can then be repeated. If it is found to be still unequal, the cause will be found either in unequal radius-rod adjustment, or, if no radius rods are fitted, in loose axle spring-clips which have permitted the springs to shift. At the front a similar check may be made from some central point on the crank case to the opposite point on the wheels.

Too many motor truck users neglect to check their wheel alignment until the occurrence of an accident or other cause that necessitates a serious repair. Misalignment is apt to result from minor causes in daily service, and unless frequently checked may go unnoticed, bringing about excessive tire destruction without apparent cause. A tire which has been damaged by misalignment is seen in Fig. 5.

Poor Filter Operation Accountable for Typhoid Outbreaks

Overworked Filters in Moline, Ill., Lead to Bypassing Nonsterilized Raw Water to Clear-Water Basin

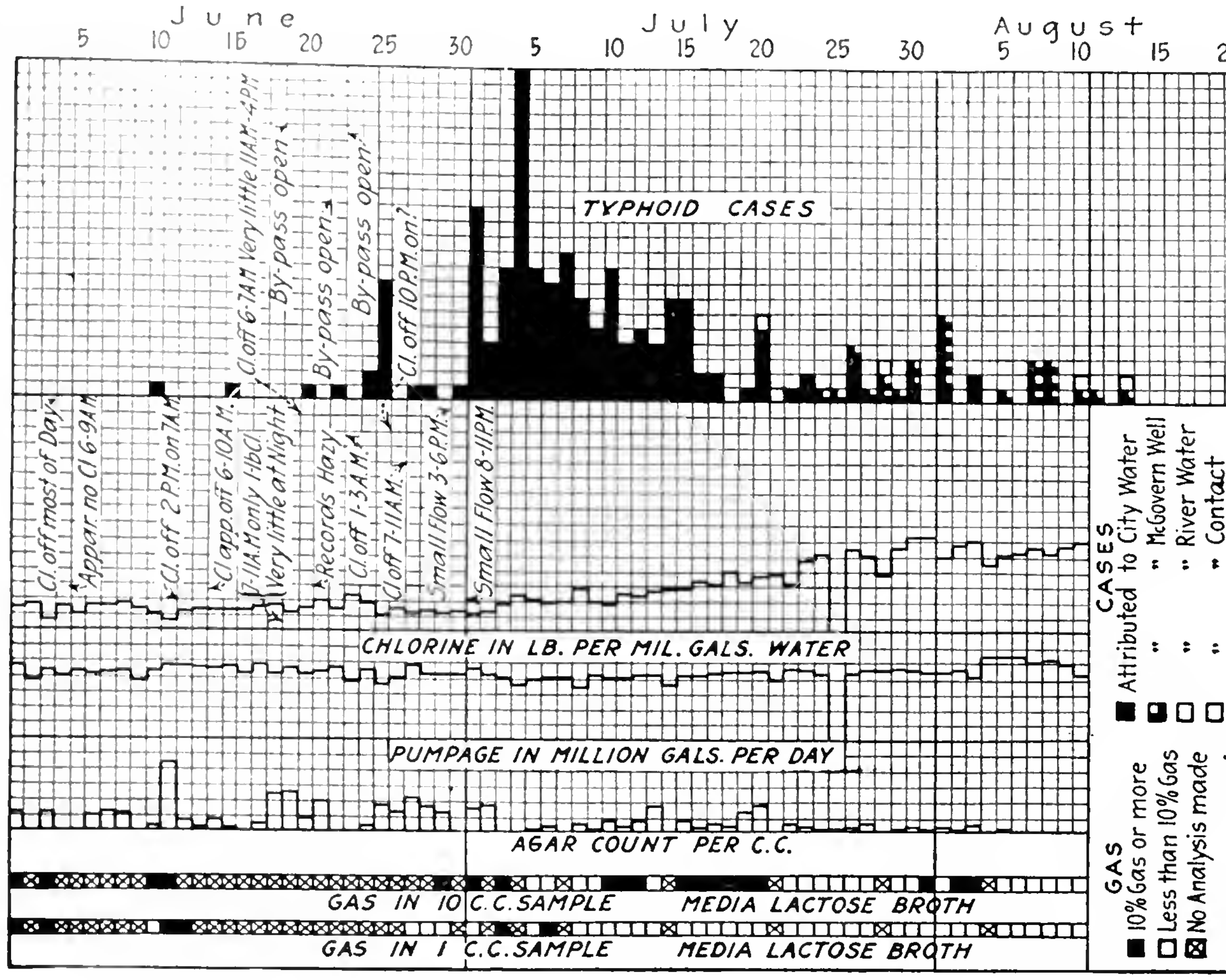
UNFILTERED water bypassed to a filtered-water basin in Moline, Ill., during the past two years has cost many lives and has caused not a little sickness. Clogged underdrains, insufficient capacity and indifferent chlorination of an unfiltered or improperly filtered supply are the links in the chain of typhoid carriage by which typhoid outbreaks have occurred in a town nominally supplied by a potable, safe water, despite newspaper boil-the-water advertisements to the contrary. Two exhaustive reports on the situation have been made by the Illinois State Board of Health. The first, dated February, 1918, went thoroughly into the series of outbreaks which occurred in the autumn and winter of 1917 and indicated that there were many interruptions in the chlorination of an inefficiently filtered and unsafe water. Typhoid in cities discharging into the river from three to 35 miles above the intake was held largely responsible for the infection of the raw river water. The second report took up a later outbreak traced to the opening of a bypass valve in June, 1918.

In 1902, Moline installed a mechanical filtration plant providing space for five 1,000,000-gal. units, but only three were equipped until 1910. An original 30-in. bed of sand overlying 14 in. of gravel was reduced to 20 in. in 1918. A large portion of the underdrainage system had become clogged, and only portions of the bed could be washed; thus the rate through the washed portions was increased excessively. Bacterial efficiencies of the plant ranged from 35 to 96 per cent., averaging 70 per cent. Due also to the clogging, the quantity filtered was insufficient, and water on the surface of the filters was bypassed directly to the filtered-water basin. This was made possible by the insertion of a valve below the junction of the wash-water outlet and effluent-to-drain outlet as shown in the sketch. The report states:

> Judging from the rather frequent use of the bypass, it appears certain that altogether too much confidence has been placed in the chlorinator, and far too little attention has been given to the filters.

Mechanical devices will sooner or later give some trouble, and the chlorinator installed at Moline was no exception, for it has balked on a number of occasions. It is only to be expected, therefore, that with the filters operating with very low efficiencies, with the water bypassed at times and the chlorine off at spells, that the water-supply must have been of a quantity at times which would menace the health of the consumers.

However, the defects of the filter plant and chlorine machine, and the dangers due to using the by-pass appear to have been reported by the operator to the city authorities at different times during the winter of 1917-18, while the public was warned by newspaper advertisements from Feb. 15 to July 2 that the water was unsafe.



CONDEMNATORY RECORDS PREVIOUS TO EXPLOSIVE TYPHOID OUTBREAKS

In July, 1918, the State Board of Health was called in again to investigate further outbreaks. Although the filter plant had been partially overhauled following the winter outbreak the investigation practically eliminated, as before, all sources of infection but the water.

Quoting again from the report:

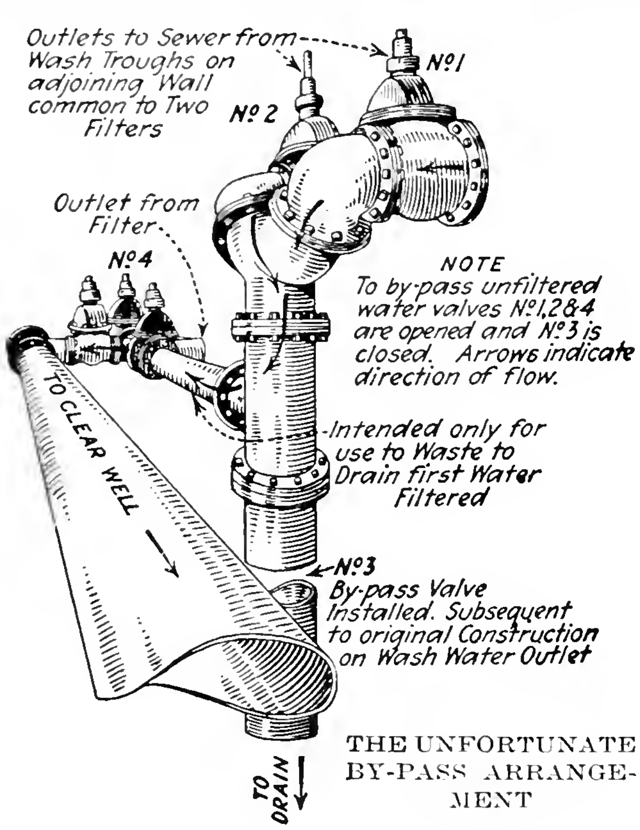
It appeared quite impossible, therefore, that so large and explosive an outbreak (see chart) could result from water which had passed through the filters, even should the chlorine used for disinfection have been turned off for some reason. It appeared so evident, however, from the investigation that the water was the source of infection that it was only natural to suspect that the bypass had been opened at some time or other. . . The raw water during a portion of this time had been passed through but one of the settling basins, as the other basin was being washed during the night. Even the settled water entering the filters and the bypass was, therefore, of inferior quality.

It was found that both on June 19 and again on June 22, during the periods the bypass was open, no chlorine was being added for considerable periods, and very small quantities the remainder of the time, due to trouble in the chlorinating apparatus.

Following the main outbreak, reports of an unwarranted number of cases continued. A study made of this situation showed that a well extending almost wholly in limestone located at 352 Eighth St. had become infected through the entrance of sewage from near-by sewers and a number of people received their infections here.

The board declares unqualifiedly that the bypass is a dangerous arrangement which should be removed at the earliest possible date. For the time being, until additional filters are installed or additional storage capacity for filtered water is afforded, the bypass might be retained, but should be fastened shut by means of a lock and chain and the key left with one of the head men at the plant. This bypass should then be opened only in the event of an emergency, and only with a very heavy and continuous flow of chlorine being applied to the water. The bypass has already caused Moline citizens sufficient trouble, and it should not be permitted under any circumstances to repeat the past performance.

Connections between manufacturers' and city mains were under suspicion, and tests indicated that the single check valves tested were not always effective, but the general spread of the outbreak over the whole town practically eliminated the dual system. The practice was condemned, however, by the board. The investigation



THE UNFORTUNATE BY-PASS ARRANGEMENT

was made under the direct supervision of M. C. Sjoblom, then acting chief engineer for the Illinois State Board of Health.

The Long Beach Sewage Screen; A Correction

In the article on the sewage screen at Long Beach, Calif., published in *Engineering News-Record* of May 22, 1919, p. 1012, the names W. J. Knowlton and J. W. Geeks should have read W. T. Knowlton and J. W. Cooke. On p. 1013, in the same article, the dates Jan. 3 and 4, 1918, should have been June 3 and 4.

Bettering Concrete by a New Mixing Method

Using as a Basis Motion Mixture Studies of Concrete in the Mixing, New Type of Mixer Is Developed In Which, It Is Claimed, Cement Gets Necessary Thorough Contact With Aggregate

By Nathan C. Johnson
Consulting Engineer, New York City

This is a part of a lecture entitled "Better Concrete; the Problem and Its Solution," delivered recently by Mr. Johnson before the Philadelphia Engineers' Club. The lecture was much longer and contained a number of motion pictures of concrete during the mixing and setting processes. These pictures were taken with a special camera with an automatic long-interval shutter, so that the views reproduce on the screen, in a few moments, natural processes taking many hours or days—Editor.

Since the majority of the units entering into concrete are minute, they may be virtually affected in whole or in part by things minute, although collectively of great importance. It may even prove on examination that what to the eye are tiny crazings, of questionable import, may be vast chasms relative to the size of a cement grain put into the mass as a medium for transferring stress from sand grain to sand grain and that they may interpose impossible barriers to its functioning. Single air voids not uncommonly bulk larger than a dozen or more sand particles; and air voids are known to be present in vast numbers. Water pockets by the thousands in a single yard of concrete may cut off certain other would-be workers by the hundreds of thousands, and even sizable stones.

To estimate the true significance of such possibilities it may be well to place in diagrammatic form, as a preface to deeper study, the family tree of concrete. (See Fig. 1.) First and foremost in importance is the "glue" formed by the union of the powdered cement of

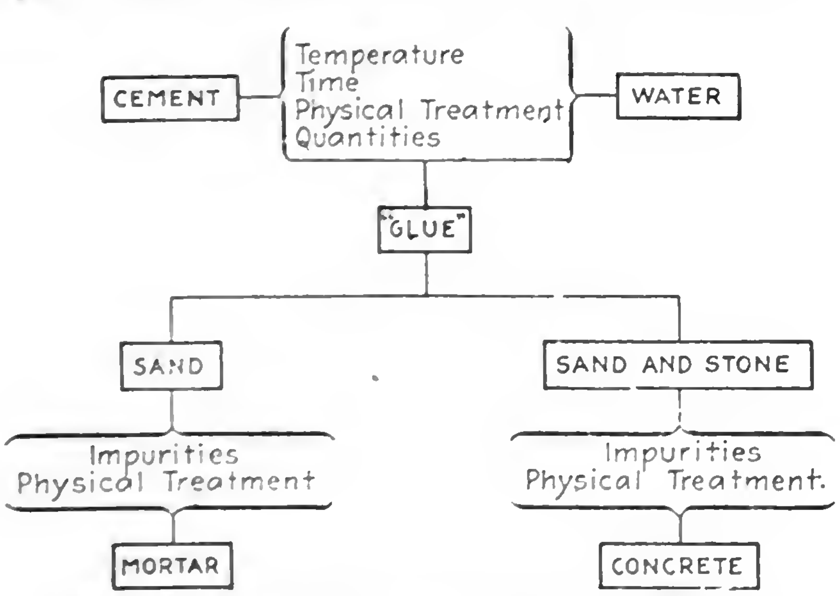


FIG. 1. GENEALOGICAL CHART OF CONCRETE AND MORTAR

commerce with water. As this formation is a chemical reaction, it follows the laws of such reactions and is affected vitally by two variables, temperature and time. The first is particularly difficult of regulation in field operations, but the second—as well as a third variable, physical treatment—may be controlled. Obviously, also, the strength of the fluid cementing solution so produced will depend primarily upon relative quantities of the two reacting substances. To the "glue" thus formed, which has greater or less worth according to the values of the variables affecting its formation, sand is added to make mortar, or sand and stone to make concrete—with, in each case, impurities, such as air, or other contaminating substances, and, again, physical treatment, entering as factors qualifying ultimate value.

If cement were supplied as ground after burning in kilns, it would be so hungry for water that reaction with mixing water would take place too quickly; and to avoid this, manufacturers add gypsum, which is hydrous or water-bearing calcium sulphate, to the still hot cement. This heat drives off water from the gypsum; and this water, spreading as steam, reacts with the hungry cement particles, forming over their surface a very thin, protecting skin of dead or hydrated cement, which for a time—depending upon the thickness of this skin and the temperature—resists penetration of mixing water to the active material within, deferring reaction to give ease in handling. It follows, therefore, that little of this chemical action has taken place before concrete is placed in forms.

Such a protective skin is pictured in the photomicrograph, Fig. 2, about an inert cement grain found in concrete. Obviously, it should be advantageous to remove this dead skin in some way when ready to use cement, so that water might find access without delay and make more and stronger "glue" in the brief hour or two of freedom before setting takes place. Of course, we must coat sand and stone with cement. Yet reason tells us that even an infinite supply of cement particles can cover a sand particle only so far as they may touch it at tangent points, while a solid bedment is assumed and desired in concrete. If there is not an infinite supply of cement particles, even this tangent covering is not possible.

Furthermore, when cement particles, sand particles and pieces of stone are wet, an envelope of water covers them, preventing contact, except accidentally, even at points of tangency, as shown in the diagram, Fig. 3, traced from the photograph, Fig. 2. This explains why there is rarely, if ever, contact between particles as their relative positions are revealed in magnified photographs.

A little thought and calculation with regard to aggregates reveal certain other facts not often considered. Briefly, these are that in a cubic yard of 1:2:4 concrete there are about one million stone particles, up to and including $1\frac{1}{2}$; that there are about 25 *billion* sand particles with a commercial coarse sand, or 200 billion particles with a very fine sand, all of which have to be distributed and wetted and mixed with some 200 to 300 billion cement particles in a space of time that will pay commercially—usually less than a minute. Evidently, since this is so, "covering" sand and stone with powdered cement would really mean that when using coarse sands there would be not to exceed four to six cement particles; and using fine sands, not to exceed 1 to $1\frac{1}{2}$ cement particles for each piece, large or small. Covering should be actual and thorough and uniform, but, obviously, true covering can only come through spreading of a liquid cementing product; and to achieve even

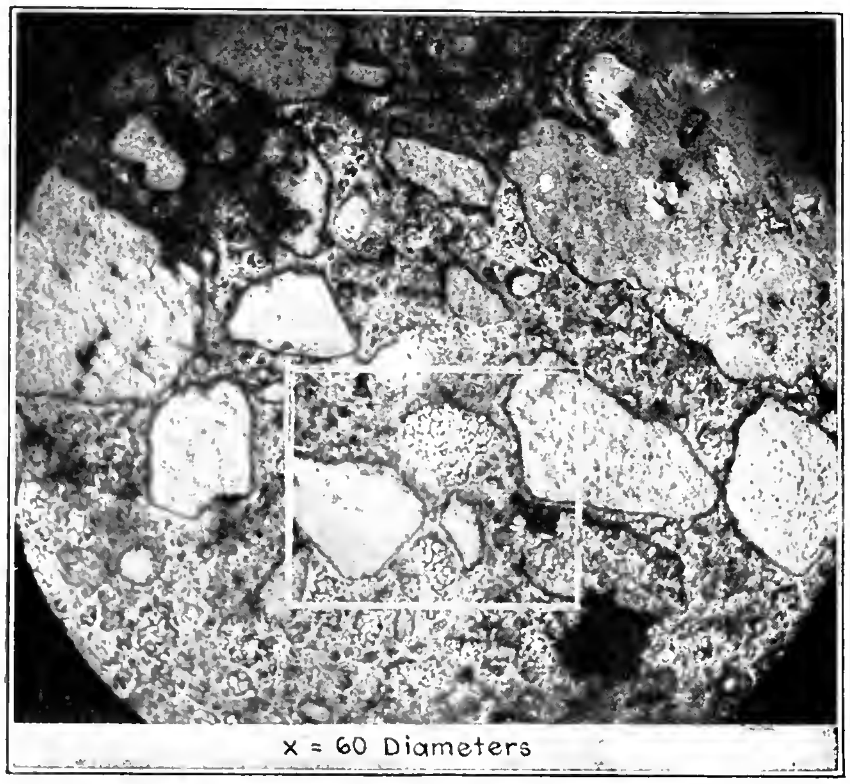


FIG. 2. PHOTOMICROGRAPHS OF COMMERCIAL CONCRETE SHOWING SAND GRAINS, UNUSED CEMENT AND AIR VOIDS

The view at left is an enlargement of the section limited by lines on the right view

a fair result, there must be left no analogue to the "unstirred sugar" of a cup of coffee, else some billions of potential workers will be rendered idle through denial of means wherewith to do their appointed share of work.

Remembering these things, further light may be gained by reconstructing the processes that formed a representative concrete, now in existence. Concrete from the warehouse of the Naumkeag Steam Cotton Co.'s warehouse at Lynn, Mass., is shown in Fig. 2, magnified 60 diameters. In it are clearly visible the sectioned sand grains with their irregular outlines; the clear matrix of hydrated cement; a few voids; and some "unstirred sugar" in the form of unhydrated cement particles. In Fig. 2 is also shown the lower center of the same field, enlarged to 180 diameters. It is to be remembered that in each of these photographs the relative positions held by the several substances are the positions held by them when placed in forms and that must be held by them so long as the concrete endues. What happened when this relationship was first established? All cement particles in the vicinity doubtless reacted with water, rather quickly for some time after the protecting skin was pierced. During this interval the sand grains lay surrounded by water, waiting quietly whatever might happen, save, perhaps, for an occasional settlement to easier position as concrete deposited above increased the general pressure.

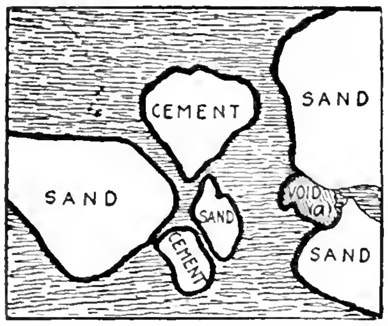


FIG. 3. PART OF FIG. 2

Showing relation held by cement and sand particles and water when placed in forms

At the surface of cement particles, however, there was, at first, saturation of the hydrated skin; then spasmodic reactions as water first reached active cement, formed new products, became sated and gradually diffused; then renewed activity as new water reached deeper layers of active cement through the same agencies, with repetition of the processes until setting of the richest products *directly at the surfaces of the cement particles* formed a new protective skin and brought about a shut-down of hydration.

The water-filled space about cement and sand particles was, during this time, gradually becoming charged by diffusion with these cementing products. But, diffusion is slow; and as distance from the source increased, concentration of these products became less, being *least* at the surface of the sand particles, where for man's purposes, it should have been *greatest*. If diffusion could have been aided by stirring, this defect would have been overcome; and, furthermore, longer activity of the cement particle would have been possible through removal of those surcharged products at its surface (where richness was not desired) and supplying of fresh water. Surely, one way of improving concrete should lie in procuring by some means a greater concentration of cementing products and distributing these, instead of insulating and diluting water, over the sand and stone *before* they find their final position in forms. If this were done, "water voids"—spaces left by water uncharged with cementing products—would disappear, for there would then be no uncharged water and the nature of such charging products is to solidify.

One other feature is prominent in these photographs; namely, an air void (recognized by its spherical or spheroidal form) tucked away at a surface pocket in a sand grain. When this grain was first wetted, this pocket was, of course, filled with air; and before the air could escape the viscous water envelope went over it, imprisoning it by surface tension; and, as diffusion progressed, molding it for all time in solidified cement.

By optical examination, boulders and sand grains of all sizes are found to have similar surfaces, full of pits and seams which are admirable for attachment of cement if contact could be brought about, but potent for ill unless inclusion of air bells is prevented. If only some means, such as stirring or scrubbing, could be utilized to remove impurities such as air, considerable improvement in general quality should result, for although one void is very minute, its duplication billions of times must be of great importance.

Although the mind sees in increasing number other possibilities indicated by reasoning as probable means of bettering concrete, those cited have every element necessary for very substantial improvement, provided they can be put into effect.

Starting experimentally with studies of the chemical union of cement and water, it is found that the process is initially of much greater rapidity at elevated temperatures. In Fig. 4, for instance, are shown interlacing crystal formations at 70° F. after three hours, as contrasted with those at 50° F. after 10 hours. As the latter photographs show no visible change from their original appearance, temperature is evidently of great assistance in forming concentrated products.

It is further to be noted from these photographs that there is grouping together of individual particles, with less intense formation of cementing products at the boundaries of such groups than at single particles. If such grouping were to exist in concrete, much of the cement would be taken from points where it should be usefully applied, since hydration would soon begin to act to unite these groups inseparably. But since these groupings are always observed, such deprivation doubtless does take place, with resultant effect on the concrete. Furthermore, examination of commercial powdered cement reveals small aggregations present in infinite number, due possibly to hydration from moist air and sticking together before it reaches a user's hands. Evidently such groupings should be forcibly broken up either prior to or during mixing, and evidently, also, there is little use in finer grinding of cement unless such groups can be broken up.

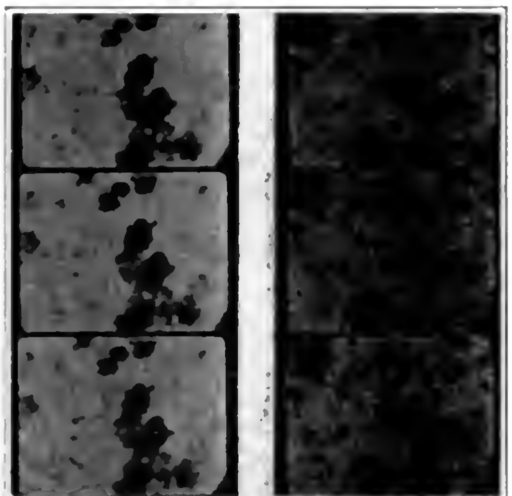


FIG. 4. HYDRATION OF PORTLAND CEMENT. CAMERA INTERVALS, 5 MINUTES

Grouping of cement particles rendering futile fine grinding

In addition to elevation of temperature, it is also found that intensive hydration can be brought about by violently stirring cement for periods longer than are usually employed, much as stirring sugar increases the sweetness of a cup of coffee. And it is further found that while sand grains poured into water are lifted bodily by tenacious air bells resident at irregularities in their surfaces, such air bells can be removed and full contacting of water (or of cementing solutions) brought about not by stirring alone, but by such violent stirring as to cause the attrition of particle on particle sufficient to bring about a scrubbing action. Considering these two phenomena in analogy, it is not improbable that the increased hydration of cement brought about by violent stirring is due to a removal of the protective skin from individual particles through such interparticle attrition, bringing about earlier and more prolonged chemical activity, as well as through the forcible breaking up of minute groupings before noted.

Combining these two benefits of removal of tenacious impurities and increased hydration by violently stirring cement and sand together in water, there is every element present of an improved process of making concrete, particularly as such violent stirring raises by internal friction the temperature of the mass, with further increase of hydration.

But what is the actual effect and result of this as expressed in accomplishment? Aside from increased hydration products as noted by the microscope, there is formed a viscous, coherent mixture, not inclined to separate even though very plastic, with little or no formation at the surface of fluffy "laitance." Remembering the levitation of sand grains in water by attached air bubbles, as well as the lubricative effect due to the mobility of gaseous bubbles in a liquid, it is not improbable that removal of such bubbles, together with the heavier specific gravity of the fluid brought about through increased solution of cement, has overcome the tendency to segregation usually present. Furthermore, it is at once evident that if increase of hydration can be assured, greater tolerance in the percentage presence of water is permissible, with increase of plasticity and ease of working, and, at the same time, assurance of a satisfactory result. Elimination of laitance and segregation on commercial operations would be of utmost importance, for materials so separated are almost valueless of themselves but would have high value if retained in their proper places.

And a corollary effect should be better compacting and greater solidity of the mass, with commensurate strength and endurance. If the particles shown in Fig. 2 had been closer together, solutions of cementing products at the surfaces of sand grains would have been stronger, through nearness to the source. Furthermore, a greater number of strong sand grains would have been present in any given volume. This result is sought in commercial work by spading, tamping or rolling, the last named being found by study to be preferable where the form of construction, as in roadways, permits of its use. Yet, if increased hydration is realized, together with very thorough distribution of such hydration products and detachment of air bubbles from sand and stone, a minimum of such artificial compacting is found to be necessary for a substantial improvement in texture and strength.

Furthermore, there should be less likelihood of points of weakness developing in such a product, either through the presence of an impurity at a center of disintegration or through loss of uncharged water, or through unequal internal strain due to nonuniformity. Study confirms this reasoning, for mortars (stuccos) and concretes reveal that three-branched cracks and their later ramifications are of primary origin, occurring at or about the time of set; and that they are induced by lack of uniform internal strength, for rupture comes suddenly, much as a sheet of paper might find relief from unbearable strain by rupturing abruptly about some point of weakness. (See Fig. 5.)

And, not least, disintegrations and softenings should, with such material, be at least mitigated, if not fully done away with. Disintegrations result from entrance of water into the body of concrete. Sea water carries so little material capable of attacking concrete that the entrance of many millions of gallons into the concrete is necessary for effective attack on a single cubic yard. Nor is the action of fresh water substantially different; and with this fluid the same requirement applies. As

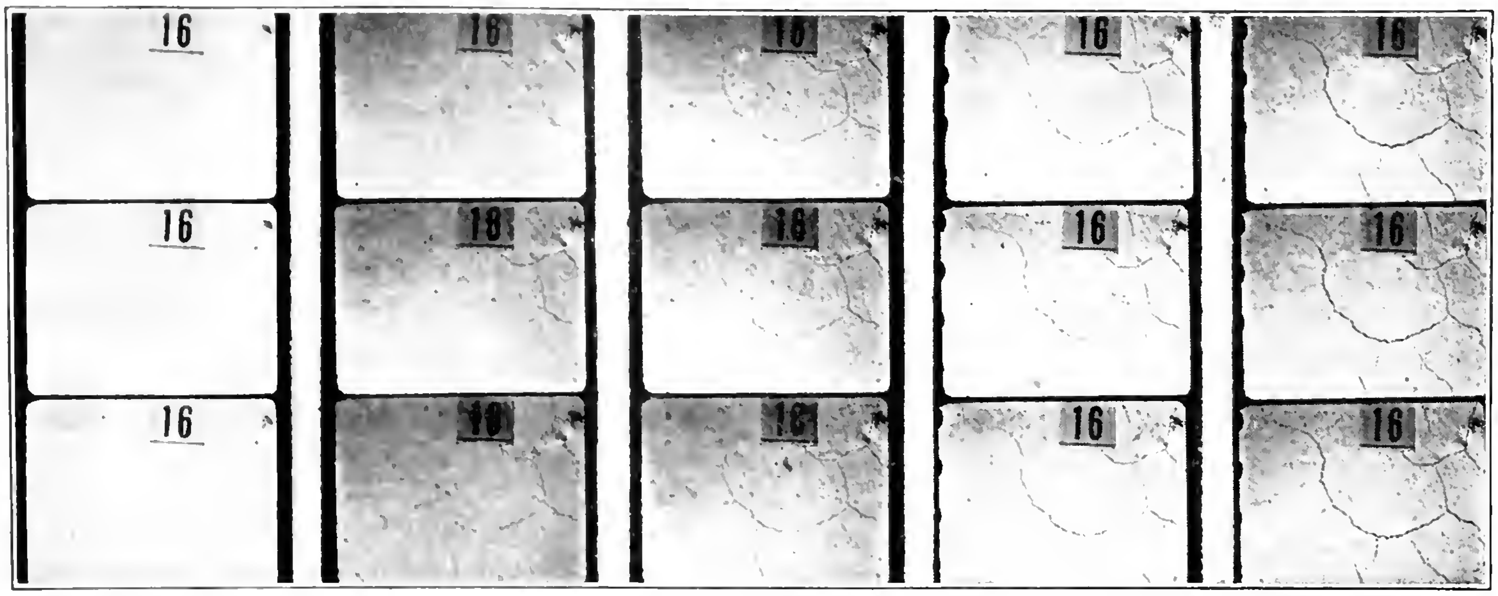


FIG. 5. FORMATION OF THREE-BRANCHED CRACKS IN STUCCO CAUGHT BY MOVIE CAMERA AT ONE-SECOND INTERVALS

Note that these originate at the surface pit seen in the upper right-hand corner

for rupture by rusting of reinforcement, the existence of this fault argues conclusively that water has reached the steel through the concrete, but when that happens, rusting, with expansion and rupture, is to be expected. On the other hand, given a uniform, dense concrete, without water or air voids, or laitance seams, or shrinkage cracks, the seas and lakes and rivers must confine their efforts to surfaces, instead of finding ready access to the interior, with proportionate endurance.

FIG. 6. FIRST CENTRIFUGAL CONCRETE-MIXING MACHINE IN ACTION. 10-INCH DIAMETER BOWL

But however much laboratory experimentation may prove, conversion into commercial terms only will be of substantial benefit.

Early in this effort, existing forms of mixers were discarded as ineffective and not susceptible of necessary changes. With time ever a limitation, the first thought was to substitute rapidity of action for customary slowness. By the same agency, also, it was hoped to effect the violence that seemed to be necessary to force reluctant materials into proper usefulness. In addition to rapidity of action, repetitive cycles and a mass held compactly together to secure interparticle attrition were indicated. These constituted a new and different process from that heretofore used and demanded new means to effect it.

High rotative speeds imply centrifugal force as a concomitant. Centrifugal force would hold the mass of materials together, but would render inactive the usual drum mixer. Furthermore, a very small portion of available drum space in such machines is in active use, the overcapacity varying from 250% to 825% of the batch size in the products of 10 different manufacturers. It was also found that much useful mixing time was consumed in charging and discharging, batches having to enter and leave through severely constricted openings.

The expedient was adopted, therefore, of using an open bowl, rotated rather rapidly in a vertical axis. Centrifugal force would compact the rotating batch in the bowl and cause it to rise toward the top. At proper points, curved blades could cut off ribbons of material, diverting them to the center, so that repetitive cycles could be brought about. Discharge could be overside by utilizing the velocity of the mass, giving a high dis-

FIG. 7. THREE-CUBIC-FOOT CENTRIFUGAL MIXER IN ACTION

charge, while the full diameter of the bowl would be available for charging, doing away with the high elevation of material necessary to make it pass through a constricted spout. Furthermore, both mechanism and mass would be open at all times to observation. [The type of mixer here described is covered by patents—EDITOR.]

The first mixer held 30 lb. of material and was improvised from an iron potato kettle with an iron tamper for a base, the bowl being rotated through one set of gears by a ¼-hp. motor which once operated an adding machine (See Fig. 6.) Diverting blades supported by small pedestals overside completed the mechanism. Strangely enough, it was successful almost from the first; and results obtained with it were so interesting that larger units were undertaken. A 3-cu.ft. machine was then constructed (Fig. 7) and later, a ½-yd. machine. Trials and tribulations were not few in number, but they are of no import in this discussion. Suffice it to say that a most intense action was secured, showing in practical result the actuality of the theoretical needs indicated by the reasoning before set forth.

Colonel Parsons' Address to His Men

ENGINEERS will appreciate the following heartfelt words by Col. William Barclay Parsons, now printed in the *Fighting Engineer*, the publication of the Eleventh Engineers' Association. It was delivered on the occasion of the regimental dinner at Hotel Pennsylvania in New York on April 30:

My men. I do not say officers and men, but, simply, my men. This is probably the only opportunity that I shall have to say a word to you all collectively.

In a few hours the process of disintegration will begin, and in a few days this regiment will exist in history only and the close comradeship that has held us for nearly two years will be at an end.

You and I have been together during that time, we have marched together by day and by night, we have worked and fought together in sunshine and in storm, in heat and in cold. We have been together and have seen our comrades fall, not to rise again, and we have stood side by side, with heads uncovered, as we laid them to rest in the far-away soil of France. Such a comradeship cannot be broken without a pulling of the heart strings. As you go on your several ways you will take with you my ever-abiding affection, and I hope that you are leaving me yours.

There are a few things that I ask you never to forget: First, and above all, the record of our regiment. That record, without a stain, without a spot, is yours. You made it, it is now yours to keep. In life let it be an inspiration to you, and when moments of temptation come, as they will come to all of us, let us remember that we belonged to the Eleventh, with its record second to none, and that it is the part of each one of us to live up to that record. You were willing to die for it; are you now willing to live for it?

It is right that men should make every effort, as men in Paris are now doing, to prevent war, but don't fool yourselves that there will be no more wars. Just so long as men are men, there will be wars and you will be called upon again. Unless the next war comes very soon, I fear that the operation of time will cut me out and it will be a younger and better man who will lead you on. For him, the best that I can ask is that you will give him the same loyal and faithful support that you have given me.

But while waiting for the next war of arms, remember there is always going on the war of good citizenship. In the war just ending you have done your duty; in the days to follow there is still a duty to perform. In your hands you have held the rifle and the pick, the weapons of the engineer; now you hold in your hands the ballot, the weapon of a good citizen. Use the latter as you have used the former, in the service of your country, and insist, as members of the Eleventh Engineers, on the highest ideals of law, order, decency, liberty and fair dealings to all men.

I cannot at this moment shake the hand of each of you, but, before we separate in the next few days, I hope that every one of you will come to me and let me give you a parting clasp. May God bless you, men, and keep you and give you, each and every one, all health, strength, happiness and success. May you triumph in the battles of life, and having gained that victory enjoy the peace that passeth all understanding.

Railway Bridge Design Loadings and Actual Engine Loads

Moment and Shear Curves for Engines of New York Central Lines West—The Question of Minimum Loading

BY B. R. LEFFLER

Bridge Engineer, New York Central Lines West of Buffalo, Cleveland, Ohio

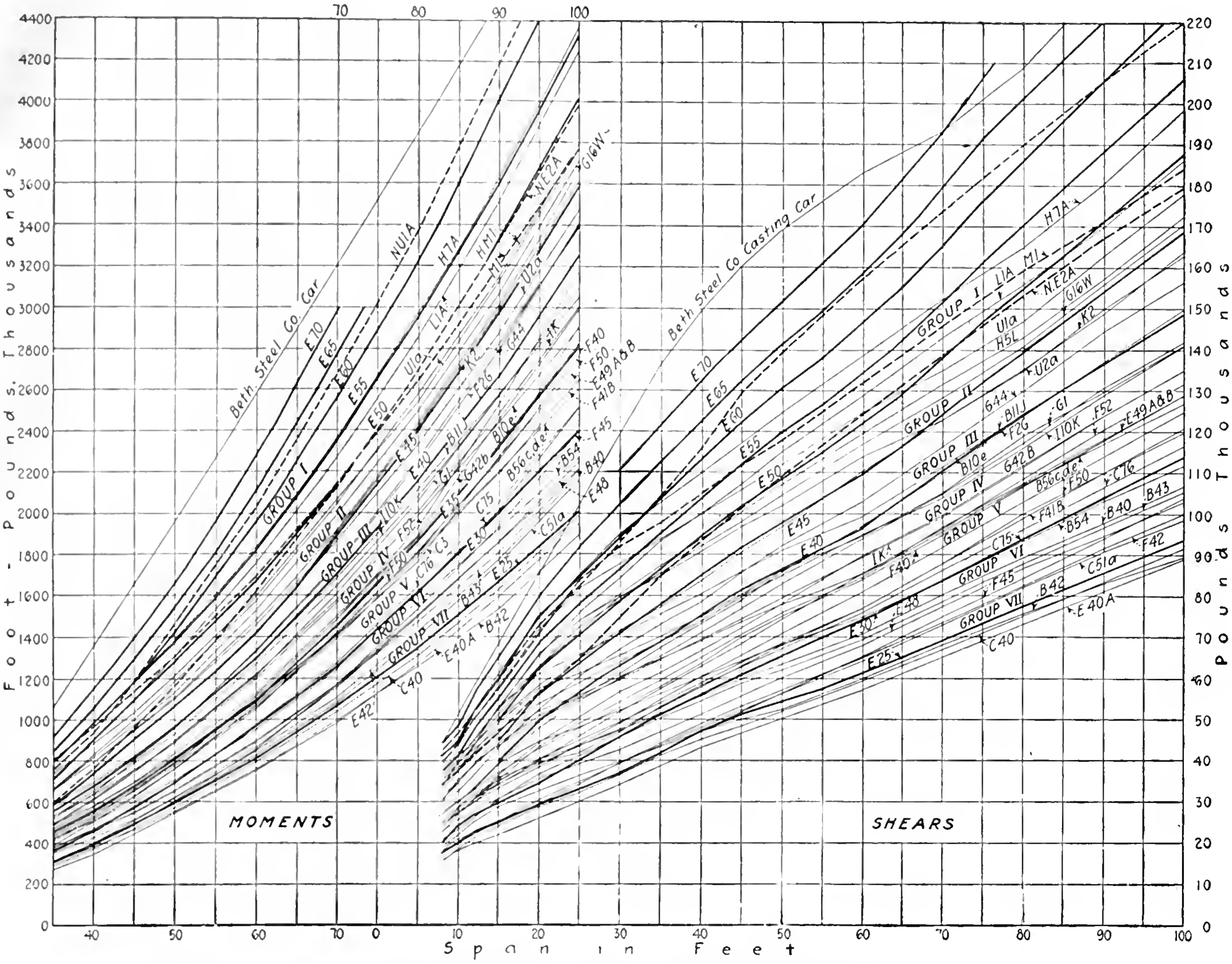
DEVELOPMENTS in railroad practice during recent years have carried engine and train weights slowly but steadily higher, until the margin between actual loads and current bridge-design loadings has become quite small. Recently, at the American Railway Engineering Association convention, remarks made in discussion of the subject of bridge specifications seemed to show a faith on the part of some that present design loadings afford a sufficient margin to last for a long time. However, an analysis of the bridge effect of engines operating on the New York Central Lines West shows that the heaviest power is very nearly up to the design loading in use today, and that special loads go even higher.

As summarized on the diagram herewith, showing moment and shear curves for spans up to 100 ft. under the various engines in use on the road, the actual loads are fairly well distributed over the range between E25 and E65. The engine designations given are those of the New York Central nomenclature. Two particularly heavy locomotives, which are also among the newest, are H7A and NU-1A. Engine H7A has four driving axles, pilot and trailing axle, and weighs 332,000 lb. without tender; its heaviest axle-load is 65,000 lb. Engine NU-1A is a Mallet with two sets of drivers, each of four axles; it weighs 622,000 lb. with tender. This engine has a moment effect equivalent to about E62 over most of the range of the diagram.

MOMENTS AND SHEARS COMPUTED FOR TWO ENGINES COUPLED

It should be said that in all cases moments and shears were computed for two engines coupled, except in the case of M1 and NE-2A, which were taken single, followed by a train of 115,000-lb. capacity cars. The NU-1A was taken single followed by a train of 70-ton capacity cars.

Wrecking cars were plotted on similar diagrams, but they produce considerably lower moments and shears than do the heavy locomotives. The heaviest wreckers do not exceed in moment 800,000 ft.-lb. per rail on a 40-ft. span. Still higher effects are produced by a heavy engine (N1S) of the Pennsylvania Lines West, which operates over New York Central tracks in Cleveland territory. It produces moments and shears exceeding those due to E70 loading. The engine is of the 2-10-2 type, has a length between couplers (tender included) of about 90 ft., and weighs 651,000 lb. with tender. Its driving wheel-loads range up to 39,000 pounds.



MOMENT AND SHEAR CURVES FOR ENGINES IN USE ON NEW YORK CENTRAL LINES WEST OF BUFFALO, AND FOR COOPER LOADINGS

Group numbers represent the classification of engines for purposes of defined bridge capacity

The moments M and shears S produced by this engine on various spans (compared with those due to E70 loading) are, per rail: On 40-ft. span, $M = 1230$ (1147), $S = 135$ (132); on 60-ft. span, $M = 2330$ (2274), $S = 169.3$ (171); on 80-ft. span, $M = 3600$ (3781), $S = 200$ (217).

Exceeding all the engines, a special car of the Bethlehem Steel Co., built for handling heavy castings, produces the critical stresses. This car has 60,000-lb. axle-loads, and its moment and shear effects are considerably above E70 on short spans. On a 100-ft. span the car produces a single-rail moment of 5126, while E70 produces a moment of 5635.

With this graphical comparison in mind, it is evident that no one can yet say what is to be taken as the heaviest railway loading. The fact that the upper lines in the diagrams represent engines added only in the past three or four years is an indication of the fact that the growth of loadings is still in progress.

Heavy motive power affects only the road on which it operates, of course. Freight cars, however, circulate everywhere, and it is difficult to exclude them from any particular division. This is especially true of coal cars, since coal must be carried to every station and to all railroad terminals.

It is found that 140,000-lb. coal cars, which are in use on the Pennsylvania and the Chesapeake & Ohio lines, are equivalent to about E45 for spans up to 40 ft., tapering to E36 for 100-ft. spans. Such rolling stock, then, would fix the minimum loading for which bridges anywhere in the country should be designed, no matter how light the power used on a particular road. From the diagram it can be seen that some of our light engines are below E30 in their effect. If a road used engines of this kind, however, and designed its bridges accordingly, the structures would be overloaded if a train that was composed of heavy coal cars were run over them.

The 140,000-lb. car is 43 ft. 8 in. long, 31 ft. 10 in. between the truck centers, and 5 ft. 10 in. in truck wheelbase. Its dead weight is 50,800 lb., and when loaded with a 10% overload (or 154,000 lb.) its wheel loads are 25,600 lb. On a 100-ft. span such cars would produce a moment of 2995 per rail, as against 2817 for E36 loading.

Edge Taping Strengthens Fiber-Board Boxes

Tests of fiber-board boxes in the box-testing machine of the Forest Products Laboratory, Madison, Wis., showed that failure usually started in the scores at the edges. When adhesive paper or tape strips were applied over the edges the strength of the box was increased about 25 per cent.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

St. Louis Electrical Engineers Advise Development Committee

In order that the representative of the St. Louis Section of the American Institute of Electrical Engineers on the national development committee might have back of him, in tangible form, the local opinion which he represents, resolution were adopted pertaining to the relation of the institute to its members, to other engineering organizations and to the public. Briefly, they are as follows:

That annual visits be paid to sections by national officers; that institute meetings to be held bimonthly in the various sections' cities, on schedule; that expenses of board members be paid; that the country be districted and a vice-president elected from each district; that the *Proceedings* be changed to 9 x 12-in. size, contain articles of live interest, current topics as well as technical articles, editorial reviews, abstracts only of strictly technical articles, and advertising; that a National Engineering Congress be held biennially for the discussion of all matters pertaining to the general profession of engineering; that the section views with disfavor any thought of losing the identity of the institute through substitution of a common engineering body, but does favor affiliations along present lines through the United Engineering Society; that the Associated Engineering Societies of St. Louis is a model of successful federation; that members of the local joint council be automatically members of a National Engineering Council; that participation in all public affairs by the local federation or the national federation shall first be approved by the respective councils.

Iowa Publicity Committee at Work

An intensive publicity organization is being perfected in Iowa by the Iowa Engineering Society. Minutes of a recent meeting of a committee in charge of the work indicate a plan by which the state is divided into 11 districts, with a subcommitteeman in charge of each district and having under him local representatives.

On district organization the following rules were adopted: That members or nonmembers may be chosen as district committeemen or local representatives; that the main purpose of the work is to obtain publicity for the profession, its work and its relation to the public, and not publicity for the society; that individuals should be chosen who are or can become acquainted with the editors of the most influential papers. District committeemen are to enlist the services of local representatives to organize and supervise the publicity work in their respective districts; to furnish to the central office lists of representatives and newspapers and to report to the central office, sending clippings of articles published.

On the local representatives depends the success of the plan. They are to make the acquaintance of the editors; to prepare news stories of engineering of local interest, to procure news items of general interest for distribution through the central office, as well as obtain publication of similar items sent to them.

In a report on the functions and work of the committee, salient features that were brought out were as follows:

The fundamental principle in publicity work is that the engineer is a public servant and must render nontechnical as well as technical service. For the former the engineer is urged to ally himself with local nontechnical organizations. He should offer his ability as an organizer and specialist in materializing ideas promoted by such organizations. In the technical-service publicity the effort should be made to prove that the engineer is a financial asset to his community. Newspaper work should be supplemented by personal talks to individuals and by addresses. General instructions call for the maintenance of so high an ethical standard that the engineer will not indulge in or seek to obtain personal publicity at the expense of some other individual.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Training in Latin and Greek Not Best for Engineers

Sir—Many years of study of the general subject of Latin and Greek as preparation for engineering, which subject is treated by Dr. M. E. Cooley as quoted in *Engineering News-Record* of May 8, 1919, p. 930, lead me to a conclusion quite opposed to the position taken by him. I am, therefore, led to offer the following principal reasons for my disagreement and my belief that these dead languages, if taught at all, should be incorporated into our teaching of English.

It is remarkable that this old controversy does not seem to down. On one side are men, some familiar with the ancient languages, who trace to them many advantages they have had from such knowledge, but ignoring the multitude of fellow students who, notwithstanding that acquirement, were never able to rise above mediocrity. On the other side are men who never studied Latin or Greek but, notwithstanding, have reached eminent positions in the world.

When a boy I studied Latin for four years and Greek for three. My study included some conversational "live" dialogues. All of this, I presume, fully meets Dean Cooley's prescription. Thus qualified, I shall try to be unbiased.

As all men differ in their capacities and opportunities, they should not and do not receive the same kind or extent of education. But, as of first importance, everyone of us should know as well as possible the language of his own country. Therefore, no education can be more valuable to an American "engineer trained for responsible citizenship" than to get a thorough knowledge of the use of the English language.

The study of the classics can have no influence whatever toward a better understanding of abstract sciences, such as logic and mathematics, or any of the concrete sciences, such as physics, chemistry, geology, astronomy, or

of the sciences of organisms, including their lives, from botany up to psychology, and even sociology. In fact, also the history of ancient civilization and of its stages of development can hardly be grasped by us in Greek or Latin as well as it can be in English when presented by specially trained linguists. The ancients at best had but rudimentary knowledge of all sciences and even less of the scientific method, which is gradually unravelling our most complex problems of practical life and our knowledge of all the fundamental inductions concerning our loftiest conceptions of religion, art and social life.

Greek and Latin of two thousand years ago do not and cannot give us, in any of these directions, what modern scientific knowledge and practical experience have given already and will surely continue to give; but they can give us something else. They can and do help us to understand and use the English language more accurately than by a knowledge merely of its words learned in childhood.

When I first gained this opinion, I asked myself, How then should I study Greek and Latin? As I had studied them? No. As my children studied them? decidedly, no. How, then, should they be taught?

Most thoroughly to understand and use a language, one should know, besides the meaning, also the derivation and life of its words, the way to form its sentences, and the relation of words and sentences to express our feelings, thoughts and conceptions. The English language was once Anglo-Saxon and into it were transfused later more than half of its words from the Norman-French after the conquest, and finally, for advanced knowledge, words from the Latin and Greek.

Therefore, we should be informed by our teachers, as in an interesting story, how the words of the English language were developed from crude origins, how they were influenced by internal and external causes, how and why they were changed from one period to another and gradually arrived where they are today—in short, we should learn the story of the life and growth of our language.

Such a story would raise a lasting interest in the growing young mind. As a first reading book, the edition of "Robinson Crusoe" written in monosyllables, almost all of Anglo-Saxon origin, might be an entertaining help. The history of the peoples who spoke these four languages—Anglo-Saxon, Norman-French, Latin and Greek—should then be learned, in order that the student may understand how and why their words and expressions were finally united with and converted into modern English.

For instance, under which conditions did our language ancestors derive their words, and which conditions caused the gradual changes in the words? What were their grammatical forms, compared with one another? Why and how did the Anglo-Saxon forefathers take over so many of its words and forms of sentences from the French language? And, finally, how were new words created to express the multiplying new ideas and conceptions, by utilizing Greek and Latin roots? Spencer says, "the development of language is a psychological process determined by social conditions."

Pari passu with these interesting stories to be told by the teacher, the young folks should memorize actual words of those old languages, with their original meanings and as used in conversational phrases, selected to cover those words that were gradually embodied in modern English. The words learned should not be vocabularies having no reference to modern English. Let us learn, for instance, the origin of the words "home," "love," "children," etc. Let us know when we see the word "geography" that it is made up of two Greek words, "*ge*," earth and "*grapho*," to write. Let us learn the declensions and conjugations in order to form simple sentences and phrases in those old tongues and so as to give the words life and interest in relation to our new tongue.

If Greek and Latin and also Norman-French and Anglo-Saxon were studied in this manner—and I see no reason why they could not be—we should better understand the spirit and weight of our words and sentences. Incidentally, we should automatically not be tempted to write the word "seperate" instead of "separate," nor say "this data" and "this phenomena" instead of "these data" and "these phenomena." Nor should we mistake the nominative for the accusative case, as is so often done, nor make any other misuses which together mean "bad" English. Our dictionaries have a list of phrases and expressions, mostly in Latin, which are used by us daily. Let us learn them early, with their original meanings, so that they are understood and correctly used—generally to differentiate or specialize the meanings when the phrases or expressions are interpolated in an English sentence.

It has seemed to me that if the study of these ancient languages were taught not as a "fad," which is evidently the case at present, but for real, practical, intellectual usefulness, we should read and hear a better language today than we do. All this interest and benefit could be obtained from efficient teachers trained along philological lines, in a fraction of the time now spent. One or two semesters at the utmost should suffice amply for teaching each one of our parent languages for the above purpose, including the interesting histories of their developments.

Why should we weaken our modern education by antiquated methods, surviving from the Middle Ages, when Greek and Latin were the only languages of culture and the only means of preserving the records of civilization and intercourse between the intellectuals of different nations? A thousand years ago the preservation of these languages was necessary, because without any printed books for general distribution there was a gradual breaking up—a vulgarization, for instance—of Latin into Italian, French, Spanish, Portuguese and Rumanian.

In our present age, however, with the constantly growing mass of necessary and useful knowledge which is pushing civilization ahead, it is becoming absolutely necessary to economize in our studies and in the time which can be devoted to them. The study of the ancient languages as above outlined would seem to be ample, if indeed such knowledge is at all necessary for most of the intellectuals of modern times. John Bright, Herbert Spencer and others who wrote excellent English say that their knowledge of Greek and Latin was not worth mentioning. The "humanists" of the Middle Ages should be transformed into "humans" of today. Waste, through conservation, should be converted into economy; extravagance, through limitation, into frugality.

One of the pet reasons given for studying Greek and Latin is to get "mental discipline." Faraday says that

"science is greatly superior to language as a means of discipline," and that it "culivates our judgment more safely and intensely." The best discipline arises when we act under laws and rules *without* exceptions, as in any scientific pursuit. The ancient languages have many exceptions to their rules, concerning genders, declensions, conjugations, etc., and even their sentences, as I remember, are not always as logical as algebraic expressions must be always.

Another of the pet reasons for holding on to Greek and Latin in the schools is that we may read the "classic literature of the ancients," which has been held as a model for civilization for several thousand years. How many Greek and Latin students of the present century are able to read, understand and really enjoy that literature in the tongues in which it was originally written, even if their minds could take themselves back into the actual state of civilization then existing?

Those who live today and must look upon the ancients as historical relics—magnificient and interesting in a museum, if you please—can certainly acquire more benefit and enjoyment by reading that same literature in the best translations, into English, French and German, of every ancient writer worth considering. Neither Americans nor Western Europeans need learn Greek and Latin for that purpose.

Finally, with reference to the editorial remark that colleges of literature and arts turn out men of more breadth and culture than engineering colleges: This may unfortunately still be true, but the reason, so far as my experience has gone, is not the study of Greek and Latin. There is another cause. The universities formerly had a rank much higher than that of the technical schools. Fifty years ago I heard it said, somewhat to my disgust, "Oh, he is not able or bright enough to study law or medicine; he must take up some engineering occupation or trade." Families of higher culture are apt to produce boys and girls of greater mental capacity and breadth. Their sons, therefore, as a rule were sent to the universities, and those who could not stand the greater strain selected engineering. This feeling was particularly common in England and Germany. It was not so in France, where engineers came often from the best families and socially had a higher standing than in any other country. M. Freycinet, for many years head of the French cabinet, was an engineer.

Greek and Latin have been studied within the past century mostly by those expecting to follow the legal and medical professions, rarely by engineering students. The lack of knowledge, until recently, concerning the origin and course of diseases was such that 39 years ago no less a person than Dr. Pettenkofer said to me: "In but few cases can we do more than make the best guess that our experience justifies." Since the advent of bacteriology, and progress along other lines, the medical profession has moved ahead with leaps and bounds, so that within a third of a century both death and sick rates in the most highly civilized countries have dropped in a great ratio than during many centuries before. Neither Greek nor Latin helped in this advance.

Since the Middle Ages even the greatest of the creating artists in music, painting, sculpture and architecture were not specially versed, if at all, in these ancient languages.

The engineering and allied professions, the students of which generally have not been obliged to study Greek and Latin, have contributed more to advance modern civilization than any of the above professions. By studying and utilizing the laws of nature, they have made it possible to travel over land and sea without limit and open up the possibilities of the entire earth for the benefit of men. They have introduced more rapid means of mental communication through the telegraph and telephone, without which the amount of our progressive work of today would be very greatly diminished. The achievements of mining, manufacturing, sanitation and agriculture during the past century did more to advance the human race toward higher planes than was done in any previous equal period.

I heartily agree with your correspondent in the issue of May 22, 1919, p. 1031, in his reference to Herbert Spencer, whose essay on "What Knowledge Is of Most Worth," written about 60 years ago, pretty thoroughly settles the question as to the relative value of the "classics" and of modern sciences. As Spencer in his early life had been an engineer himself, Dean Cooley should take that philosopher's opinion as applying especially to engineering students, and "as a means of training (them) for responsible citizenship."

New York City. RUDOLPH HERING, Consulting Engineer.

The Manning Formula Again

Sir—Considering the discussions that have recently appeared in *Engineering News-Record* [see *Engineering News-Record* of Jan. 16, 1919, p. 149; Mar. 13, 1919, p. 536, and Apr. 3, 1919, p. 685] regarding the treatment of the Manning formulas in the Miami Conservancy District's Technical Report, Part IV, it seems pertinent to add a few remarks concerning these equations.

Up to the time Professor King's "Handbook of Hydraulics" was published, which was after the manuscript for Part IV had gone to the printer, the equation generally known as the Manning formula had been mentioned but briefly in American engineering literature. For this reason, although it was known that the formula is used to a limited extent in certain foreign countries, it was not considered necessary to publish a detailed treatment of the equation, especially as our investigations had led to the conclusion that nothing could be gained by its use.

The formula recommended by Manning, given on p. 221 of Part IV, never found any appreciable acceptance among practicing engineers, although it is, next to the Ganguillet and Kutter formula, the best one so far proposed. It was this equation that was referred to on p. 243 of Part IV in the statement: "The average error of the results calculated by the Manning formula for the gagings of Humphreys and Abbot was 19.8%, while the average of those calculated by Kutter's formula for the same gagings was only 4%." These average errors were determined by Manning in a manner similar to that used by Leach in calculating the "average departure from mean" (*Engineering News-Record* of Mar. 13, 1919, p. 536) and consequently would not be affected by constant errors in velocity measurements.

The equation now known as the Manning formula is merely an exponential formula in which the coefficient is given as a function of n. It would have been discussed under the heading "Exponential Formulas," in Part IV, if it had not been for its connection with the

VARIATIONS IN VALUES OF KUTTER'S n AND MANNING'S n CALCULATED FROM EXPERIMENTAL DATA

Description of Data	Number of Experiments in Series	Average Values K's n	Average Values M's n	Difference in % of K's n	Average Variation* K's n	Average Variation* M's n
Experiments 16a and 17a, Table 112, King's "Handbook"	2	0.0127	0.0137	7.9	2.36	9.48
Experiments 18a and 19a, Table 112, King's "Handbook"	2	0.0124	0.0121	2.4	0.81	2.48
Experiments 46, 48 and 50, Table 112, King's "Handbook"	3	0.0194	0.0198	2.1	3.95	3.88
Experiments 47 and 49, Table 112, King's "Handbook"	2	0.0184	0.0190	3.3	4.35	6.31
Experiments 60a to 63a, Table 112, King's "Handbook"	4	0.0119	0.0116	2.5	4.83	5.17
Experiments 65 to 68, Table 112, King's "Handbook"	4	0.0130	0.0127	2.3	7.31	7.08
Experiments 137 to 140, Table 112, King's "Handbook"	4	0.0193	0.0196	1.6	1.82	1.78
Experiments 206 to 208, Table 112, King's "Handbook"	3	0.0281	0.0314	11.7	3.20	4.77
Experiments 247a and 248a, Table 112, King's "Handbook"	2	0.0524	0.0711	35.7	0.96	0.56
Bazin's Series 6, "Récherches Hydrauliques"	12	0.0127	0.0125	1.6	1.1	1.27
Bazin's Series 7, "Récherches Hydrauliques"	12	0.0120	0.0118	1.7	1.0	0.99
Bazin's Series 8, "Récherches Hydrauliques"	12	0.0116	0.0114	1.7	2.5	1.67
Bazin's Series 9, "Récherches Hydrauliques"	7	0.0130	0.0129	0.8	1.2	3.24
Bazin's Series 10, "Récherches Hydrauliques"	7	0.0117	0.0115	1.7	1.4	0.71
Bazin's Series 11, "Récherches Hydrauliques"	7	0.0113	0.0111	1.8	3.8	2.12
Bazin's Series 12, "Récherches Hydrauliques"	7	0.0151	0.0153	1.3	1.0	1.31
Bazin's Series 13, "Récherches Hydrauliques"	7	0.0148	0.0153	3.4	1.2	1.87
Bazin's Series 14, "Récherches Hydrauliques"	7	0.0150	0.0155	3.3	1.8	0.92
Bazin's Series 15, "Récherches Hydrauliques"	7	0.0209	0.0223	6.7	1.2	2.76
Bazin's Series 16, "Récherches Hydrauliques"	7	0.0212	0.0232	9.4	1.6	2.46
Bazin's Series 17, "Récherches Hydrauliques"	7	0.0215	0.0237	10.2	2.2	1.51
Bazin's Series 32, "Récherches Hydrauliques"	4	0.0168	0.0177	5.4	0.4	1.69
Bazin's Series 33, "Récherches Hydrauliques"	4	0.0171	0.0177	3.5	1.2	2.26
Bazin's Series 44, "Récherches Hydrauliques"	4	0.0195	0.0202	3.6	8.8	10.64
Bazin's Series 46, "Récherches Hydrauliques"	4	0.0205	0.0212	3.4	5.7	7.54
Tadmor experiments, 2, 4, 6 and 10, Table 9, Pt. IV	5	0.0316	0.0305	3.5	4.9	4.59
Ark. ditches, experiments 40 to 45, Table 9, Pt. IV	6	0.0342	0.0317	7.3	1.6	2.94
Total number of measurements	241	Mean Variations		10.1	3.58	5.02

* Average variation from mean in per cent. of mean value.

original Manning equation which is not of the exponential type. Manning investigated this equation, in a slightly different form, and rejected it because it did not give satisfactory results for the Mississippi River gagings. Bazin, in his paper in "Annales des Ponts et Chaussées," 1871, entitled "Étude Comparative des Formules Nouvellement Proposées Pour Calculer le Débit des Canaux Déconverts," showed that an exponential formula is not the proper kind of an equation to represent the conditions of flow in open channels. He showed that the curve is not the right kind of a curve, that while it may be made to fit a small range in conditions in a given case, by varying the coefficients and exponents, it cannot be used as a general formula.

One way in which the Manning formula may be compared with Kutter's is to calculate, by the two equations, the values of n for several series of measurements, in channels where *the roughness conditions are constant* and then to compare the constancy of the calculated values. This method was used in several instances in Part IV. The method used by Leach in his studies, referred to above, was similar, except that he assumed that the roughness factor for a given channel should be the same for all stages, irrespective of actual differences in roughness conditions. Mr. Horton, in his reply to Mr. Leach, has already called attention to the great differences in actual roughness that may exist in a given channel with different stages. The Tadmor measurements, which Mr. Leach used and to which he gave greater weight than to any of the others which he investigated, may be cited as an example of such conditions. The experiment, made during the 2-ft. stage of September, 1916, which causes the Manning formula to appear so much better than the Kutter formula, was made when the water was comparatively low. For such stages the channel is smoother than it is during flood stages, when the other measurements were made. The bed and banks are more regular, and the disturbing effect of the fringes of trees along the banks, which is very marked during flood stages, is entirely absent. While this was not emphasized in our report, it was mentioned in the descriptions of the Tadmor measurements and also on p. 142. For the above reasons this experiment was omitted from the Tadmor series in the studies given on pp. 239, 243 and 260 of our report, and also in the study of the Manning and Kutter formulas given in the accompanying table.

The table printed above gives, for each of several series of measurements, the average value of Kutter's n, the average value of Manning's n, the difference in the two values expressed as a percentage of Kutter's n, the average variation in Kutter's n in per cent. of the mean value, the average variation in Manning's n, and the number of measurements in each series. It also shows the mean values of the average variations of the two factors and of the actual differences in the factors for the entire group of 241 measurements. The data chosen for this study include those used in comparing the Bazin and Kutter formulas, on p. 260 of our report, and also such data given in Table 112 of Professor King's "Handbook of Hydraulics" as might properly be used for this purpose. Owing to the fact that the calculations were made at different times, some of the values of average variation of Kutter's n are computed to tenths of a per cent. only, instead of to hundredths as are the others. However, this has no material effect on the results.

A study of the results given in this table shows some interesting conditions. A comparison of the last two columns shows that the average variation of the Kutter roughness factor is the greater in 12 cases and the less in 23. The mean variation of Kutter's n for all measurements is 3.58%, while the mean variation of Mannings' n is 5.02%, or about 40% greater. The difference between the absolute average values of the two coefficients varies from 0.8 to 43.5%, the mean value for the 35 locations being 10.1%. If the experiments made on the Bogue Phalia, the Mississippi, the Irawadi, and the Volga are omitted (the only ones made in channels of unusually large size) the mean variation of Kutter's n is 2.67%, the mean variation of Manning's n is 3.41%, and the mean difference between the two roughness factors is 5.18 per cent.

This shows that Kutter's formula is better for channels of ordinary dimensions as well as for channels of unusual size. In view of the large number of diagrams and tables that are available for aid in using the Kutter formula, the advantage of simplicity possessed by the Manning formula does not seem to be of great importance, certainly not of sufficient im-

portance to warrant its general adoption and the rejection of the Kutter formula. While the Manning formula might be used in approximate calculations, as might also several other equations, it would seem to be better to use the Kutter formula in all important calculations in channels of ordinary dimensions as well as in channels of unusual size. Although the Kutter formula is not ideal, it is the best we have at the present time.

IVAN E. HOUK.

Miami Conservancy District, Dayton, Ohio.

United States Chamber of Scientists Proposed for Engineers

Sir—I have read with much interest W. L. Saunders' article in your issue of Apr. 17, 1919, p. 756, on an Engineering Civic Federation. It appears to me to be the most practical and logical solution of the many troubles that beset the engineering profession at this time, but I would go farther.

Everyone is doubtless familiar with the activities and influence of the United States Chamber of Commerce in the commercial world. The federation proposed by Mr. Saunders would have a similar influence and effect on engineering and all scientific progress and civic betterment if open to all technical, scientific and engineering societies, to all technical engineers, surveyors, architects, and, in general, to scientific men or women who work with their brains more than with their hands in engineering and science in all branches.

Mr. Saunders has well said that engineering societies are not effective in public matters. The public and legislators cannot be made to believe that their aims are unselfish, although these classes are the most altruistic of the human race. One does not have to go far to discover the reason for this. Scientific men and engineers are all technical and the public and legislators do not want technics, but policy and (we trust) public betterment.

I remember very well when this fact was first brought home to me in the late '80s when the late E. L. Corthell, Lyman E. Cooley and several others, including myself, then secretary and director of the Southern Society of Civil Engineers, prepared a bill for the establishment of a Department of Public Works to take over the river and harbor work of the national Government and place it in the hands of the civil engineers. The bill was promptly killed as "class legislation."

The engineers in this country are, however, very restless, and something must be done to better their condition, which is certainly deplorable when compared with that of the workmen under them. This condition has been brought about largely by the action of the War Department in this war in establishing the rank of "engineer" from men more noted for their brawn and fighting ability than for their engineering knowledge, in many cases. Pick-and-shovel men, railroad trackmen and trainmen, chauffeurs and auto-repair men and even lumberjacks were all called "engineers," and the general public does not discriminate.

These conditions must be radically changed, and the American Association of Engineers and Engineering Council are doing a praiseworthy work, but they cannot reach the great mass of the people, and so wield an overpowering influence as can a chamber of science, with a membership of half a million.

Important as the salary question is, it is not everything, and the result can perhaps be brought about in a more dignified and desirable manner. My old professor urged his students to give no thought to pecuniary emoluments but to rest assured that with professional success "all these things would be added."

I do not like the word "federation." It savors too much of a labor union. I prefer United States Chamber of Scientists. If the public knows that half a million voters are behind us we carry far more prestige than 50,000 could possibly do, and if a measure is before Congress it may be embodied in a bill that will not appear selfish, sordid or as class legislation, but, as the Chinese told his partner, who objected to certain items not being specified in a bill they were about to present, "You no see 'em, but they there allee same."

And now comes the report that the Boston engineers have joined the American Federation of Labor, a trade union. Shades of the immortal Stevenson, Roebling, Eads and Francis! And this is the modern Athens, city of culture and of the Pilgrims, and my birthplace!

Everyone should read the admirable article by Mr. Saunders and also the able address of W. W. K. Sparrow, chief engineer of the Chicago, Milwaukee & St. Paul R.R. printed in the April number of the *Monad*, the organ of the American Association of Engineers, both of which advocate a chamber of commerce of engineers along similar lines. No better man can be found for president than Maj. Gen. George W. Goethals, as proposed by Mr. Saunders. I have had the pleasure of knowing him for nearly 30 years. One of the first activities for this chamber of scientists to undertake will be educational and missionary work among the people, and especially among the engineers of Boston.

J. FRANCIS LE BARON,
Panama City, Fla. Consulting Engineer.

Variation of Roughness Coefficient in Manning's and Kutter's Formulas

Sir—Concerning the correspondence in your issue of Jan. 20 and Mar. 13 under above heading, and also Mr. Houk's most interesting report on the "Calculation of Flow in Open Channels," I trust the following statement will not be regarded as controversial:

I notice that all of the engineers concerned use the gagings of the Irawadi at Saiktha as an example. I have a very high respect for those investigations, but I think, considering their date and the methods used, that it is unwise to regard them as sufficiently authoritative for testing the newer standard formulas. The exigencies of the war have separated us from libraries, so I speak from memory, but I believe that (1) these experiments were made before 1880; (2) the standard apparatus was the twin float, though current meters of an experimental type were also employed; (3) the results when plotted against any of the newer standard formulas, Bazin's (1899) or Manning's, are less concordant than the average of modern observations.

For their date the Irawadi experiments were first-class, but I think that in the present state of knowledge they, like the earlier Mississippi work, should be considered as second-class only.

I would add that for the present purpose, their selection, even if they were first-class, appears unfortunate. The investigation is concerned with changes in Kutter's (or Manning's) n and Bazin's γ produced by variations in gage heights. The Saiktha gage site is situated up-

stream from a bar and crosses a deep pool. Thus, the conditions affecting the connection between the gage height and the discharge must be abnormal when compared with those existing in the ordinary cases to which it is desired to apply the results of the investigations.

Kuala Lumpur. P. PARKER.

Definition of Engineering

Sir—Writing definitions of human vocations is not a simple matter, as Mr. Condron has doubtless found out, judging from your issue of May 29, 1919, p. 1079.

Attempting to make a suggestion, a definition of engineering was formulated, containing 72 words. By revision, it was reduced to the form which follows, containing 45 words. This is thought to be sufficiently inclusive and not too inclusive. It is not the result of the effort of one mind, but rather of the efforts of three minds.

For use in license laws it seems to be desirable to define not only engineering but professional engineering, or perhaps a professional engineer. Therefore, a definition of professional engineer is added:

> Engineering is the intelligent application of the laws of mathematics and physics and often those of other sciences in the design, construction and operation of machines and the physical structures of public and private enterprises, and in the discussion, investigation and solution of related problems.
>
> A professional engineer is one whose vocation is engineering.

APPLIED SCIENCE.

Classes Draftsmen With Engineers

Sir—In your issue of Apr. 24, 1919, p. 834, Thomas P. Morrissey makes a statement to the effect that draftsmen are to be classed in the same category as bricklayers, carpenters and other mechanics. He then asks these questions: "Are they engineers? Tell me, now, are men of this type qualified to receive as much or more than mechanics? What do you mean when you say 'engineer'?"

Of a similar tenor are the remarks of Palmer C. Ricketts in your issue of May 29, 1919, p. 1075 where he says, "The difficulty is that common surveying and ordinary drafting are not difficult to learn and the law of supply and demand takes care of the pay for this kind of work. It is also a fact that a good carpenter is often worth more to a community than a good leveler or a good draftsman."

Now, giving the matter honest and due consideration, is it really fair, just, or even correct to give the young graduate engineer who is serving as a structural draftsman a classification on a par with, or even lower than a mechanic? Take my own case, which is fairly typical. During the summers of 1913, 1914 and 1915 I earned a part of the expense of technical training by working at the carpenter's trade, and I am capable of holding the best kind of a carpenter's job today. From this experience I can say that any lively young man with a whit of mechanical ability can learn the carpenter's trade in six months.

Engineering knowledge is not gained with any such ease. If, then, the difficulties in becoming proficient as a competent structural draftsman are to have anything to do with his worth as compared with that of the carpenter, the odds are heavy in favor of the structural draftsman. Moreover, the draftsman in preparing his drawing lays out the work and directs the activities of mechanics. Is it not usually considered in the industrial world that the man who directs the activities of others is to be given compensation and rank above them?

On the other hand, how many mechanics can be found who are competent to prepare a rational and economical design in structural steel or reinforced concrete? It may not be the constant duty of the structural draftsman to perform such work, yet it is required of him at times, and he is expected to be able to do it at any time. To suggest that a carpenter or mechanic could do it, or attempt it, is positively absurd.

It is true that complaint regarding the classification and pay for engineering services has come largely from draftsmen and instrumentmen. And the reason is this: Compensation for a mechanic's services in 1914 was less than for the draftsman. Since that time the increase in pay of the former has kept pace with the increased cost of living because of his union and the urgency of war work. The draftsman's pay, however, has not kept pace with the increased cost of living and today he is paid no more than the mechanic and, in some cases, less.

Our Government has compiled figures to show that the increase in cost of living has been 66% since 1914. Draftsmen's salaries have increased a spare 25 to 30%. Mechanics' wages have increased the full 66% and in some cases have doubled.

Now, as to "What is an engineer?" and "Is a structural draftsman an engineer?" I should say that an engineer is a man who has, by endowment and development, what I would call the engineering mind. The engineering mind works in two phases, the analytic and synthetic, to direct the forces of nature toward the upbuilding of modern industry, and for the benefit of mankind.

In order so to direct the forces of nature, the engineer must conceive a structure, a machine, a railroad, a plant, or perhaps a whole industry. Such a conception takes place in the mind of the engineer and must be presented to the minds of other engineers and workmen before it can become a reality. This presentation is usually made through the medium of an engineer's drawing. Here is the function of the engineering draftsman.

Usually the engineer does not make his own drawing but details this work to another engineer—a draftsman, usually younger, of less experience and naturally subordinate to his instructions. I have called a draftsman an engineer because he must have, to a certain degree, the same engineering mentality or mind as has his superior, else he will not efficiently and successfully grasp the conception which his superior holds in mind, and place it for him into an intelligible drawing. I would say, then, that a draftsman, if competent, is a minor or junior engineer, but an engineer, nevertheless.

I am not alone in this opinion. For example, in "Design of Plate Girders" by Lewis E. Moore, associate professor of structural engineering at the Massachusetts Institute of Technology, occurs the following: "The draftsman who plans his work with reference to needs of the shop and erection department, while carry-

ing out the intention of the designing engineer, is entitled to a part of the credit for the completed work and may rightfully feel that he is an engineer, not a mere mechanic." A. F. FOWLER.

Detroit, Mich.

Chart for Estimating Motor Truck and Trailer Haulage Costs

Sir—The writer has read with interest several articles appearing in *Engineering News-Record* relative to the operating cost of a five-ton truck. I am sending you herewith a chart which was compiled originally for the purpose of comparing the operating cost of a five-ton truck and a five-ton truck with trailer. The chart is based on the assumption of a five-year life of the truck, averaging 300 days per year.

It is, of course, impossible to make any rule which will fit all the various conditions encountered in motor-

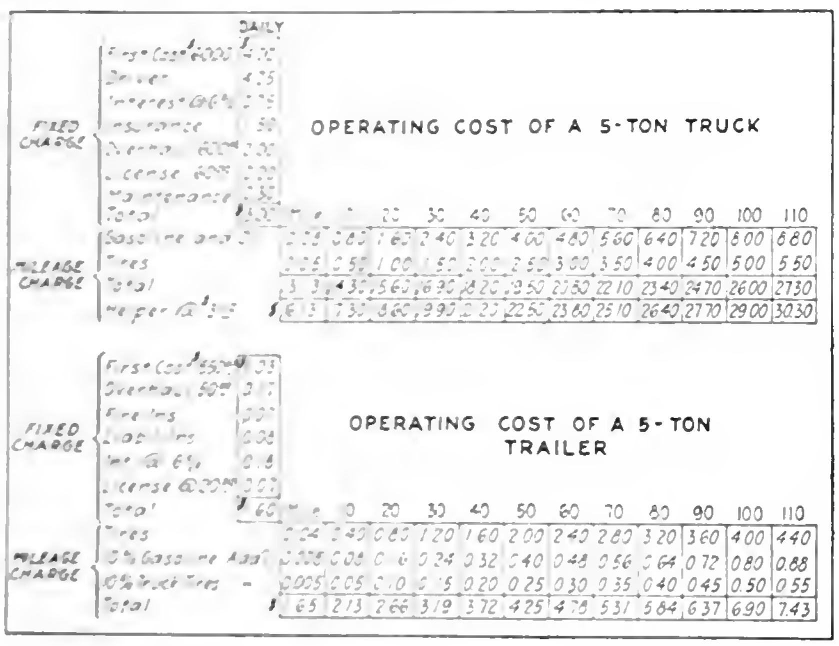


CHART FOR RAPID ESTIMATING OF TRUCK AND TRAILER COSTS

truck haulage, and it has therefore been my intention to derive figures which will fit the majority of cases. I have also tried to divide the operating costs into a fixed charge and a mileage charge, although really all of the charges listed as fixed are dependent upon mileage, with the exception of interest, insurance and license. Gasoline and oil are based on current prices, and the average mileage obtained per gallon. Tires are reduced to a cost per mile by dividing the list price by guaranteed mileage.

The operating cost of the trailer is estimated in exactly the same manner as the above. The average increase in gasoline consumption due to the trailer is 10%, and the increase in wear on truck tires is about the same.

The chart was reduced to mileage, in order to estimate rapidly on a known haul. For instance, a case comes up in which two five-ton trucks are engaged in a haul of say 25 miles, or 50 miles for the round trip. A glance at the chart shows a cost of $19.50 per day per truck, or $39.00 for the two.

If conditions are right, the trailer can be used displacing one truck. The cost is then $22.50 for the truck (with helper), and the trailer operation costs $4.25—a total of $26.75. If the resulting saving of $12.25 is credited to the trailer, it is not long in paying for itself.

The costs above may seem low, and unquestionably there are many items which might legitimately be added. The garage charges have been left out, as they vary. Against a large fleet, there may be charged superintendance. Board and lodging of a driver on the road may occur in a few instances. The purpose of the chart, however, is to strike a fair average.

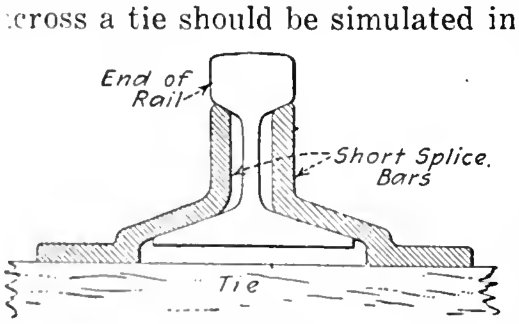
A careful analysis of hauling costs is sometimes disconcerting to the truck operator, as not enough study has been given to this particular problem. Investigations should be made before and not after purchase, as changes invariably prove expensive. The trailer has a large field of usefulness, and only a careful study of hauling conditions is required to open it up.

WALLACE BIGELOW,
The Miller Equipment Co., Incorporated.
Syracuse, N. Y.

Rail Joint to Carry Rails by the Heads

Sir—After a long journey across the continent, listening to and observing the conditions and reactions of rail joints, a few possibly new thoughts on the subject are not inopportune. In view of multitudinous repetitions of wheel passes—each of minute effect—combining to produce evident effects on the rail, it has occurred to me that in order to receive uniform wear from the wheels a stretch of rails must be homogeneous through the junctions or joints.

Without any attempt to criticize present modes of connecting rails, and as a wholly novel contemplation of the problem, it is suggested that the posture of a rail across a tie should be simulated in connecting rails on a tie — that is, there should be present across the gap at rail ends—and for both rail ends in common—the combined head, web and base of a rail to carry the wheel through the juncture, identically as it is borne by a rail across a tie.



RAIL JOINT GIVES HEAD SUPPORT TO RAIL ENDS

Recent reports of the American Railway Engineering Association on tests of short four-hole angle bars indicate that two-hole angle bars of length equal to tie width, connecting rail ends on a tie, offer probably as much resistance as the rail itself. With the flanges of the splice bars extended laterally and depended below the base of the rail to form feet resting on the tie, the base of the rail would be held out of contact with the tie, and the heads of the two rail ends would be supported by a combined web and base in the same way as the head of a rail crossing a tie. The principle is shown by the accompanying section through the gap at the joint. The wheel drop incidental to the gap at rail ends is negligible, therefore actual continuation of the rail head through the gap is not essential. This method of joining rail ends might be termed a rail-joint chair, and it is the elementary form of many rail-joint inventions.

W. M. PEGRAM.

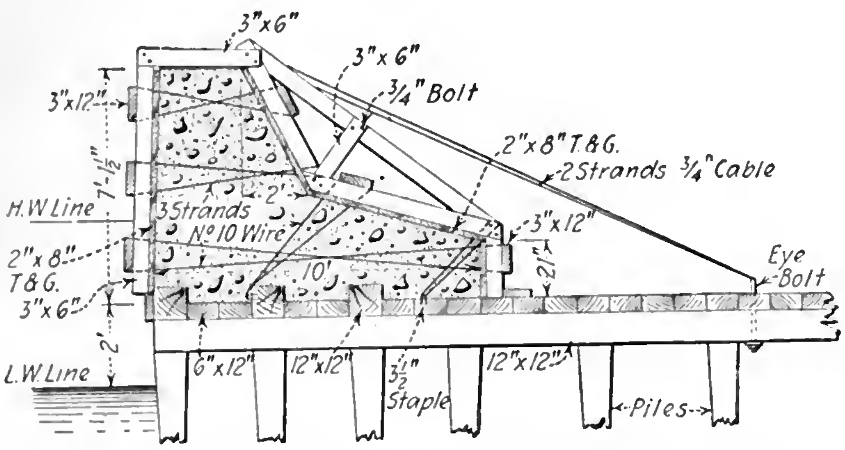
Los Angeles, Calif.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Unit Form Permits Building Concrete Wall on Pier Edge

CONCRETE bulkhead walls on the water side of piers present some difficulties in construction, on account of the necessity of having outboard bracing, and also because of the possible entrance of water into the forms with the rise of tide or water level. The form shown in the accompanying sketch was used by



FORM FOR CONCRETE WALL ON EDGE OF PIER

Henry Steers, Inc., of New York City, in the construction of a pier in Brooklyn and was devised to meet the difficulties.

Forms are built in panels 15 ft. long, are moved from place to place, and are used successfully several times over. Each panel consists of transverse frames, made up of 3 x 6-in. sticks spaced 5 ft. c. to c., with outside and inside lagging of 2 x 8-in. tongue-and-groove planks, the whole resting on the timber framing of the pier proper. The form is held against outward movement by the two strands of ¾-in. cable fastened to the upper bolt of the frame and to an I-bolt back on the pier. The form is wired together, as shown, against interior buckling, and held down to the pier proper by wires attached to staples in the deck.

The sections are quickly erected with the aid of a floating derrick. Concrete is started as the tide recedes below the level of the deck, and it has been found that the 2 x 8-in. tongue-and-groove boards offer sufficient protection to the concrete against scouring action of the rising tide.

The form was described in the "Contractors' Atlas" of June, 1919, by A. R. Moxter, superintendent of construction of Henry Steers, Incorporated.

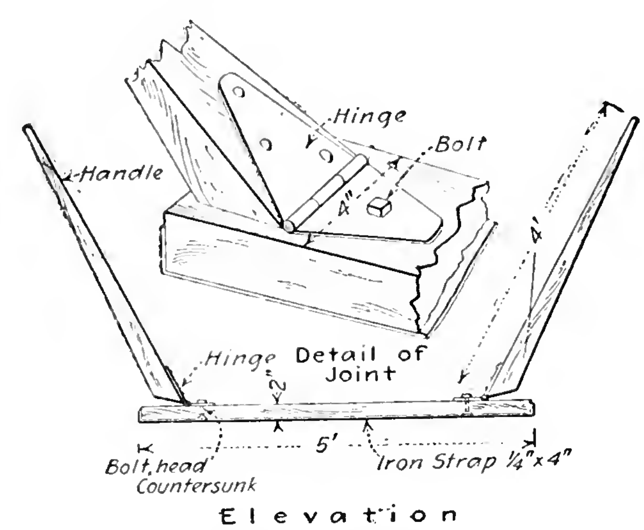
Short Straight-Edge With Handles for Use on Narrow Widths

By George W. McAlpin
Point Pleasant, W. Va.

A CONVENIENT, short straight-edge for leveling off concrete paving in narrow widths is shown herewith. With this tool it was found that two men could easily accomplish the work previously done by four, operating the old type without handles.

Other Articles in This Issue of Interest to Contractors:

It is made of a 2 x 4-in. scantling, laid flat, and is provided with an iron strap, ¼ in. thick, on the bottom. The handles are so attached by strap hinges and one bolt that they may be moved in two directions. This



DETAILS OF SHORT STRAIGHT-EDGE—NOTE DOUBLE HINGED JOINTS

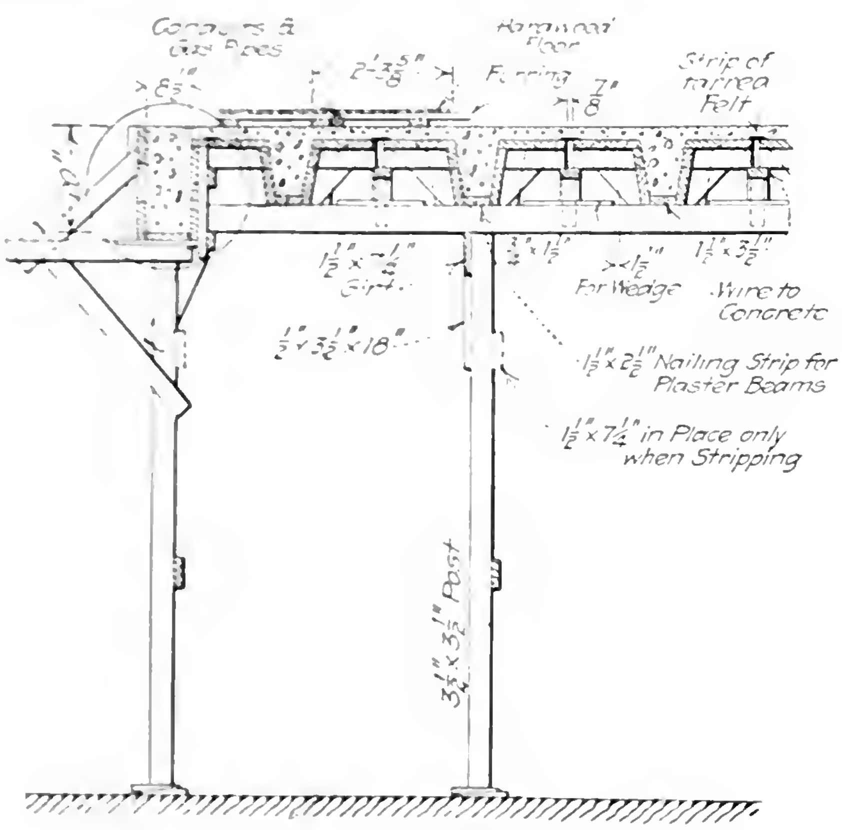
permits the operators to work from a standing position, instead of the kneeling position required for operating with efficiency the straight-edge of the ordinary type.

The double-hinged joint also permits the usual sawing motion that is employed in the cutting off of concrete surfaces.

STRAIGHT-EDGE WITH HANDLES IN OPERATION ON NARROW PAVEMENT

Forms for Concrete Floor Made Up of Wood Frame Sections

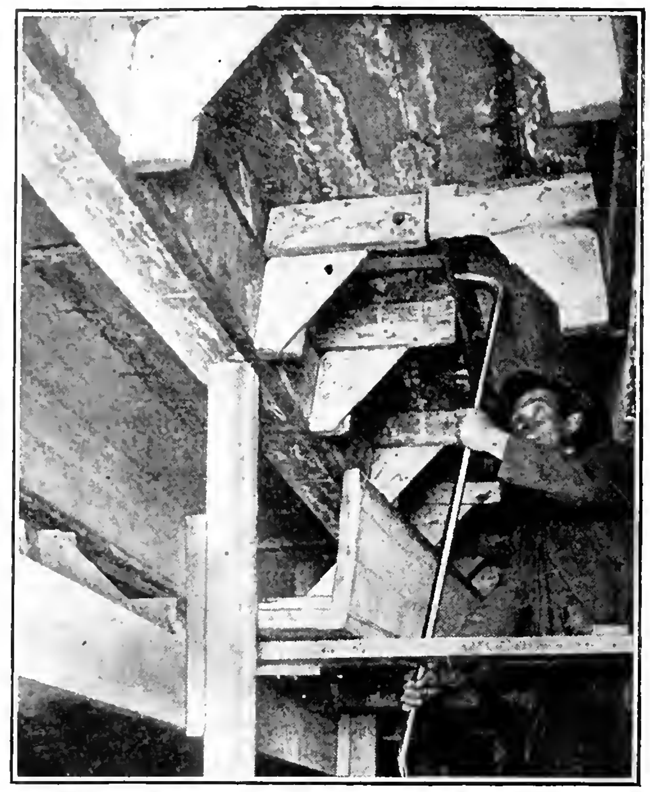
SECTIONAL wood forms, of inverted-trough section, were used over and over again in the construction of the floors of a reinforced-concrete apartment house at Salt Lake City, Utah, by Villadsen Brothers, Inc., contractors, of that city. Details of the construction and views in place are given in the illustrations printed herewith.



WOOD BOX FLOOR FORMS READY FOR USE
Note small end section where beam joins girder

The floor consists of a $2\frac{1}{2}$-in. slab supported on tapered beams, spaced 3 ft. c. to c. spanning between the girders on the columns. Forms for the beam and slab unit are in about 10-ft. lengths of an inverted "L" shape, making up one of the tapering sides of the beam and the bottom of half of the slab width between beams.

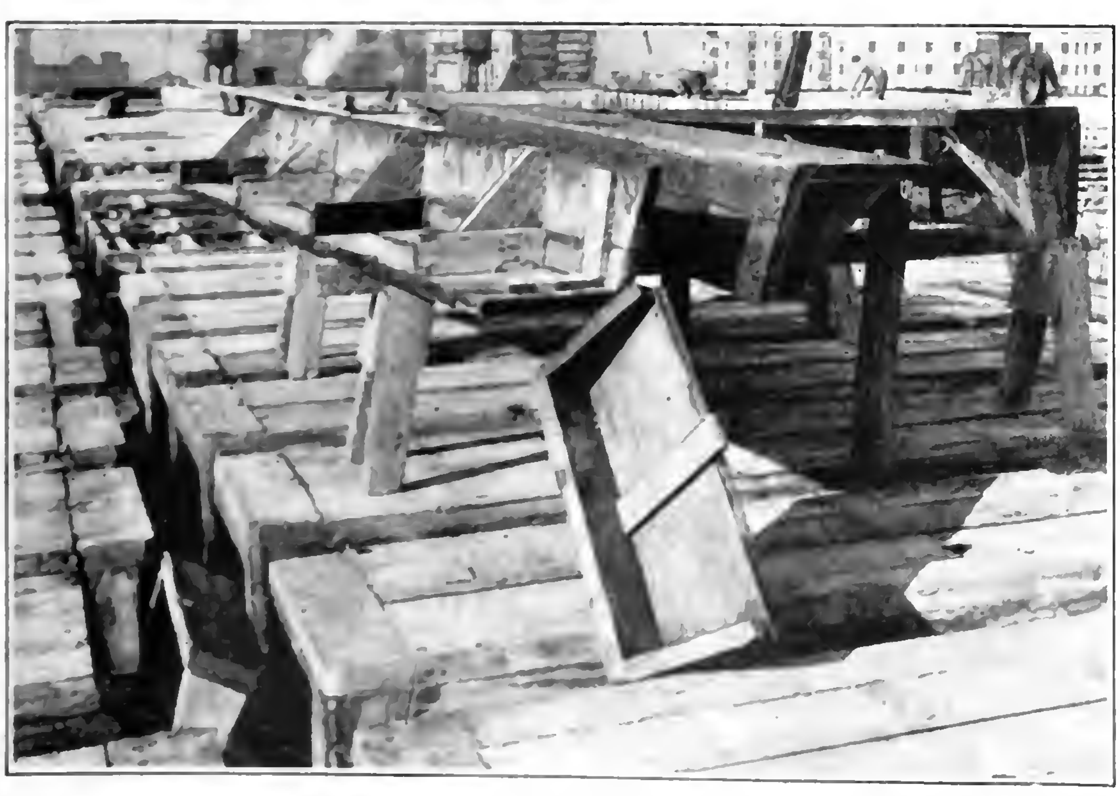
These units are carried on stringpieces and girts at the bottom of the beam section, and at the middle are supported on elevated $1\frac{1}{2}$ x 3-in. stringers which rest on small supports tacked to the stringpieces. A $\frac{7}{8}$-in. opening between adjacent slab forms is covered with a strip of tarred felt over which the concrete is poured.



SPECIAL BARS USED TO REMOVE FLOOR FORM UNITS
Note scaffold to catch forms

The bottom of the beam is carried on a separate strip, which is permitted to remain in place after the forms are removed, to serve as a tacking strip to which are attached the plaster ceiling boards. The ends of the floor-beam forms are beveled, and a separate piece squaring the ends is used to facilitate form removal.

In the stripping, wedges against a small piece on the stringpiece are knocked out, the vertical holding strips are removed, and the forms are taken off with bent bars, as shown in one of the views. Special scaffolding was provided about 2 ft. below the forms on which to drop them in the removal process. The forms were used many times without any considerable intermediate repair being required.



RE-USABLE WOODEN FLOOR BOXES FOR CONCRETE FLOOR

Washing Sand for Concrete

BRITISH practice in preparing fine aggregate for concrete was outlined by P. G. H. Boswell in a paper before the Concrete Institute, as follows: "Some method of 'scrubbing' is the only way to clean ballast effectively from adherent clay and loam. On the other hand, the dust produced in the crushing of aggregate can easily be washed away. If the aggregate is required down to 50-mesh, an upward current of water at ordinary temperatures of about 5 ft. per minute will remove all material smaller than this. If the aggregate is required to be not smaller than 20-mesh, a velocity of about 15 ft. per minute will remove the material not required."

News of the Week

New York, June 26, 1919

Roumania Wants Americans to Rebuild Its Bridges

Commission Now in This Country to Make Arrangements for Delivery of 25,000 Tons of Bridge Steel

Opportunity is afforded American bridge contractors to enter the European field, in the construction of a number of large bridges destroyed in Roumania during the war. There is now at the Hotel Cumberland, New York City, the Roumanian Bridge Commission, sent here by the Roumanian government to get proposals on this bridge reconstruction. The total amount of steel needed is about 25,000 tons, practically all in railway single-track bridges, although some highway bridges are required.

While the Roumanian finances are in process of reconstruction, it is probable that the firms taking over the bridge work will have to arrange for a time at least to finance the projects, but the stability of Roumania seems assured, and the rapid assumption of its financial responsibilities a matter of a short time.

The principal bridge to be replaced is that over the Borcea branch of the Danube, on the line which connects Bucharest with the sea at the port of Constanta. This point of the Danube is divided into two branches, and there is a large bridge with cantilevers of about 400-ft. span in each branch. One of these branches was destroyed by the Roumanians in their retreat from the Dobrudja. The Germans, it is understood, had intended to replace this bridge, and have in their shops in Germany a new bridge of about 2700 tons, of which 2000 tons is ready to deliver. The Roumanians, however, do not choose to do business with the Germans and utilize this structure.

It is announced that spans from 20 to 65 m. are required, a total of about 1500 m. for double-track and highway and 1700 m. for single-track railway bridges. Delivery should be made as soon as possible to Roumanian ports, the principal one of which is Constanta on the Black Sea.

Army Equipment from France To Be Distributed to States

In response to a request from the Department of Agriculture, the War Department has ordered returned from France, as soon as possible, a large quantity of engineering equipment to be distributed by the Department of Agriculture through the Bureau of Public Roads to the states for use in the construction and maintenance of Federal-aid highways. The equipment will be apportioned on the basis of the allotments in the Federal-aid road act in the same way in which the 20,000 Army motor trucks are now being distributed.

Included in the equipment which has been requested are 1500 caterpillar tractors; 400 road rollers, and a large number of concrete mixers, road graders, elevating graders, rock crushers, industrial locomotives, industrial-railway tracks, dump cars, steam shovels, hoisting engines, electric motors, and quantities of smaller equipment. The Bureau of Public Roads will distribute this equipment, when received, on requests from the state departments.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment Service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Extend Alaska Railway Location

The Alaskan Engineering Commission has sent out a party to locate the route of the Alaska Government railway on the 100-mile gap from the Susitna River north through Broad Pass, to connect the present line running north from Seward and Anchorage with that running south from Nenana. The party is in charge of T. W. Secrest. William C. Edes is chairman and chief engineer of the commission. The progress of work on this railway was described in *Engineering News-Record* of Jan. 2, 1919, p. 46.

Commerce Chamber Committee Railroad Report

Conclusions Provide for Early Return of Roads to Private Operation With Guaranteed Returns

Emphasizing adherence to a policy of corporate ownership and operation of railroads, the committee on railroads of the Chamber of Commerce of the United States, appointed to investigate and report on remedial legislation, has submitted 10 separate recommendations providing for the return of the railroads to corporate operation as soon as the necessary legislation can be enacted, the consolidation of a limited number of strong competing systems, exclusive Federal regulation of capital expenditures, and guarantee of return on investment through rate regulation. The recommendations of the committee are now being submitted to all members of the Chamber of Commerce in the form of a letter ballot, merely as a means of obtaining tthe opinion of the commercial organizations of the country regarding a final settlement of the railroad situation.

The recommendations of the committee provide for:

Adherence to the policy of corporate ownership and operation, with comprehensive regulation.

Return of roads to corporate operation as soon as remedial legislation can be enacted.

Adherence to the period of Federal control as now fixed unless and until impossibility of remedial legislation in this period clearly appears.

Permission for consolidation in the public interest, with prior approval by Government authority, in a limited number of strong competing systems.

A requirement that railroad companies engaging in interstate commerce become Federal corporations, with rights of taxation and police regulation reserved for states.

Exclusive Federal regulation of capital expenditures, and security issues of railroads engaged in interstate commerce, with provision for notice and hearing for state authorities.

Federal regulation of intrastate rates affecting interstate commerce.

A statutory rule providing that rates in each traffic section shall yield an adequate return on a fair value of the property as determined by public authority.

Payment into a fund of a share of the excess earned by any railroad system under application of the above statutory rule over an equitable minimum return upon the fair value of the property, this fund to be used as Congress directs for strengthening general railroad credit and increasing general railroad efficiency.

A Federal transportation board to promote development of a national system of rail,

water, and highway transportation and articulation of all transportation facilities.

In explanation of the recommendation for consolidating a limited number of strong competing systems, the committee points out that the regrouping should be about the present large systems and not by territorial subdivisions of the country, maintaining competition in service and permitting financial aid to weak roads from strong systems.

In connection with the provision guaranteeing return on investment through rate adjustment and the turning over to Congress, to strengthen railroad credit, of income in excess of an equitable return on investment, it is stated that the purpose is to prevent individual companies from obtaining excessive profits at the expense of others and that the proposed rule would not deprive the present prosperous roads of an equitable return, but would at the same time tend to strengthen railroad credit as a whole.

Transport Committee Plans Better Highway Transportation

With the idea of producing better transportation conditions and increasing the use of highway haulage throughout the country, the highways transport committee of the Council of National Defense has sent out two bulletins. One of these consists of a letter to all representatives and senators requesting that they have surveys made of their districts with a view to determining where there is a lack of transportation facilities and a need for rural motor express; the other concerns a nation-wide campaign for the adoption of uniform highway traffic regulations and gives notice of the preparation of directions to traffic. This, it is believed, will decrease the large number of accidents that now occur upon the highways.

In writing to the senators and representatives, attention is called to a number of examples where farm and other products have been ruined on account of inadequate transportation facilities. It is felt that conditions similar to the examples given exist, in all probability, throughout the country. The survey is for the purpose of giving the council the necessary information for establishing motor transportation for such localities. The communication sets forth that the railroads and electric roads which need more traffic will be benefited by the traffic developed and also that the cost of the commodities will be decreased by the increase in the supply.

The traffic regulations referred to are those recently compiled by William P. Eno and submitted for criticism to various traffic associations and highway engineers throughout the country. They give minute directions for the proper procedure in driving motor vehicles on the highways, and for pedestrians in crossing the highways. These have been printed in a folder for distribution. It is hoped by this means to reduce the number of accidents both in cities and country districts.

Arguments Against National Highways Answered

Highway Industries Association Replies to Criticisms of the Proposed System by Secretary Houston

Replying to arguments advanced by Secretary of Agriculture Houston, as reported in *Engineering News-Record* of May 29, 1919, p. 1083, against the proposal to form a Federal Highway Commission to build and maintain a national highway system, the Highway Industries Association calls attention to the impossibility of obtaining such a system by present methods. The fact that the proposed law would not interfere in any way with the coöperative plan now existing between the states and the Federal Government, as suggested by Mr. Houston, is also brought out. Extracts from the association's statement follow:

The National highway bill introduced into Congress by Senator Townsend, providing for the creation of a Federal highway commission and the establishment of a national system of highways, is a piece of legislation designed to bring about the construction of a national highway system in a reasonable length of time, to coördinate all the highway activities of the Federal Government, and to publish statistics and data on highway transportation, construction and maintenance for the benefit of all the people.

Arguments made against this bill in a letter from the Secretary of Agriculture to a city chamber of commerce were: "That the roads in each section of the country are of varying degrees of importance in the service rendered or that may be rendered to any particular locality. That the traffic conditions vary greatly in the different sections. That the state highway departments are better able to classify the roads than anyone else. That under the present Bankhead bill the Government is coöperating with state highway departments in the classification of the roads, and that when the classification has been carefully made, and by agreement between the state highway departments of adjoining states, the roads of first importance generally meet at state boundaries." Having the above points in mind, Mr. Houston stated that he could not see the wisdom of "substituting for the present coöperative program a plan which would commit or limit the Federal Government to the construction of two Federally-owned trunk-line highways in each state."

The national highway bill does not in any way interfere with the plan now existing among the states to coöperate with the Federal Government. It only substitutes for the Secretary of Agriculture the Federal Highway Commission, which, under the law, is charged with the duty of carrying out the provisions of the Federal-aid law as now operated, and all other obligations or contracts entered into by the Secretary of Agriculture with the respective states. The national highway bill is entirely a new piece of legislation. Its object is to build trunk-line highways in each state, to the extent of not less than 2% nor more than 5% of the total mileage of the state, and to join them up with the main trunk-lines of other states, so as to make a complete national system connecting the entire country. It creates a system of national highways, independent of the states—highways that will carry interstate traffic and that are necessary for the welfare of the country as a whole.

Under the present Federal-aid law the Federal Government has no power to select the roads in any one state that will be improved. The initiative is with the state highway departments, and in many instances is really with the counties, which have to put up the state's share of the money.

The only limitations prescribed by the Federal-aid law are that the roads shall be "rural post roads." When a road has met this condition, it is the duty of the Secretary of Agriculture to give his approval to its construction. All Federal-aid projects start with the 48 state highway departments and such projects are considered in 48 different lights, by 48 different men, holding 48 opinions, and it can be seen that a national plan that would evolve from such a procedure would be most chaotic, to say the least. Furthermore, the personnel of these departments, and with them the state highway systems, are constantly changing. It is also impossible under the Federal-aid law so to coördinate the 48 state systems that a plan would be finally evolved that would form a connected system throughout the country in a lifetime.

Many of the states have laid out a system of state highways. Many of the roads as laid out, on which Federal-aid is being expended, should not be and never will be classified as national highways, but they constitute a large portion of the mileage of the plans that have been approved as a general state system, and on which there has already been granted Federal aid.

We have seen the road work of the country expand from the township unit into the county unit; from the county unit into the state-aid unit; from the state-aid unit to the state unit; from the state unit to the Federal-aid unit, and it is but logical and reasonable that the final steps should be taken by establishing a Federal unit.

Many of the highway activities of the states were carried on in coöperation with the agricultural departments of the state or with the agricultural colleges, but it was soon found necessary to provide an independent unit of the state Government to look after this one important development. Likewise, the day has come when the road work of the Federal Government should be separated from the Agricultural Department. The advocates of good roads are only asking in this national highway bill that the roads should be put on an equal footing with the other departments of the Government, so that they can receive proper consideration and study.

Bids for Hetch Hetchy Dam Asked

Bids for the construction of the Hetch Hetchy dam for the San Francisco water-supply will be opened July 30. The dam will be of cyclopean concrete, 212 ft. high above the stream bed, but designed for a possible addition of 100 ft. The thickness will be 320 ft. at the lowest point, 168 ft. at the stream bed and 25 ft. at the 212-ft. height, where the length will be 600 ft. There will be 128,000 cu.yd. of excavation and 360,000 cu.yd. of concrete. The contract provides a bonus of $200 a day for completion in less than the 900-day contract period and a penalty of like amount for noncompletion. The estimated cost of the dam is $4,000,000. M. M. O'Shaughnessy is city engineer.

Public Service Engineers of New York Organize

The engineers of the Public Service Commission, New York City, have formed the Rapid Transit Engineers' Association. It is stated that these engineers have received no increases of pay in the past five years.

To discuss the problem, the foregoing association (whose membership is now about 600) has called a meeting to be held June 26 at the Municipal Building. To this meeting, engineers of other departments of the city Government than the Public Service Commission have also been invited to come.

Imperial Valley Active on All-American Canal

A contract was recently entered into between the United States and the Imperial Irrigation District, and it was ratified by a two-thirds majority of the voters within the district. Under this contract the district undertakes to construct an All-American canal from

Laguna Dam to serve the present irrigated area within the United States in Imperial Valley. It is contemplated that this canal will also serve all of the additional land, to the east, north and west of the present irrigated area, that can be irrigated from the new canal by gravity. A delegation representing the district has been sent to Washington to complete negotiations with the Government preparatory to beginning work.

Labor Advocates Scientific Research

A resolution in favor of a "broad program of scientific and technical research" was adopted by the American Federation of Labor at its Atlantic City convention, concluded this week. The supporting arguments, as well as the resolution itself, follow:

Whereas, scientific research and the technical application of results of research form a fundamental basis upon which the development of our industries, manufacturing, agriculture, mining, and others, must rest; and

Whereas, the productivity of industry is greatly increased by the technical application of the results of scientific research in physics, chemistry, biology and geology, in engineering and agriculture, and in the related sciences; and the health and well-being not only of the workers, but of the whole population as well, are dependent upon advances in medicine and sanitation; so that the value of scietific advancement to the welfare of the nation is many times greater than the cost of the necessary research; and

Whereas, the increased productivity of industry resulting from scientific research is a most potent factor in the ever-increasing struggle of the workers to raise their standards of living, and the importance of this factor must steadily increase, since there is a limit beyond which the average standard of living of the whole population cannot progress by the usual methods of readjustment, which limit can only be raised by research and the utilization of the results of research in industry; and

Whereas, there are numerous important and pressing problems of administration and regulation now faced by Federal, state, and local Governments, the wise solution of which depends upon scientific and technical research; and

Whereas, the war has brought home to all the nations engaged in it the overwhelming importance of science and technology to national welfare, whether in war or in peace, and not only is private initiative attempting to organize far-reaching research in these fields on a national scale, but in several countries Governmental participation and support of such undertakings are already active; therefore be it

Resolved, by the American Federation of Labor in convention assembled, that a broad program of scientific and technical research is of major importance to the national welfare and should be fostered in every way by the Federal Government, and that the activities of the Government itself in such research should be adequately and generously supported in order that the work may be greatly strengthened and extended; and the secretary of the federation is instructed to transmit copies of this resolution to the President of the United States, to the President pro tempore of the Senate, and to the Speaker of the House of Representatives.

American Society of Civil Engineers at Minneapolis

Following the meeting of the American Society of Civil Engineers, at which the development committee report, details of which were given in last week's issue of *Engineering News-Record*, was discussed, members of the society spent four days in visiting engineering works and in various social affairs planned to increase acquaintanceship among the members. At the business meeting, in addition to the development committee discussion, it was announced that the vote taken upon the question of the form in which the list of members should in future be printed resulted in a majority for the plan to consolidate all lists into one. The vote also favored discontinuing the publication of changes of address in the monthly *Proceedings*.

The evening of June 17 was devoted to a reception tendered by the local membership at the Radisson Hotel. Wednesday was entirely given up to an automobile drive around the Twin Cities, with luncheon at the St. Paul Hotel, in St. Paul, and dinner at the St. Paul Town and Country Club, these functions being arranged by the St. Paul Engineers' Society.

Thursday was devoted to an all-day excursion to Lake Minnetonka, which included a two-hour trip on the lake, followed by luncheon at the Lafayette Club. A golf tournament, with prizes donated by the local committee, was held in the afternoon. On Thursday evening Lieut. Col. F. W. Scheidenhelm delivered an illustrated lecture on "The Work of Engineer Troops of the American First Army in France." This was followed by a smoker under the auspices of the Minneapolis Engineers' Club.

On Friday morning the party broke up into small groups for visits to various engineering projects around Minneapolis and St. Paul. At 1.30 p.m. a special train left for Duluth, where the members were received by a large delegation composed of the Duluth Association of Members of the American Society of Civil Engineers and the Duluth Engineers' Club. A steamer was in waiting, and several hours were spent in a cruise about the Duluth-Superior harbor.

At 6.30 a.m. Saturday a special train started from Duluth, via the Duluth, Missabe & Northern Ry., to Hibbing, where the party transferred to flat-cars for a trip down into one of the big open-pit iron mines. Luncheon was served at the Oliver Club, by the courtesy of the Oliver Iron Mining Co., and then, under the auspices of the Engineers' Club of Northern Minnesota, the party went by automobile along the Iron Range 30 miles to Eveleth, thus affording an opportunity to see the development of the Missabe open-pit mines, which produced 60,000,000 tons of ore last year. At Eveleth the special was in waiting to take the party over the Duluth & Iron Range R.R. to the ore-shipping port of Two Harbors, where an inspection was made of the ore docks. The special returned to Duluth at 8.30 p.m., and the party, after a drive around the boulevard on the heights above the city, was entertained at a reception and dance at the Kitchi Gammi Club, the festivities closnig in time to permit the visitors to catch the special leaving at midnight for Minneapolis.

MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON FLAT CARS INSPECTING OPEN-PIT IRON MINE AT HIBBING

About three hundred members were in attendance at the meetings and inspection trips in St. Paul and Minneapolis, and probably a hundred more joined the party at Duluth.

Important City Charter Changes in Philadelphia

Notable changes in the charter of the City of Philadelphia have been made in a bill which has passed the Pennsylvania legislature. The old two-chambered council of many members is replaced by a single relatively small council. The councilmen will be paid $5,000 a year. The bureau of health will become a department. There will be a city architect in the mayor's department. To the city-planning commission are given statutory powers.

Street Cleaning and Garbage Changes at Philadelphia

Under the new charter for Philadelphia recently enacted by the legislature, the city will clean its streets and collect and dispose of its garbage, rubbish and ashes, after Dec. 31, 1920,

unless the council by a majority vote, with the approval of the mayor, authorizes the letting of contracts for the work. In the latter event, the present contract restriction of one year is removed. In case a contract for more than four years is made, the city has the option of terminating it at the end of that time or any time subsequently, without damages to the contractor for loss of profits for the unexpired portion of the contract.

Indianapolis Asks Bids on Sewage-Disposal Plant

The board of sanitary commissioners of Indianapolis, Ind., has invited bids for the first of the five sections of the new sewage-disposal plant, and will soon invite bids for the second division. The estimated cost of these are $300,000 and $450,000, respectively, while the total cost of the plant will be about $2,000,000. The first division includes the grit chambers and screens, a 60-in. cast-iron siphon, 1000 ft. long, to pass under the White River, and a 78-in. concrete conduit extending 7700 ft. to the pumping station. The second division will include the buildings for the disposal plant at Sellers farm. For handling the sewage there will be six electrically-driven turbine pumps. Charles H. Hurd is consulting engineer to the board.

Large Dam To Be Built For New York Water-Supply

Contract has been awarded the Hugh Nawn Contracting Co., by the New York City Board of Water Supply, for the construction of Gilboa dam, in Schoharie County, New York, a part of the recent addition to the water-supply of New York City. The dam will divert the Schoharie River from emptying into the Mohawk and divert it to the Ashokan reservoir. It is in two parts, a concrete gravity overfall section 1300 ft. long and 160 ft. total height, and an earth embankment 1000 ft. long. There will be formed a reservoir six miles long with 20,000,000,000-gal. capacity. Quantities are estimated as follows: Excavation, 500,000 cu.yd.; rolled embankment, 500,000 cu.yd.; cement, 480,000 bbl.; masonry, 400,000 cu.yd. The contract price was $6,819,910.

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Assistant designing engineer, Naval Ordnance Plant, South Charleston, W. Va., $9.20 per diem. July 8. File applications before July 8.

Assistant inspector of engineering material (aircraft), $5.92 per diem. July 15. File applications before July 15.

United States.—Chief ship draftsman, U. S. Navy Department, $10 to $12 per diem, draftsman, grade A, $8 to $9.60 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

United States.—Chief draftsman, general engineering, architectural, power plant, heating and ventilating, electrical, U. S. Navy Department, $10 to $12 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

Valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 30, Oct. 1-3, Albany, N. Y.

The Engineering Alumni of the University of Kansas elected the following officers at the fourth annual meeting, held June 16 at Lawrence: President, J. S. Worley; vice-president, W. E. Baldry; secretary-treasurer, George Hood, Kansas University, Lawrence.

The Southern California Association of Members of the American Society of Civil Engineers was addressed June 11 on "Check Dams" by F. H. Olmsted, and on flood-water acts and legislation by Charles E. Haas, the author of the new California conservancy act.

The Cleveland Chapter of the American Association of Engineers elected the following officers at the recent annual meeting: President, F. D. Richards; vice-president, W. P. Blair; secretary, C. M. Williams, and treasurer, A. M. Clark. The chapter is preparing to conduct an investigation of salaries paid technical engineers in Cleveland with a view to working out a schedule of minimum salaries which the county and city will be asked to put into effect.

The Southwestern Society of Engineers, at the recent annual meeting in El Paso, Tex., resolved to organize a publicity committee; to form local sections; to initiate the policy of greater activity in civic affairs; to establish an employment bureau; to make an organized effort to prevent the employment of incompetent men in engineering work, and to approve licensing. It was also resolved that the society is convinced that compensation nearer the modern level of prices is required to retain the services of the best technical men. The board of directors recommended a plan to charter the society as a district of the American Association of Engineers, provided that all of the members of the society go into the association in a body.

The New York Chapter of the American Association of Engineers held a meeting June 25 at which the following papers were presented: "Railroad Engineering," by R. S. Parsons, chief engineer, Erie R. R.; "Highway Engineering," by W. G. Thompson, state highway engineer of New Jersey, and "The Work of the Engineer at the Front with a Combat Division," illustrated, by Col. F. A. Snyder, 103rd United States Engineers.

The Portland Chapter of the American Association of Engineers has effected a permanent organization, with the following officers: President, W. H. Marsh; vice-presidents, A. H. McKeen, T. W. Saul and O. Laurgaard; secretary, R. W. Barnes and treasurer, C. F. Thomas. Tentative plans have been drawn for amalgamation with the Oregon Society of Engineers. They are under consideration by the national board of the American Association of Engineers.

The Engineers' Club of Minneapolis and the Twin City Chapter of the American Association of Engineers have formed a joint engineering committee to assist in the solution of the engineering problems arising in connection with the settlement of the street-railway franchise. F. K. Bennett is chairman of the committee.

The Engineers' Club of Trenton, N. J. gave a reception June 17 to Trenton men who have returned from overseas duty with the engineers.

Personal Notes

R. T. Betts, for the past five years deputy chief engineer, Department of Docks, New York City, has resigned to become chief engineer, Robbins-Ripley Co., Inc., 50 Church St., New York City. Mr. Betts has been in the service of the Department of Docks for the past 22 years. He was previously in the Bureau of the Wallabout Improvement, Department of City Work, of Brooklyn, and in water-supply work for the City of Brooklyn. He was graduated from the School of Mines, Columbia College, in 1890.

Capt. Walter S. Ingalls, U. S. A., who recently returned from France and received his discharge from the service, has been appointed adjutant

general of the State of Arizona. For a number of years previous to his war service he was an engineer in the office of the surveyor general of the state. He is a veteran of the Spanish-American War and has been connected for some time with the Arizona National Guard.

CHARLES C. COOK, has resigned as city engineer of Wheeling, W. Va., after 16 years of service.

HARRY W. BOETZKES, formerly in irrigation, highway and contracting work in the Northwest, with headquarters in Seattle, and since 1917 captain with United States Engineers in France and the Balkan States, has returned, demobilized, with the Roumanian Bridge Commission, and in that connection will make his headquarters in New York City.

CAPT. HARRY TUCKER, Engineers, U. S. A., who recently returned from France and received his discharge from the service, has been appointed associate professor of highway engineering, State College of North Carolina, and becomes acting head of the new department of highway engineering, which has just been created as a subdivision of the civil engineering department.

JAMES E. SELLERS, formerly of San Diego, Calif., and Phoenix, Ariz., has returned to the States after serving for 18 months with the 23rd Engineers. Mr. Sellers was one of the organizers of the Society of the 23rd Engineers, now having a membership of nearly 4000. He will return to Phoenix and resume his engineering practice.

MAJ. ERIC KEBBON, Engineers, U. S. A., who recently received his discharge from the service, has become associated with Welles Bosworth in the practice of architecture, with offices at 527 Fifth Ave., New York City.

WILLIAM MCGIBBON, previously of the State Highway Commission of Iowa, has been appointed county engineer with headquarters at Knoxville, Iowa, succeeding W. O. PRICE, who has been appointed district engineer, with headquarters at Chariton, as noted elsewhere.

W. SYDNEY WAGNER and ROBERT R. HOUSTON have been admitted to partnership with William S. Post and J. Otis Post in the firm of GEORGE B. POST & SONS, architects, New York City and Cleveland. The business is to be continued under the present firm name.

LIEUT. JOHN A. FULKMAN, Sanitary Corps, U. S. A., has received his discharge from the service and has resumed his former work as assistant engineer, MORRIS KNOWLES, INC., engineers, Pittsburgh.

LLEWELLYN N. EDWARDS, supervising engineer of bridges, Department of Works, Toronto, Ont., has resigned to become senior highway bridge engineer, United States Bureau of Public Roads, Washington, D. C. He was graduated from the University of Maine in 1898 and engaged in bridge-engineering work. In 1905 he became designer and estimator, office of the bridge engineer, Boston & Maine R.R., and later engaged in similar work for the Chicago & Northwestern Ry. In 1907 he was appointed structural engineer, Grand Trunk Ry. In 1913 he joined the engineering staff of the City of Toronto.

H. A. SEWELL, formerly county engineer, Pend O'Reille County, Washington, has been appointed engineer, Panhandle Highway District of Idaho, with headquarters at Spirit Lake.

JULIUS K. MUNROE, previously of the engineering department, Morgantown & Kingwood Ry., has been appointed state road commissioner of West Virginia, with headquarters at Charleston, succeeding T. S. SCANLON, resigned.

H. G. CLARK, chief engineer, Chicago, Rock Island & Pacific R.R. previous to the recent return of C. A. Morse, has been appointed assistant to the Federal manager, succeeding H. M. SLOANE, resigned to become assistant to the president, Chicago, Milwaukee & St. Paul R.R., as noted elsewhere.

LIEUT. WILLIAM L. STANTON, Engineers, U. S. A., who recently returned from France, has been discharged from the service and is now in the office of the city engineer, Flint, Mich.

I. J. EIDMAN, assistant bridge engineer, Kansas State Highway Commission, has been appointed bridge engineer, South Western Engineering Co., Hutchinson, Kans.

H. M. SLOANE, assistant to the Federal manager, Chicago, Rock Island & Pacific R.R., has resigned to become assistant to the president, Chicago, Milwaukee & St. Paul Railroad.

HARRY S. MARSHALL, has resigned as chief engineer, A. J. Yawger & Co., general contractors, Indianapolis, to become chief engineer in charge of construction, F. K. Vaughn Building Co., Hamilton, Ohio.

LIEUT. HENRY J. HORN, Sanitary Corps, U. S. A., recently returned from France, has received his discharge from the service and has resumed his former work with GANNETT, SEELYE & FLEMING, engineers, Harrisburg, Penn.

R. E. BURGER has resigned as president and general manager of the Richland Public Service Co., of Ohio, to become chief engineer of Henry L. Doherty & Co., public utility operators, New York City.

MAJ. THERON M. RIPLEY, U. S. A., has received his discharge from the service and will return to his duties as division engineer, Division No. 3, State Highway Department of New York, with headquarters at Watertown.

H. A. MARSHALL, acting road engineer, Kansas State Highway Commission, has been appointed chief engineer, South Western Engineering Co., Hutchinson, Kans.

LIEUT. H. E. MILLER, Construction Division, U. S. A., who was recently discharged from the service, has been appointed director of the bureau of engineering and inspection, North Carolina State Board of Health, with headquarters in Raleigh.

HARRY CONRAD, of the firm of COULTER & CONRAD, engineers, Wheeling, W. Va., has been appointed city engineer of Wheeling, succeeding CHARLES C. COOK, resigned.

FRED OLDER, Adrian, Mich., has been appointed city engineer of Ypsilanti, Mich., succeeding W. R. CALDWELL, resigned to become chief engineer of the Palma Construction Co., Ypsilanti, as noted elsewhere.

GEARY KIMBALL, CHARLES SEMPER and C. W. CROSS have been assigned as highway engineers to the Ogden, Utah, branch of District No. 2, United States Bureau of Public Roads.

W. R. CALDWELL has resigned as city engineer of Ypsilanti, Mich., to become chief engineer of the Palma Construction Co., highway contractors, of Ypsilanti.

LIEUT. CHARLES BOYCE, U. S. A., has received his discharge from the service and will report to the American Red Cross at Washington, D. C., to become sanitary engineer.

W. O. PRICE, county engineer, Knoxville, Iowa, has been appointed district engineer, with headquarters at Chariton.

J. F. WITT has resigned as county engineer of Dallas County, Texas, in which position he has served since 1907.

FRED W. SIMONS, city engineer of Rahway, N. J., has been appointed city manager of Elizabeth, N. C.

D. E. GILMER, of Hutchinson, Kans., has been appointed superintendent of construction, Federal-aid roads, Reno County.

FRED HOFFMAN, contractor and engineer of Long Beach, Calif., has been appointed city engineer.

A. R. TOWSE has been elected county engineer of Pensacola, Fla.

OBITUARY

ERWIN F. PAYNE, head of the E. F. Payne Paving & Contracting Co., Cleveland, died recently in that city. He had been at the head of the company for the past 40 years and was actively engaged in the business until his retirement two years ago.

FRANK C. LAMARCHE, general superintendent, South Chicago Shipbuilding Co., died recently in Chicago. He was previously general superintendent of the American Shipbuilding Co., of Cleveland.

West Coast Lumbermen To Hold Annual Meeting

The West Coast Lumbermen's Association announces that it will hold its annual midsummer meeting at Paradise Inn, Mount Rainier National Park, July 30-31. It is expected that lumbermen from both Oregon and Washington, with their families, will attend the convention in large numbers.

A report will be made by Axel Oxholm, who has just returned from the Scandinavian countries, where he studied lumber trade conditions for the United States Department of Commerce. Other speakers will be C. E. Paul, consulting engineer for the National Lumber Manufacturers' Association; Chester J. Hogue, in charge of the West Coast Association's New York office, and L. C. Boyle, attorney for the national organization.

Asphalt Association Announces Increase in Staff

Several additions to its organization have been announced by the Asphalt Association, recently formed, as reported in *Engineering News-Record* of June 19, 1919, p. 1237. The research and testing department of the association is headed by Prevost Hubbard, formerly chief of the research and testing division of the Bureau of Public Roads.

Several field engineers have also been appointed; Fred W. Sarr, formerly second deputy highway commissioner of New York; A. T. Rhodes, who was for several years street commissioner of Worcester, Mass., and, more recently, secretary of the Granite Block Manufacturers' Association, will have charge of the New England territory and other Eastern points; and J. B. Hittell, formerly city engineer of Chicago, who will have charge of the association's work in the Middle Western States. No representative for the district to be controlled from the Atlanta, Ga., office has been named.

Canadian Industrial Congress To Be Held at Calgary

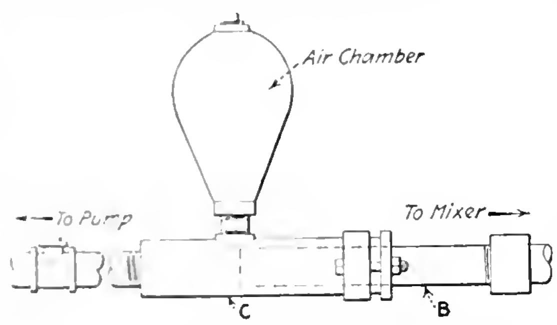
Western Canada is to have an industrial congress which will meet at Calgary, Alta., Aug. 13-14, and will then take a trip through the territory, including other Western Canadian cities. Among the places to be visited will be Medicine Hat, Alberta and Edmonton. The congress will be educational to a large extent, and along industrial lines.

Some of the subjects for discussion are: "Western Markets," "Western Industry," "Pacific Trade and Transportation Routes," "Oriental Commerce," "Future Alignment of Manufacturing, Considered with Reference to the East and West," and the question of building up the Pacific region and adjacent inland territories. Congress headquarters have been opened at the Palliser Hotel, Calgary, Canada, under the manager, John M. McGreevy. Further information may be obtained there.

Expansion-Joint Air Chamber for Roadbuilders' Pipe Lines

A combined expansion joint and air chamber to prevent water hammer, for pipe lines laid above ground in roadbuilding and other work, is shown in the accompanying illustration. It is claimed that this joint will overcome all the difficulties due to contraction and expansion of pipes which throws them out of line, while the air chamber prevents trouble with water hammer which often breaks pipe and mixer hose when the water is shut off suddenly.

One of these expansion joints is recommended for every 800 to 1000 ft. of



PIPE LINE EXPANSION JOINT AND AIR CHAMBER

pipe. While the combination joint and air chamber can be supplied, it is not necessary to use the air chamber on every joint. Its use upon about every third joint is said to be sufficient.

The expansion joint, which allows for 12 in. of expansion or contraction, is formed by having a brass pipe B, which telescopes into the casing C through a gland or stuffing box. The pipe line is connected to each end of the combination, which thus becomes a part of the line.

The combination described is manufactured by the C. H. and E. Mfg. Co., of 384 Clinton St., Milwaukee, Wis.

Business Notes

THE OSHKOSH MFG. CO., manufacturer of contractors' machinery and equipment, of Oshkosh, Wis., has reported the appointment of Ross Hunter as Eastern sales manager. Mr. Hunter has had long experience in the machinery selling field, his territory covering the entire country. His offices will be at 154 W. 38th St., New York City, where a complete line of Oshkosh contracting machinery will be kept in stock.

THE MACON CONCRETE ROLLER CO., of Macon, Ga., has been formed to manufacture concrete paving rollers by a process patented by W. L. Ashmore and W. T. Morgan, Jr.

THE C. J. CARTER LUMBER CO., of Kansas City, Mo., THE DONIPHAN LUMBER CO., of Kensett, Ark., and THE MARSH AND TRUMAN LUMBER CO., of Chicago, which are all manufacturing and selling interests of Bloxonend flooring, give notice that they have been merged into a single corporation, to be known as the CARTER BLOXONEND FLOORING CO., with home office in Kansas City. The sales office will be located at 1601 McCormick Bldg., Chicago, Ill. The individual lumber business of each of these firms will be continued under the old names as heretofore. C. J. Carter, the president, will have charge of the Kansas City office, while M. G. Truman, the vice-president, will be in charge of the Chicago office.

THE MCGRAW-HILL CO., INC., of 10th Ave. at 36th St., New York City, reports the removal of the Western office of *Chemical and Metallurgical Engineering* and *Engineering and Mining Journal* from the Newhouse Bldg., Salt Lake City, Utah, to the Rialto Bldg., San Francisco, Calif.

THE AUSTIN CO., of Cleveland, Ohio, announces that O. D. Conover, formerly vice-president and chief engineer of the C. W. Price Engineering Co., of New York and Chicago, and production manager of the Ludlum Electric Furnace Co., has resigned the latter position to become associated as production and sales engineer on foundries and steel plants for the Austin Co. Mr. Conover has had experience as engineer in charge of the design and construction of a large number of steel plants, foundaries, electric furnaces, and other equipment, both in this country and abroad.

THE SULLIVAN MACHINERY CO. has established a branch office at Room 810 Park Bldg., Cleveland, Ohio, under the management of Ralph T. Stone, formerly sales engineer in the New York office.

Trade Publications

The following companies have issued trade publications:

THE HOLT MANUFACTURING CO., of Peoria, Ill.; bulletin, 9 x 12 in., 16 pages, illustrated; describes the various standard sizes of Caterpillar tractors.

THE TRAILMOBILE CO., of 571 East Fifth St., Cincinnati, Ohio; catalog 7 x 9 in., 31 pages, illustrated, and three folders 8½ x 11 in., illustrated; describe various forms of trailers manufactured by the company.

THE AMERICAN MANGANESE BRONZE CO., of Holmesburg, Philadelphia, Penn.; catalog, illustrated; contains descriptive matter and illustrations of hydraulic castings, gear wheels, propellers, ingots, valves, bronze forgings, etc. The title of the catalog is "High-Grade Bronzes for Engineering Purposes."

THE TIDEWATER OIL CO., of 11 Broadway, New York City; catalog, 6 x 9 in., 46 pages, illustrated; describes the uses, economy and efficiency of fuel oil and the apparatus necessary for its use.